Basic Study on Application of Blockchain Technology in Multi color Painting Work

Deokseok Seo, Junmo Park

***Abstract*—Multi color paint is widely used in construction projects, and lawsuits sur-rounding it are frequently filed in Korea. Construction projects often have missing documents during construction, so many records are not computerized, making it difficult to respond to disputes effectively. This study sought to find a way to amicably resolve disputes surrounding multi-color painting work by utilizing blockchain technology. Construction stakeholders select critical work stages and define and review key information.**

***Keywords*—Multi color paint top coat, construction lawsuit, blockchain**

I. Introduction

In the housing construction process, tasks are performed simultaneously to meet the construction lead time. These are executed using verbal instruction rather than written documents, which means many documents are omitted [1]. Document and project management systems were introduced to address this issue, but managing massive amounts of data became more difficult [2].

Due to the double agony of economic recession and price hikes, disputes arising during housing construction are increasing and continuing even after a project’s completion [3]. These disputes escalate to lawsuits, where documents that serve as official evidence are crucial. However, documents are missing from the document management systems mentioned above, and they are often contradictory.

Let us assume there is a document recording that 50 cans of multi-color paint materials applied on the corridor or elevator hall wall were delivered, and the work was done. The constructor reported performing the job based on the materials and claimed the cost. However, upon closer inspection, the information on the materials listed in the documents submitted as supporting data and the materials used for construction differ. There are cases where the paint manufacturer is different, the product name is different, and even the construction site for materials delivery is different. In such cases, whether the work was conducted correctly and whether the relevant documents are credible is doubtful. When the authors analyzed 32 lawsuit cases recently in Korea, it was found that the topcoat work with multi-color paint was the 7th most critical issue in terms of cost.

Due to these issues, in Korea, it is mandatory to submit construction-related documents to the Facility Management System operated by the Korea Authority of Land and Infrastructure Safety, a government agency under the Ministry of Land, Infra-structure and Transport. However, there are cases where the documents submitted here differ from those held by the project owner and the constructor. These are even different from those documents submitted to the city hall, which is the licensing authority. In other words, tens of thousands of documents are exchanged between home construction stakeholders, but it is not easy to trust that they contain accurate information about home construction. Therefore, regarding lawsuits, each party will present documents from various sources and argue only with their favorable points. Accordingly, judges of the court or appraisers who review the objectivity or circumstantial validity of documents on behalf of judges also become confused, and there are countless cases of misjudgments.

There is an urgent need to formalize the documents generated during the home construction process and establish a more transparent and reliable documentation system. Construction officials must mutually acknowledge the existence and fair-ness of these documents, thereby preparing for potential disputes in the future. Although various systems exist, construction documents are still in physical forms, and the problem is that documents are not entirely digitized. Even if the major document is electronic, the attached sub-documents are often physical. In addition, there is another limitation: each stakeholder has a different authority. The project owner, constructor, and inspector are given access to the system and directly participate in recording and approval, and a department or person in charge is assigned to this. However, the subcontractors who do the work cannot access the system, and dedicated staff who can submit or manage documents or data to the system are also unavailable.

This study is optimistic about the potential of blockchain technology as a solution to these document-related problems in the construction industry. Disputes can be resolved more clearly by applying blockchain to home construction document management and enabling construction stakeholders to confirm documents and data through numerous checks and mutual verifications. This study analyzes the main stakeholders and work process of multi-color paint topcoats during home construction and reviews the promising possibility of applying blockchain technology.

Manuscript received Nov. 12, 2025.

Deokseok Seo is with Halla University, Wonju-si, Gangwon, 26404 Republic of Korea

Junmo Park is with Sunmoon University, Asan-si, Chungnam, 31460, Republic of Korea

https://doi.org/10.17758/URUAE30.UA1225301

II. WORK PROCESS

A. *Multi Color Painting Work*

Multi-color painting, a complex process consisting of three stages: under coat, intermediate coat, and top coat [4], poses a significant challenge in the construction industry. The undercoat involves applying water-based paint to a concrete surface, followed by applying multi-color paint, and finally, the topcoat, which is a transparent coating. This complexity underscores the need for a reliable solution to manage and verify the execution of these tasks (Fig 1).

