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# Sensitivity Analysis and Stress Testing

FY 2024-25

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# Introduction

# INTRODUCTION

**Sensitivity Analysis:** Identifies variables with the most impact on the dependent variable, predicting outcomes and understanding uncertainty and risk. Used in financial modeling, engineering, and economics to test robustness, prioritize variables, and evaluate risk factors for strategic planning.

"Future-Proofing Business Against Climate & Water Risks"

| WHY? | HOW? | OUTCOME |
| --- | --- | --- |
| Rising climate shocks (cyclones, water stress) demand proactive risk modeling. | Combining sensitivity analysis (key variable impact) + stress testing (extreme scenarios) to build resilience. | Align with global standards (ISSB, TCFD) while unlocking growth in sustainability. |

**Stress Testing:** Stress testing assesses the resilience of systems under extreme conditions, identifying breaking points and potential failures. It is often used in financial services to test economic shocks and is required by regulators to ensure stability. Provides data for contingency planning, helping organizations prepare for worst-case scenarios and improve risk management. Applicable to IT systems, healthcare, supply chains, and more.

# Climate: Cyclone

# SCOPE AND OBJECTIVE

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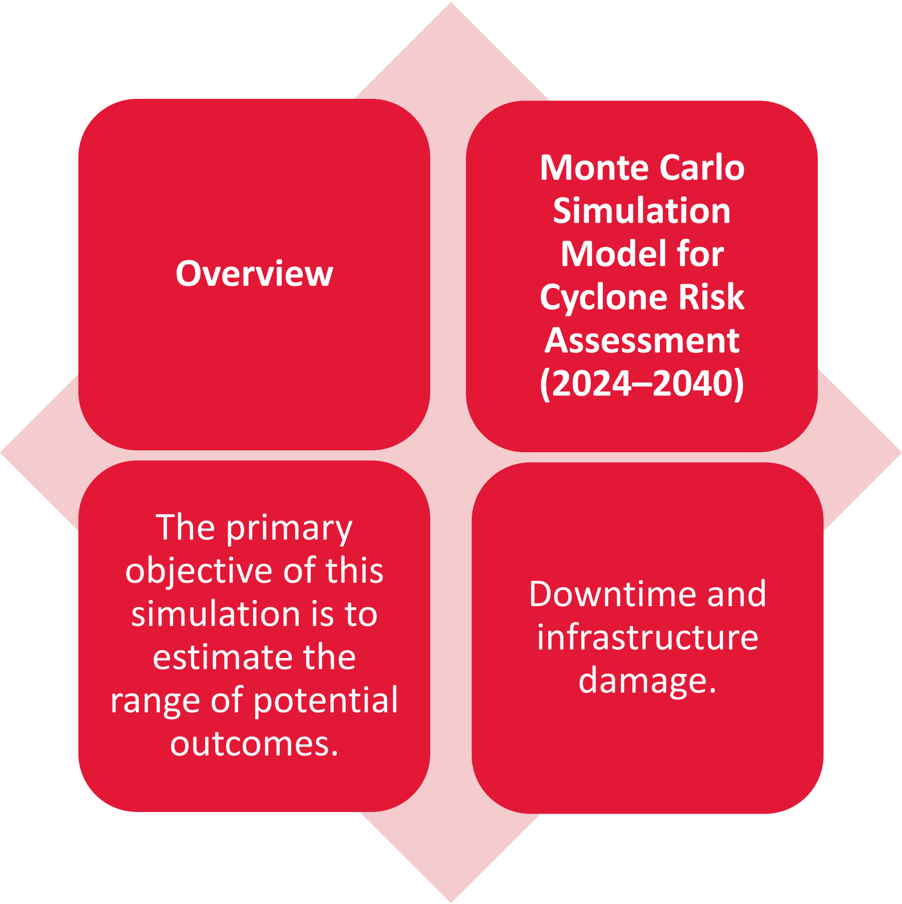
## Overview

This analysis leverages a Monte Carlo simulation to evaluate the potential impact of cyclonic activity on service continuity and infrastructure integrity over the period 2024–2040. The model incorporates plausible variations in climate-related risk drivers to estimate future operational risks and damages in a probabilistic manner.

## Model Objective

The primary objective of this simulation is to estimate the range of potential outcomes for:
**Service Downtime** (in days) due to cyclonic disruptions, and
**Infrastructure Damage** (as a percentage of total infrastructure value), based on projected changes in environmental and storm-related variables influenced by climate change.



