Editorial

Technology and Management Applied in Construction Engineering Projects

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Abstract: The current Special Issue is a digest of 13 published articles that referred to the following scientific and professional areas: construction project management and quality management in construction engineering and supervision; cost discount and the financial control of construction projects; multi-criteria feasibility studies of investment enterprises; the qualitative and quantitative research of engineering buildings by probabilistic and fuzzy sets approach; multidiscipline expertise investigations of buildings that significantly differ in structure and use.

Keywords: management; project cost; investment schedule; risk mitigation; uncertainty; randomness; fuzziness; health and safety control

1. Introduction

Construction project management is a process that includes several operations, activities, and decisions that are closely related to carried-out enterprises, which aim to increase existing or create new fixed assets to achieve utility effects. The utility effect of the construction process may be the construction of a new building or the renovation or modernization of an existing building. In each construction process, according to the definition of the building’s life cycle, the following four basic phases are distinguished: the programming/planning phase, the implementation phase, the operation/use/maintenance phase, and the decommissioning or demolition phase. The appropriate planning of the entire construction process is an important operation that has a direct impact on the success achieved while implementing an investment project.

The construction industry is characterized by a high complexity of implemented construction processes, variability of implementation conditions, and diversity of facilities, applied technologies, and methods of work organization. The execution of construction projects is specific and difficult because each implementation is a unique, complex, and dynamic process that consists of several subprocesses related to each other in which various participants of the investment process take part.

Therefore, there is still a vital need to study, research, and conclude engineering technology and management applied in construction projects.

2. Contributions

The current Special Issue includes 13 research articles, presented in Table 1. A total of 35 authors or co-authors took part. The authors originate from seven countries: Canada, Chile, China, Croatia, Poland, Romania, and Spain. Each of the published papers represents valuable and novel research works on state-of-the-art applications.
Table 1. The content of the Special Issue “Technology and Management Applied in Construction Engineering Projects”.

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<td>Daniel Przywara, Adam Rak</td>
<td>Poland</td>
<td>Monitoring of Time and Cost Variances of Schedule Using Simple Earned Value Method Indicators</td>
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<td>Xun Liu, Le Shen, Kun Zhang</td>
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<td>Estimating the Probability Distribution of Construction Project Completion Times Based on Drum-Buffer-Rope Theory</td>
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<td>Hubert Anysz, Jerzy Roslon, Andrzej Foremny</td>
<td>Poland</td>
<td>7-Score Function for Assessing the Strength of Association Rules Applied for Construction Risk Quantifying</td>
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<td>4</td>
<td>Tadeusz Kasprowicz, Anna Starczyk-Kolbyk, Robert Wójcik</td>
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<td>construction project management; time-at-risk (TaR); investment-construction process model; Monte Carlo simulation resilience; baseline schedule; uncertainty; taxonomy; construction project</td>
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<td>Janusz Sobieraj, Dominik Metelski</td>
<td>Poland, Spain</td>
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<td>construction reports; construction contracts; natural language processing; machine learning; simulation modeling monitoring progress; construction phase; automated monitoring; digital tools; as-built; as-planned</td>
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<td>Martina Milat, Snejzana Knezić, Jelena Sedlar</td>
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<td>resilience; baseline schedule; uncertainty; taxonomy; construction project</td>
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<td>7</td>
<td>Parinaz Jafari, Malak Al Hattab, Emad Mohamed, Simaan AbouRizk</td>
<td>Canada</td>
<td>Automated Extraction and Time-Cost Prediction of Contractual Reporting Requirements in Construction Using Natural Language Processing and Simulation</td>
<td>construction reports; construction contracts; natural language processing; machine learning; simulation modeling monitoring progress; construction phase; automated monitoring; digital tools; as-built; as-planned</td>
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<td>Luz Duarte-Vidal, Rodrigo F. Herrera, Edison Atencio, Felipe Muñoz-La Rivera</td>
<td>Chile, Spain</td>
<td>Interoperability of Digital Tools for the Monitoring and Control of Construction Projects</td>
<td>building information modelling (BIM); automatization; facilities design; domestic plumbing and sanitation</td>
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<td>Edison Atencio, Pablo Araya, Francisco Oyarce, Rodrigo F. Herrera, Felipe Muñoz-La Rivera, Fidel Lozano-Galant</td>
<td>Chile, Spain</td>
<td>Towards the Integration and Automation of the Design Process for Domestic Drinking-Water and Sewerage Systems with BIM</td>
<td>building information modelling (BIM); automatization; facilities design; domestic plumbing and sanitation</td>
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Appropriate planning and effective control with the constant monitoring of construction projects are important for the successful execution of a project within planned initial conditions. Budget planning at the investment preparation stage, as well as the control of cash flows during project implementation, is of key importance for investors, project managers, and construction work contractors [14,15].

