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A Review-Trade off Time-Cost-Quality by Genetic Algorithm

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Abstract: Project success is measured in terms of time, money, and quality. As a result, they are regarded as the most significant goals in construction projects. Project managers must complete their work on schedule, on budget, and to a high standard of quality. Project managers introduce a variety of approaches to achieve these contradictory goals. For each activity in the project, there are different modes of execution. The goal of this research is to propose an optimization model that can be used to support project managers and decision makers in completing this difficult work, which leads to the selection of the best candidate's solution. The developed model is based on Genetic Algorithms, which offer numerous benefits over older methods. Optimization strategies and are thought to be suitable for many goal functions. Genetic engineering has been developed. The target function, design variables impacting that target, and problem limitations are all included in the algorithms model. The model's viability is tested by applying it to two projects. The findings suggest that the proposed method is effective technique can assist practitioners in assessing several modes of activity and quickly determining the lowest cost. A deadline for the project that meets the quality requirements. The model can quickly find the optimal solution from a large number of options. A large number of solutions in a fair amount of time Furthermore, the results show that the current strategy can be employed in the creation of a set of optimal solutions.
Keywords: Optimization, Genetic Algorithm, Optimal solution.

I. INTRODUCTION

In a few languages, optimization refers to the process of improving or civilizing a fantastic concept. It comprises of a vexing modification on top of a basic concept in order to improve the concept. Because of its wide range of applications, it's difficult to give a precise definition. In computation and manufacturing, the goal is to make the most of a system's or application's performance with the least amount of time and resources. The term "optimization" has a broad definition: It's a method of looking for the best element among a group of items based on a set of criteria. These requirements are expressed as mathematical functions, often known as objective or fitness functions. Optimization algorithms can be divided into two categories: deterministic and stochastic algorithms. The calculus-based analytical method and enumerative methods are two types of deterministic procedures. There are no direct and direct approaches in analytical methods. The local function optima can be determined via indirect approaches by solving a set of equations. Direct technique search for a local optimum on the function graph by leaping from side to side in the direction defined by the gradient. Both strategies have their own set of drawbacks. They have a limited range, for starters, because they look for optimal solutions in the vicinity of a specific point. Second, their use is predicated on the presence of derivatives. As a result, analytical approaches have a limited use. Enumerative procedures come in a variety of shapes and sizes. In a finite search space, the most basic way would be to manipulate the object function value while also going over each possible answer one by one. Despite its simplicity and resemblance to human reasoning, this strategy has one major flaw: it is worthless. Many issues have such a huge search space that finding all of the points within a reasonable time constraint is unfeasible. The random r stochastic approaches, which consisted of random space searching and remembering the best solution, are the second primary family of optimization algorithms. Meta-heuristics, a family of stochastic approaches that are applied to a set of objective functions, have become a popular research topic in recent years. . Approximately half a century ago, the original work in this area began. Excellence, cost, and quality were declared to be the three classic design and building objectives for project construction. Quality can refer to aesthetics, functionality, or performance. Sometimes, even if it costs more and takes longer, quality is more important. Most customers have stretched budgets so that they can actually define the scope of their project. Cost: might mean initial or enduring pricing, but most customers have stretched budgets so that they can genuinely define the scope of their project.

Time: can refer to the amount of time it takes to complete a task or the amount of time it takes to process a certain piece of data; some clients have strict deadlines. The process of ensuring that the development will satisfy the needs for which it was done was mentioned as part of the Project Quality Administration. The following major project quality control procedures: best fix: find out what quality standards are relevant to the project and decide how to make them happy, Quality Declaration: Regular project performance evaluation always gives confidence that the project will satisfy the right candidates standards, quality Control: monitoring the specific project outcomes that need to be addressed when achieving appropriate quality values and identifying ways to eliminate substandard operational causes. These processes interact with processes in other fields of knowledge as well. The concept was discussed in a number of ways, quality does not match what we think quality is, quality is what the client thinks and is willing to do pay you. Normal; Quality is determined over a long period of time by the customs, traditions and customs that vary greatly from place to place and from group to group. Therefore, it must be understood that quality is not a term that can be easily defined. Rather, it is a compound term, expressed in terms of attributes. It has been described as a way to get an idea of the consensus of managers in order to get the best quality in their projects. Evaluation is a practical practice in development. It was said; Problems surrounding perception, sensitivity and height assessment are caused by a lack of size. It concluded with 16 elements to improve efficiency in the Indian building industry, and emphasized the importance of size. Installed in cities and used for reproduction capable of measuring the quality of construction projects. This model, although functional but not based on controlling the actual cost of reduced quality. It is made in urban areas and used to measure the quality of the base wrapping structure. It is a low-cost and simple technology. In a nutshell, biogas is a renewable energy source that is both environmentally beneficial and cost-effective.

