

### Introduction

SiteSim is simulation software designed to model real world behavior. It allows the operator to analyse, understand and predict the outcomes of possible operational changes they may have in planning. Although specifically designed for the quarrying and extractive industry, SiteSim [Q] could be adapted for use in transportation, production and manufacturing environments.

Its core ability is to reproduce the outcomes of the real world without bias, to better understand how and why particular outcomes occur.

Its operational strength is its ability to provide objective and accurate measures of efficiency and likely outcomes for alternative scenarios to current processes. A good example of this would be to model the effect of adding a second weighbridge, or a new high capacity loader at the quarry.

### Quarry Simulation

Quarry simulation is the simulation of vehicle and material flow around a quarry site.

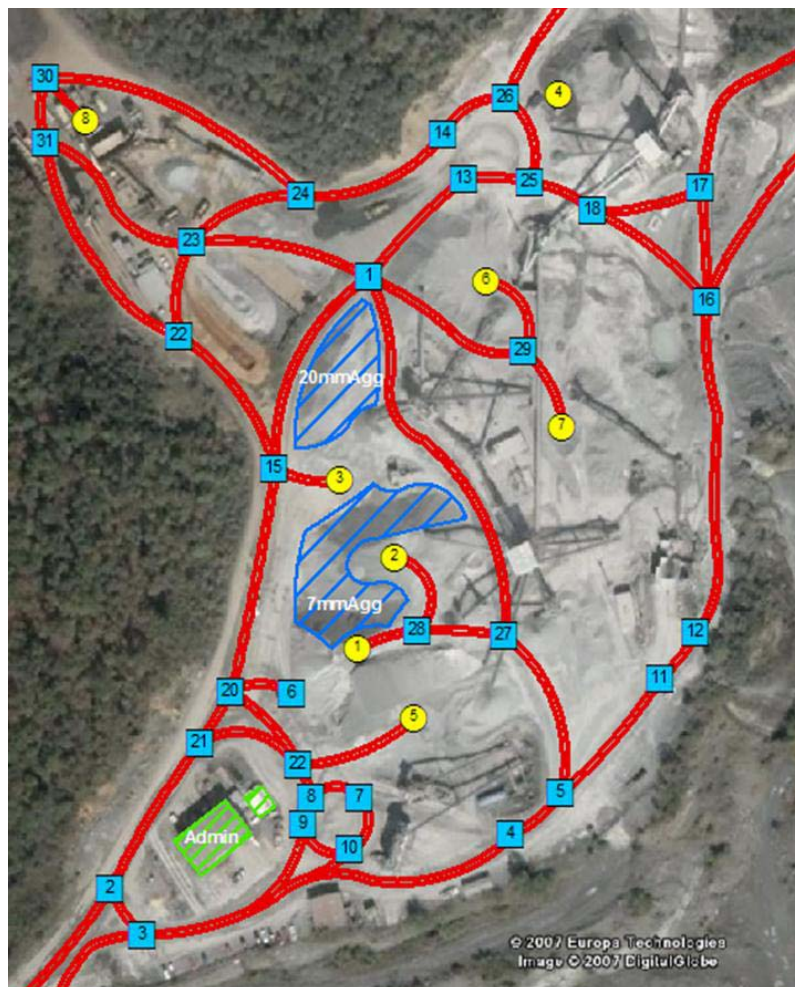


Figure 1. Shows a quarry and some of the nodes and links in the traffic network where vehicles and product potentially travel.

A quarry simulation serves four important and distinctly different purposes:

1. *Identifying current and future safety risk hot spots, where likelihood of vehicle collision is high due to many vehicles in close proximity to each other.*

Zone Description	400 Tippers	600 Tippers
Pugmill Intersection	Med Risk	High Risk
Service Yard Intersection	Med Risk	Med Risk

Figure 2. Shows risk calculations for various sales scenarios, e.g. 400 and 600 tippers per day.

Before expending valuable time and financial resources, SiteSim [Q] can be used to determine the most efficient and cost effective changes in operational procedures to minimise risk to employees, equipment and lost production time. The operator can compare the likely change in location and level of risk associated with numerous operational scenarios, e.g. introducing overhead bin loading.

Partnering with accredited road safety auditors, IMIS can provide expertise in interpreting the risk indicated by SiteSim [Q] and providing advice in changing operational procedures to minimise that risk.

