Adapting to Demand

C&T Productions and The SuperFlI Series Jet

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ELI 9110: Risk Assessment & Management

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Introduction

As the world begins to return to the skies after years of lockdowns and uncertainty, the global aviation industry is back on the rise. Major companies like Boeing and Airbus are struggling to keep up with demand. Boeing is in the middle of a crisis as their reputation has been repeatedly damaged through disasters and questionable conduct, forever tarnishing their imagine and bringing fear into passengers looking to travel. ultimately leading fliers to select flights that do not travel through use of a Boeing plane, as a recent study states "36.6 percent of respondents would choose to avoid flying on a Boeing aircraft."[1] This results in airline carriers seeking alternative manufacturers to attract this demographic of customer. This provides C&T Productions (C&T) with an ideal opportunity to capitalize on the market trend. C&T currently produces their SuperFLI (Super Fast, Super Light, Super Innovative) series jet which has entered the market as a direct competitor to both Boeing and Airbus in the narrow body jet market. As of 2024 Boeing is sitting on 5625 unfulfilled jets,[2] a portion of which can be cancelled by the carrier. This presents the opportunity for C&T to scale production of the SuperFLI series jets to secure a foothold in the industry. However, a significant capital investment is required to scale production of this Canadian based company. Given the ever-shrinking manufacturing sector in Canada, Trudeau, in a last-ditch effort to save his spot in parliament, has offered companies up to a 60% investment at 15% interest rates to invest in increasing the manufacturing sector to bring thousands of new jobs to Canadians.[3]

With this lucrative opportunity in front of C&T, they have three options to proceed. The first option involves selection and construction of a new plant to run in unison with the previous plant to increase production through a modern facility with highly efficient practice, optimized supply chain, and quality control. Option two involves investing in their current facility, increasing

[1] Giulia Carbonaro, "Americans Will Pay More to Avoid Boeing," Newsweek, Newsweek Digital LLC, April 5, 2024, www.newsweek.com/americans-will-pay-more-avoid-boeing.
[2] Valerie Insinna, "Boeing, Pressured over 737 MAX 9 Blowout, Says January Deliveries Shrank 29%," Reuters, February 13, 2024, www.reuters.com/business/aerospace-defense/boeing.
[3] "Subsidy Tracker Parent Company Summary." Subsidy Tracker. Good Jobs First. Accessed April 14, 2023, subsidytracker.goodjobsfirst.org/parent/boeing.

production through updating equipment and implementation of better management of supply chain and quality control. Thirdly, C&T could opt to do nothing and continue production as is, which could be selected if it is deemed that the other two options do not provide a great enough return on investment or are deemed too risky to implement.

Objective

The objective of this case study is to assess C&T's potential to establish presence in an industry largely controlled by Airbus and Boeing. With the goal of attracting customers who are considering canceling unmet orders for the 737 MAX series. This will be done by evaluating strategic options for increasing production capacity of the SuperFli Series Jet. We will explore the implications of three approaches: expanding production within the current facility, establishing a new facility, or maintaining the current production setup. This study aims to provide insights into the risks, opportunities, and trade-offs associated with each option. Through a comprehensive analysis of factors such as cost, operational efficiency, timeline, and risk management, this study seeks to offer recommendations to C&T on the most effective course of action.

Budget & Financials

The first option is estimated to take three years to complete, with a total investment of $500M. The second option is estimated to take one year and require a total investment of $150M. Additionally, both options would receive financing of 60% from the federal government with a simple interest of 15% in a total duration of 5 years,[4] starting after production resumes where no interest is incurred to reduce strain on the companies willing to take on the risk. Finally, according to company policy and data sourced from the major players in the sector a required rate of return of 25% is put in place for a project to be considered profitable.[5]

[4] "Boeing Aircraft Prices 2022," Statista, Statista Research Department, March 28, 2024, https://www.statista.com/statistics/273941/prices-of-boeing-aircraft-by-type/.
[5] "Boeing Return on Investment 2010-2023: BA," Macrotrends, Macrotrends LLC, accessed April 7, 2024, www.macrotrends.net/stocks/charts/BA/boeing/roi.

