

A Review on Feasible Cost Prediction Model in Construction Projects

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Abstract: This paper proceeded with the decision-making within the early stages of a construction project which can have a major impact on the project. Restricted and unsure data makes it troublesome to accurately predict construction prices. The advanced cosmic microwave background model can be developed to integrate the benefits of prediction methodologies like cosmic microwave background, Multivariate Regression Analysis (MRA) and Artificial Neural Networks (ANN). An improved method of employing a genetic algorithmic rule is needed to predict the cost fluctuations on the industry. This study outlined four improvement factors, as: minimum threshold for rating the attribute similarity, attribute weight factors, case choice factors and tolerance factor between models. As the model was carried out as victimization, the MS-Excel based platform, Visual Basic Application (VBA) is implemented for easy handling, thus it can be presumed that the idea supports the stakeholders thought of predicting and managing a construction price within the early stages of a construction projects by incorporating results studied from historical cases as references. From previous studies, we've studied the average of construction material prices, which can be incorporated in formulating the prototype.

Keywords: Construction project; Multivariate Regression Analysis (MRA); Construction cost; Visual Basic Application(VBA); Artificial Neural Networks(ANN); Prediction models

1. Introduction

Conceptual value estimates are developed at the first stage of comes. Because the construction drawings and specifications don't seem to be typically accessible throughout the first stages, these estimates are typically created without amount take-off. The accuracy of abstract value estimates chiefly depends on the amount of knowledge accessible and additionally the techniques being employed to work out the abstract value estimates. The accuracy of AN estimate at a sure data level may well be improved by mistreatment the correct technique for the accessible information. Many modeling techniques are steered for abstract estimating together with probabilistic modeling, multivariate analysis, and neural networks. Every technique has sure benefits and downsides betting on the information accessible and also the

purpose of the estimating. The aim of this paper is to review and compare the abstract value estimating modeling techniques. Construction comes usually struggle from a great deal of ambiguity on several fronts: time, resources, efficiency, and safety are all factors to consider. The majority of the research is based on estimation value unforeseen circumstances. Although development undertaking programing was being issued intensive focus from investigators, unforeseen circumstances wasn't a good situation within the body of knowledge. So as to fulfill the point an undertaking, correct programing ought to be sought-after. Thanks to the character of construction comes, programing ought to be versatile sufficient to handle adjustments while not adversely touching the length of the undertaking. As a result, the priorities of the analysis given during this paper are to consider the elements that have an effect on programing contingency and to develop an easy model which will be employed when calculating a building project's planned time uncertainty. A study of sixteen construction sites corporations in city was performed, Québec, Canada. After that, the information collected from the survey was analyzed mistreatment Analytic Hierarchy Processes (AHP) to build a time backup plan. The expected time variance the real time contingency, according to the results matches eighty-seven of the calculable uncertainty for true comes. The time uncertainty model that was established yielded excellent results. According to this paper tries to evaluate the output of a database application cosmic radiation. The effect of reference weights developed on the estimation method by 3 completely alternate improvement methods, specifically unique numeration, simulated annealing and back propagation. The burden methods of creation and therefore the following to the cosmic radiation findings are given in a very easy computer program format that's clear and straight forward to hire. The design is put into practice by making predictions the value of the housing good structural framework comes at associate degree prior stage. The model is validated and proposals created.

2. Literature Review

Othman Subhi Alshamrani considered about the RS suggests that was accustomed estimating the national building average prices for 2014, that was afterward utilized to improve the design. The design was improved in 3 important stages, like first-step nosology on knowledge quality, design

improvement, and comparison. The improved design was with success tested and valid with period of time knowledge. The design was valid by comparison the forecasting with original information, further as by victimization mathematical equations. The design confirmation incontestable appropriate inconsistencies, whereas the precision of mathematical validation was found to be 94.3% [24].