# METHODOLOGY AND ASSUMPTIONS

A Monte Carlo simulation was employed, wherein key risk drivers were varied across 1000 iterations to reflect potential real-world variability. These iterations represent random combinations of input variables drawn from assumed distributions based on climate scenarios.

The simulation used the following three **key risk drivers** as independent variables:

- **Sea Surface Temperature (SST)** in degrees Celsius, which influences the formation and intensity of cyclones.
- **Cyclone Frequency**, representing the expected number of cyclones per year.
- **Cyclone Speed** in meters per second, capturing the intensity of each event.

For each scenario generated, the model estimated:

- **Service Downtime**, calculated based on the interaction between cyclone frequency and speed, and
- **Infrastructure Damage**, influenced by storm intensity and temperature anomalies.

## Assumptions and Base Year Data

To simulate future conditions, the model incorporated the following assumptions:
A 1°C increase in sea surface temperature, 2% increase in cyclone frequency, an 8 m/s increase in average cyclone speed, an estimated 5 days of service disruption per cyclone, an infrastructure damage rate of 0.023% per unit of cyclone intensity

| Risk Drivers | SST (degree Celsius) | Cyclone Frequency per year | Cyclone Speed (m/s) | Service downtime (days) per cyclone | Infrastructure damage per cyclone intensity |
|---|---|---|---|---|---|
| **Assumptions** | 1.00 | 2% | 8.00 | 5 | 0.023% |
| **Base Data** | 25 | 4 | 33.33 | 20 | 3.00% |

# RESULTS AND INTERPRETATIONS (1/2)

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**Statistical Distribution of Output:**

**Service downtime** ranged from 19.34 to 25.90 days, with a mean of 22.41 days and a standard deviation of 1.47 days.

**Infrastructure damage** varied between 0.88% and 6.49%, with an average of 3.40% and a standard deviation of 0.91%.
Percentile estimates further refined the risk envelope:
5th percentile:
  Downtime: 20.20 days
  Damage: 1.99%
95th percentile:
  Downtime: 24.76 days
  Damage: 4.92%

These results highlight the presence of both central tendencies and tail risks, indicating the importance of preparedness even for relatively rare but severe outcomes.

**Correlation Analysis**

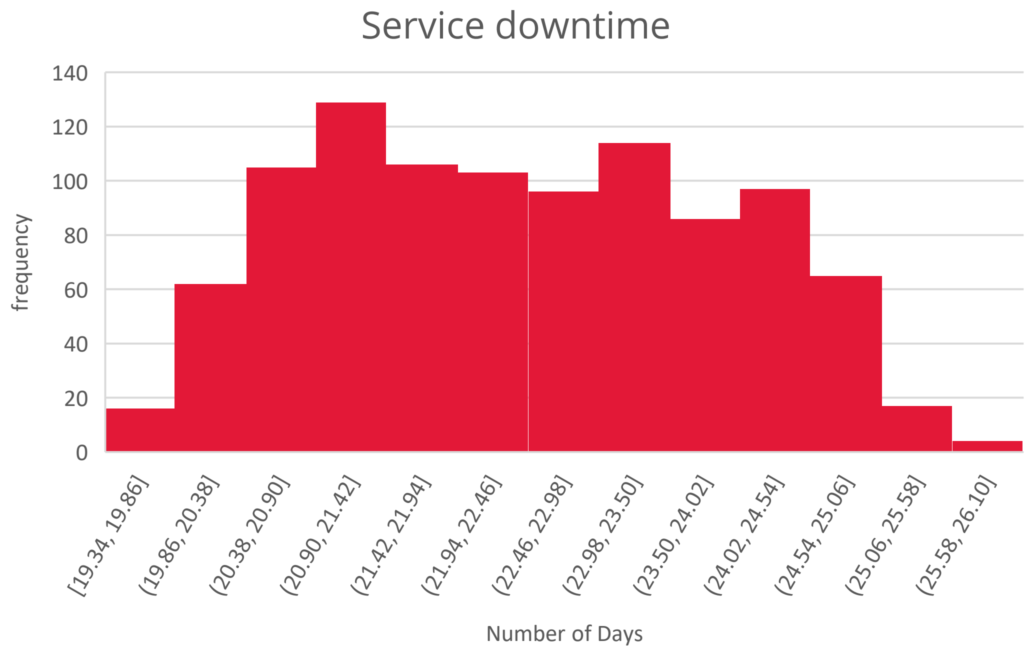
**Service downtime** is a near-perfect correlation with cyclone frequency
**Infrastructure damage** is strongly correlated with both sea surface temperature and cyclone speed