The Canadian economy has returned to stability following the global lockdown and inflation hovers between highs of 3% and lows of 2.8%[6] and a long-term average of 3.15%. The Canadian economy is relatively stable and an inflation rate of 3.15% will be set to provide a conservative outlook on the future.[7]

The average production cost of the SuperFli series jets falls at $90M per jet with an average sale price of $95M per jet.[8] This yields a profit margin of $5M per jet,[9] however incentives are in place to encourage airlines to buy planes in bulk. this factor results in an average profit margin of $3M per jet.[10] Assuming the market is desperately seeking jets to fill their inventory and customer requirements it can be assumed that newly produced jets do not sit on lots for very long.

Technical Information

Option 1:

The completion of a new facility would provide an additional 13 jets per month adding to the existing capabilities of the previous plant which produces 4 jets per month. This option would provide 17 jets per month or 204 jets per year.[11] Additionally, the operation and maintenance costs of the facilities is estimated to be $95M per year[12] and the new facility is expected to have a life expectancy of 20 years before major refitting of the facility is required for production of next generation aircraft. Finally, plant location must be considered for this option:

1. London – A key city in Ontario with a strong tie to the manufacturing sector, along with the potential for high quality, cheap labour and government subsidies through recruitment of recent graduates from the University of Western. However, hiring of an inexperienced workforce could lead to potential downsides during the initial years of operation.

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[6] "Canada Inflation Rate (I:CIRUMY)," YCharts, accessed April 10, 2024, https://ycharts.com/indicators/canada_inflation_rate.
[7] "Monetary Policy Report - April 2024," Bank of Canada, April 10, 2024, https://www.bankofcanada.ca/2024/04/mpr-2024-04-10/.
[8] "Boeing Aircraft Prices 2022," Statista.
[9] Benjamin Zhang, "Here's How Much Boeing Is Estimated to Make on Each 737 Max 8 Plane," Business Insider, Insider Inc, March 13, 2024, https://www.businessinsider.com/boeing-737-max-profit-moodys-2019-3.
[10] Zhang, "Here's How Much Boeing Is Estimated to Make on Each 737 Max 8 Plane."
[11] Jon Hemmerdinger, "Boeing Clarifies That 737 Suppliers Are Running at 38-Monthly Rate, But Not Boeing Itself," Flight Global, DVV MEDIA INTERNATIONAL LIMITED, February 13, 2023, www.flightglobal.com/airframers/boeing.
[12] "Total Operating Expenses for Boeing Co.," FinBox, accessed April 17, 2024, https://finbox.com/NYSE:BA/explorer/total_oper_expen/.

2. Windsor – The Manufacturing center of Ontario, plant placement in Windsor would benefit from the recruitment of highly experienced individuals, with knowledge of efficient manufacturing practices. However, the automotive industry based in Windsor often experience work stoppages due to the strong union presence, which could lead to operational delays.
3. Saskatchewan – an unlikely candidate for the manufacturing sector, however, boasts a well-educated cheap work force, with the benefit of affordable land. Downsides arise in the geographical sparsity and the increased supply chain and transportation risks.

Option 2:

The overhaul of the existing facility would provide an additional 2.5 jets per month adding to the existing capabilities of the plant which produces 4 jets per month. This option would provide 6.5 jets per month or 78 jets per year.[13] Additionally, the operation and maintenance costs of the facilities is estimated to be $77M per year[14] and the overhauled facility is expected to have a life expectancy of 20 years before major refitting of the facility is required for production of next generation aircraft.

Option 3:

Finally C&T can elect to maintain production as is. This option would maintain the existing 4 jets per month, or 48 jets per year.[15] Additionally, the operation and maintenance costs of the facilities are estimated to be $60M per year[16] and the facility is expected to have a life expectancy of 10 years before major refitting of the facility is required as equipment and current practices begin to age.

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[13] Hemmerdinger, "Boeing Clarifies That 737 Suppliers Are Running at 38-Monthly Rate, But Not Boeing Itself."
[14] "Total Operating Expenses for Boeing Co.," FinBox.
[15] Hemmerdinger, "Boeing Clarifies That 737 Suppliers Are Running at 38-Monthly Rate, But Not Boeing Itself."
[16] "Total Operating Expenses for Boeing Co.," FinBox.

Economic Analysis

Federal Government Incentives Program

The loan provided by the federal government would cover 60% of the total investment, resulting in a \$300M and \$90M loan for option 1 and 2 respectively. Both Options have a simple interest rate of 15% payable over 5 years after production resumes.

