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Reviewing Quality Control Management of Road Construction Projects
Debby Willar, Anak Agung Diah Parami Dewi, and Febriane P. Makalew Abstract Along with the pace of development of road infrastructure in Indonesia, improving the quality of road construction project execution is becoming a concern of the government and related stakeholders. The poor project execution process of national road construction certainly has an impact on the failure of the construction products as well as the increase in work accident rates.

This paper reviews the government regulation on the practices of quality control procedures and quality assurance system, and safety control, to provide an evaluation and then a recommendation for stakeholders on the effective implementation of quality control management in road construction projects. Quality documentations must be available, containing quality targets to be achieved throughout the construction process. Quality control and safety control must ensure that all components of road construction are thoroughly secured to meet the specified quality and safety requirements.

Far fewer demands are made on the quality assurance system, which both the government and construction companies must develop to ensure that the quality control and safety control processes are sufficiently targeted and effective. The results of the review can be used to stimulate the implementation of quality control and quality assurance of road construction projects integrated with occupational health and safety in order to build qualified road infrastructure projects, which function according to their life span. The review's significance contributes to the knowledge in the area of quality control management of construction projects.

The review will help improve awareness among the policymakers and construction practitioners to enable them to be consistent in achieving the quality-safety of infrastructure project delivery. Keywords Quality control · Quality assurance · Safety control D. Wiliar (B) · F. P. Makalew Manado State Polytechnic, Manado, Indonesia A. A. D. P. Dewi Udayana University, Denpasar, Indonesia © The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2022 S. Belayutham et al. (eds.), Proceedings of the 5th International Conference on Sustainable Civil Engineering Structures and Construction Materials, Lecture Notes in Civil Engineering 215, https://doi.org/10.1007/978-981-16-7924-7_82 1261-1262

Introduction Public infrastructure, particularly road infrastructure, has a strong linkage with the economic growth of a nation. Road construction is vital as the primary support of dynamic economic activity at both the central and local levels. In Indonesia, as in all other countries around the world, the possession of a good road network is necessary to support growth in both the central and regional levels. Road infrastructure has become a crucial part of daily life.

Individual road users, logistic firms, and public transportation agencies expect reliable and safe road infrastructure for traveling from one location to another and transporting goods and people. Road agencies need to properly plan, build, maintain, and operate road infrastructure in order for it to create value for road users [1]. This is associated with the quality of the road. The quality of roads in Indonesia is still not optimal. Based on the Global Competitiveness Index report, the quality of roads in Indonesia ranks 75. This position is below Singapore (1), Malaysia (20), Brunei Darussalam (32), and Thailand (55).

The competitiveness of road infrastructure in Indonesia is still below that of Singapore, Malaysia, and Thailand [2, 3]. The quality of the road, both concrete and asphalt, does not seem to be able to last 5–10 years. Recently, it has been discovered that there are roads that have been damaged in the second year and some after even 10 days. In addition, the growth of new road construction has been slow. Such a worrying condition is compounded by the fact that many of the roads that are in poor condition are located in provincial and rural areas.

Given the critical role of road infrastructure in supporting economic development, there is an urgent need for the Indonesian Government to improve the quality of road infrastructure [4]. The success of road infrastructure development is measured in terms of physical construction and its performance, which includes the functioning of the road according to its life span. The government has enacted main policies on

construction services, i.e., UU No.

2/2017, which states that service providers and or sub-service providers are required to submit the results of their construction products right cost, right quality and right time according to the construction contract. In addition, the government also requires that both service users and service providers meet the security, safety, health and sustainability standards in using materials, tools, and practicing occupational, health and safety (OHS). However, there are still poor project execution processes of national road construction that impact the failure of the construction products and the increase in work accident rates.

In doing so, the Ministry of Public Works and Housing has set out in more detail several policies focusing on quality control and quality assurance in the management of road construction projects, with the involvement of both private and public sectors. This concern has been studied by Meijer and Visscher [5] regarding the quality control of constructions in seven European countries, which shows that quality control has become more privatized and implemented throughout the construction process with the focus on safety aspects.

Using Indonesian regulatory and the review of current practices as the secondary data, this paper aims to review the practices of quality control management of road construction projects, particularly in terms of quality control and quality assurance procedures, and safety control. Reviewing Quality Control Management ... 1263 The results of the review serve as an overview to stimulate the implementation of quality control and quality assurance of road construction projects integrated with occupational health and safety in order to build qualified road infrastructure projects, which function according to their lifespan.