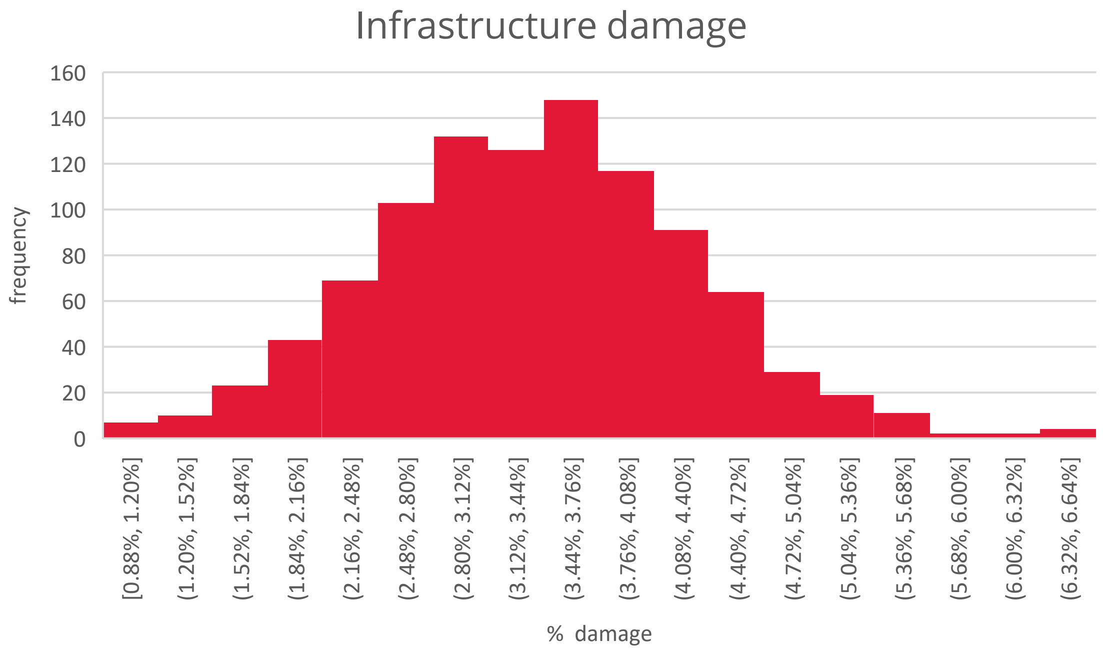
| Correlation | Service downtime | Infrastructure damage |
|---|---|---|
| Cyclone frequency | 0.998 | 0.498 |
| SST | 0.278 | 0.969 |
| Cyclone speed | 0.279 | 0.970 |

# RESULTS AND INTERPRETATIONS (2/2)

## Visual Interpretation

The histograms included in the analysis depict the distribution of both service downtime and infrastructure damage across all simulation scenarios. The results display near-normal distributions, with some skewness indicating the possibility of outlier scenarios with significantly higher impacts.



# Climate: Water Stress

# SCOPE AND OBJECTIVE

This simulation aims to evaluate the long-term financial risk associated with rising water stress in an urban IT facility located in Bengaluru. The model focuses on estimating the increase in tanker water procurement costs driven by **two key factors**:

- An expanding employee headcount raises water demand.
- Escalation in tanker water prices, due to increasing reliance on private water suppliers amid local water scarcity.

**Scope of Analysis**

The simulation is built around a large-scale IT/ITES office in **Bengaluru**, a city known for its growing urban population and increasing water stress. Since such facilities often rely on private water tankers due to inadequate municipal or groundwater supply, the financial exposure to water price inflation is significant.

# METHODOLOGY AND ASSUMPTIONS

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## Identification of Key Variables

Three key variables drive the financial outcome of this model:

- **Headcount**: The number of employees in the facility, which directly affects water demand.
- **Tanker Water Cost (₹/kl)**: The market rate for purchasing water from private suppliers, expected to rise annually.
- **Tanker Water Demand (kl)**: Computed as the product of headcount and per capita water consumption.