Option 1:

Future Value during the construction period: \$300M/5 years = \$60M per year

Future Value after the construction period: \$60M/year * 1.15 = \$69M per year

Option 2:

Future Value during the construction period: \$90M/5 years = \$18M per year

Future Value after the construction period: \$18M/year * 1.15 = \$20.7M per year

Investment

The remaining 40% will be paid at the beginning of the project which yields an initial investment of \$200M and \$60M for option 1 and 2 respectively.

Operational Cost

Previously mentioned as \$95M, \$77M and \$60M for option 1, 2 and 3 respectively. Both options will be set as net present value for year 0 and will be influenced by inflation.

Future Value: Op_Cost * $(1+\text{Inflation})^t$

Production

Option 1:

Production Future Value = 204jet/year * \$3M/jet = \$612M/year

Option 2:

Production Future Value = 78jet/year * \$3M/jet = \$234M/year

Cash Flow Net Present Value at Year 0 $= \sum_{t=0}^{n} \frac{CFFV}{(1+Inf+RRR)^t} = \sum_{t=0}^{n} \frac{CFFV}{(1.2815)^t}$

Solution

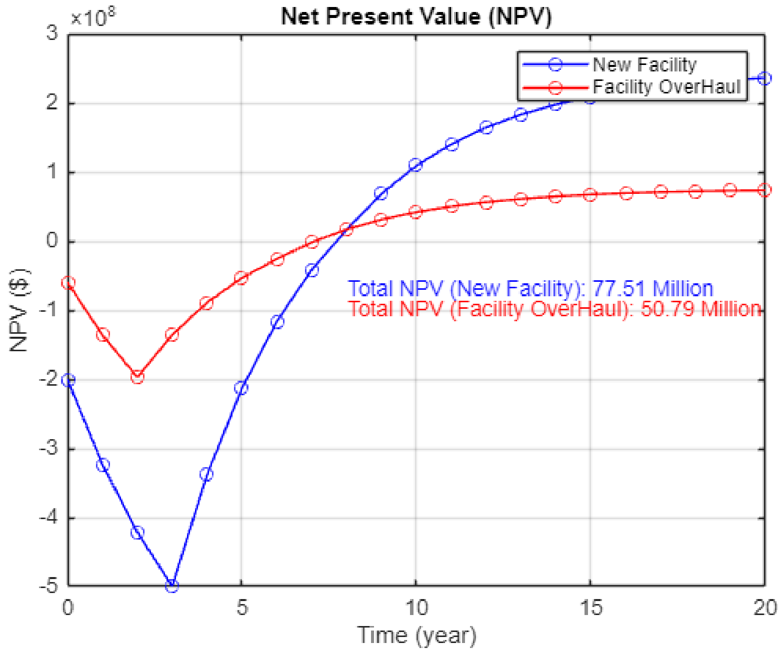

Figure 1: NPV Analysis (Note y-Axis:10^8)