R. Sonmez et al mainly focused on the construction drawings and specifications aren't sometimes accessible throughout the first stages, these estimates are typically created while not amount take-off. The accuracy of abstract price estimates in the main on the basis of amount of data accessible and conjointly the methods being assigned to see the abstract price estimation. Probabilistic value estimation is one amongst the unremarkably used techniques for quantifying uncertainties enclosed within the value estimates. this method needs historical value knowledge of past construction comes. A chance distribution operate is chosen for the price knowledge by securing the information in relation to major distribution functions in theory and scrutiny the suits well. Beta and log traditional spreads are unremarkably used distribution operates for construction prices but choosing the distribution function for a particular knowledge set could rely upon the characteristics of the project knowledge and alternative distribution functions could offer higher fits. The aim of this paper is to review and compare these abstract value estimating modeling techniques mistreatment examples from building comes [25].

Ayman A. Abu Hammad et al considered Risk is relieved within the path of accurate forecasting. A model that is based on probabilities is planned to forecast the danger effects on the time and price of buildings comes. Managers and contractors who work on projects will hire the design in predicting project value and length supported the past information. The analysis goal is to implement a design to forecast project value and length supported historic information of comparable comes. The design result is often utilized by project managers within the coming up with part to confirm the procedure essential path length and project expense. The analysis technique is driven by the following steps: i) Perform a statistic take a look at for project value and output in real time. ii) To forecast a project, create generic multiple-regression model value and length victimization past strategy information. iii) The % The error of estimation is statistically measured and located to be substantial; therefore, iv) Personalized multiples correlation designs square measure improved for every project sort to get the findings are scientifically valid. Construction comes square measure seldom made as designed. Consequently, as-built plans and consistent change of project schedules square measure this procedure for modeling project modification impacting each value and time. the project budget and length of the CPM schedule ought to be verified against the historic performance

of comes. An applied math model is developed during this analysis to predict with important confidence the terminal project value and length. Therefore, construction contracts and processed project management tools will incorporate the applied math model results through incorporating further float to project length and analyzing monetary contingency. Network schedules ought to be fine-tuned with the regression model leads to order to accommodate for the danger of modification. Moreover, contract length and value ought to be calculable victimization the model results. Therefore, floats and budgets ought to be extended to account for the danger of modification that is calculable by victimization the planned regression model [2].

Kabir Bala et al observed about the aim of this research was to improve a machine-based price Institutional growth prediction model comes. Using the employment of the factitious Artificial neural network (ANN) technique. The back-propagation network is based on the principle of learning by doing smart predictions for great cases. The feedback factors were got from connected works with alterations and recommendation from professionals through a field survey. The 260 finished project information were used for coaching and improved the ANN model. A propagation backwards formula victimization the with a learning law that is loss function delta constant of point four percent was used. The feedback layer of the design consists of 9 factors; building stature, conservatives of building, development length, outside divider space, net floor space, assortment of floors, the extent of hole on outer dividers, area file, and also the time index [12].

Ajibade A. Aibinu et al considered that study rumored during implementation of this paper arranged the use of artificial neural organizations (ANN) as a variable distinctive to relapse for foreseeing the cost of building administration segments at the primary phase of style. The goal of this paper is to execute, test, and confirm neural network models at anticipating the expenses of electrical administrations components. Designing administrations zone unit fundamental parts of a structure. They typify brilliant light and force, gas administrations, region warming, ventilation frameworks, state change cooling, cooling, water framework, chimney security, correspondence frameworks, transportation frameworks (for example convey and elevators), clean pipes, sterile apparatuses, and extraordinary administrations (which could epitomize lighting assurance and security frameworks). They will rate somewhere in the range of thirty and forty percent of the whole costs of a structure (Rawlinsons,2012). Services components may impact the operational prices of a building. Therefore, they are vital components to think about throughout the project coming up with and style stage once finding ways that to stop cost associated once trying to realize an energy productive structure. In any case, the price of service components is that the most troublesome to figure at

the first phase of the structure style method. The matter with administration segments is that their style, determination of framework so their costs generally depend upon the field and primary style or design and direction of a structure. The costs may likewise be affected by a larger than usual scope of style factors that zone unit normally problematic to get a handle on and disentangle by visual investigation of style records. The effects of the factors might be inconvenient to sum on the reason of the assessor's skill. On prime of that, a larger than usual scope of factors will enormously affect the specific expense nearby. Value prognostication for service components for the aim of value coming up with and management further as for evaluating different style proposals could be important activity at the look stage. A fast technique of prognostication and checking prices as style choices area unit made ought to facilitate the analysis of other style choices. It should encourage examination of costs with the cost of a past style and with the whole money available for the undertaking while not the need to go to work the full style for the structure is finished. The investigation is vital because of the model created will be wont to dependably and immediately estimate costs once style data is fragmented and uncertain, and explained styles don't appear to be regardless evolved. The model likely could be stretched out to various assistance segments and diverse structure segments and will be associated with get contributions from 3D building info model (BIM) [1].