The paper of Przywara and Rak [1] attempts to analyze the emerging time and cost deviations using proprietary time variances from the schedule and variances from planned costs based on simple indicators of the Earned Value Method. The construction of a multi-family housing development was used as an example to study the variances between planned and incurred costs.

In turn, the article of Liu et al. [2] applied the “drum-buffer-rope” construction schedule management and control technology into a PERT network to improve the relationship among the activities. The research described that the method derived from the theory of constraints (TOC) attempts to enhance the couplings among tasks to revise and further reduce the uncertainty of construction activities which leads to improving the reliability of project progression. The elements of drum, buffer, and rope (DBR) in TOC are added to the PERT network schedule. To illustrate the impact of DBR applications on improving project schedule reliability, a case of a hydropower station is used as an example to show the enhanced reliability of scheduling.

The planning and implementation of construction projects are difficult processes and are burdened with many risk elements. Over the years, many approaches to construction project risk management have been developed by various researchers.

In the paper of Anysz et al. [3], the 7-Score Function for Assessing the Strength of Association Rules Applied for Construction Risk Quantifying was invented. Based on the 7-score function, the most powerful and the most informative rules can be found, which allows their importance to be ranked. It crucially introduced an innovative method of quantitative risk assessment, not based on the experts’ opinions but rather on evidence concerning collected and completed construction contracts of the same kind.

The objective of the research conducted by Kasprowicz et al. [4] was to verify the correct probabilistic method for the analysis and assessment of the Net Present Value

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<td>Paul Sestras [10]</td>
<td>Romania</td>
<td>Applied Construction Layout Plan with Batter Boards Stake-Out Methods Comparison: A Case Study of Romania</td>
<td>land surveyor; construction surveying; building layout; polar coordinates; stake-out methods; total station; bridge expansion and contraction installation (BECI); decision making (DM); technical condition assessment; analytic hierarchy process (AHP); whale optimization algorithm; tent chaotic mapping; Lévy flight; decision-making process; decision modelling in construction activities; decisions in civil engineering; liquid cooling system; flow calibration; differential pressure; experimental method; aircraft</td>
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<td>11</td>
<td>Zian Xu, Minshui Huang [11]</td>
<td>China</td>
<td>Improving Bridge Expansion and Contraction Installation Replacement Decision System Using Hybrid Chaotic Whale Optimization Algorithm</td>
<td>bridge expansion and contraction installation (BECI); decision making (DM); technical condition assessment; analytic hierarchy process (AHP); whale optimization algorithm; tent chaotic mapping; Lévy flight; decision-making process; decision modelling in construction activities; decisions in civil engineering; liquid cooling system; flow calibration; differential pressure; experimental method; aircraft</td>
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<td>12</td>
<td>Elżbieta Szafranko, Jolanta Harasymiuk [12]</td>
<td>Poland</td>
<td>Modelling of Decision Processes in Construction Activity</td>
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<td>13</td>
<td>Yingije Zhao, Fan Yang, Yijiang Ma [13]</td>
<td>China</td>
<td>Experimental Method for Flow Calibration of the Aircraft Liquid Cooling System</td>
<td>decision-making process; decision modelling in construction activities; decisions in civil engineering; liquid cooling system; flow calibration; differential pressure; experimental method; aircraft</td>
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of unstable construction projects. The results of the real building investments by the randomized method of the estimation of construction projects’ efficiency were presented.