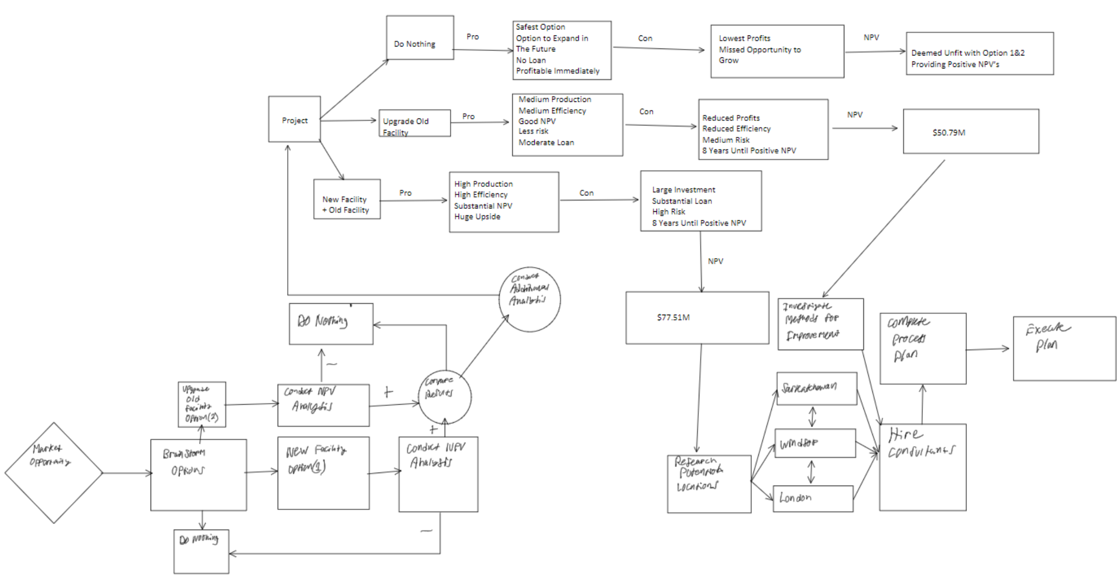

Figure 2: Decision Tree, Pro/Con

The Following figure depict the code utilized to calculate and graph the NPV's along with the variables and equations.

```
% Parameters
rrr = 0.25; Inflation = 0.0315; % Rate of return & Inflation
I0 = [-200e6, -60e6]; % Initial Investments
n = 20; % 20 years
Loan = [-60e6, -18e6]; % No interest loan
Loan_Interest = [-69e6, -20.7e6]; % Interest laon
PFV = [204*3e6, 78*3e6]; % Production future value
r = rrr + Inflation;  % Discount rate with inflation
Op_Cost = [-95e6, -77e6]; % Operational cost

% Initialize NPV arrays
npv = zeros(2, n+1);  % Adjusting size to account for time starting at t=0
total_npv = zeros(2,1);
for i = 1:2

    % Cash flow functions, note PFV & Loan Values change with stage
    cash_flow_1 = @(t,i) Loan(i) + Op_Cost(i) * (1 + Inflation).^t;
    cash_flow_2 = @(t,i) PFV(i) + Loan_Interest(i) + Op_Cost(i) * (1 + Inflation).^t;
    cash_flow_3 = @(t,i) PFV(i) + Op_Cost(i) * (1 + Inflation).^t;

    % Calculate NPV
    for t = 0:n  % Start from t = 0
        if t == 0 % Set Initial Investment
            npv(i, t+1) = I0(i);
        elseif t <= 3 && i == 1 % i = 1, Option 1
            npv(i, t+1) = npv(i, t) + cash_flow_1(t, i) / (1 + r)^t;
        elseif t <= 8 && i == 1 % i = 1, Option 1
            npv(i, t+1) = npv(i, t) + cash_flow_2(t, i) / (1 + r)^t;
        elseif t <= 2 && i == 2 % i = 2, Option 2
            npv(i, t+1) = npv(i, t) + cash_flow_1(t, i) / (1 + r)^t;
        elseif t <= 6 && i == 2 % i = 2, Option 2
            npv(i, t+1) = npv(i, t) + cash_flow_2(t, i) / (1 + r)^t;
        else % Same for both
            npv(i, t+1) = npv(i, t) + cash_flow_3(t, i) / (1 + r)^t;
        end
    end
    % Sum up the NPV values
    total_npv(i) = sum(npv(i,:));
end
```

Figure 3: MATLAB Code

Both Options were analysed through use of MATLAB and yielded positive NPV's of \$77.51M and \$50.79M for Option 1 and Option 2 Respectively. This demonstrates that both options are profitable throughout their lifespan of the project with a required rate of return of 25%. However, Option 1 produced a value \$26.72M higher than option 2. Additionally, although option 1 has a longer period without production, both options break 0 during their 7^{th} year further pushing the point that option 1 can produce a better upside than option 2. With this data in mind, the report will move forwards with option 1 selected as it has the potential to cement C&T as a major player in the public transportation aviation industry. Further analysis must be conducted for proper location selection with a focus on more qualitative analysis and associated risks.

Technical Analysis

Decisions must be made on the proper location for the new plant. The first option includes construction of the plant in London Ontario, which would achieve benefits through hiring students for internships and new graduates from UWO. This provides benefits through wage subsidies from hiring students[17] and cheaper wages, driven from the desire for valuable work experience. However, this option will come with downsides of a less experienced workforce and could lead to hiccups in production. The second option involves the placement of a facility in Windsor Ontario, which is the manufacturing hub of Ontario. This facility would boast a more experienced workforce, however, would come at the cost of higher wages and an increased chance of labour disruptions. Finally, the facility can be situated in Saskatchewan which would benefit from cheap land and wages, however could pose logistical issues due to lack of existing infrastructure.