Sangyong Kim et al considered that predicting cost of the route comes with perfect precision at the initial step of execution improvement is vital for thinking of and practicableness examines. numerous analysis has tried to improve value advanced models within the primary phase of a construction life cycle. This examination utilizes the crossover assessing device to supply viable worth data the board for course comes and therefore builds up a useful worth assessing framework. This examination focused on the occasion of a ton of right gauge procedure for course comes in Asian country at the primary stage employing a hybrid analytic hierarchy method (AHP) and case-based reasoning (CBR). Original contextual analyses square measure acclimated with the cases and affirms the upsides of the projected methodology. It is expected that the established cosmic microwave background system is to supply makers of decisions with correct value data to assess and contrasting various options for getting the optimum answer and dominant value. Successful management among a restricted budget is a very a crucial consideration in every building project. Does not contain of data and reliable strategies that assist in estimating method created it troublesome to initiate estimating reports throughout the project drawing board (Chou, O'Connor 2007). So as to manage the value among an appropriate level, it needs acceptable and correct activity of assorted project-related determinants and, as a result, an appreciation of their

importance. As a result, the significance of early estimation cannot be overstated. variety of prices estimating models, however, are restricted in road and bridge construction. The method for estimating costs has developed Associate in Nursing integral a part of any advanced value management modelling. Such systems build Associate in Nursing estimation of the correct project value and improvement in value prediction rate attainable. bestowed analysis, thus targeted on constructing the hybrid AHP-CBR system that provides correct predictions of the long run value of various route comes [31].

ChoongWan Koo et al observed that the decision-making within a building project's initial phases can have a significant effect on the task. Confined and uncertain data, be that as it may, makes it difficult to precisely anticipate tightening costs. To determine this downside, this examination built up the high level case-based Reasoning (CBR) model with 101 instances of multi-family lodging comes. The high level astronomical microwave foundation model was created to coordinate the advantages of expectation strategies like cosmic microwave background, multivariate analysis analysis (MRA), and artificial neural networks (ANN), and additionally the improvement strategy utilizing a hereditary algorithmic standard. These examination defined four improvement boundaries, as: the base rule for rating the trait similitude, the property weight, the case decision shift, and cross-range resistance fluctuation among MRA and ANN. Dynamic inside the beginning phases of a construction undertaking can have a decent outcome on the venture. As a task is implemented, data on that turns into a great deal of a ton of, that makes it a ton of right to make determinations like progressed construction costs. The venture's time and exertion necessities create in lockstep, in any case, and furthermore. The task's prosperity endures because of this (Construction trade Institute (CII), 1998; archangel, 1990). The normal forecast precision of the high level infinite microwave foundation model was reasoned as 87.4%, where MCAS, RAW, RCS, and TRCRMA were set at the upgraded worth through the improvement strategy [4].

Rifat Sonmez observed that the bootstrap strategy for the combination of constant also, probabilistic worth assessment procedures. inside the arranged procedure, a combination of multivariate. The approach of examination and bootstrap resampling utilized to create shift assessments of building costs. The strategy is used to constant vary estimation of building comes as Associate in Nursing example. The bootstrap process entails blessings of probability-based and constant prediction strategies, at constant time it needs as compared to traditional methods, there are fewer assumptions applied mathematics techniques. This study is of connection to experts and academics, because it gives a sturdy methodology for abstract construction cost estimate prices. Budgeting is quite important and practicableness selections area unit supported the value estimates ready at the first construction