II. LITERATURE REVIEW

Refaat H. Abd El Razek, Ahmed M. Diab, Sherif M. Hafez, Remon F. Aziz [1] TCO (Time-Cost Optimization) is one of the most difficult difficulties in construction project planning and control, because optimizing either time or cost usually comes at the expense of the other. of one another The multi-objective aspect of this study was the emphasis of this research. a model for optimizing common construction projects software that is useful Typical Automated Multi-Objective the Construction Resource Optimization System, or CROS, as it's also known, is an "AMTCROS". The system under investigation was created in four stages. The following are the primary tasks that led to the development of: 1) A relational database project data details are stored in a database module. descriptions of activities, relationships between activities, and resources for activities options for use, parameters for the genetic algorithm, and Data on AMTCROS software optimization; 2) A logical module to provide calculations with a seamless integration of the relational database module, the user interface module, the modifying module, and the multi-objective optimization model; 3) A modifying module to change the durations and relationships between sequential activities from one stage to all stages; (Modified Critical Path Method "CPM"). That is being created to allow the logical module to be integrated with the multi-objective optimization model; and 4) a user interface module to make the input of project and genetic algorithm parameters, as well as the visualization and rating of the produced optimal solutions, more convenient. The current work focused on practical software that uses a multi-objective optimization approach for common building projects. Typical Automated Multi-Objective The current work focused on practical software that uses a multi-objective optimization approach for common building projects. The Construction Resource Optimization System, or CROS, as it is also known, is an "AMTCROS". it absolutely was created to form the optimization process easier. in order to maximize resource utilization in conventional construction projects to reduce project cost and duration at the identical time enhancing the standard of it.

Remon Fayek Aziz [2] one of the foremost complex objectives for a construction project planner is to optimize resource utilization while minimizing project length, project/bid price, and project maximum capital while increasing the project's net present value. Project managers are confronted with complex multivariate, multi-objective optimization problems that necessitate trade-off analysis. Furthermore, construction management decisions about multi-objective optimization for executing activities are made during the first planning phase of projects, despite the very fact that a lot of different scenarios should be addressed during the feasibility study phase. to beat the aforementioned limitations of conventional methods and solve simultaneous optimization problems in construction project planning, evolutionary algorithms like Genetic Algorithms (GAs) and Particle Swarm Optimization (PSO) are used as advanced computational optimization methods. The paper described the creation of the Optimizing Software Strategy (OSS), which used a multi-objective optimization formulation to search out the simplest project offering in an exceedingly typical repetitive construction project using multi-mode resource options for all activities, minimizing project duration, project/bid price, and project maximum capital while simultaneously maximizing net present value.

This paper described the creation of the Optimizing Software Strategy (OSS), which used a multi-objective optimization formulation to find the best project tender offer in a typical repetitive construction project using multi-mode resource options for all activities, minimizing project duration, project/bid price, and project maximum working capital while simultaneously maximizing net present value. OSS was created to accomplish two major goals: First and foremost, any recurrent construction project must be incorporated and enabled for optimization. The second objective is to permit available starting times for all activities in the investigated project and to choose the most appropriate start time for each activity within its entire float to obtain the optimum optimization scenario among large-scale solutions.

Aware Satish B. and Dr. Hedaoo M.N. [3] A GA is a search algorithm that is based on natural selection and population genetics mechanisms. A genetic algorithm searches for globally optimal solutions in a random but directed manner. To encode feasible solutions to optimization problems, a typical set of genetic algorithms requires a representation scheme. Typically, the answer is represented as a linear string called a "chromosome," the length of which varies depending on the application. Multi-objective construction optimization is mostly accomplished using a modified genetic algorithm. Those multiple objectives could include reducing building time, cost, and resource fluctuations, among others. To produce scheduling solutions that addressed all of these goals, a multi-objective optimization (MOO) approach was used. Time cost multi-objective problems include optimization as well.

