Economics World Cup 2024

Final Round Case Study

Risk, Resources, Responsibility

205 labour hours were spent on the production of this case study.

This Case Study is based on a real scenario. Certain figures, numbers, and locations may have been fictionalized in order to protect the confidentiality of our sources.

This case is designed to take **5-10 hours** to solve. During the 2024 EWC, teams were given 7 days to solve this case.

Section 1: Introduction

Introduction

Case File 1229: Mid-Sized North Indian City Requires Upgraded Fire Department

Welcome. You and your teammates are consultants at a public capital projects consultancy firm called Bharat Capital Projects Consulting. For ease of communication, you can call it Bharat CPC.

Your client is the City Council of Rajora, a small city in Northern India.

Rajora has experienced rapid development over the last decade, leading to increased fire hazards. The aging fire department fleet is insufficient to meet the current needs.

Fortunately, the city has received a grant from the Central Government specifically for upgrading the fire department. The Central Government's grant is intended to cover all one-off investment expenses associated with this upgrade.

However, the future operational costs of this fire department must be covered by the Rajora municipality budget.

Your team's task is to devise a strategic plan to use the funds and efficiently upgrade the fire department. Your team must create a project plan to identify where various fire bases should be built, what types of fire bases should be built, and which types of fire vehicles should be purchased in order to minimize the risk of fire damage, while meeting the city's targets for average response time.

In this project brief, you will receive background data on Rajora's financial situation, demographic details, and specific costs related to upgrading the fire department.

In your analysis, you may consider factors including, but not limited to, the:

- Land costs
- Fire department capital expenses
- Operational expenses
- Population density
- Risk factors
- Environmental impact

Through this case study, your team will explore and refine your skills in **key economic concepts** such as:

Cost-Benefit Analysis: The ability to evaluate the costs and benefits of different options for upgrading the fire department, including infrastructure, vehicles, and technologies.

Opportunity Cost: The ability to discuss the trade-offs of allocating funds to this project versus other potential uses.

Supply and Demand: The ability to consider how the demand for emergency services in a growing city impacts the supply of necessary resources and equipment.

Externalities: The ability to analyze the social and environmental impacts of your recommendations, such as the choice between electric and diesel trucks.

Budget Constraints: The ability to work within the given budgetary limitations to propose a feasible plan.

Section 2: Client Profile

Rajora: Client City 1-Page Brief

Location:	Northern India, close to Yamuna River
Population:	Approx. 1,050,000 residents (2021 census)
Area:	113 square kilometers
Economic Activity:	Mixed economy with a significant manufacturing sector and growing IT services.

Discretionary Grant Funding Allocated for Project: **1,600 million INR**

*The city has an option to apply for a further 1,000 million INR **credit facility** from the Central Government. This credit facility is in the form of low-interest loans over a 15 or 30-year term.*

Operating Budget Allocated to Project (per Year): **310 million INR**

The city has the option to allocate a further 200 million INR per year by levying local property taxes. However, raising property taxes is unpopular with locals.

Special comments from **Mayor Dr. Rohan Patel**:

"While Rajora has allocated certain funds, we don't necessarily want to spend our entire budget. If your analysis concludes that the costs are not worth the benefits after a certain point, you may advise us to save that money and spend it on other municipal priorities, such as local schools and roads."

Section 3: Schematic Map of Rajora

Schematic Map of Rajora

Rajora is divided into **6 types of regions**.

Metropolitan Regions

Metropolitan areas are characterized by their high population density and land costs. There are, simply put, a lot of people there.

While the risk of fire in any given year is low, any potential damage could be severe; a fire could result in skyscrapers collapsing onto nearby buildings.

Optional Intervention: High-Rise Sprinkler Systems

In metropolitan areas, an additional measure is available that is not feasible in other regions: the installation of water sprinkler systems within high-rise buildings. Water sprinklers will reduce the expected cost of a fire by 50%.