The review will also help improve awareness among the policymakers and construction practitioners to enable them to be consistent in achieving the quality-safety of infrastructure project delivery. 2 Methodology The reviews of quality control management of road construction projects are undertaken using Indonesian government regulations on the practices of quality control procedures and quality assurance system, and safety control, together with the relevant literature in the area of quality and construction project management. The first stage of the review is to select the materials. The main consideration in selecting proper materials is the topic's key ideas [6].

The review aims to provide an evaluation and then a recommendation for road construction projects' stakeholders on the practical implementation of quality control

and quality assurance integrated with occupational health and safety, hence will help improve awareness among them to be consistent in achieving the quality-safety of infrastructure project delivery. The second stage is to analyze the materials. One of the three functions in doing the literature reviews is identifying and discussing others' works and then using the reviews to solve similar problems [7]. These reviews consist of four parts.

The first part is a review of the importance of quality documentation that must be developed by both the service users and the service providers. The second one is a review of the importance of quality control in securing the execution of road construction projects to meet the specified quality requirements. Furthermore, the review covers quality assurance, which is the process to ensure whether the quality control process is sufficiently targeted and effective.

The last part is a review of the importance of safety control in implementing road construction projects. Premised on these reviews, the quality control management of road construction projects in Indonesia are identified and discussed. Quality in Project Management Processes of Road Infrastructure Project management is the application of knowledge, skills, tools and techniques to project activities to meet the project requirements [8]. PMI's A Guide to the Project Management Body of Knowledge has identified the project management processes consisting of (1) initiating, (2) planning, (3) executing, (4) monitoring and controlling, and (5) closing.

Further, the PMBOK Guide identifies one of the 1264 D. Williams et al. project management knowledge areas as quality. These two elements synergize with the dynamic characteristics of construction work that require an integrated, precise and safe management in the execution of projects in order to achieve final results of construction products that meet the performance target of both the project owner and the construction service providers. By focusing on the performance of targeted construction products, quality is a must throughout the project management processes.

The performance of construction works is generally measured by the satisfaction of the project stakeholders within the constraints of cost, quality, and time [9, 10]. Subsequently, the development of construction works performance expands into health and safety and environmentally friendly construction [11, 12], project team level of effectiveness [13], sustainable construction [14–16], and human resource competence [17]. These performance indicators determine the process of fulfilling the quality assurance of public road construction works throughout the project management processes of road infrastructure.

Road infrastructure conditions that have not been optimal may be caused by problems in the project management processes of road infrastructure projects, especially in terms of quality during the execution phase. The quality of road infrastructure in Indonesia has been subject to debate. The government's road-building program has often been hampered by quality issues. Handling construction quality problems in government projects has been regulated by the Ministry of Public Works No. 04/PRT/M/2009 about the Quality Management System (QMS), and by the Ministry of Public Works and Housing Regulation No.31/PRT/M/2015 about Procurement of Construction Works and Consultancy Services, and by The Ministry of Public Works and Housing Regulation No. 02/PRT/M/2018 about Occupational Health and Safety.

These regulations are intended to lead the construction service providers to the project management processes, for the achievement of performance based on their QMS and OHS policies, which is integrated accordingly with the quality policy specified in the Ministry of Public Works and Housing. Since the project management processes of road infrastructure involve various parties, the quality aspect should rely on both technical and non-technical aspects. There are technical standards and specifications for road construction that the contractors must follow.

On the other hand, several non-technical aspects may impact the weak implementation of quality in project management processes of road infrastructure. Such weak implementation is often caused by several factors, such as managerial, organization, communication, finance, culture, education and auditing [18]. The weakness of managerial factors lies in the difficulty of mobilizing interactions between the production department and the quality department, and the difficulty in carrying out quality control in every department.

Moreover, there are traits within construction organizations that support the quality implementation in project management processes, which is generally bounded in the form of organizational quality culture. In the case of improving the quality performance of Indonesian transport infrastructure projects, Agustiawan et al. [19] found that there is a need for the project stakeholders to be more integrative, cooperative, flexible and focused on being goal-oriented and people-oriented.

Reviewing Quality Control Management ... 1265 Organizational culture developed by every organization of project stakeholders will benefit in developing a quality relationship and communication between project parties, which will, in turn, contribute to better project performance [19]. In addition, studies show that organizational culture influences the quality performance of Indonesian construction companies in

undertaking projects, and, hence, improves their business performances [20, 21]. The paradigm in managing projects has moved from traditional patterns to a more relationship-based approach [19].