Depending on the ingredients, the top coat is classified into water-based and oil-based, and depending on the gloss, it can be classified into gloss, half gloss, and matte. However, since it is a transparent material regardless of the composition or gloss of the topcoat, it is difficult to clearly distinguish whether the top coat was applied as the subcontractor claimed. That is, there is no way to confirm the exact execution of work other than checking at the time of work. Moreover, since the law-suit would be filed years after the house was built, it is hard to determine whether work took place, so documents that record the situation at the time of work can be a basis for judgment.

Fig. 1. Multi color painting work case in elevator hall wall

B. *Construction Stakeholders*

The stakeholders involved in construction projects play crucial roles. These include the owner, designer, constructor, and inspector. The constructor, for instance, is comprised of the general contractor entrusted with the overall construction management by the owner and the subcontractor, who performs a limited scope of construction with the general contractor. Painting work, such as multi-color painting, is typically performed by subcontractors rather than general contractors. Therefore, at least five stakeholders are involved in the multi-color painting work: the owner, designer, inspector, general contractor, and subcontractor. However, designers in Korea do not directly participate in construction after creating drawings, so the stakeholders involved in the construction stages are the owner, inspector, general contractor, and subcontractor.

C. *Document Management Process*

Construction involves establishing a construction plan and selecting a subcontractor to perform the work. Then, the subcontractor sets up a detailed plan, consults with the general contractor, and receives permission from the inspector and owner to conduct the work. Afterward, during the middle or final stages of work, the inspector will be present to check whether the work was performed. In the case of valuable work, the owner may directly supervise whether the construction is being conducted, and the inspector will be present to provide advice.

In the case of multi-color painting work, the general contractor establishes an overall construction plan, reports it to the owner through the inspector, and receives approval. The general contractor recruits and selects subcontractors; an inspector or owner will be involved if there is an integral part in the process. Sometimes, the owner desires to use a specific company's product as the material. An experienced inspector may request that a particular subcontractor be replaced if the subcontractor is of inferior quality and has a bad reputation. Once a subcontractor is selected, the subcontractor establishes a multi-color painting work plan according to the construction schedule and reports it to the general contractor, who then reports it to the inspector and owner for approval. When the general contractor notifies the subcontractor of this, the subcontractor prepares for work by securing workers and materials.

The subcontractor shall bring the materials for the undercoat, intermediate coat, and topcoat of the multi-color painting work to the site and get the confirmation of the information and quantity of each product from the general contractor and inspector. Although it is expected that multi-color paint topcoats will be applied in the previous stages, it is unclear which products will be applied. Now, it is possible to check the manufacturer, the quantity, and the use status of the product. Therefore, information must be accurate, and records and documents must exist from this stage onwards. Most of the data generated at this stage at the construction site are record-ed and can be checked even after construction. Of course, much data was generated in the previous stages, but there is uncertainty because the construction plan can change. Still, it is the stage of topcoat application; there will be no problem if the topcoat has been applied.

The problem is that although there are records showing that materials were brought in for the work, there is no other document to cross-check that the date on the document matches the work execution date in most cases. When a subcontractor brings in the materials, he submits a document reporting the material brought in to the general contractor, and the general contractor then prepares and submits a document reporting to the inspector and the owner based on this. However, though this document existed during the work stage, after several years of lawsuits and the completion of construction, these documents did not exist in most cases.

