

Construction Research Congress 2022

Project Management and Delivery, Contracts, and Design and Materials

Selected Papers from the Construction Research
Congress 2022

Arlington, Virginia, USA
9 – 12 March 2022

Volume 1 of 2

Editors:

**Farrokh Jazizadeh
Tripp Shealy
Michael J. Garvin**

ISBN: 978-1-7138-4444-0

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2022) by American Society of Civil Engineers
All rights reserved.

Printed with permission by Curran Associates, Inc. (2022)

For permission requests, please contact American Society of Civil Engineers
at the address below.

American Society of Civil Engineers
1801 Alexander Bell Drive
Reston, VA 20191
USA

Phone: (800) 548-2723
Fax: (703) 295-6333

www.asce.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2633
Email: curran@proceedings.com
Web: www.proceedings.com

Contents

Contracting, Project Delivery, and Legal Issues

Precontract Negotiations in Design-Build Projects	1
Elif Deniz Oguz Erkal and Keith Molenaar	
Fairly Apportioning Concurrent Delay Liability: A Game Theory Approach.....	11
Huu T. Huynh, Gunnar Lucko, and Mohamed S. Eid	
Sharing Risk Contingency Costs in Construction Joint Venture Agreements: A Cooperative Game Theory Approach	20
Radwa Eissa, Yasmehin Shahin, and Mohamed S. Eid	
Project Performance Comparison of Vertical Projects versus Horizontal Projects	30
Prasenjit P. Shrestha and Elina Prajapati	
Impacts of Alternative Contracting Methods for Utility Coordination of Transportation Projects	41
Tarig Omer, Roy Sturgill, and Timothy Taylor	
In the Name of the Pandemic: A Case Study of Contractual Modifications in PPP Solicited and Unsolicited Proposals in COVID-19 Times.....	50
Gabriel Castelblanco, Jose Guevara, and Paula Mendez-Gonzalez	
Identifying Contingency Liability from P3 Contracts Using Rule-Based NLP	59
Yu Wang, Kunqi Zhang, Man Liang, and Qingbin Cui	
Longitudinal Study of Information Management in University Construction Contracts	69
Amelia Celozza, Daniel P. de Oliveira, and Fernanda Leite	
Major Causes of Claims and Disputes on Transportation Public-Private Partnership Projects.....	79
Omar Shabana and Ghada Gad	
Leveraging Alternative Technical Concept for Contract Delivery of Accelerated Bridge Construction	89
Piyush Pradhananga and Mohamed Elzomor	

PPP Renegotiation Flight Simulator: A System Dynamics Model for Renegotiating PPPs after Pandemic Crisis	100
Gabriel Castelblanco, Jose Guevara, and Paula Mendez-Gonzalez	
Current State of Practice in Selection and Implementation of Airport Capital Project Delivery Methods	109
Phuong Nguyen and Daniel Tran	
Dimensions of Innovation in Project Delivery Method Selection for Highway Projects	119
Vassiliki Demetracopoulou, William J. O'Brien, and Nabeel Khwaja	
Transferal of Responsibilities of PPP European Equity Markets: Dependency Analysis	129
John S. Salazar, Jose A. Guevara, and Luis A. Herrera	
Investigating Financial Risks Associated with Public–Private Partnerships for Transportation Project Delivery	139
Kalyani Joshi, Christofer M. Harper, John Killingsworth, and Suren Chen	
The Moderating Role of Trustworthiness in the Relationship between Institutional Distance and Private Ownerships in PPPs: Evidence from Emerging Markets and Developing Countries	149
Qinghua He, Yang Li, Ge Wang, and Zilun Wang	
State-of-the-Art Review on the Applicability of Natural Language Processing (NLP) Methods to Address Legal Issues in Construction	159
Fahad UI Hassan and Tuyen Le	
Enabling Faster Project Delivery through Use of Construction-Driven Designs	169
Aleksandra Markovic Graff and Jesus M. de la Garza	
Determining Contract Requirements for Quality Assurance Program in Innovative Project Delivery	179
Jung Hyun Lee, Evan Mistur, Lier Liu, and Baabak Ashuri	
CMAR Procurement in US Public Projects: Qualifications-Driven Processes and Criteria	189
Hala Sanboskani, Mounir El Asmar, Bahaa Chammout, and Oscar Bou Maachar	
Award Algorithms and Technical Scoring Trends in Design-Build Best-Value Highway Projects	200
Maria Calahorra-Jimenez	