Suburban Regions

Compared to their metropolitan counterparts, suburban regions have low population density and land costs. Unfortunately, there is a higher risk of a fire because:

(a) Most homes are made of a timber structure, which is more susceptible to fire.
(b) Most homes lack smoke detectors.

Due to the sparse land area, the financial damage from a fire is much lower than in metropolitan regions.

Optional Intervention: Smoke Detector Social Program

In suburban regions, an intervention is available in the form of a municipality-funded social program. Under this program, the City Council would install smoke detectors in every suburban home. This program will reduce the probability of fire by 40%.

Industrial Regions

Rajora has 2 major industrial areas. The industrial areas contain factories which are the lifeblood of this city's economy, employing 32.2% of the local population.

Industrial areas have a very low fire risk as the factories follow the latest best practices in fire prevention.

Nonetheless, the city cannot afford a fire in the industrial regions. The potential consequences are catastrophic, with the scale of economic losses posing an existential risk to Rajora.

Parks

Parks are where the Rajora's population goes to relax. This is where kids play sports and senior citizens do yoga.

Parks are classified as low-risk areas by the Rajora Fire Council. There is a low chance of fires occurring, and even then, a park fire would not cause much damage.

However, a fire would result in environmental harm and risk the city's social welfare, as it is a common leisure spot for many of the city's populace.

Rainforests

Rainforests are subject to a high fire risk, particularly during the summer months when dry conditions coincide with temperatures exceeding 45°C. While a rainforest fire will not have many economic consequences, the environmental damage could be ruinous.

Special Risk: Contagion

Rainforest fires present a very high risk of contagion. If a rainforest fire is not quelled promptly, there is a 25% chance that the fire will spread to an adjacent region.

Water Sources

The Yamuna River flows through Rajora. Over the years, the Yamuna River has been a key facilitator of the economy, allowing goods to be traded from far away lands.

Special Resource: Helitanker Support

Water sources play an important role in the operation of helitankers. Helitankers are fire-fighting helicopters which collect water to combat large fires.

Helitankers cannot operate unless there is a water source in the vicinity of the fire.

Section 4: The Rajora Fire Council's Risk Assessment

The Rajora Fire Council's Risk Assessment

Rajora's fire bureau has conducted an assessment of the city's various regions. Below, they have shared their results of their analysis, where they estimate the:

(a) Probability of a fire occurring in any given year.
(b) Damage that would occur if a fire does occur.

Probabilistic Risk Forecast

Area Type *(color code)*	**Probability of Fire** *(per year)*	**Damage if Fire not Quelled** *(millions of INR)*
Metropolitan Region	1%	3,000
Suburban Region	3%	200
Industrial Region	0.1%	10,000
Park	1%	20
Rainforest	33%	50
Water Source	0%	–

Rajora's fire department has also conducted an analysis to determine what equipment it would take to quell a fire in the various city regions. In certain regions, like parks, there are multiple ways to quell a fire. In a park, 2 water tankers and 2 fire engines are equally sufficient for quelling a fire.

In certain regions, the city can invest in special options.

Rajora Needs Assessment

Area Type *(color code)*		**Necessary Fire Equipment** *to quell a fire*	**Special Options**
	Metropolitan Region	3 Fire Ladders *and* *Any 3 Land-based Fire Vehicles* --- 3 Fire Ladders *and* 1 Helitanker	Install sprinklers in every metropolitan high-rise building. Reduce expected damage by 50%.
	Suburban Region	2 Fire Engines	Install smoke detectors in every suburban home. Reduce the probability of fire by 40%.
	Industrial Region	6 Fire Engines --- 3 Fire Ladders --- 1 Helitanker *and* *Any 2 Land-based Fire Vehicles*	–
	Park	2 Water Tankers --- 2 Fire Engines	–
	Rainforest	6 Water Tankers --- 1 Helitanker *and* 2 Water Tankers	–
	Water Source	–	–

Section 5: Procurement Tenders

Summary of Supplier Vehicle Proposals

To strengthen its emergency response capacity, the City Council issued a public tender last year for the procurement of fire vehicles, including both aerial and ground-based units.