The article of Sobieraj and Metelski [5] proposed a framework for quantifying the risk of time variation in a project based on Monte Carlo simulation and probabilistic Time-at-risk analysis. This is an approach to explicitly quantify the uncertainty in the duration of the whole project as well as its individual stages. The possibilities of the proposed approach are explained using a simple example of the construction of a housing estate in Warsaw-Bemowo, which was carried out in the period 1999–2012.

The aim of the paper of Milat et al. [6] was to structure sources of uncertainty related to complex construction projects. The main objective of the research was to propose a comprehensive mathematical model for resilient scheduling as a trade-off between project robustness, project duration, and contractor profit. The proposed optimization problem is illustrated in the example project network, along which the probabilistic simulation method that was used to validate the results of the scheduling process in uncertain conditions. According to the authors, the proposed resilient scheduling approach leads to more accurate forecasting; therefore, the project planning calculations are accepted with increased confidence levels.

Some problems in the construction industry involve communication and reporting procedures. Construction reports are often required by clients as a way of monitoring project progress, estimating production rates, and resolving disputes and claims. Ineffective reporting systems lead to poor project management. To prevent such drawbacks, Jafari et al. [7] developed an automated reporting requirement identification and time–cost prediction framework.

Monitoring the progress of a construction site during the construction phase is essential. An inadequate understanding of the project status can lead to mistakes and inappropriate actions, causing delays and increased costs. The manuscript of Duarte-Vidal et al. [8] presented a bibliographic synthesis and interpretation of 30 nonconventional digital tools for monitoring a construction project’s progress that was achieved by the means of building information modeling (BIM), unmanned aerial vehicles (UAVs), and photogrammetry.

According to Atencio et al. [9], the use of building information modelling (BIM) in construction projects is expanding, and its usability throughout building lifecycles, from planning and construction to operation and maintenance, is gaining increasing evidence.

The issue of planning also concerns the efficient layout planning of a construction site. According to Sestras [10], this is a fundamental task for any project undertaking. It is each survey engineer’s responsibility to guide the builders and conduct an accurate, safe, and time- and cost-efficient layout of the designed structure.

Due to the complexity of situations in which construction activity decisions are made, the decision-making process can be supported by different mathematical methods, systems, and models. Xu and Huang [11] proposed the multi-criteria model BECI technical condition assessment approach, which contains specific on-site inspection regulations with both qualitative and quantitative variables. The hybrid chaotic whale optimization algorithm (WOA) was designed and utilized to improve and automate the process of optimal replacement plan selection with the assistance of the analytic hierarchy process (AHP).

The article of Szafranko and Harasymiuk [12] includes descriptions of decision support methods and models, including single-criteria and multi-criteria models, operations research, and fuzzy models. The article contains an analysis of the model approaches proposed in the literature confronted with decision-making processes in engineering practice. The study covered 34 construction projects and 15 companies operating in the construction industry. Several decision situations have been considered. The observations obtained during the research helped the authors to develop the decision support models dedicated to engineering practice while managing construction projects.

3. Conclusions

The presented unanimous research approach is a result of many years of studies conducted by 35 well-experienced authors. The common subject of research concerned the
development of methods and tools for modelling multicriteria processes in construction engineering. Real-time decision-making seems to be well-recognized as a deterministic cause–effect event and is supported by many programs/applications in everyday engineering and managerial work. A much more interesting challenge is the analysis of past states, the effects of which are observed in the present, and also the current modelling of continuous processes, the effects of which will be visible in the future. When using two-valued logic, in which the premise results in an arbitrary conclusion, a decision is determined by the inference model. When such logic is insufficient, it has been noticed that decisions cease to be deterministic and instead become multivariate. Actions are also undertaken in a multi-variant way and assume the tracking of circumstances and a possible change during the implementation of the decision. There is no doubt that real situations are more complicated and they, therefore, require a more complex decision-making management process, as presented in the published works.

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