Management and Contract Allocation of Geotechnical Risks on Mega Design-Build Infrastructure Projects.....	210
Hajer W. Dawoody and Ghada M. Gad	
Uncertainty Factors Affecting Bid Price from Pre-Bid Clarification Document of Transport Construction Projects.....	219
YeEun Jang, JeongWook Son, and June-Seong Yi	
A Comparison of Georgia DOT’s Design-Build Legislation and Project Expenditures with Those of Bordering States.....	225
Wesley D. Mitchell, Raed T. Jarrah, and Chang-Ray Chen	
Synthesis of Challenges for Public–Private Partnerships (PPPs) in Transportation Infrastructure in Southeast Asia	235
Chi A. Nguyen and Michael J. Garvin	
Selection Factors for Progressive Design-Build Delivery Method	244
Ruqaya Alameri and Behzad Esmaeili	
<i>Construction Scheduling, Estimating, Economics, and Controls</i>	
Economic Vulnerability Assessment of the Construction Industry in the United States.....	254
Arkaprabha Bhattacharyya and Makarand Hastak	
Determination of Optimal Rolling Planning Period for the Management of BIM-Based Construction Supply Chain Processes	263
Qian Chen, Borja Garcia de Soto, and Bryan T. Adey	
Construction Insurance Machine-Learning Estimation Approach for Multiple Attempted Bids	274
Ayman H. El Hakea and Mohamed S. Eid	
Developing a Multivariate Time-Series Model to Forecast the Level of Competition in Transportation Projects.....	283
Minsoo Baek, Baabak Ashuri, and Suma Veeravenkatappa	
Machine Learning Framework to Predict Last Planner System Performance Metrics	292
Lynn Shehab, Diana Salhab, Elyar Pourrahimian, Karim Noueihed, Gunnar Lucko, and Farook R. Hamzeh	
A Pattern-Recognition Method for Highway Construction Project Expenditure Cash Flows Using Clustering-Based K-Means Approach	302
Minsoo Baek, Yunping Liang, and Baabak Ashuri	

Global and Local Risk Factors Causing Correlation between Activities in Fuzzy Linear Schedules	311
Yi Su, Shabtai Isaac, and Gunnar Lucko	
Framework of Automatic Cycle Schedule Management Based on BIM Technology	322
Yanhui Jia and Ding Liu	
Construction Procedural Information Extraction from Textual Sources to Support Scheduling	330
Ran Ren and Jiansong Zhang	
Predicting Ratio of Low Bid to Owner’s Estimate Using Feedforward Neural Networks for Highway Construction	340
Mingshu Li, Qiu Zheng, and Baabak Ashuri	
Feasibility of an Integrated Heuristic and Machine Learning Approach for Schedule Health Monitoring in Construction	351
Yoonhwa Jung, Fouad Amer, and Mani Golparvar-Fard	
Prediction of Egypt’s Construction Industry Resilience	361
Ahmed Shiha and Elkhayam M. Dorra	
Integrated DEMATEL and ANP-Based Framework to Model Construction Labor Productivity	370
Ali Bayesteh, Elyar Pourrahimian, Ming Lu, and Simaan AbouRizk	
Cost Estimate Risk Factors in US Army Corps of Engineers’ Emergency Streambank Protection Projects	381
Hunter Waugaman, M. Ammar Alzarrad, and James Bryce	
Forecasting Architecture Billings Index Using Time Series Models	391
Soojin Kim, Bahram Abediniangerabi, and Mohsen Shahandashti	
Developing Assessment Criteria for State DOTs’ Standard Specifications on Contractor Schedules	403
Byung Gi Han, Junghye Son, Nabeel Khwaja, and William J. O’Brien	
An Artificial Intelligence Based Model for Construction Activity Sequence Prediction in Highway Projects	414
Hamed Alikhani and H. David Jeong	
Building Optimization Model for Minimizing Operation and Maintenance Costs	422
Mahdi Ghafouri and Moatassem Abdallah	