One example of the conflict that occurs, primarily during the project execution phase, is usually due to the difficulty of the contractor organization in controlling sub-contractors. A better practical collaboration impacts trust, which propagates in face-to-face communication, team building, and information sharing, which are all essential traits to perform quality project management processes [22]. 4 **Quality Control Management of Road Construction Projects** The lack of understanding of the benefits of QMS possessed by the individual contractor, as well as how the QMS can be applied together between service providers and construction project owners, can hamper internal improvement in the quality and performance of the organization against the effectiveness of QMS implementation in construction.

If the stakeholders of infrastructure projects understand and consolidate each other to implement a **quality control and quality assurance** system during the project execution phase, then the final product performance of road infrastructure construction can be ensured to be effective, qualified and safe. In general, the quality aspect consists of three parts, namely quality planning, quality assurance, and quality control [23, 24]. Quality planning is used for setting quality objectives and required planning resources for meeting quality requirements. Quality control supports preventing and correcting defects in pre-production, production, and post-production stages.

Quality assurance focuses on assuring that prerequisites (e.g., work-force, technologies, materials) of providing/creating a high-quality service or product are available. Currently, **the concept of quality** planning and quality assurance has been relatively good with a numerous variety of existing policies. However, the application of quality control often causes problems or quality issues under the project management practices of the construction phase.

The quality of government projects is often seen in terms of product results and the function of the infrastructure products. **On the other hand, quality has two complementary forms, including (1) qualities of processes and (2) qualities of products** [25–28]. As stated above, the quality context may cause a problem of **project management practices in road** infrastructure. Even though there are several regulations associated with quality, it can be found that some conditions of road infrastructure have deteriorated.

In the **Indonesian context, there are several essential functions of quality control**

management in road infrastructure projects, namely. 1266 D. Wi llar e t a l. 4.1 Quality Documentations The necessary quality documentation i s a quality policy developed by both t he service users and the s ervice providers. In the case of t he Indonesian r oad construction projects, the s ervice user is t he Ministry of Public Works and Housing, while the service providers are contractors, sub-contractors and suppliers.

The quality policy i s an effort to guarantee the availability of reliable i nfrastructure f or the community with the principle of being ef?cient and effective as well as i mprove the quality of activities sustainably [23, 24]. Another quality documentation r equired t o s tart undertaking a project construction i s a contract quality plan. This document is prepared in the i nitial process at t he pre-construction s tage. The contract quality plan i s a QMS document prepared by the construction s ervices providers f or each contract of work in order to guarantee quality.

The contract quality plan contains quality targets, which describe measurable quality achievement targets by f ollowing the project speci?cation. Ensuring that the quality of the r oad infrastructure can be improved, the f unda- mental aspects of quality related t o t he project management have to be ful?lled under the r esponsibility of a t echnical director and quality controller, as stated in several quality plans and quality procedures documentations. Quality plan and quality proce- dures documentations are methods and guidelines that explain t he work processes to be undertaken by f ollowing the r equirements and speci?cations to be achieved.

Subsequently are t he quality assurance and quality control. These are carried out during t he process of executing, controlling and monitoring the r oad infrastructure project. 4.2 Quality Control Quality control s ecur es all components t horoughly and in detail (not randomly) t o meet the s peci?ed quality requirements, and always has a checklist of what will be inspected. This is a way whereby there i s a global growth in demand f or i mprovement of road infrastructure i n I ndonesia as a developing country to improve quality.

Quality control i n construction projects can be de?ned as a procedure t hat monitors speci?c project outcomes to de?ne whether they conform t o s peci?cations, and identify ways to disregard t he causes of poor results [29]. A t rue r e?ection of critical risks of developing countries' i nfrastructure projects delivery i s i mproper quality control [30]. The r ationale behind quality control i s t hat it involves a monitoring action, but i s also concerned with ?nding and eliminating causes of quality problems, so that the necessities of t he customer are determinedly met [31].

From a construction project perspective, quality control i ncludes observing or

measuring actual performance remedial actions to determine whether there are deviations [32]. Quality control conveys with it a general framework for quality management and is essentially the actions and systems applied to attain and sustain the quality of a product or service. **Reviewing Quality Control Management** ... 1267 [33]. **The quality control activities** should describe, but not necessarily be limited to, defining and implementing a measurement system and measuring the selected parameters, for instance, weight and temperature [32].