Control Chart

From the NPV calculation the minimum production rate of 203 jets per year provides a positive NPV over a 17-year span after construction of the plant, any mean production rate below this threshold poses significant effects on the long-term profitability of the project. A sample evaluation of the expected production per year will be conducted. Note for the sake of length and speculation, only 8 years of production will be estimated on the following table. Additionally, it should be mentioned that variance in production can be attributed to inexperienced workforce, strikes and other factors which can lead to either an increase or decrease in yearly production.

Plane Production Per Year			
Sample	London	Windsor	Saskatchewan
1	203	204	203
2	203	204	203
3	203	204	202
4	204	192	202

[17] "Find Wage Subsidies to Hire Students in STEM or Business," Government of Canada, August 9, 2023, https://www.canada.ca/en/employment-social-development/services/student-work-placements-wage-subsidies.html.

5	204	205	203
6	203	206	203
7	204	204	204
8	204	205	202
Total	1628	1624	1622
Mean	203.38	203.12	202.75
Minimum	202	192	202
Standard Deviation	0.74	4.58	0.71
Conclusion	Pass	Pass	Fail

Table 1: Yearly Production Rate

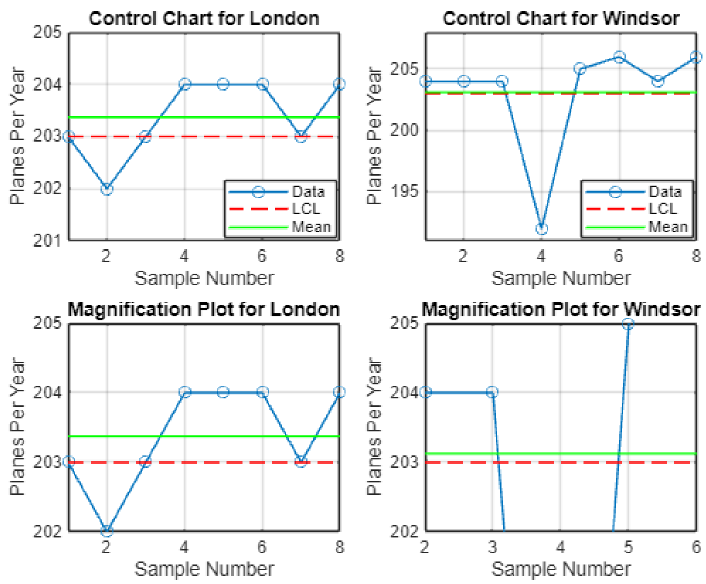

Figure 4: Control Chart with Magnification

Both Passing options exhibit-controlled behavior, however there are points of instability. Given the nature of the project a focus on the T value or standard deviation is not essential as a production rate higher than expected is viewed as beneficial for the project. However, a focus must be placed on the lowest year value and mean production rate over the timespan. Based on this analysis

Saskatchewan is deemed unsatisfactory and removed from evaluation. The remaining facilities yield a mean production rate higher than required. However, Windsor is deemed less attractive as the resulting mean production rate is very close to the lower control limit and work stoppages longer than a month in the early stages of production can lead to detrimental downstream effects.

Wage Cost Over Time Vs Production Rate

Both remaining options have their own average wage cost. London utilizing student recruitment means and including government subsidies, has an expected average annual salary of $60000,[18] while Windsor recruiting a more experienced workforce, leads to an expected average annual salary of $80000.[19] Research into the Canadian economy has yielded an annual salary increase of 3.6%.[1] Based on the low entry salary, London is expected to have an annual salary increase of 3%, while Windsor is expected to have an annual salary increase of 2%. Using this information in conjunction with the average production per year we can develop a speculative graph relating the salary cost per person per plane over an 8-year span.

Figure 5: Salary Cost Per Plane

[18] "Wages in the London Region," Job Bank, Government of Canada / Gouvernement du Canada, March 19, 2024, https://www.jobbank.gc.ca/wagereport/location/geo27234.
[19] Ibid.

Examination of the graph indicate that over the lifespan of the project, London will maintain an average salary cost per plane lower than that of Windsor further indicating the benefits of selecting London for plant location.

Force Field Analysis

To conclude the analysis of plant location selection, a force field analysis will be conducted utilizing information gathered from the previous steps. This analysis will provide recommendations for mitigating restraining forces, as well as a final recommendation for C&T.