Estimating Electricity Consumption of Buildings Using Information Theory and Machine Learning Methods	432
Mahdi Ghafoori and Moatassem Abdallah	
Improving the Efficiency of Rebar Manufacturing Works for Simultaneous Multiple Projects Using Discrete Event Simulation	441
Eunbin Hong, June-Seong Yi, JeongWook Son, MinYoung Hong, and YeEun Jang	
Optimization of Multi-Skilled Labor with the Application of Partial Allocation of Resources	451
Amira A. Saleh, Ibrahim S. Abotaleb, and Ossama A. Hosny	
Linear Optimization Model for Scheduling Repetitive Construction Projects with Multiple Crews	461
Shahryar Monghasemi and Moatassem Abdallah	
Benefits of Building Information Modeling in Road Projects for Cost Overrun Factors Mitigation.....	472
Omar Sánchez, Karen Castañeda, Rodrigo F. Herrera, and Eugenio Pellicer	
A Rating Score for Assessing the Risks and Challenges Associated with Modular Construction	483
Mohamad Abdul Nabi and Islam H. El-Adaway	
<i>Engineering and Materials Design, Quality, and Value Management</i>	
Cost Analysis of a Mass Timber Building Project: Comparison of Budgeted and Actual Construction Cost	493
Shafayet Ahmed and Ingrid Arocho	
Identifying the Level of Awareness and Challenges to Adopt Mass Timber by the Construction Practitioners in the United States	502
Shafayet Ahmed and Ingrid Arocho	
Developing a Value Dashboard for Tracking Value Alignment during Design	513
Salam Khalife and Farook Hamzeh	
Structural Behavior of Composite Reinforced Concrete One-Way Slabs Voided with Plastic Bubbles.....	524
Amer M. Ibrahim, Ibrahim A. Ali, and Rouaida H. Ali	
Unveiling Value Creation in Megaprojects from the Perspective of Stakeholder Value Network	535
Ouyang Luxia, Zheng Xian, Li Yongkui, Pang Bo, and Gao Xinglin	

Critical Constructability Review Indicators for Construction of Transportation Infrastructure.....	544
Minerva Bonilla, William Rasdorf, Amin Akhnoukh, Nick Norboge, Daniel Findley, and Clare Fullerton	
Life Cycle Cost Assessment of Green Lightweight Concrete Utilizing Recycled Plastic Based Lightweight Aggregates.....	553
Fahad K. Alqahtani, Ibrahim S. Abotaleb, and Mohamed Elmenshawy	
Examination of Contractor Quality Control Plans for Highway Construction Projects.....	563
Mamdouh Mohamed and Daniel Tran	
Performance of Engineered Cementitious Composite Material under Differing Site Conditions.....	574
Michèle Anderson and Susan M. Bogus	
Identifying and Prioritizing Criteria for Selecting Sustainable Façade Materials of High-Rise Buildings.....	583
Pouria Mohammadi, Amir Mohammad Ramezaniyanpour, and Abdolmajid Erfani	
Exploring Utilization of the 3D Printed Housing as Post-Disaster Temporary Shelter for Displaced People.....	594
Karthik Subramanya and Sharareh Kermanshachi	
Streamlining WELL Concepts of Office Buildings for Developing Countries: The Case of Malaysia.....	606
Carmen Y. M. Tan, Rahimi A. Rahman, Bo Xia, and Qing Chen	
Mistakeproofing Framework and Applications in Civil Engineering Operations and Products.....	617
Iris D. Tommelein and Karilin Yiu	
Modular Adaptable Hospital Design (MAHD): Proposing a Design and Construction Methodology for Flexible and Adaptable Hospitals.....	627
Gordan Kucan, Konrad Graser, David Grossmann, and Daniel M. Hall	
Upstream Digitized Materials Tracking by Vendors and Suppliers—Barriers, Drivers, and Benefits.....	638
Verena Schneider and David Grau	
Multi-Objective Optimization Model to Minimize Upgrade and Utility Costs of Large Existing Buildings.....	648
Mahdi Ghafoori and Moatassem Abdallah	