## 2. Confirming the likely return from capital expenditure.

In order to maximise return on funds invested, management can simulate any proposed changes designed to improve either operational or safety performance and compare those with the base case before proceeding.

Once the current operational environment has been validated, it is possible to model the addition or relocation of equipment/infrastructure (e.g. loaders, weighbridges, hoppers, roads, stockpiles etc), to determine the overall effect on quarry efficiency or throughput.

This makes *SiteSim [Q]* an invaluable aid for supporting operational changes, particularly when multiple scenarios are to be considered. Decisions can be made with a high degree of confidence in final outcomes.

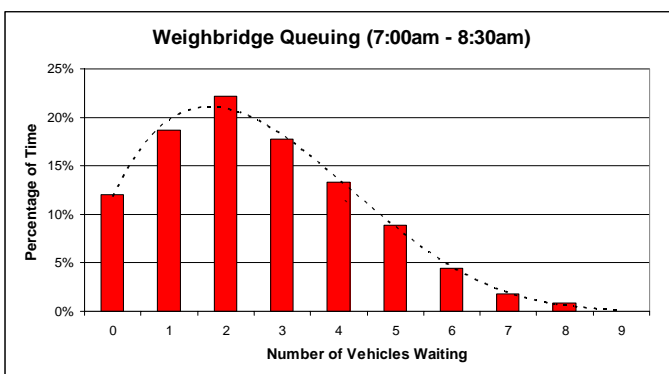


Figure 3. Shows the % of time that vehicles are queuing on the weighbridge. 16% of the time there are 2 vehicles waiting to be ticketed. This indicator would be used in proving the value of investing in dual weigh bridges, or more efficient ticketing systems, for example.

## 3. Optimising the quarry's operations.

Although *SiteSim [Q]* will not automatically optimise a quarry, it will enable the operator to test different scenarios to objectively determine those that lead to the best operational performance e.g. throughput, cycle times.

For example, users can model changed stockpile locations to see the effect on tipper cycle time; change vehicle routes, locations of stop and give-way signs etc, to see the effect on safety; determine how cycle times or congestion is effected by increases in vehicle numbers; and many other scenarios.

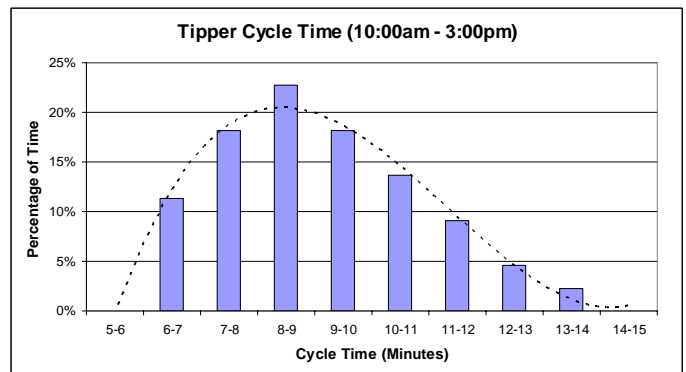


Figure 4. Shows cycle time for tippers. This graph could be the results of a simulated operational change and the cycle times can be compared to the base case. Here, over 40% of all trucks are cycling through the quarry between 8 and 11 minutes.

## 4. To aid short-, medium- and long-term planning.

The user is able to determine the effect of one off projects e.g. supplying large road infrastructure projects, on Key Performance Indicators i.e. safety, vehicle cycle times, congestion and queuing.

## Quarry Simulation Data

To enable confidence in the outputs of *SiteSim [Q]*, site-specific data is required. The data includes: road locations and characteristics, stockpile locations, vehicle characteristics, vehicle arrival rates and distributions, loading and unloading times, vehicle routes and travel zones.

## The SiteSim-Q Model

*SiteSim-[Q]* is designed to simulate quarry traffic movements with the objective of identifying safety hot spots, better understanding traffic and quarry operations, and allowing alternative scenario testing before implementation to make quarry operations more safe, efficient and economic.

IMIS staff have expertise in collecting site-specific quarry data and setting up these types of quarry simulation models. Once the model has been established and validated for a particular site, it can be used by both IMIS and quarry staff to undertake analysis of current and alternative operating environments.

Each quarry operation is different and so *SiteSim [Q]* can be tailored to meet individual site specific challenges. IMIS staff will work closely with management and staff to ensure the best outcome for each quarry.