

Reduction of Carbon Footprint for Skyworks Global Singapore Factories

1. Project Description

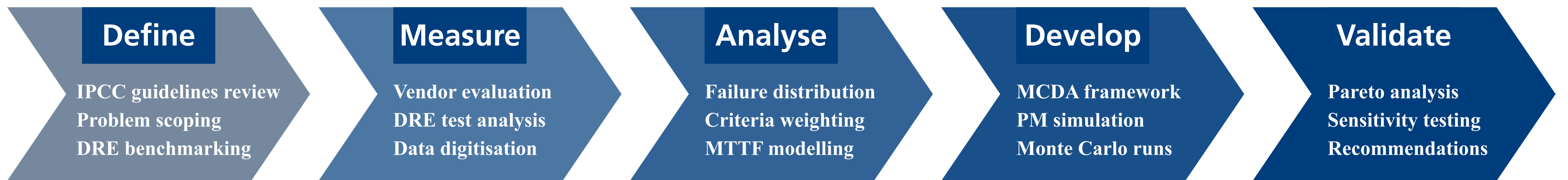
This project is conducted in collaboration with Skyworks Global Singapore, a semiconductor manufacturer that produces GHGs such as CF₄, C₂F₆, CHF₃, NF₃, and SF₆ during its manufacturing processes. Skyworks currently use plasma abatement scrubber systems to treat these gases before release. Third-party DRE testing revealed opportunities for improvement, prompting this project to develop decision-support tools that help Skyworks better manage scrubber performance and reliability.

2. Project Objectives

To reduce the carbon footprint of Skyworks' Singapore factories through the development of a two-part decision-support solution in accordance with IPCC and client sustainability requirements:

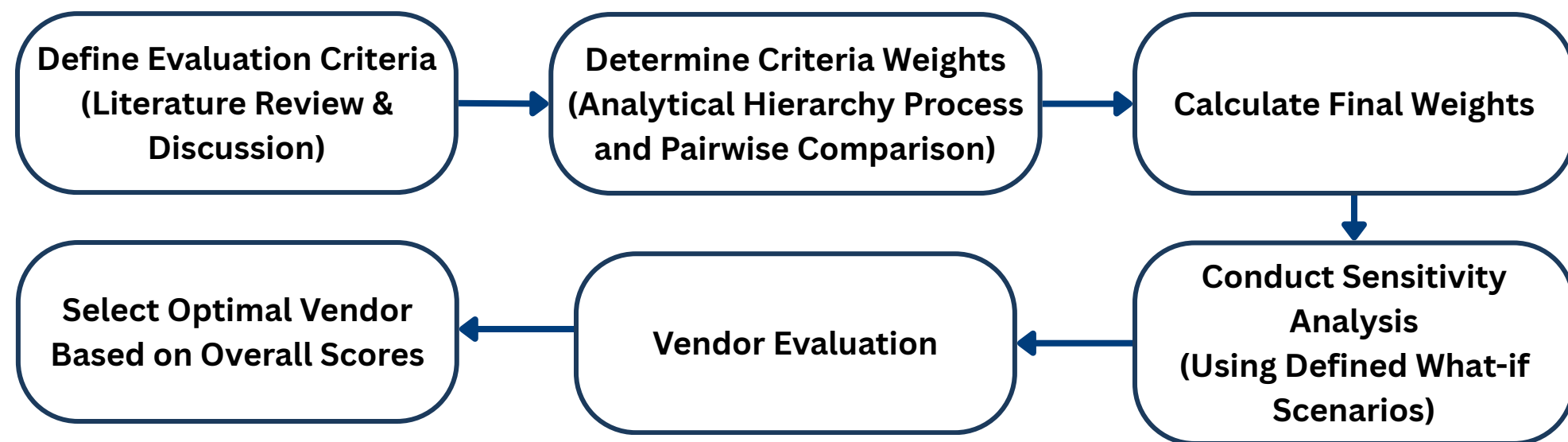
1. A Framework to Evaluate Competing Scrubber Vendors
2. A Preventive Maintenance Simulation model aimed at optimising scrubber selection by maximising system uptime.

