GRAND-VISION: An Intelligent System for Optimized Deployment Scheduling of Law Enforcement Agents

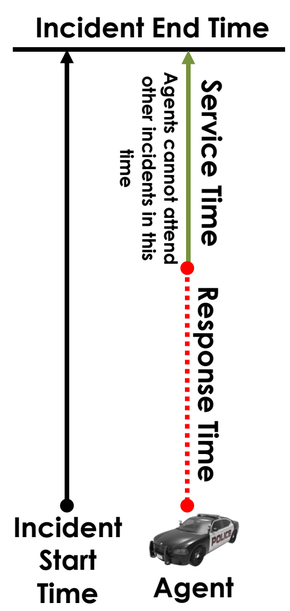
Jonathan Chase, Tran Phong, Kang Long, Tony Le
Corresponding Author: Hoong Chuin Lau
Singapore Management University

Data-Driven Optimized Deployment Scheduling

With limited manpower, law enforcement agencies are turning to AI to predict and prevent incidents through smart patrol strategies. Working with local law enforcement, we have developed GRAND-VISION (Ground Response Allocation and Deployment: Visualization, Simulation, and Optimization), a data-driven daily patrol planning system. The system optimizes response times through a daily algorithm that accommodates break times and manual input to deploy law enforcement agents to predefined patrol regions in a real-world scenario informed by machine learning.

The GV system employs a 4-step deployment process:

Agents patrol their assigned geographic regions. When an incident occurs, an agent is assigned to attend with a travel time that can meet the QoS requirements.



Incident generator

The incident generator produces training and testing incident sets for the selected date.

Optimizer

Incident sets are fed into an MIP to find a robust allocation plan giving the number of cars per region in each time period. The aim is to **minimize the number of failed incidents**.

Scheduler

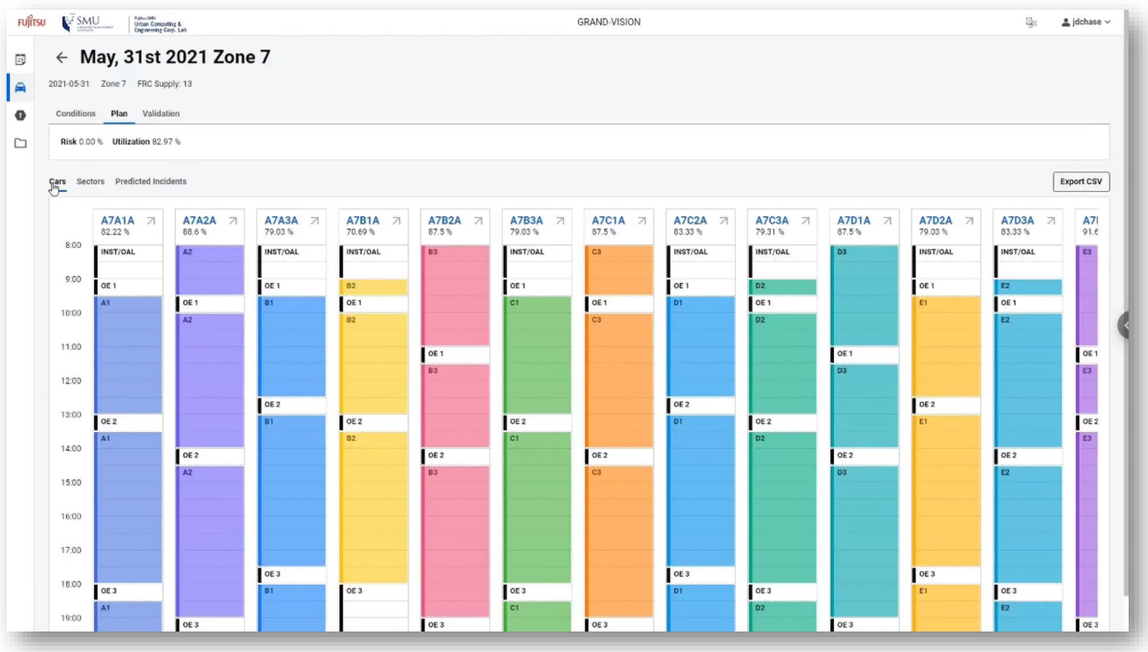
Takes the allocation plan and assigns specific patrol cars to the regions they are required in so that the amount time spent travelling required by the cars is minimized.