<table>
<tr><td colspan="3">Force Field Analysis For London</td></tr>
<tr><td>Priority Ranking</td><td>Driving Forces</td><td>Restraining Forces</td></tr>
<tr><td>1</td><td>Low Strike Risk</td><td>Inexperienced Workforce</td></tr>
<tr><td>2</td><td>Increased Public Reception Through Hiring Students</td><td>More Frequent Delays</td></tr>
<tr><td>3</td><td>Cheap Labour Cost</td><td>Long Training Programs</td></tr>
<tr><td>4</td><td>Wage Subsidies Associated With Hiring Students</td><td>Higher Annual Salary Increase</td></tr>
<tr><td>5</td><td>New Graduates Are A Clean Slate Without Negative Workplace Habits</td><td></td></tr>
<tr><td>Actions</td><td colspan="2">-Source Top Candidates From UWO
-No Action Needed As Time Value Money Determines That Cheaper Labour Costs Now Is Superior Than The Alternative
-Hire Qualified Project Leads To Organize Teams And Reduce Delays
-Hire Candidates With Prior Workplace Experience</td></tr>
<tr><td colspan="3">Force Field Analysis For Windsor</td></tr>
<tr><td>Priority Ranking</td><td>Driving Forces</td><td>Restraining Forces</td></tr>
</table>

1	Frequent quota over achievement	High Strike Risk
2	Highly experienced workforce	Higher Cost Over Lifespan
3	Short Training Programs	High Initial Salary
Actions	-Disincentivize Unionization -Conduct Large Number of Interviews Searching For Cheap Qualified Individuals -Implement Tight Salary Increase Policies	
Recommendation	It Is Recommended That C&T Productions Select London As The Location For The Plant And Implement The Recommended Actions To Mitigate Restraining Forces.	

Table 2: Force Field Analysis

Based on the resulting Force Field Analysis this report recommends that C&T opt to build a new facility in conjunction with the existing facility. The location for the new plant is recommended to be located in London Ontario, utilizing a potential partnership with the University of Western to recruit new graduates for coop or full-time employment. Additionally, this would boast brand image through hiring graduates of Canadian universities.

Risks

Supply Chain Risk

The established supply chain plays an instrumental role in production rate. Negative effects experienced in the supply chain can lead to delays and an overall reduced production rate for the year. The risks associated with the supply chain are outlined in the following supply chain risk matrix. This matrix focuses on highlighting potential consequences of risks and the introduction of mitigation factors that could prove essential in the effective planning and execution of plant operation.

Risks Related to Supply Chain (Causes)	Eventual Consequences	Probability	Impact	Factors to Mitigate
Supplier Risk - Dependence on a single or few suppliers	Part availability fluctuations	Low	High	Implement backup strategies to source alternative suppliers
Bogus Part Risk - Suppliers change parts without informing C&T	Reduced quality and increased failure chance. Customer quality concerns	Moderate	High	Implement rigorous quality control techniques and supplier facility checks
Logistics and Transportation Risk - Transportation delays (e.g., road conditions, accidents)	Production delays	High	High	Source local suppliers to reduce chance of increased transportation times
Operational Risks - Supplier Production delays or disruptions - Quality control failures leading to product recalls	Delays and dealings with suppliers suffering from recalls can damage public image	Moderate	High	Source reliable suppliers with proper quality assurance in place
Financial Risks - Volatility in part prices - Cost escalation due to inflation or economic downturns	Would lead to a decrease in profit margins	Moderate	High	Implement contracts to buy parts in bulk, preventing the ability of suppliers to increase prices during production
Environmental and Natural Disaster Risks - Natural disasters (e.g., earthquakes, hurricanes, floods)	Supply chain disruptions resulting in substantial delays	Low	High	Acts of God cannot be mitigated, however backup suppliers should be scouted prior to disaster
Geopolitical and Trade Risks - Trade policy changes (e.g., tariffs, trade agreements, trade barriers) - Political instability or conflicts - Sanctions	Depending on the three subcategories it can range from increased prices to inability to acquire parts from affected suppliers	Low	Low	Ensure part sourcing involves considering Geopolitical factors to prevent selecting suppliers in susceptible regions.

Table 3: Supply Chain Risk Matrix

Strike Risk

Although Strikes were highlighted as a downside for a plant based in Windsor, strikes must be considered for a manufacturing plant regardless of location. For this a fishbone analysis will be utilized to identify and analyze potential causes of a strike. Analysis of strike risk is essential for the development of the project to ensure measures are in place to mitigate and prevent profit and public image damage. Analysis of the causes can lead to effective risk mitigation strategies.