3. Methodology



4. Multi-Criteria Decision Framework

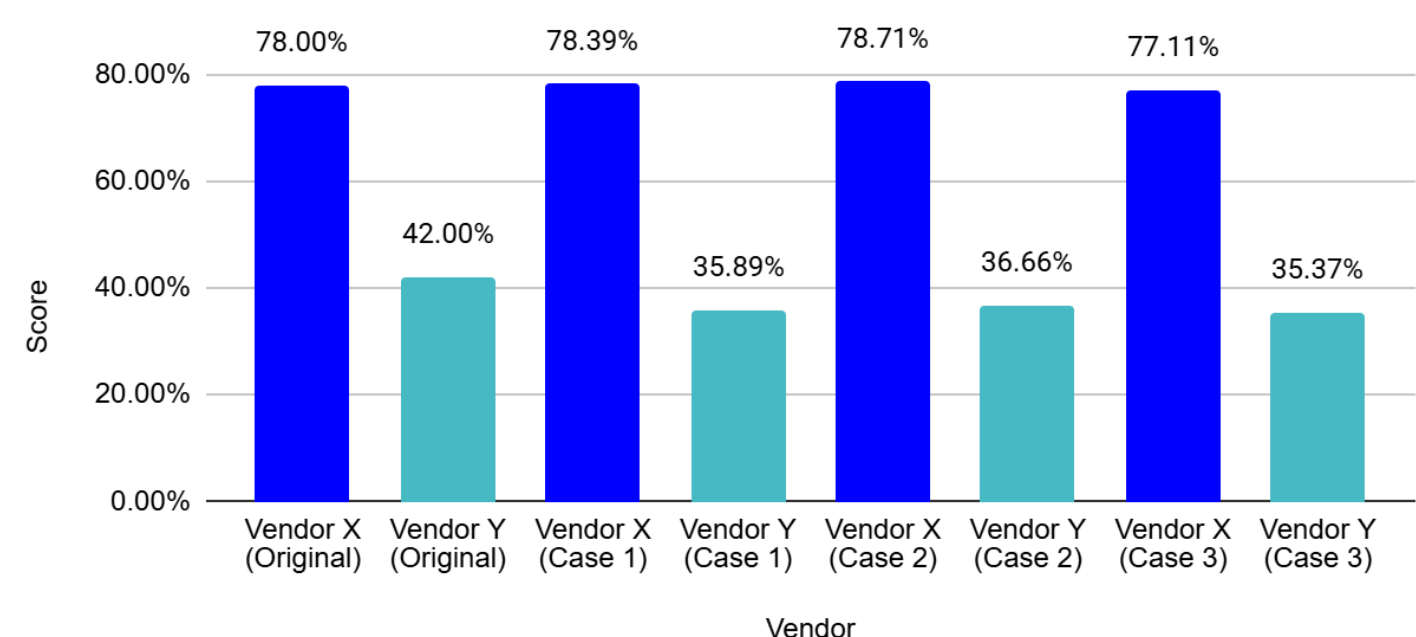
Determine Vendor by Evaluating Capability and Compliance



Weighted Criteria Vendor Scoring Matrix

Criteria	Weightage	Vendor X (scored over 5)	Vendor X Weighted Score	Vendor Y (scored over 5)	Vendor Y Weighted Score
Adherence to the Statement of Work Requirements	10%	3	6%	3	6%
Technological/Industrial Competence	10%	4	8%	2	4%
Submission of Destruction and Removal Efficiency (DRE) test results	20%	4	16%	0	0%
Implementation of quality assurance with relevant certification	5%	4	4%	4	4%
Alignment with Design standards & Material requirements	25%	4	20%	1	5%
Project Lead Time Performance	5%	0	0%	1	1%
Risk Assessment and Troubleshooting Competency	5%	4	4%	4	4%
Provision of warranty terms for products and services	5%	5	5%	3	3%
Compliance with Safety Regulations	10%	5	10%	5	10%
Effective Design Planning	5%	5	5%	5	5%
Total	100%	38	78%	28	42%

Scenario-based Sensitivity Analysis



A sensitivity analysis using structured what-if scenarios was conducted by modifying criteria weights to examine its influence on the overall robustness of the evaluation outcome.

Consideration 1: Destruction Rate Efficiency & Safety

Regulators impose strict compliance standards for environmental performance in line with the increased focus on sustainability.

Consideration 2: Risk & Track Record

Reputation and success of the vendor's product at similar sites mitigates the risk of failure.

Consideration 3: Lead Time

A faster delivery will lead to environment benefits to be enjoyed even sooner.