Simulator

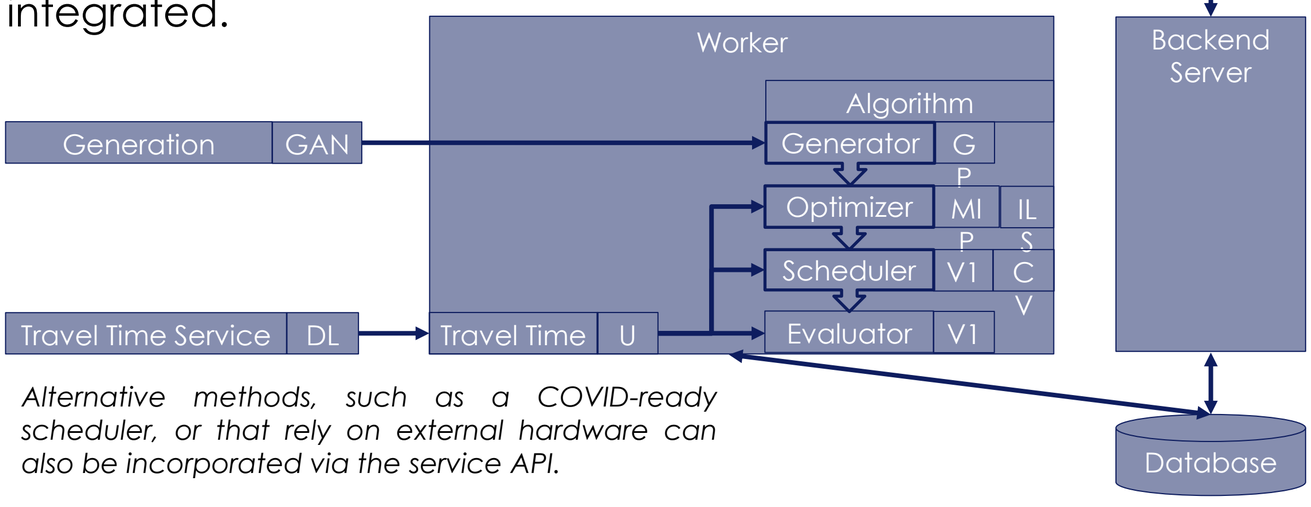
A simulation tests the allocation plan on the testing incident sets to determine expected performance when the plan is put into practice.

GRAND-VISION SYSTEM

The system supports two users – Commanders, who have a stream-lined interface for daily deployment, and Analysts, who are power users and can experiment with new methods and update the prediction models.



The system is deployed using a Python backend and a web-based frontend. A service-based architecture allows new implementations to be seamlessly integrated.



Alternative methods, such as a COVID-ready scheduler, or that rely on external hardware can also be incorporated via the service API.

The deployment plan output is the centrepiece of the system. This screen provides commanders the information needed to use the plan. Individual agent schedules can be exported for distribution to agents. Changes of location are clearly indicated by colour and breaks are marked by white blocks.

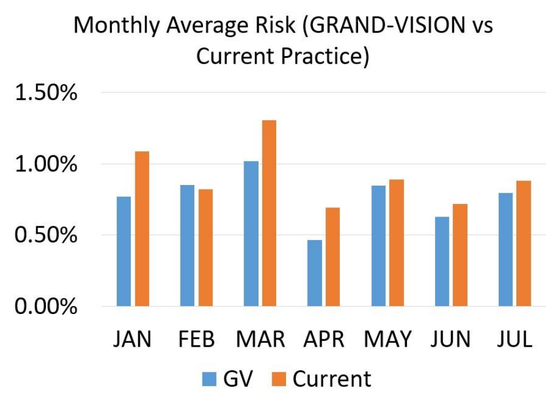
Development and Trial Experience

COVID-19 was disruptive to partner meetings and trial execution, but also provided new research opportunities, by adapting the scheduler to limit cross contact. Methods always needed to be assessed for operational viability, and the limitations on automated prediction could also be explored through working with experienced agents.

Ethical Considerations

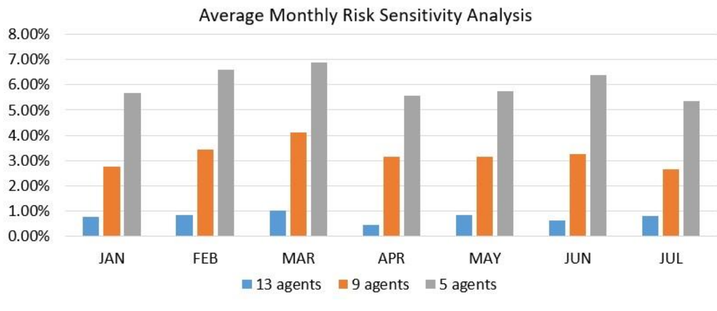
Predictive policing can be controversial due to biased data polluted by discriminatory policing. Our context features racially integrated housing, auto-generated emergency call data, and non-crime incidents, that all reduce the potential for LEA bias to negatively influence the data. However, the care must be taken when applying the system to new contexts and data sources to ensure the input data is not biased.

Numerical Results



The GV deployment planner fares favourably against a static plan representing current practice. Monthly average risk favours our planner, in tests run using the system dispatch simulator.

Sensitivity analysis shows a manpower reduction from 13 to 9 is tolerable, giving insight into situations such as agents being in COVID-19 quarantine.



NATIONAL RESEARCH FOUNDATION
PRIME MINISTER'S OFFICE
SINGAPORE

This research project is funded by the National Research Foundation Singapore under its Corp Lab @ University scheme and Fujitsu Limited as part of the A*STAR-Fujitsu-SMU Urban Computing and Engineering Centre of Excellence