phases comes because the project scope isn't finalized throughout these abstract phases, amount take-off can't be performed to make an in depth value estimate. Though abstract value estimates don't seem to be expected to be exact, erroneous assessments could cause lost freedoms, and beneath expected returns Oberlender and Trost 2001. Steady assessment systems are fast in numerous examinations to upgrade the exactness of theoretical worth evaluations. In steady anticipating, a plan just as the vital boundaries are made to foresee the development of a structure costs, exploitation information on past comes and neural organization strategies zone unit. In past investigations multivariate examination was implemented to appraise development costs for building comes Kouskoulas and Koehn 1974; Karshenas 1984; Lowe et al. 2006, and seaward decommissioning activities Kaiser 2006. The relapse strategy is a technique for anticipating the future allows similarly simple investigation to orchestrated the effects of the boundaries on the task esteem. Neural organizations are arranged as another to multivariate investigation for steady worth displaying. Neural organizations are utilized with progress to assess costs of building comes Kim et al. 2005, course comes Hegazy and Ayed 1998, and solid asphalts Adeli and Wu 1998. Parametric models, all in all, make some degree gauge for the venture esteem. One worth gauge doesn't offer adequate information in regards to the degree of vulnerability encased inside the gauge. This is regularly especially essential all through possibility setting, or go/off limits determinations, as conceptual worth evaluations, as a rule, just as significant degrees of vulnerability. The degree of vulnerability encased inside the assessments is evaluated by probabilistic assessing procedures. In probabilistic assessing, the undertaking esteem is taken into account as a risk variable and a possibility dissemination perform for the worth is generally recreation procedures have been created Touran and Wisner 1992; Wang 2002; Isidore and Back 2002. Curran 1989; Touran and Wisner 1992; Wang 2002; Isidore and Back 2002. The possibility dispersion perform created is acclimated anticipate the opportunity of a spending overwhelm, or to work out an assortment of an assortment of appraisals for accomplishing an ideal degree of certainty decision of Associate in Nursing satisfactory hypothetical possibility circulation perform for the worth things and incorporation of the relationships between's worth things territory unit the most the challenges of reproduction strategies. The 2 significant challenges in just as the relationships zone unit one assessing connection coefficients, several giving Associate in Nursing right to represent these similitudes, a hypothetical exploration method was utilized. In 2007 Hudak and Maxwell. Insightful systems offer another to reproduction for fluctuate figuring of undertaking costs Diekmann 1983; Moselhi and Dimitrov 1993; Skitmore and weight unit 2002. While demonstrating and research instruments take into account a wide scope of assessments, the

impacts of factors on the undertaking should be viewed as worth don't appear to be normally encased with these methods. On the contrary hand, the consistent assessment strategies encapsulate the information on the boundaries notwithstanding, some of the time don't typify shift gauges at the venture costs. The most level headed of this examination is to create Associate in Nursing coordinated procedure, which can epitomize the advantages of steady and probabilistic assessing methods simultaneously [27].

M. Park observed that The case-based reasoning (CBR) approach can be a valuable tool for estimating construction costs by applying information acquired from previous experiences. CBR has also been shown to improve the precision of construction cost estimates. However, there are still issues with the retrieval of knowledge and information that need to be resolved. The computation of similarity and the assignment of attribute weight values are two challenges. To resolve these problems, this paper uses a Euclidean distance definition and genetic algorithms to construct a CBR cost estimate model for building projects. As a result, it was discovered that this model would increase cost estimation accuracy and serve as a framework for future research into the fundamentals of the case-based reasoning process [34].

RunZhi Jin considered the quality management plan price assessment in the beginning phases of a development project is critical to the team's achievement. Consequently, several researchers have planned varied techniques for forecasting the price within the initial part with the employment of restricted data. The point of this examination was to improve the exactness of a worth forecast model that utilized the Case-Based Reasoning (CBR) method, that has as of late become wide utilized. Toward this completion, partner degree improved CBR model that utilizes the multivariate Analysis (MRA) method inside the modification part of the CBR strategy was created. An examination was attempted on 41 branch workplaces and 99 intra lodging units to approve the proposed model's expectation results. The discoveries uncovered that the refreshed CBR model's forecast precision for business offices and multi-family lodgings expanded by a factor of two seventeen 23% and four 39%, severally, contrasted with it of the current CBR model. The arranged The amended CBR model based on MRA should be helpful in foreseeing development esteem in the beginning phases of a task. Assessing the expense of a structure project precisely might be basic to the task's advancement. Therefore, it's basic to have a worth forecast model that works with restricted information in the beginning phases of a development project (Hegazy, 2002). Thus, the point of this examination was to improve the forecast proficiency of the CBR-based worth expectation model, focusing on the regularly utilized CBR method. To do this, a refreshed CBR model was created by presenting a MRA-based correction way to deal with the modification interaction of the CBR cycle [26].