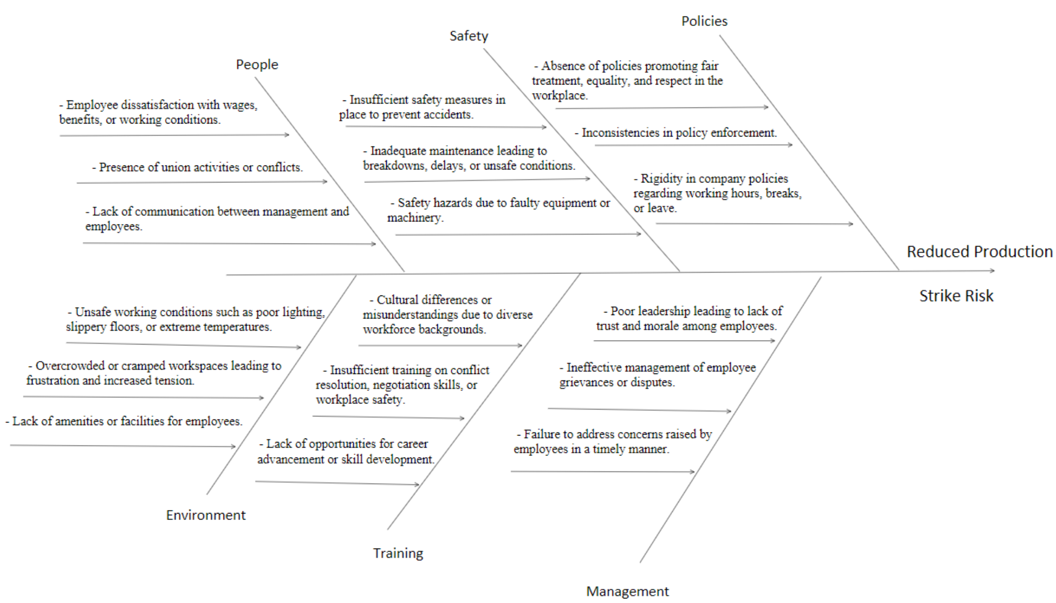

Figure 6: Strike Risk Fishbone Analysis

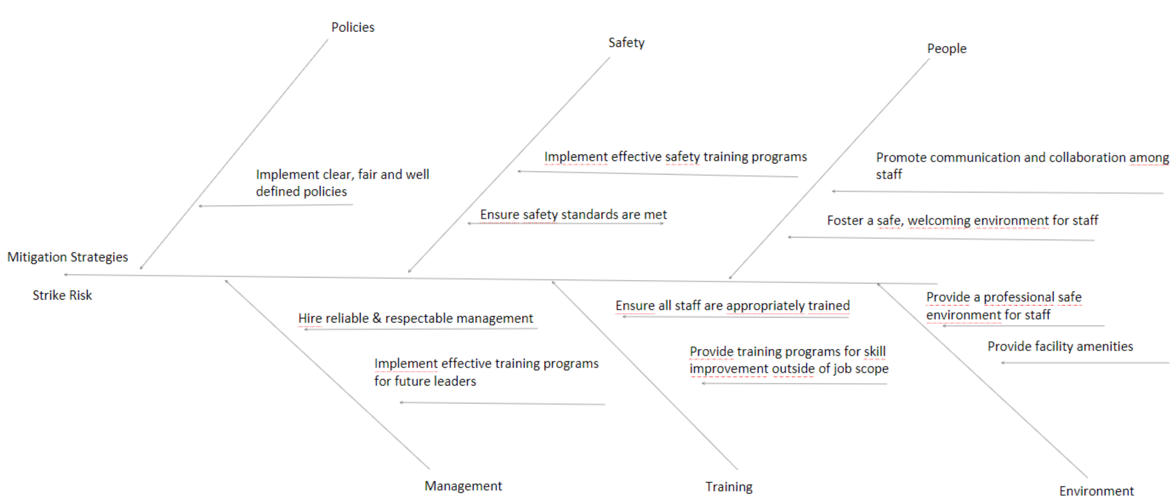

Figure 7: Management Strategies Fishbone Analysis

Facility Construction Delay Risk

Risk analysis using a why-why diagram can be used to describe delays and find the root cause of delays during the construction process. Due to the long nature of both construction processes, variance plays a large role on the resulting construction time, inevitable circumstances will take place, either resulting in a decrease in time, or in the more likely situation an increase in construction time. Through this analysis process it is determined that the root cause of construction variance is effective planning or the lack of an effective planning strategy.