Literature Review of Residential Aboveground Storm Shelter.....	658
Bi Zhang and Ajay Shanker	
A Framework for Estimating the Reuse Value of In Situ Building Materials.....	666
Aida Mollaei, Chris Bachmann, and Carl Haas	
Strategies for Enhancing Construction Waste Recycling: A Fuzzy Synthetic Evaluation.....	676
Mazen M. Omer, Rahimi A. Rahman, and Saud Almutairi	
Investigation of Relationship between Geotechnical Parameters and Electrical Resistivity of Sandy Soils.....	686
Mina Zamanian and Mohsen Shahandashti	
LEED Assessment of Green Lightweight Concrete Containing Plastic Based Aggregates in Construction	696
Fahad K. Alqahtani, Ibrahim S. Abotaleb, and Sara Harb	
<i>Project and Organizational Management and Planning</i>	
Mapping the Preconstruction Project Development Process for Transportation Projects	706
Tanin A. Haidary, Dennis C. Bausman, Ajay S. Jadhav, and Mashrur Chowdhury	
Facility Design Standardization: Six Solution Pieces and Industry Maximization Enablers	715
Jin Ouk Choi, Binit K. Shrestha, Seung Ho Song, Jennifer S. Shane, and Young Hoon Kwak	
Choosing by Advantages (CBA) Method to Determine Feasibility of Mass Timber Building Material in the US Construction Market	724
Shafayet Ahmed and Ingrid Arocho	
POP: A Data-Based Construction Project Overall Performance Model.....	734
Hiba Jalloul, Awad S. Hanna, and Wafik Lotfallah	
Identifying Multilevel Metrics for Construction Competency and Performance Measures	744
Yisshak T. Gebretekle and Aminah Robinson Fayek	
A Framework to Measure the Cost of Controversy Surrounding Energy Construction Projects	754
Michaela LaPatin, Lauryn Spearing, Helena R. Tiedmann, Olga Kavvada, Maria Giorda, Jean Daniélou, and Kasey M. Faust	

Barriers and Motivators of Knowledge Sharing in a Virtual Engineering Office	764
Marilyn Karam, Hala Sanboskani, Daoud Kiomjian, and Issam Srour	
Exploring Trends in Risk Statements among Design and Construction of Scientific Research Facility Projects	774
Evan P. Dicks and Keith R. Molenaar	
An Integrated Sustainability Performance Criteria Checklist for Sustainable Public Housing Projects.....	784
Asma A. Sharafeddin and Ingrid Arocho	
Making Project Risk Response Decisions through Stakeholders' Impact on Project Risk Interaction.....	794
Zhixue Liu, Ronggui Ding, Lei Wang, Rui Song, and Xinyi Song	
Human Values and Sustainable Construction Management: A Literature Review	805
David Gutierrez and Leidy Klotz	
Understanding and Comparing the Different Fund Levels in Airport Improvement Projects: A Graph Theory Approach	815
Ramy Khalef and Islam H. El-Adaway	
Collaborative Planning Metrics in Construction Projects: A Factor Analysis Approach	825
Amr Elsayegh and Islam El-Adaway	
Mitigating the Winner's Curse Dilemma in Multi-Stage Construction Bidding.....	835
Muaz O. Ahmed, Islam H. El-Adaway, and Kalyn Coatney	
Improved Project Planning Strategies for Transportation Assets: The Necessity of Early Stakeholder Involvement.....	845
Bukola Oni and Katherine Madson	
Understanding Organizational Improvisation in Construction Megaprojects	855
Kaiwen Jiang, Yun Le, Xian Zheng, and Xinyue Zhang	
An Integrated Framework to Quantify the Impact of Competency Factors on Project Performance.....	863
Mina Naguib, Ebrahim S. Eldamhoury, Awad S. Hanna, and Wafik Lotfallah	
Using Functional Near-Infrared Spectroscopy (fNIRS) to Evaluate the Construction Decision Making Inventory (CDMI).....	874
Tulio Sulbaran and Krishna P. Kisi	