1) Minimization of construction duration
2) Minimization of construction cost

Gul Polat, DUÕV. DSODQ, Befrin Neval Bingol [4] In this study, subcontractors for all-work packages in a construction project were chosen based on their performance in terms of time, cost, and quality. Subcontractors provide approximately 90% of the construction work in construction projects, especially in building projects. The genetic algorithm-based multi objective optimization model was used to successfully go for the most appropriate subcontractors who would carry out job packages in the case study. By considering the interactions between the subcontractors and their impact on the overall project performance in terms of time, cost, and quality, the proposed model allowed the general contractor to select the best subcontractor combination for all work packages.

Fig 1: Flow chart of GA process

J. MAGALHAES-MENDES [5] The GA procedure is discussed in this publication. To begin with, a random population of potential solutions (individual) is formed. The individual candidate for reproduction can be chosen using a selection technique based on a fitness function. The crossover operator is used to recombine two individuals, which may be followed by a mutation in the progeny. As a result, a new generation is created from the initial population. The same process produces a second new generation from this new generation, and so on. The number of generations is usually used as a stop condition. The time-cost-quality optimization problem has been solved using a GA-based methodology. The project activities are categorized into construction modes, which reflect distinct approaches to completing the task, with each mode having a different impact on the project's duration and cost. The problem's chromosomal representation is based on random keys. The schedules are created using a priority rule in which the genetic algorithm determines the priorities. The current method offers an intriguing alternative for solving multi-objective building optimization problems. The time-cost tradeoff problem has been widely researched since cost and time are two of the foremost key purposes that may be easily quantified in a very building project. Quality is a crucial characteristic that includes a strong relationship with time and cost. Nevertheless, because it's not a quantifiable parameter, useful time-cost-quality tradeoff models are rarely created from past research.

Afshar, A. Kaveh and O.R. Shoghli [6] Construction planners are frequently faced with the difficulty of maximizing resource usage while balancing multiple, often opposing aspects of projects. Each project's time, cost, and quality of delivery are all important factors. New things appear contracts that put increased focus on project quality maximization while To cut down on time and money, models must be developed that consider quality. in addition to time and cost, both of which have been carefully modeled. A new meta heuristic is presented in this work. A multi-colony ant method is devised to solve a trade-off problem with three objectives: time, cost, and quality. The capabilities of the system are demonstrated using an example. Current method for finding optimal/near-optimal solutions, the model can also be used for two objective cost-time trade-off problems .To investigate the advanced time-cost-quality trade-off dilemma, a Multi-Objective Ant Colony Optimization is designed. The model is capable of balancing critical aspects of building projects, such as lowering project time and cost while maximizing project quality. The effectiveness of the proposed method is demonstrated by an example, which demonstrates the model's capacity to assess quality and generate Pareto optimum results. Furthermore, the model was used to optimize the time-cost trade-off for the same example, and the results were compared to the results of the example modeled using the MAWA approach (Zheng), demonstrating the model's capabilities. The current technique offers an appealing alternative for solving multi-objective building optimization issues.

Mohamed M. Marzouk , Ahmed A. El Kherbawy , Mostafa Khalifa [7] The process of selecting the best subcontractor is centred on minimizing project risk while maximizing quality. There are ten criteria for selecting subcontractors, as well as numerous other techniques. In order to make a final judgment, different governments employ different approaches to selecting contractors and determining the competitiveness of the award. "Know how" is another crucial criterion. Introduced 43 sub-criteria to select the optimal alternative, which backed up this result. The research has three goals: to learn about the various criteria used in contractor selection; to learn about the different criteria used in contractor selection; and to learn about the different criteria used in contractor selection. In building projects, choosing the best subcontractor is critical. When it comes to choosing subcontractors, there are numerous variables to consider. Improper subcontractor selection might cause a slew of issues as the project progresses. These include poor work quality and project duration delays. Many variables influence this process. Previous research has uncovered 46 characteristics that influence subcontractor selection. The most critical elements that determine subcontractor selection are identified in this research. A questionnaire was distributed & provided to building specialists to judge the significance of certain factors. The main contractor considers these factors when choosing the best subcontractor.