Several private firms and international suppliers responded, and the following section summarizes the best bids Rajora received.

The Mayor, Dr. Patel has given us some additional comments, *"Where practical, we would prefer to purchase from Indian companies and support the local economy."*

Flip over to the next page.

Fire Engines

Fire Engine, Diesel

Designed by Himachal Fireworks, an Indian manufacturer, the Diesel Fire Engine is the standard fire engine. Himachal Fireworks has released an updated 2024 model that can go everywhere except for rainforests.

Purchase Cost: **4 million INR**
Operating Cost (per Year): **0.4 million INR**

Fire Engine, Electric

Designed by foreign manufacturer BTS, the Electric Fire Engine is a brand new fire engine model that uses LFP electric batteries. The BTS Electric Fire Engine has the same capabilities as Himachal Fireworks' Engine, but it is better for the environment.

Purchase Cost: **8 million INR**
Operating Cost (per Year): **0.1 million INR**

Ladder Trucks

Ladder Truck, Diesel

The Diesel Ladder Truck is also designed by Himachal Fireworks. The Diesel Ladder Truck cannot be used in parks or rainforests. However, it is especially important in metropolitan areas, because other land-based fire vehicles cannot reach the top floors of high-rise buildings.

Purchase Cost: **6 million INR**
Operating Cost (per Year): **0.6 million INR**

Ladder Truck, Electric

The Electric Ladder Truck has the same capabilities as the Diesel Ladder Truck, but it is better for the environment. It is designed by foreign manufacturer BTS.

Purchase Cost: **10 million INR**
Operating Cost (per Year): **0.1 million INR**

Water Tankers

Water Tanker, Diesel

The Diesel Water Tanker is designed by a foreign legacy manufacturer called EXX Emergency Solutions. The Diesel Water Tanker can store 5,000 liters of water and is specifically built to function in rural areas like parks and rainforests.

Purchase Cost: **2 million INR**
Operating Cost (per Year): **0.2 million INR**

Water Tanker, Electric

The Electric Water Tanker is also designed by EXX Emergency Solutions. It has the same capabilities as the Diesel Water Tanker, but it is better for the environment.

Purchase Cost: **4 million INR**
Operating Cost (per Year): **0.1 million INR**

Helitankers

Helitanker, Turbine-based Jet A1

The best bid that Rajora received for their helitankers was from foreign manufacturer Watercopters, Inc. A helitanker is useful for large fires; it has the output of multiple other vehicles. Helitankers can only tend to fires within 35 minutes of a water zone.

Purchase Cost: **20 million INR**
Operating Cost (per Year): **4 million INR**

Section 6: Construction Tenders

Summary of Construction Proposals

To improve fire safety capacity across the city, the City Council partnered with Delhi Firebases, a construction company experienced in building fire bases. Delhi Firebases provided cost estimates for different types of facilities, and the following section lists the prices they quoted.

Fire Base Construction Costs

Base Type	**Capacity** *(vehicles)*	**Land Requirements** *(sq. km)*	**Cost** *(millions of INR)*	**Annual Operating Expense** *(millions of INR)*
Regional Headquarters	6	2	750	50
Standard Base	3	0.5	350	25
Minibase	2	0.5	200	5

NOTE: *In your project proposal, you will need to highlight the locations where to build fire bases. You can mark those areas with R (for Regional Headquarters), S (for Standard Bases), or M (for Minibases).*

Luckily, the city administration can take advantage of an 'eminent domain' law, which allows the city to acquire land anywhere in the city. Different regions have different land costs, and you will need to take this into account in your calculations.