Dalia Mohamed pointed out that the key objectives of any reputable construction project management system is to complete the project on schedule, under budget, and within the prescribed quality limits. The 3 goals square measure interconnected wherever every of them has effects on, and being littered with, the others. So as to satisfy the time point in time of a project, correct planning ought to be wanted. Because of the distinctive Construction comes with its own range of problems, including time limitations and project instability. For proper preparation, they're necessary, that ought to be versatile enough to accommodate changes while not negatively poignant the length of the project. It's essential to assign a contingency worth to each price and time (Touran, 2003). Yet, there square measure things wherever there may well. There may be delays in activities that cause a pause in the total project duration. As a result, these delays can have a negative effect on the project's quality and budget. As a result, calculating time contingency is regarded as a significant challenge issue for the intention of completing an excellent building project. Though many industrial industries were generated and used code for estimating time and value contingencies so as to attenuate delays and overspending, nonetheless restricted efforts square measure reported within the literature within the space of predicting time contingency within the construction sector. Therefore, the target of the conferred analysis during this paper is to spot the factors that have an effect on Build a model that forecasts the potential contingency of a construction project and plan (time) variance [6].

Sevgi Zeynep Dogan said that the construction trade utilizes expertise. Knowledge from past events is crucial in building management when it comes to finding solutions to existing issues. Case-based reasoning cosmic radiation has completely become a man-made knowledge AI-based strategy that gives other to goal development related issues that need escalated aptitude. Late investigation incontestable the possible benefits of this framework Tokdemir (1999) in development the board and its better accomplishment over elective AI and antiquated expectation procedures; Yau and guideline 1998. Really examining CBR's capacities in the field of development the board could be a commendable undertaking. CBR can utilize basic data as specific illustrations. To put it another way, cosmic radiation can recuperate verifiably handled arrangements from a case base to anticipate the result of a test suit. Building cosmic radiation frameworks requires a huge data designing undertaking, as per proficient artist and Bonzana 1999. By settling on the main agent case attributes, improving case base association and recovery, and refining the interaction of similitude assessment, the data assortment exertion would be limited. Jarmake's stomach in 1999; Jarmulak and partners, 2000. A logical correlation of the qualities of a test suit with the credits of all cases inside the case base is utilized in likeness assessment. Its

effectiveness is largely determined by the weights used to replicate the relative value of attributes. The fitting of attribute weights will be performed by a site specialist, who will manually select the appropriate attributes and show their relative value for similarity evaluation, although this can be difficult and unstable as a result of it's troublesome to search out the proper professional UN agency is intimate with these problems and since professional opinion is sort of subjective. It's seemingly that completely different consultants can Weights are a point of contention. It is easy, nevertheless not optimum, to deem the opinions of 1 single professional. However, techniques such as the analytical hierarchy approach, which uses pairwise comparisons and a sequence of statistical manipulations to ensure that no contradictions occur between the different pairwise comparisons, will be explored. This is a well-known technique developed by Saaty in 1980 and 1994. One also can use the city technique whereby a panel of consultants is employed to succeed in agreement once many rounds of inquisitory Adler and Ziglio (1996), Linstone and Turoff (1975). Given the arbitrary aspect of attribute weight creation by a personality's ex-spirited, using an automated rule to determine attribute weights is interesting [30].

