Industry and Academic Research Review
Volume 4 Issue 1 July 2023

SDA-MCS Based Risk Response Strategy Model for Road Construction Project

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Abstract

The SDA-MCS Based Risk Response Strategy (RRS) Model for Road Construction Project is developed to formulate strategies in improving the current condition by analyzing the risk factors and simulating strategies. The first part of the research focused on risk evaluation by Schedule Delay Analysis method: As-planned vs As-built method. The SDA determined the commonly occurring delaying factors and its extent in the project. Risk Response Strategy matrix is used to categorize risk factors according to occurrence probability and impact to the project; and strategize. Subsequently, these strategies can be imposed to the project schedule baseline in consideration with project scope and admissibility. Monte Carlo simulation is done to generate possible critical path duration. Moreover, the simulated critical paths are tested to determine the probability of success.

Keywords: *Risk Response Strategy, Delay, Schedule Delay Analysis (SDA), As-planned vs As-built method, Planned Schedule, Road Construction Project, Monte Carlo Simulation*

Article History:

Received: *May 24, 2023* ***Revised***: *June 4, 2023*
Accepted: *June 20, 2023* ***Published online***: *July 31, 2023*

Suggested Citation:
Jinang, R.S. (2023). SDA-MCS Based Risk Response Strategy Model for Road Construction Project. *Industry and Academic Research Review,* 4 (1), 420-425.

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**This paper is presented at the 4th International Conference on Multidisciplinary Industry and Academic Research (ICMIAR)-2023*

Introduction

Risk Response Strategy (RRS) is an action plan to address risk on a project. Although RRS are generally attributed to strategies for projects other studies use the same method on managing risk in an organization. Moreover, RRS is framework or model that serves as a guide if risk factors reoccur. The developed SDA-MCS RRS model for road projects works by; analyzing delaying factor and its extent, simulating project baseline schedule; and identifying probability of success. The general conceptual model can also be applied to other infrastructure or non-infrastructure projects; and risk management in organizations.

Methodology

This research aims to formulate Risk Response Strategy (RSS) model through Schedule Delay Analysis (SDA) and Monte Carlo simulation to manage delays on road construction projects. Although the resulting model focuses on creating a simulated project schedule for road projects the main function of the model is to create a Risk Response Strategy framework for both infrastructure and non-infrastructure projects. Consequently, this RSS model can be used in any projects with standard procedures or specifics. The accuracy of the simulated project schedule depends on the quality of data and the frequency of the simulation.

The first two parts of this research covered descriptive and regression analysis so that the researcher can identify the factors and its impact on the project schedule. The regression also determined the strength of the relationship between the delays and delaying factors. When the strength of the relationship is established, RSS will be applied to the top delaying factors or factors with high probability of occurrence. The RSS model assumption is that high risk factors and factors with high probability of occurrence should be considered when making the project schedule and therefore should reflect on the first project baseline schedule before the project construction start. Delays vary depending on probability of factor occurrence and its impact on the project simply adding the estimated delay duration on the estimated project duration will not yield accurate result therefore, the RSS-adjusted baseline is simulated. Furthermore, to explain the impact of the risk and uncertainty in prediction and forecasting models Monte Carlo simulation model is utilized.

The RSS model as shown is cyclical because improvements can be incorporated on the Risk Response Strategies (RSS) on every cycle and resulting simulations' accuracy improves with repetitive simulation. Also, some Risk Response Strategies (RSS) are not simulated because some solutions are proactive only, while others can be retroactive; or both proactive and retroactive. The skip on simulation is caused by proactive solution to a presumed problem and therefor recurrence of this problem on the project is no longer expected or in low probability.

Findings

In 2015 there are 25 delayed road projects that had 58 different memorandum orders. From 2016 to 2017 there are 34 and 43 delayed road projects that had 93 and 116 different memorandum orders consecutively. In 2018 there are 74 delayed road projects that had 117 different memorandum orders. Although some delays can be considered compensable not all are given with extra compensation or time extension.

These projects are composed of different types of road construction projects from roads, bridges, off-carriage way, drainage, etc. It was observed that delays often occurred on road projects between 2016 and 2017.

It is observable that 31% of all the road projects from these periods do not indicate any form of delay. The other 34% and 35% signify road projects with excusable and inexcusable delay.

Accordingly, road projects approved from 2015 to 2018 had a total planned duration of 29946 days and an actual duration of 40918 days.

For four years, these road projects exhibit an average of 73.2% productivity rate.

On the application of SDA-MCS RRS on a FMR in Buenavista, the FMR project originally has an estimated duration of 59 days and its probability of finishing on time is only approximately 2%. On the other hand, adjusting the estimated duration to 66 calendar days will yield a probability of finishing in time of approximately 63%. Moreover, adjusting the estimated duration to 69 calendar days will yield a probability of finishing in time of approximately 91%. These adjustments are just assumptions, the decision on how should it be adjusted depends on the stakeholders' prerogative.

Conclusion

The researcher was able to create a Risk Response Strategy (RRS) model for road construction project with Schedule Delay Analysis (SDA)-based Monte Carlo Simulation on project baseline. Furthermore, the researcher created a conceptual model for the general purpose of RSS and a specific conceptual framework for road projects.

The top delaying factors on road projects in Marinduque are unworkable ground condition, slow productivity, non-issuance of permit for aggregate extraction, variation order.

SDA showed that 31% of road projects have no delay; 35 % of project has inexcusable delay; 34% of projects are excusable and 2% from it is only compensable.

Almost all projects on every road category exhibited delay except for diversion road and access roads which were also the smallest project in terms of planned duration.

The Paired Sample T test of as-planned versus as-built method shows that from 2015 to 2018 only 2015 projects showed no significant difference on planned and actual duration. Also, 2015 had the least number of approved projects for the last four years. It was observed that delay also increased along with increased of approved projects.

The linear regression formed by comparing planned duration to actual duration has an equation of $y = 1.318x + 5.848$. This linear equation shows that it has a slope of 1.318 which means that most road projects increase its actual duration to almost 32% more than its planned duration.

(On the application of the SDA-MSC RRS on the FMR in Buenavista) According to SDA-MSC RRS Model without any catch-up plans and only using Retain & Mitigate Strategy for unworkable ground condition due to severe weather condition the probability of success for 59 calendar days is only 2.22%. The probability of success for Retain and Mitigate Strategy is 100% if the project duration is 75 days. Aside from the delay due to severe weather condition, additional lag due to low productivity rate may have contributed to delay of the project.

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