Land Costs

Area Type *(color code)*		**Land Cost** *(millions of INR/sq. km)*
	Metropolitan Region	180
	Suburban Region	30
	Industrial Region	70
	Park	70
	Rainforest	5
	Water Source	–

A separate construction firm, Nimriddi LLC, has submitted the best quote for installing water sprinklers in every high-rise building and smoke alarms in every suburban home.

Special Project Costs

Project	**Implementation TIme** *(months)*	**Land Requirements** *(sq. km)*	**Cost** *(millions of INR)*	**Annual Operating Expense** *(millions of INR)*
Installing Water Sprinklers	24	0	1000	0
Installing Smoke Alarms	36	0	200	0

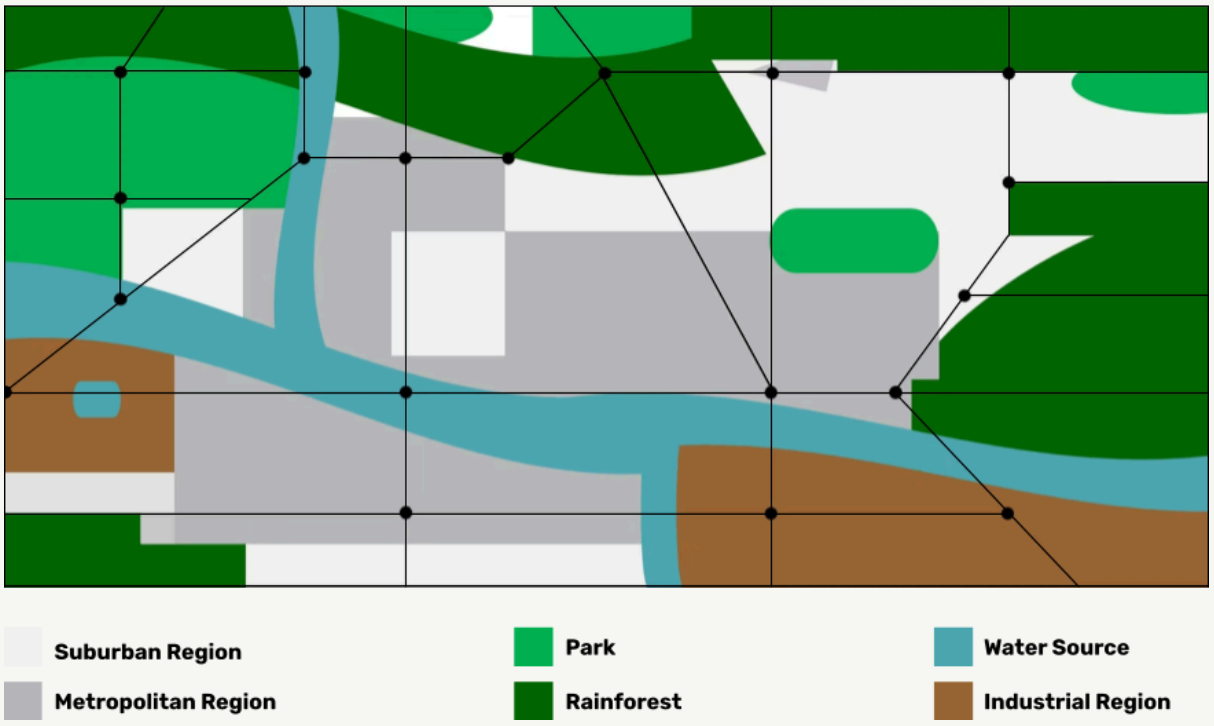
Section 7: Target Response Time

Target Average Response Time

The Rajora City Council wants to target an average initial response time of 15 minutes and an average full response time of 25 minutes. This means that the 1st vehicle on scene should arrive within 15 minutes, and the full squad necessary to quell the fire should be on scene within 25 minutes.

In the schematic diagram below, the Rajora Fire Council has split the city into various pieces.