Front End Planning for Industrial Projects: Identifying the Reasons behind Schedule and Cost Overruns Using the New PDRI MATRS	883
Namho Cho, G. Edward Gibson Jr., and Mounir El Asmar	
A Pre-Demolition Planning Framework to Balance Recyclability and Productivity	892
Hiba Jalloul, Ana Pinto, and Juyeong Choi	
The Effect of the Economic and Social Motivations on Knowledge Sharing Behavior in Megaprojects: A Mediating Effect of Environmental Dynamism	902
Hui He, Xiaoxue Liu, Qinghua He, Ge Wang, and Jun Zhu	
Assessing Automation Readiness of Recurring Pavement Failure in Developing Countries: Case Studies of Nigeria and Jordan	912
Olugbenro Ogunrinde, Ifeanyi Okpala, Rapheal A. Ojelabi, Opeyemi Oyeyipo, and Muhammad T. Hatamleh	
Are Different Innovations More Challenging to Implement? A Comparison of Different Types of Changes in the AEC	922
Omar Maali, Amirali Shalwani, Brian Lines, Kristen Hurtado, and Kenneth Sullivan	
Lean Adoption for Trade Contractors: Benefits, Barriers, and Path Forward	932
Elnaz Asadian, Robert M. Leicht, and John I. Messner	
New Heuristic Method of Section Network Compression Process for Large-Scale Networks.....	943
Silas Stewart and Yoojung Yoon	
Development of Key Performance Indicators for Performance Assessment of Owners' Project Managers	954
Shantanu Kumar and Mohammed S. Hashem M. Mehany	
Comparative Analysis of Right of Way Acquisition Processes by State DOTs	964
Frederick Chung and Baabak Ashuri	
A Framework for Assessing Strategies to Combat Individuals' Resistance to Technological Innovation in the Construction Industry.....	974
Yelly Kwesy Lawluy, Fangyu Guo, and Kaiyang Wang	
Digital Technology in Architecture, Engineering, and Construction (AEC) Industry: Research Trends and Practical Status toward Construction 4.0	983
Kaiyang Wang, Fangyu Guo, Cheng Zhang, Jianli Hao, and Dirk Schaefer	

A Quantitative Assessment of Change Adoption Success within the Facility Management Industry	993
Dipin Kasana, Justin Dodd, Jake Smithwick, Amirali Shalwani, and Brian Lines	
Identification of the Barriers to Data-Centric Approach in the Construction Industry	1002
Ali Karji, John Messner, Robert Leicht, and Christopher McComb	
Project Team Collaborations during Time of Disruptions: Transaction Costs, Knowledge Flows, and Social Network Theory Perspective	1012
Hasan Gokberk Bayhan, Sinem Mollaoglu, Hanzhe Zhang, and Kenneth A. Frank	
A Comparative Analysis of Production Metrics across VDC Implementations	1024
Tulika Majumdar, Steinar G. Rasmussen, Alexandre Almeida Del Savio, Katrin Johannesdottir, Eilif Hjelseth, and Martin Fischer	
Identification of Management Processes That Impact Capital Efficiency on Downstream and Chemical Projects	1034
Zhe Yin, Carlos Caldas, and Daniel de Oliveira	
Review of Current Practices for Implementing Organization-Wide Knowledge Repositories	1045
Siddharth Banerjee, Abdullah Alsharif, Edward J. Jaselskis, and Kalyan R. Piratla	
Knowledge Exchanges in Complex Project Networks: Influence Model	1055
Meltem Duva, Dong Zhao, Sinem Mollaoglu, and Kenneth A. Frank	
Network Topologies and Team Performance: A Comparative Study of AEC Projects	1062
Meltem Duva, Sinem Mollaoglu, Dong Zhao, and Kenneth A. Frank	
Integration of Utility Coordination and Highway Design	1072
Shani A. Montes Victorio, Roy E. Sturgill, and Timothy R. B. Taylor	
Transition to Supervision: A Skill Gap Analysis between Female and Male Construction Supervisors	1083
Callie Thomason French and Susan M. Bogus	
Construction Business Strategies Used by General Contractors in the United States for Market Enhancement	1091
Haiyan Sally Xie, Jayraj Singh Solanki, and Owen Shi	

EVMS Maturity and Its Impact on Project Cost and Schedule Performance of Large and Complex Projects: A Preliminary Analysis.....	1100
Vartenie Aramali, Hala Sanboskani, G. Edward Gibson Jr., and Mounir El Asmar	
Determinants for Operating Organization Selection in Urban Rail Transit Project under Public–Private Partnerships.....	1110
Xian Zheng, Rui Li, Yilong Han, Jiaying Chen, and Xiao Hu	