Juran and Gryna [34] state that quality controllers should be experts in the fields of project and statistical quality control, sampling and probability, and must be able to measure quality outputs. Often these control processes include the monitoring of actual project results to evaluate compliance with quality standards and to eradicate poor performance, developments, and products [29, 35, 36]. **The quality of construction depends** mostly **upon the control of construction, which is** the critical concern of the contractor [37]. In addition to supervision, quality control issues are also governed by organizational aspects.

It can be given that roads in Indonesia consist of **national roads, provincial roads** and regency roads. In this road division, there are three levels in management, namely top, middle, and bottom level. At the top is management, and at the bottom is the field—the men who work on the grade. In between is **a large group of** dedicated people in the central office, in the laboratory and in the district offices who constitute the backbone of the department (administration). 4.3

Quality Assurance Quality assurance (QA), is a systematic and planned activity determined **in the quality system** to ensure whether **the quality control process** is sufficiently targeted and effective enough. In this process, quality is also expected to be achieved by following the quality plan. Quality assurance is a system whereby the government, as an agency or owner in place, monitors the quality control efforts of the contractor. **In contrast, quality control is** generally the contractors' system in place during the construction to manage, control and document activities in order to comply with contract requirements.

The government plays an essential role in assuring **the quality of road** construction projects meet the standard of infrastructure facilities as the primary support of dynamic economic activity at both the central and local levels. The government, therefore, must ensure that the adoption of quality standard policy and regulation by the service providers—as their partners—are based on true motivations to enhance **quality in the construction of road infrastructure projects**. It is true that in assuring **the quality of construction** projects, both internal and external motivation [38] and the

commitment to comply with the regulations [5], are found to be significant factors perceived by the contractors to enhance a quality assurance program for the construction industry. 1268 D. Willette al. Fig. 1 A framework of quality control management practices in road construction projects 4.4

Safety Control Safety control technically secures the work structure and should be emphasized in all processes involved. The current issue is the importance of safety control in the implementation of road construction projects. In Indonesia, safety is regulated in the current regulations; however, the implementation is not optimally implemented. Research results on the adoption barriers of the engineering construction standards by Wang et al. [39] found policy barriers due to lack of improper guidance and imperfect standard legal systems.

The Indonesian government, as an agency or project owner, needs to pay more attention to the barriers that the Indonesian service providers face and be firm in implementing this rule by providing more technical guidelines. It is also necessary to conduct periodic observation to make the project run according to the quality plan and policy as well as safety regulations. The stages of quality management in road infrastructure projects are explicitly written. However, all these stages have not been able to run well from the pre-construction to post-construction stages. There are still obstacles in achieving the project objectives, both from the quality plan stage to the periodic observation stage.

Quality and safety issues in service organizations are inseparable [40]. The imperfect implementation process of national road construction certainly has an impact on the failure of the construction process and products, as well as the increase in work accident rates. Nevertheless, all parties have to be aware of and not to be shy to admit their mistakes.

Love and Smith [41] stated that construction enterprises' board of management should open horizons by 'learning from errors' in order to enhance quality and safety performance. A specific framework has been developed to simplify understanding the identified quality control management practices in road construction projects (see Fig. 1). 5 Conclusion The quality of road infrastructure in Indonesia has been subject to debate since the government's road-building program has often been hampered by quality issues.

The poor quality of roads can be seen by the damage that still occurs on the road. Based on Reviewing Quality Control Management ... 1269 the literature and regulation reviews, problems that may cause poor road infrastructure products are identified as

problems in the project management processes, especially in terms of quality implementation during the execution phase concerning non-technical aspects, such as lack of interaction amongst departments and cooperation between parent contractors and sub-contractors.

This study also evaluates the practices of quality control procedures and quality assurance system and safety control of road construction projects. The availability of quality policy, quality plan and quality procedures are the first steps in explaining the quality work processes to be undertaken and, hence, the quality performance of road infrastructure to be achieved. Subsequently are the quality control and safety control. Through these activities, all components of road construction are thoroughly secured to meet the specified quality and safety requirements.

Last but not least, there is a quality assurance system that both the government as owner and service user and construction companies as service providers must develop to ensure whether the quality and safety control and processes are sufficiently targeted and effective. The results of the study have helped to enhance the implementation of quality control management of road construction projects that the stakeholders face. Acknowledgements This study was supported by the Ministry of Research and Technology/National Research and Innovation Agency of Indonesia through the 2020 Fundamental Research Scheme.

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