Meanwhile, the multi-color painting work will be conducted if the materials have been received. As mentioned earlier, the undercoat will be applied first, then the intermediate coat will be applied, and finally, the topcoat will be applied. However, painting work such as multi-color painting does not start the subsequent work im-mediately after the preceding work. Instead, time is required for the paint to dry even after the preceding work is completed. According to the Standard Specification for Construction Work used as a standard guideline for construction work in Korea, the undercoat should dry for at least 3 hours, and the undercoat should be applied twice [4]. After that, the intermediate coat must dry for at least 24 hours. Finally, the topcoat is applied. Because the construction schedule is tight, however, it is common for the topcoat to be omitted or applied insufficiently. In addition, painting work such as multi-color painting requires multiple spraying works, so masks and protective clothing must be worn because the paint material can fly and be harmful if it enters the respiratory system. In addition, due to environmental issues, the paint material must not fly outside, so the work is done in a sealed state with a screen. Since subcontractors are required to perform the actual work, they are inside the site. Still, general contractors or inspectors observe from outside the work site or perform other tasks, making it difficult to confirm whether the topcoat has been completed even during construction. Therefore, the topcoat application can be confirmed after the work is completed. Still, since there is no technical standard for how to check it specifically, the general contractor and inspector check it arbitrarily. If there were any supporting documents that the work was completed, the dispute would be re-solved amicably without going to court later. However, in most cases, there is no separate record of the completion of the painting work.

III. Blockchain for Multi color Painting Work

A. Participation

Let us briefly consider how to introduce blockchain technology to create and clarify work records and supportive data for multi-color painting work.

First, it is necessary to clarify how each construction stakeholder engages in the multi-color paint topcoat work. As mentioned earlier, the multi-color paint topcoat material is the most important, which is realized when selecting a subcontractor. The type and quantity of material to be used are then determined. This is part of the plan that the subcontractor submits to get the construction contract, so there is room for change later. However, since the subcontractor has contracted with the type of mate-rial and its cost, this can be considered confirmed if there are no significant issues. Therefore, from this stage, information on the multi-color paint topcoat is generated between the subcontractor and the general contractor, and this is finally reported to the owner through the inspector. Therefore, information on the multi-color paint topcoat is generated between these four stakeholders. Suppose information is created in blockchain at this stage and managed to continue until the final work completion stage. In that case, even minor changes can be recorded so that they can be helpful in future lawsuits.

In addition, if we consider the work completion inspection, the final report to the licensing authority, or submission to the facility information management system, the city hall or the National Land Safety Management Agency can also become essential stakeholders participating in the blockchain-bound information.

B. Main Information

Next, as far as the information that needs to be managed properly is concerned, the most critical information among the data on the multi-color paint topcoat would be the actual information, such as whether the topcoat was delivered to the construction site, when the work was carried out, whether all the materials were used, or whether some were leftover or used more because materials were insufficient.

In construction work, information on construction materials is specified in drawings and specifications. Still, in the Work Breakdown Structure, information for the upper-level work is described, and information for the lower-level work is often omitted. In general, multi-color paints are indicated in drawings, but they rarely specify the topcoat. Instead, they are mentioned in specifications but are not specific and only contain general information. Only basic information, such as how to con-duct topcoat work, and the procedures specified. It is important to note that product name and quantity must be managed and, moreover, recorded in the quantity calculation sheet. Quantity calculation sheets are available because they are needed dur-ing the settlement process after construction is completed. However, even if there are changes in the product or quantity of materials if they are not significant or the amount has not changed significantly, in most cases, only the quantity calculation sheet initially created is left, making it difficult to deal with if there were changes. For example, more paint materials will be required if work is done during dry weather and hot temperatures than under standard conditions. Suppose 30 cans of topcoat materials were initially expected, but 35 cans were practically needed during construction. In that case, the cost for the increased 5 cans will be charged more, so the quantity calculation sheet must be changed. However, since cost increases are not often recognized and this procedure is cumbersome, there are cases where only the original quantity calculation sheet is left without being rewritten to reflect the changed quantity and cost.

In addition, proof that the topcoat manufacturer sold the material to the subcon-tractor is required to verify whether materials were brought in during the work stage and whether work was conducted. A material approval request is also important supporting data to confirm and obtain approval for the topcoat to be used this time.