3. Conclusion

This study included various literature findings and found that advanced cosmic microwave background model can be utilized for predicting construction costs. This model integrated the benefits of Prediction methodologies like cosmic microwave background, ANN, and MRA with the improvement method. This study particularly outlined many improvement parameters like not solely MCAS and RAW, that had been established in previous studies [19], [22]. The advanced cosmic microwave background model (CBR-3) has the prediction capability higher than others; this implies that the improvement parameters like MCAS, RAW, RCS, and TRCRMA ought to be adopted and regarded within the development of the cosmic microwave background method. As mentioned in previous studies [19], [20] the advanced cosmic microwave background model that was developed during this study may be a versatile tool in terms of growth. In developing a cosmic microwave background algorithmic rule for various sorts of comes, the improvement method that was utilized in this study may well be applied to the advance of the prediction capability. The improvement method may well be reactivated whenever the data area unit modified. It couldn't be applied to distinctive sorts of comes, however as they are doing not have historical knowledge. The advanced cosmic microwave background model may be a useful gizmo which will, by itself, optimize the development value prediction method for affordable decision-making. It's expected that this tool can support stakeholders World Health Organization area unit responsible of predicting and managing construction

prices within the early stages of a construction project. Therefore, further studies on the updated methods, may be next stage of the cosmic microwave background method, may boost the prediction capability of the variables considered.

References

- [1] A.A. Aibinu, D. Dassanayake, T. Chan, R. Thangaraj, “Cost estimation for electric light and power elements during building design – a neural network approach”, *Eng. Constr. Archit. Manag.* 22 (2) 2015, 190–213.
- [2] AAA Hammad, SMA Ali, GJ Sweis, “Jordan Journal of Civil”, 2008.
- [3] C. Koo, T. Hong, C. Hyun, S.H. Park, J. Seo, “A study on the development of a cost model based on the owner’s decision making at the early stages of a construction project”, *Int. J. Strateg. Prop. Manag.* 14 (2) 2010, 121–137.
- [4] C. Koo, T. Hong, C. Hyun, “The development of a construction cost prediction model with improved prediction capacity using the advanced CBR approach”, *Expert Syst. Appl.* 38 (7) 2011 8597–8606.
- [5] D.J. Lowe, M.W. Emsley, A. Harding, “Predicting construction cost using multiple regression techniques”, *J. Constr. Eng. Manag.* 132 July 7, 2006, 750–758.
- [6] D Mohamed, F Srour, W Tabra, T Zayed “Construction Research Congress 2009: Building a Sustainable Future”, 736-745.
- [7] G.-H. Kim, S.-H. An, K.-I. Kang, “Comparison of construction cost estimating models based on regression analysis, neural networks, and case-based reasoning”, *Build. Environ.* 39 (10) 2004, 1235–1242.
- [8] G.-H. Kim, J.-E. Yoon, S.-H. An, H.-H. Cho, K.-I. Kang, “Neural network model incorporating a genetic algorithm in estimating construction costs”, *Build. Environ.* 39 (11), 2004, 1333–1340.
- [9] H.M. Günaydın, S.Z. Dog˘an, “A neural network approach for early cost estimation of structural systems of buildings”, *Int. J. Proj. Manag.* 22 (7), 2004, 595–602.
- [10] H. Li, Q.P. Shen, P.E.D. Love, “Cost modelling of office buildings in Hong Kong: an exploratory study”, *Facilities* 23 (9/10), 2005, 438–452.
- [11] I. Siqueira, “Neural Network-based Cost Estimating” (Master thesis), Concordia University, 1999.
- [12] K. Bala, S.A. Mustani, B.S. Waziri, “A computer-based cost prediction model for institutional building projects in Nigeria”, *J. Eng. Des. Technol.* 12 (4), 2014, 518–529.
- [13] M.Y. Cheng, H.C. Tsai, W.S. Hsieh, “Web-based conceptual cost estimates for construction projects using evolutionary fuzzy neural inference model”, *Autom. Constr.* 18 (2), 2009, 164–172.
- [14] M.Y. Cheng, H.-C. Tsai, E. Sudjono, “Conceptual cost estimates using evolutionary fuzzy hybrid neural network for projects in construction industry”, *Expert Syst. Appl.* 37 (6), 2010, 4224–4231.
- [15] M. Juszczak, “The use of artificial neural networks for residential buildings conceptual cost estimation”, in: *AIP Conference Proceedings* 1558, vol. 1302, no. May, 2013, pp. 1302–1306.
- [16] M. Kutner, C. Nachtsheim, J. Neter, W. Li, “Applied Linear Statistical Models”, 5th ed., McGraw-Hill/Irwin, 2004.
- [17] N.P.Srinivasan, A.Rangaraj “Study on Factors Influencing Risk Management in Construction Projects” *Adalya Journal*, Volume 9, Issue 1, January 2020.
- [18] N.P.Srinivasan, S.Dhivya “An Empirical Study on Stakeholder Management in Construction Projects” *Materials Today: Proceedings*, Volume 21, 2020.
- [19] N.P.Srinivasan et al. “A Review on Implementation of Lean Construction Principles in Construction Projects” *Test Engineering and Management*, Volume 83, May-June 2020.
- [20] N.P.Srinivasan et al. “A Review on Stress Management for Site Engineers Working in Construction Industry” *Test Engineering and Management*, Volume 83, May-June 2020.
- [21] N.P.Srinivasan, N.Nandhini “An Exploratory Study on Factors Governing Crisis Management Implementation in Construction Projects” *International Journal of Engineering and Management Research (IJEMR)*, Volume 6, Issue 2, March - April, 2016.
- [22] N.P.Srinivasan, N.Nandhini “A Study on Crisis Management in Construction Projects” *International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)*, Volume 4, Issue 10, Oct. 2015.
- [23] N.P.Srinivasan, N.Nandhini “Factors influencing Crisis Management in Construction Projects.” *International Journal of Applied Engineering Research (IJAER)*, Volume 10, No. 93, 2015.
- [24] OS Alshamrani – “Journal of Taibah University for Science”, 2017 – Elsevier.
- [25] R. Sonmez, “Review of conceptual cost modeling techniques”, *AACE Int. Trans.* 2005 EST.07.1–EST.07.4.
- [26] RZ Jin, KM Cho, CT Hyun, MJ Son –“Expert Systems with Applications”, 2012 - Elsevier
- [27] R. Sonmez, “Parametric range estimating of building costs using regression models and bootstrap”, *J. Constr. Eng. Manag.* 134, December 12 200,8 1011–1016.
- [28] R. Sonmez, “Conceptual cost estimation of building projects with regression analysis and neural networks”, *Can. J. Civil Eng.* 31 (4), 2004, 677–683.
- [29] S.-H. An, G.-H. Kim, K.-I. Kang, “A case-based reasoning cost estimating model using experience by