Five Minute Map



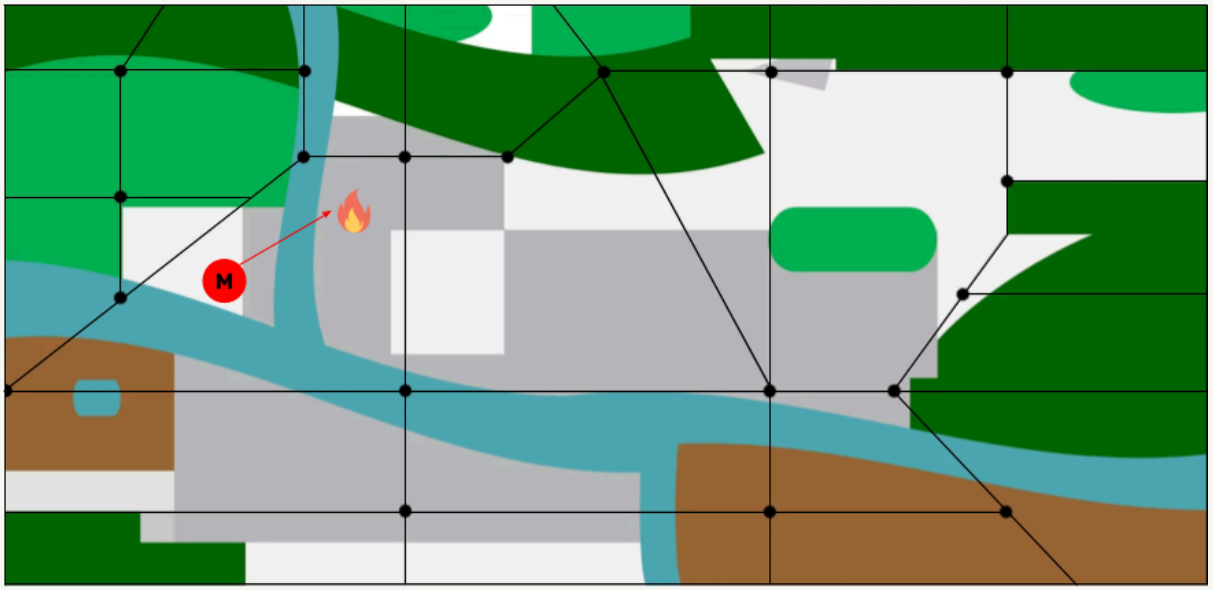
Each piece represents a 5-minute response time. If a fire occurs in a zone where a fire base is located, then the fire department will have a 5-minute response time. Even if there is water, the fire vehicles will be able to cross them via bridges or tunnels (the Rajora Fire Council has kindly abstracted the bridges and tunnels to simplify it for you).

However, if a fire truck has to cross a border to an adjacent zone, the response time will increase by an extra 10 minutes. For every border a fire truck crosses, its response time increases by 10 minutes. If a fire vehicle crosses a zone through a black circle, it is the equivalent of crossing 2 zones and adding 20 minutes to the response time.

A fire truck will always take the shortest route.

Below, our team at Bharat Capital Projects Consulting has created some worked examples to show you how fire vehicles transport between zones.