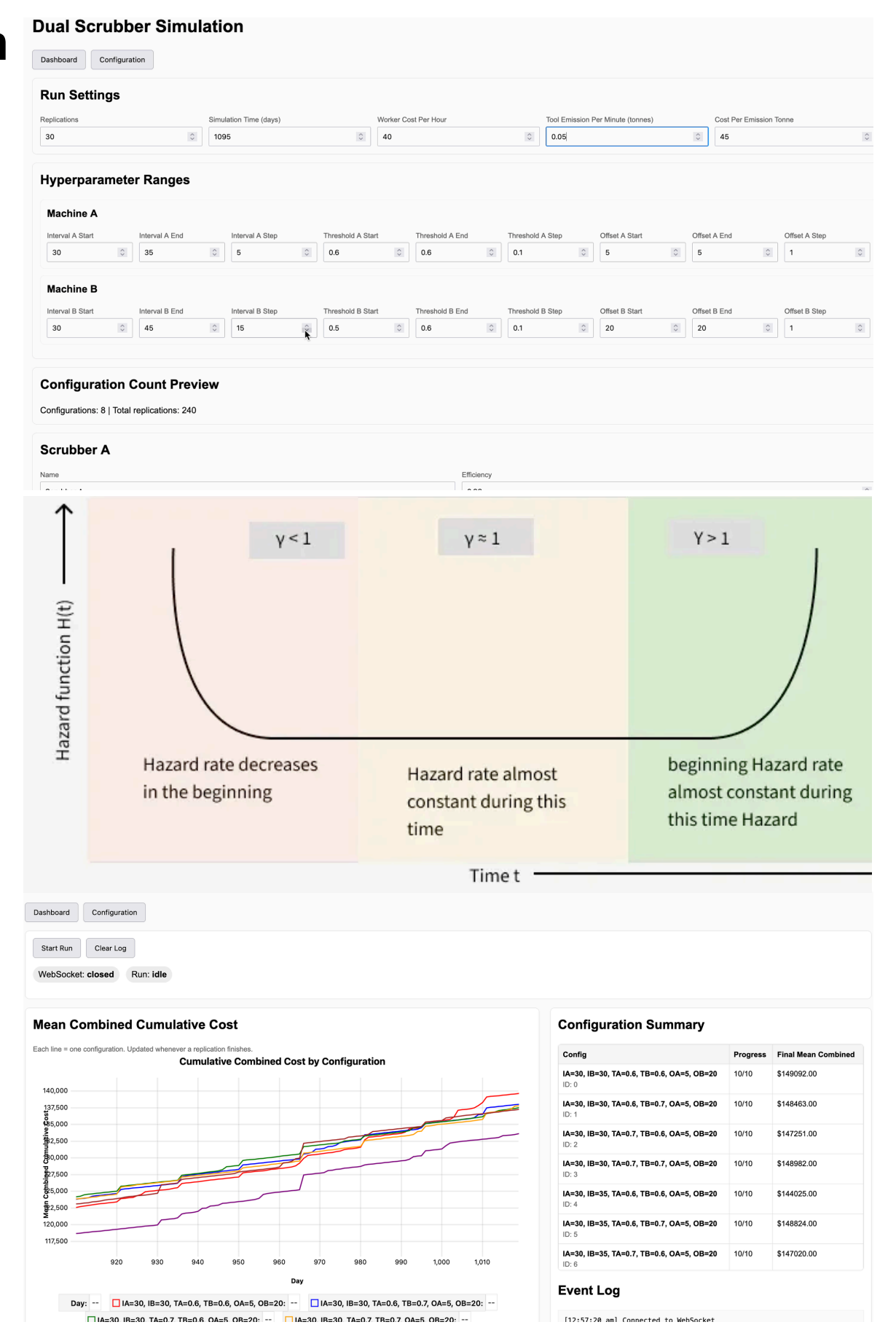
5. PM Simulation Model

Monte Carlo Simulation

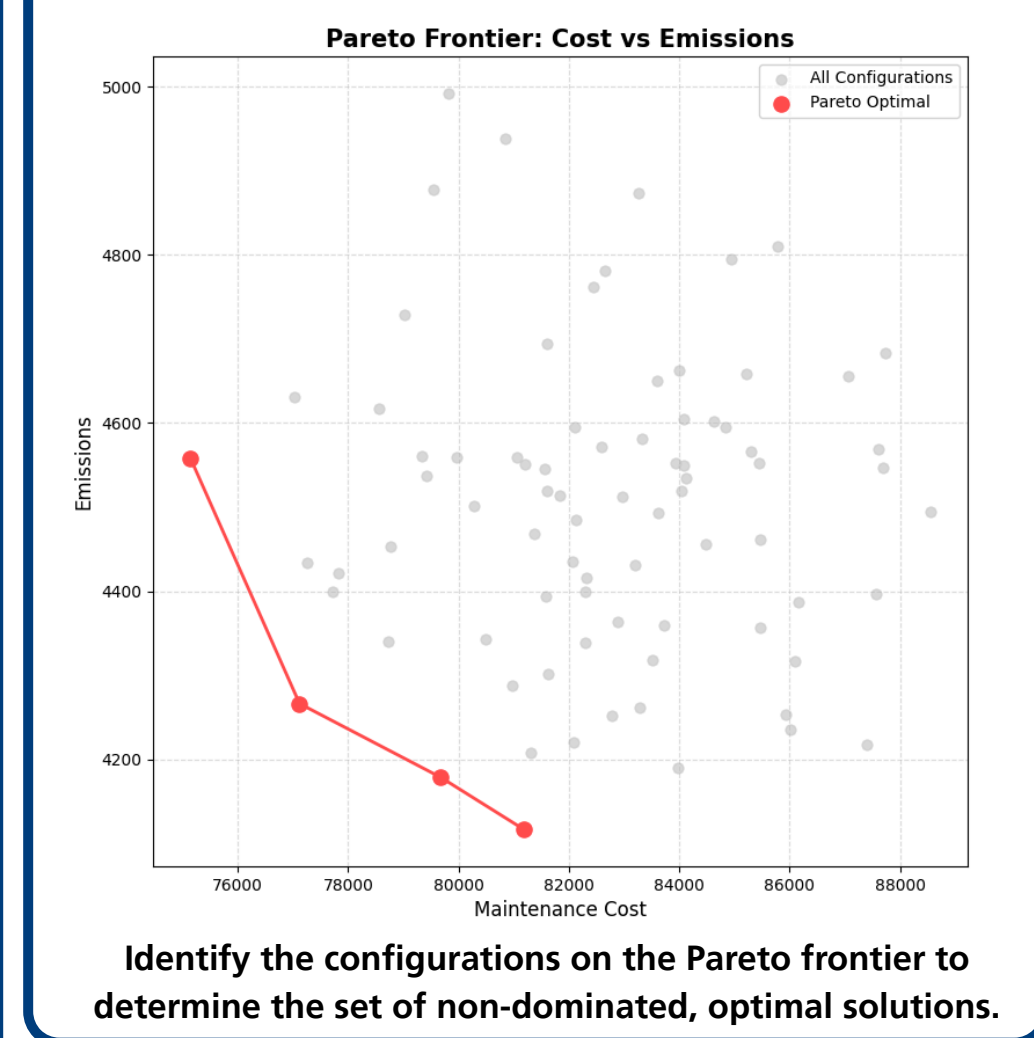
Input
1) Scrubber Part Specifications
2) Simulation Parameters

Algorithm
Main Event Loop:
1) Parts Age
2) Parts Breakdown (Modelled off Hazard Function)
3) Maintenance Carried Out
4) Emissions And Costs Tallied

Output
1) Emission And Cost Performance of All Simulation Configurations
2) Recommendation Based on Pareto Frontier and other considerations



Comparison of Various Configurations



Verification and validation

Tested simulation output with past data to see if the output conforms with the past
Consulted with industry supervisors for correctness of domain knowledge and simulation output

Future Direction

- Additional support for more robust visualisations
- Data Persistence using database management solutions

*Data used in graphics is not representative of actual company data

6. Results & Recommendations

Multi-Criteria Decision Framework

Based on our framework, which applied a weighted scoring system, Vendor X achieved a higher overall score than Vendor Y, indicating higher capability and compliance in the initial evaluation.

Sensitivity analysis was conducted on 3 different scenarios, the results also showed that Vendor X consistently performs better as compared to Y, indicating that the decision is robust and not sensitive to changes in weightage in different scenarios. Thus, Vendor X is recommended as the optimal selection.

PM Simulation Model

After testing various PM schedules and thresholds, we have come up with a set of Pareto optimal recommendations that either minimize emissions, costs or some weighted combination of both.

Apart from our recommendations, the dashboard created also serves as a decision making tool that allows Skyworks to evaluate the possible performance of new scrubber models and decide whether to proceed with such a decision.