analytic hierarchy process”, *Build. Environ.* 42 (7), 2007, 2573–2579.

- [30]SZ Doğan, D Arditi, HM Günaydın – “*Journal of Construction*”, 2006.
- [31]S. Kim, “Hybrid forecasting system based on case-based reasoning and analytic hierarchy process for cost estimation”, *J. Civil Eng. Manag.* 19 (1), 2013, 86–96.
- [32] S.W. Moon, J.S. Kim, K.N. Kwon, “Effectiveness of OLAP-based cost data management in construction cost estimate”, *Autom. Constr.* 16 (3), 2007, 336–344.
- [33]S.M. Trost, G.D. Oberlender, “Predicting accuracy of early cost estimates using factor analysis and multivariate regression”, *J. Constr. Eng. Manag.* 129 (2), 2003, 198–204.
- [34] S.-H. Ji, M. Park, H.-S. Lee, “Cost estimation model for building projects using case-based reasoning”, *Can. J. Civil Eng.* 38, May 5, 2011.
- [35] T. Hong, C. Hyun, H. Moon, “CBR-based cost prediction model- II of the design phase for multi-family housing projects”, *Expert Syst. Appl.* 38 (3), 2011, 2797–2808.
- [36] T.M. Zayed, D.W. Halpin, “Productivity and cost regression models for pile construction”, *J. Constr. Eng. Manag.* 131 (7), 2005, 779–789.
- [37] W. Yu, C. Lai, W. Lee, “A WICE approach to real-time construction cost estimation”, *Autom. Constr.* 15 (1), 2006, 12–19.
- [38] W. Yu, PIREM: “A new model for conceptual cost estimation”, *Constr. Manag. Econ.* 24 (3), 2006, 259–270.
- [39] Y.H. Ahn, “The Development of Models to Identify Relationships Between First Costs of Green Building Strategies and Technologies and Life Cycle Cost for Public Green Facilities” (PhD thesis), Virginia Polytechnic Institute and State University, 2010.