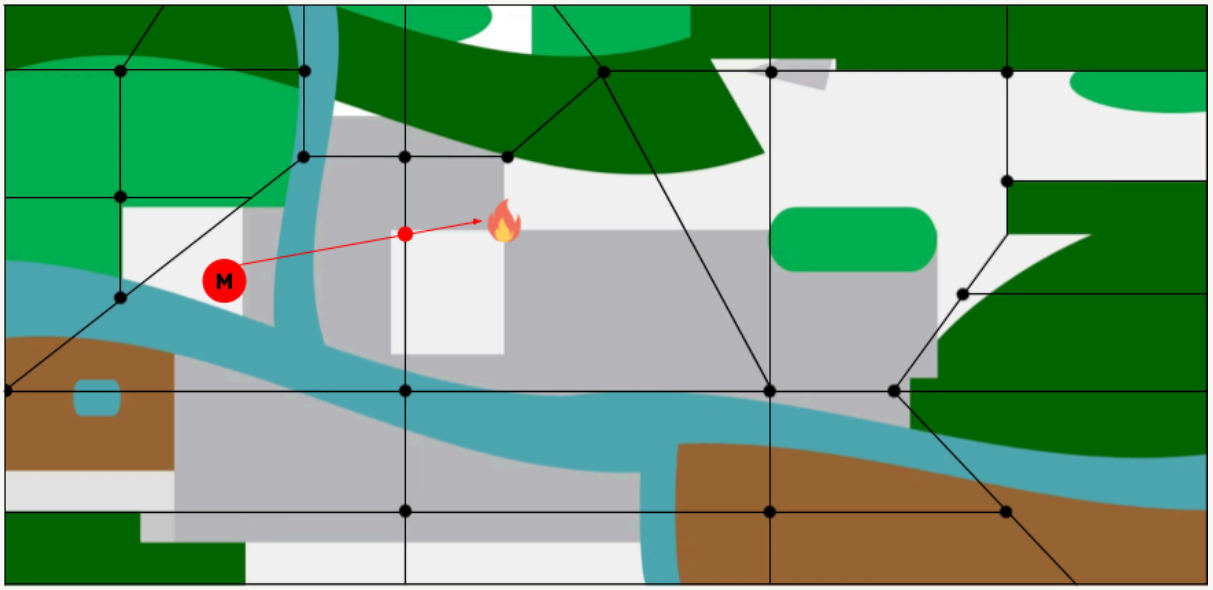
Worked Example 1



M Fire Department Minibase Fire

The response time will be 5 minutes, because the fire is in the same zone as the fire department.

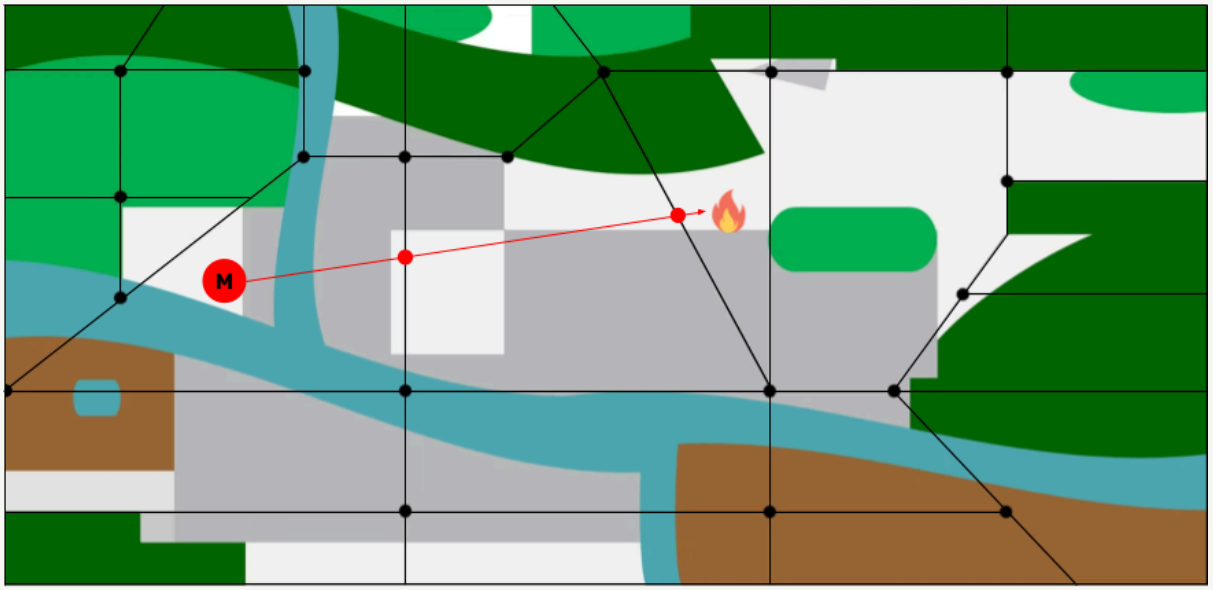
Worked Example 2



M Fire Department Minibase Fire

The response time will be 15 minutes, because the fire truck had to cross a border to go to the adjacent zone.