## Assumptions and Base Year Data

**3. Scenario Assumptions (2025–2045)**
The model simulates water cost over 20 years based on various combinations of:

- **Annual headcount growth**: 1%, 2%, and 3%.
- **Annual tanker water cost increase**: Between 1% - 5%.

These values reflect a range of plausible operational and market realities, including urban expansion, talent recruitment, and inflation in tanker water markets. Per capita water demand is kept constant across scenarios

**4. Base Year Inputs (2025)**
The simulation begins with the following base year values:

- The facility employs **17,564 people**, leading to an estimated **41,818 kl** of water demand annually.
- The tanker water cost is set at **₹89.42 per kl**, resulting in a **total financial outflow of ₹3.74 million** for water procurement.

# RESULTS AND INTERPRETATIONS

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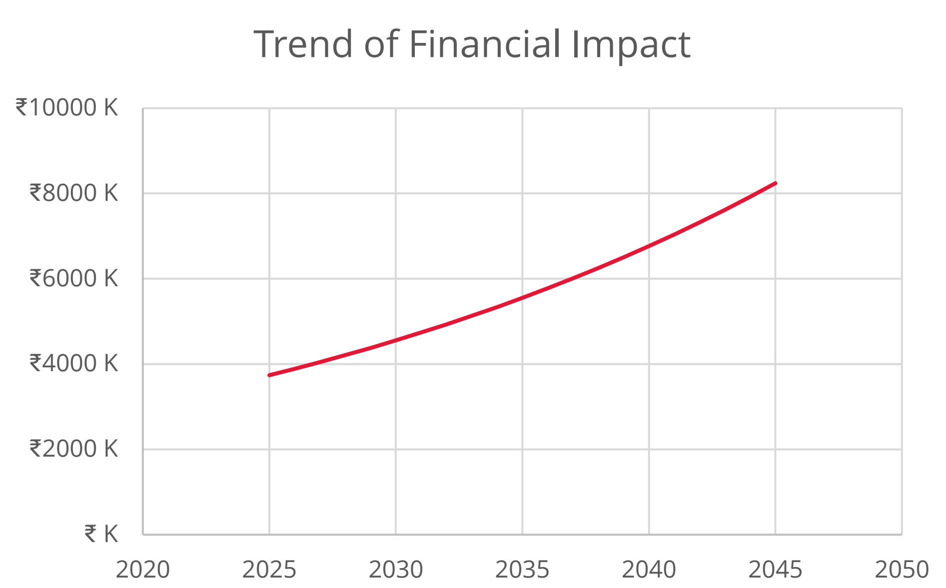
The model examines the financial impact under different growth scenarios over coming years




These findings indicate that a **2% increase in headcount combined with a 5% rise in tanker cost** can lead to an annual water cost escalation of over **7%**, compounding over time

## Interpretation of Correlation Matrix

To understand how each variable influences the financial impact, a **Pearson correlation analysis** was conducted.

The results show that:

- The **tanker water cost per kilolitre** has the **strongest influence** on the financial impact, with a correlation coefficient of **0.9996**. This means that any increase in water price leads to a nearly proportional increase in total cost.
- **Headcount** and **tanker water demand** are also **strongly correlated** with financial impact, both showing a coefficient of **0.9969.**
- All correlations are **strongly positive**, confirming that as each driver increases, so does the financial burden on the organization.
- This implies that **water price volatility** poses the greatest financial risk, especially when combined with headcount growth.

# Conclusions

# CONCLUSIONS

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### CLIMATE: CYCLONE

The Monte Carlo simulation presents a robust, data-driven framework for forecasting the operational and physical impacts of future cyclonic activity.

The findings emphasize the need for: Strategic planning to mitigate service disruptions, particularly under increasing cyclone frequencies, and Investment in climate-resilient infrastructure to reduce vulnerability to higher storm intensities. As climate conditions continue to evolve, such probabilistic models will be critical for informing long-term risk management and sustainability planning.

### CLIMATE: WATER

The cost of water is the most sensitive variable, meaning that any shift in tanker pricing due to scarcity or regulation will significantly affect the company’s operational costs. Employee growth indirectly drives this impact, showing the importance of integrating resource planning with HR and real estate strategies.

The model confirms that unless water efficiency measures (like rainwater harvesting or greywater reuse) are implemented, the company’s exposure to water stress will steadily grow.

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