A. Sathya Narayanan and C. R. Suribabu [8] the fundamental goal of construction project planning and control is to complete the project on schedule and on budget while meeting the quality standards. The multi-objective time, cost, and quality optimization problem is solved using a differential evolution approach. The methodology is intended to select optimal subcontracting strategies that save project time and expense while maintaining high quality. By comparing it to other existing ways, the current approach's capacity to generate the best general optimal solution is tested. It should be highlighted that the differential evolution method is capable of producing efficient outcomes when compared to other methods. The current method offers an intriguing alternative for solving construction multi-objective optimization issues. Every building project considers time and money as crucial considerations. Many different research methods have been used to model the time-cost connection. The employment of new contract mechanisms that give incentives for maximizing quality is on the rise. Due to novel contracting methods that involve establishing models that incorporate quality, time, and money, there is rising need to improve project performance. To improve project performance, a principal contractor typically subcontracts the majority of the project's tasks. Choosing a right offer that meets the project's time, cost, and quality objectives is always a complex and difficult assignment for a main contractor. A differential evolution algorithm is employed to solve this problem in this work.

Mariarosa Sorrentino [9] These three parameters are interconnected in every project: time, money, and quality. We apply artificial intelligence in this project to optimize time, cost, and quality all at the same time. To do so, we use multi-objective genetic algorithms. It discovers novel methods that can be used to project configurations. Prof. of the University of Bologna supervised a thesis whose main goal was to plan road building with the goal of simultaneously optimizing time, cost, and quality. In recent years, there has been a focus on quality, which we assess using key performance indicators (KPIs), which are crucial metrics that define the project grade in a concise and accurate manner, and which we can use to forecast future project performance. The case study is about a road construction project for the "Strada Provincial" that yielded reasonable results after applying GA. The outcome is that project 2 is superior to project 1 in terms of time and quality, with a 10% difference between them. Project number two is 4 million euros less expensive than project number one. Construction projects must meet a number of difficult standards, which are made up of often conflicting, if not contradicting, elements: On the one hand, time and financial constraints must be followed; on the other, worksite safety and environmental impact must be minimised. Finally, the materials are properly compensated by mitigation and enhancement works. All processes must achieve the highest level of excellence. The time-cost-quality trade-off has been present from the start. the foundation of the Project Manager's work: in every project, these three elements form a triangle. three interconnected variables The Project Manager's job is to keep the project on track. the triangle: it's impossible to change the project's budget, schedule, or quality goals. without influencing

Setenay Isikyildiz, Cemil Akcay [10]. Instead of using the usual two-dimensional time-cost analysis method, a multi-purpose multi-alternative optimization model has been designed for three-dimensional time-cost-quality tradeoff analysis. This approach aims to find the best resource usage plans that save construction time and expense while maintaining high quality. This is exemplified in a case study. A real-world time-cost-quality trade-off problem is investigated and solved in this paper. In order to address a problem, A genetic method consisting of evolutionary-based metaheuristic was employed by developing computer code in Matlab to solve a multi-purpose and multi-alternative optimization problem.GA was used to evaluate the effect of population size on Pareto value in this study's problem. With an increase in the number of populations, the number of Pareto pictures grew. While the iteration number was not considered a limitation, a time constraint was introduced. The In ordinary GA applications, the mutation value was set to 0.05. As a result, the best results for the problem are within 1000 populations, an application project may be completed. According to the data, the number of populations varies. the size of each problem, as well as the constraints that each problem imposes The goal of this research was to create a model that uses the genetic algorithm method to optimize Time-Cost-Quality in construction projects. Matlab scripts for a multi-purpose genetic algorithm that performs Time-Cost-Quality optimization were built and deployed to the challenge to achieve this, and the targeted success level was largely met. Instead of the standard two-dimensional time-cost tradeoff analysis, this model can perform and visualize an advanced three-dimensional time, cost, and quality tradeoff analysis. Under the project conditions, it was able to select the desired option by getting Pareto pictures referred to as a group of solutions rather than a single answer. Furthermore, one of the primary goals of this research is to produce an effective model to aid the construction's main contractors selecting the most suitable subcontractors.

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