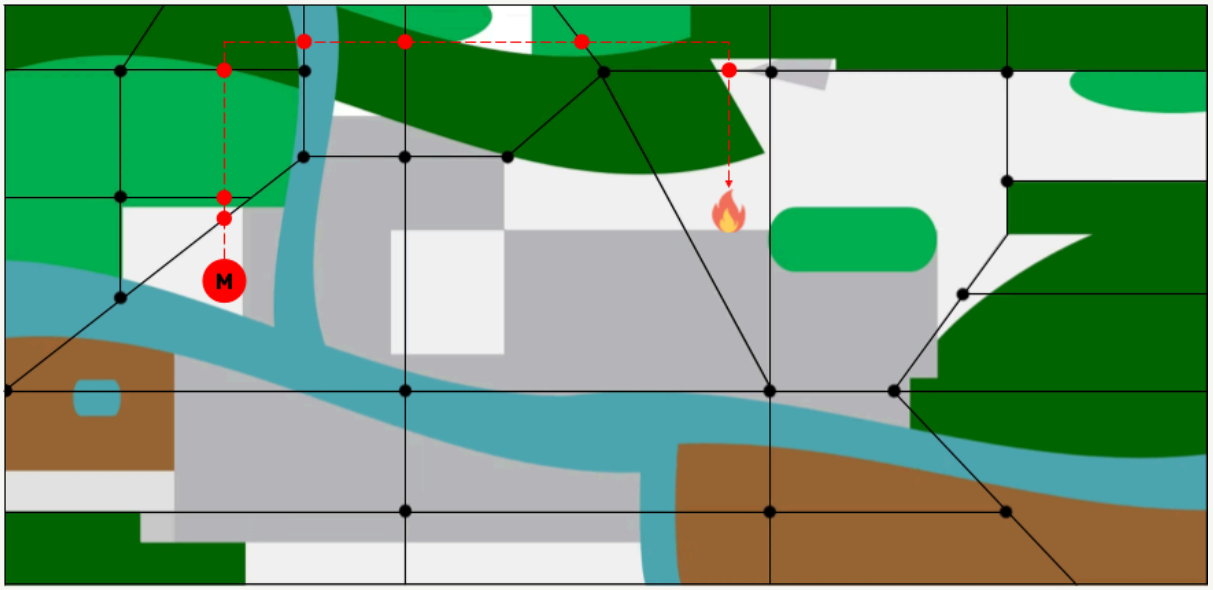
Worked Example 3



M Fire Department Minibase Fire

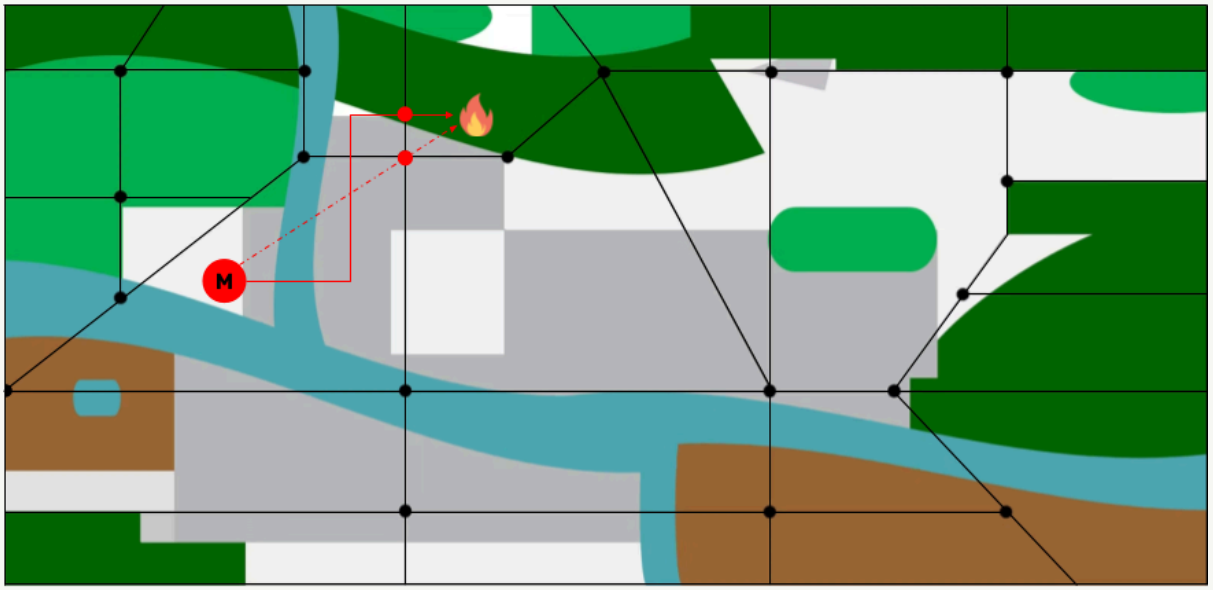
The response time will be 25 minutes, because the fire truck has to cross 2 borders to the fire.

Notice that the fire truck always takes the shortest route. It does **not** take the long route **below** which would cross 7 borders and take 75 minutes to get to.



M Fire Department Minibase Fire

Worked Example 4



M Fire Department Minibase Fire

If a fire vehicle crosses a zone through a black circle, it is the equivalent of crossing 2 zones and adding 20 minutes to the response time.

In the above example, the route highlighted by the solid red line and the route highlighted by the dashed red line are equivalent. Both routes will take 25 minutes.

Section 8: Your Team’s Strategic Recommendation

Submission Guidelines

Your team's submission may be one of the following options:

1. A video (maximum 5 minutes long)
2. A podcast (maximum 10 minutes long)
3. A presentation (maximum 10 slides)
4. An essay/report (maximum 1,000 words)

Alongside your submission, your team may submit an appendix showing your methodology and worked solutions.

If your team does choose to submit an appendix, please make sure that it is structured in a coherent manner and easy to follow.

For the purposes of this case study, assume inflation does not exist.

Judgement Criteria

There is no single correct answer. Your team may find that the optimal solution is to build smaller fire stations. Or your team may choose to go big and install sprinklers in every building, confident in your long-term infrastructure outlook.

Whatever your answer is, make sure it's logical, grounded in data, and communicated clearly. Best of luck.

We will use the below criteria to mark your submission. Our scoring system includes a carefully designed grading coefficient so every submission will be assessed in context to assure fairness.

Quantitative Performance (Return On Investment)

Teams with a better return on investment in relation to cost and expected benefit will be given higher marks.

Feasibility

Teams that provide solutions that do not break the constraints of the case study will be given higher marks.

Communication Skills

Teams that structure their communication and engage the audience through confident delivery will be given higher marks.

Reasoning Skills

Teams with logical, data-based solutions with clear justification of choices and assumptions will be given higher marks.

Technical Skills

Teams with a high quality of submission (e.g. structured essay without any typos, well-edited video in 720p or better quality, podcast with clear audio, etc) will be given higher marks.

Risk Management

Teams that show awareness of potential downsides and include strategies to manage uncertainty will be given higher marks.

Creativity and Innovation

Teams that introduce original or unconventional ideas that add significant value without sacrificing feasibility will be given higher marks.