U.S. Department of the Interior
Bureau of Reclamation
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Econometric Analysis and Forecast Model for Reclamation Corrosion Protection Costs

Research Bulletin
S&T Project 19155

Mission Issue

Cost prediction tools allow Reclamation facilities to better understand future costs for relining large diameter steel pipes, which reduces corrosion and increases the reliability of water delivery and power generation.

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Problem

The Bureau of Reclamation (Reclamation) operates and maintains 188 hydroelectric power penstocks and an unquantified number of additional large and small diameter steel pipes, such as storage reservoir outlet pipes. The 188 penstocks alone comprise a combined 6.6 million square feet of interior surface area. The steel surface requires protective coatings to prevent corrosion damage, e.g., metal loss by wall thinning and pitting, which lead to expensive weld repairs or section replacements. Corrosion damage reduces the reliability of water delivery and power generation and can result in pipe rupture or decommissioning.

The periodic costs associated with spot repairing or removing and replacing protective coatings, i.e., coatings and linings, are part of operation and maintenance budgets for the facility. In some cases, end users, such as water and power customers, fund this maintenance. Recent experience suggests an upward trend in the frequency and cost of this maintenance, indicating that future budget needs may be rising. Better understanding these cost trends and improving the available cost estimating tools will aid budgeting, project planning, and communication.

Solution

An econometric analysis of pipe physical features and contract data was conducted to investigate cost drivers associated with interior lining maintenance (i.e., relining jobs) for large diameter steel pipes (42-inch diameter and larger). Econometrics is the application of statistical methods to economic data and allows for the evaluation of datasets to identify statistically significant variables, relationships, and trends. Understanding the cost drivers for these relining jobs improves budgeting and exposes opportunities to increase efficiencies. A final regression model that estimates large diameter pipe relining cost as a function of select explanatory variables was developed.

"The ability to predict coating relining costs will be extremely beneficial for planning and executing large pipe maintenance activities—ultimately improving the way Reclamation budgets for certain, often critical, jobs."

Stephanie Prochaska,
Materials Engineer
Bureau of Reclamation

More Information

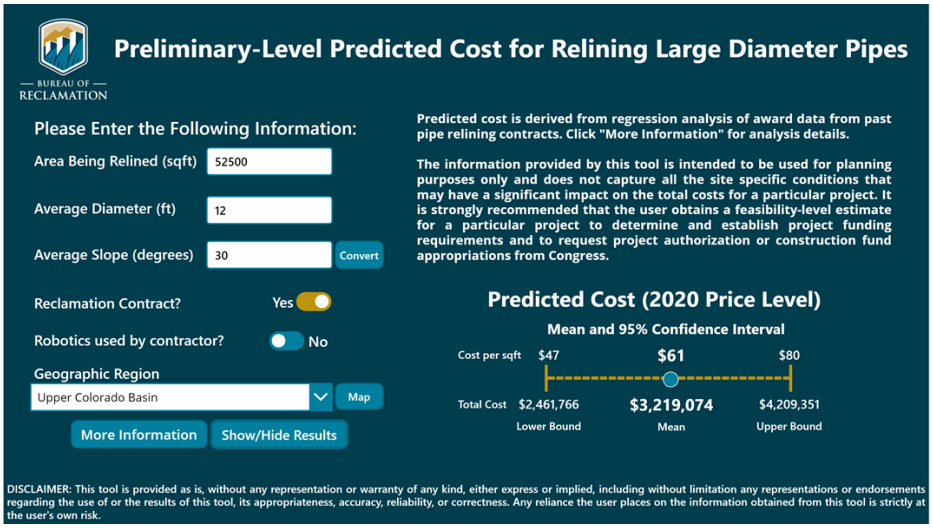
https://www.usbr.gov/research/projects/detail.cfm?id=19155

Application and Results

The econometric analysis employed regression analysis for 73 observations developed from multiple relining job award contracts. The following preliminary conclusions could be drawn from these results:

- Quantity relined is found to be the main driver of total relining cost and a main driver of unit cost due to strong economies of scale.
- The effect of pipe diameter on cost is dependent on whether application is manual or robotic.
- The effect of pipe slope on cost is dependent on whether application is manual or robotic.
- The model indicates that geographic region has a significant effect on relining cost.
- There is a significant, and pronounced, interagency effect on relining unit cost.

An application-based tool (app tool) was developed based on the results of the final regression model. The app tool requires the user to input the regression model variables. The output is a predicted cost, i.e., forecasted cost, in 2020$.



Microsoft Power Apps app tool for predicting large steel pipe relining costs.

Future Plans

The app tool will be applied to upcoming large pipe relining projects to obtain a preliminary-level predicted cost. This helps facilities and designers to approximate the cost and the steps required to complete the project. Future research should incorporate new relining job data into the observation dataset as it becomes available. Future econometric analysis and updating of the regression model will be enhance the predictive tools accuracy and improve understandings of the cost relationships and trends.