Next, as evidence to confirm whether actual work has been conducted, there is a work plan or order that notifies the plan to start work, along with a work completion certificate or work completion confirmation that notifies the work completion. As mentioned above, these documents certainly exist during work. Still, many of them are paper documents rather than electronic ones. In urgent work cases, reporting and receiving approval verbally or over the phone is common, so there are often no sup-porting documents left. In rare cases, work plans related to building construction exist at the lawsuit stage. There were no documents left in the cases where the re-search team experienced. Therefore, to prove that the topcoat was conducted and that it was legitimate and objective, if documents at this stage are created and mutually confirmed by each party and then made as a blockchain, it will be able to make a significant contribution to responding to problems that may arise in the future.

Finally, since the final confirmation is made at the settlement stage, where the cost is paid after the work is completed, it is necessary to record and blockchain the facts confirmed by the relevant parties. However, as mentioned earlier, in construction projects, the paperwork is often omitted unless there are significant changes, so even if there are actual changes and the total cost is changed, the related documents are frequently replaced with the original documents. Moreover, since the topcoat alone is not separately settled, even if there is a construction settlement statement for the entire multi-color paintwork, no document can clearly provide facts about the topcoat. There are even cases where there are no accounting statements for multi-color painting, and the reality is that information exists only as part of the entire painting work. Therefore, preparing separate, detailed supporting data for critical issues and having an accounting statement for the multi-colored paint topcoat upon project completion is vital to respond to disputes such as lawsuits effectively.

IV. Conclusion

Although informatization in the construction industry has reached an elevated level, existing information technology is insufficient to respond to disputes. To dramatically improve this, blockchain technology that guarantees the reliability of in-formation is essential. This study reviewed the stakeholders, work stage, and information type to apply blockchain technology to multi-color painting work in construction projects.

In the future, we plan to research how to apply blockchain technology in construction projects based on specific cases and how to integrate each existing technology effectively.

Acknowledgment

This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government (RS-2024-00343417).

References

[1] N. Schümchen, N. Lilja, "No trash – do not touch': Handwritten textual objects at a construction site," *Discourse & Communication*, vol. 18, no. 5, pp. 663-829, May 2024. https://doi.org/10.1177/17504813241240394

[2] M. Kiu, W. Lai, F. Chia, P. Wong, "Blockchain integration into electronic document management (EDM) system in construction common data environment," *Smart and Sustainable Built Environment*, vol. 13, no. 1) pp. 117-132, August 2024. https://doi.org/10.1108/SASBE-12-2021-0231

[3] J. Park, D. Seo, "Comparative Study on Housing Defect Repair Cost through Linear Regression Model," *ENG*, vol. 5, no. 3, id: 5030121, September 2024. https://doi.org/10.3390/eng5030121

[4] Korean Ministry of Land, Infrastructure, and Transport, *Construction Work Standard Specification: KCS 41 47 00 Painting Work*, Republic of Korea, 2022.

Deokseok Seo was born in Gongju, Korea in 1964. He currently lives in Wonju, Korea and is a professor of the College of Architecture at Halla University. He received bachelor's, master's, and doctoral degrees from Korea University in Korea. He also worked as a researcher at Korea Land & Housing Corporation, the only professional public company in Korea's apartment houses. He is the first researcher who received a doctorate in research on defects in apartment housing in Korea. Until now, he has been conducting various researches with government support on defects in apartment houses. In 2016, he was also listed in the World Dictionary of Marquis Who's Who in the World. In addition, he received a commendation from the Minister of Education as an excellent researcher. He has done various researches with Dr. Park, and has written academic papers and thesis. Recently, with the support of the Korea Research Foundation, a specialized research institute under the Ministry of Education, Korea, he is conducting a study on defect repairing cost and bond in apartment buildings.

Junmo Park was born in 1980 in Seoul, South Korea. He currently lives in Asan, Korea and is an assistant professor of the Division of Architecture at Sunmoon University. He majored in Architectural Engineering at the Chungbuk National University in Korea, graduated in 2006 with a master's degree in 2008, and received his Ph.D in 2012. Since 2005, he has been involved in various research and development projects commissioned by the Korean government and corporations and has lectured at many universities since 2010. Research on the defects of apartment buildings has been carried out with Professor Seo, with support from Korean government over 7 projects since 2008. Currently, he is working with Professor Seo on defect repairing cost and bond for apartment housing.