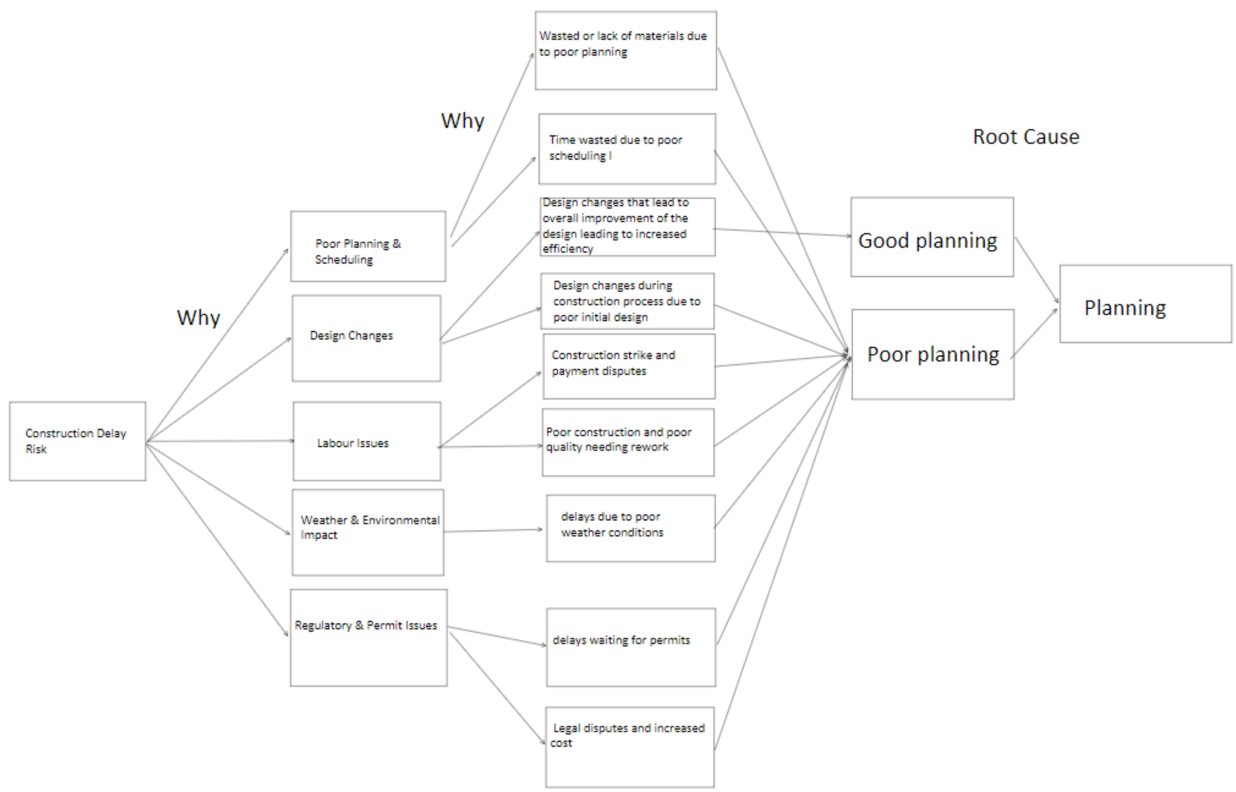

Figure 8: Why-Why Diagram

Conclusion

Qualitative risk analysis tools are an essential and effective means of documenting potential risks associated with any project and can lead to the implementation of measures to reduce such consequences. Ultimately it is determined that C&T should peruse construction of a new facility located in London Ontario and undertake effective risk management strategies to manage risks.

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Appendix

NPV Analysis

```
close all; clear all; clc;

% Parameters
rrr = 0.25; Inflation = 0.0315; % Rate of return & Inflation
I0 = [-200e6, -60e6]; % Initial Investments
n = 20; % 20 years
Loan = [-60e6, -18e6]; % No interest loan
Loan_Interest = [-69e6, -20.7e6]; % Interest laon
PFV = [204*3e6, 78*3e6]; % Production future value
r = rrr + Inflation;  % Discount rate with inflation
Op_Cost = [-95e6, -77e6]; % Operational cost

% Initialize NPV arrays
npv = zeros(2, n+1);  % Adjusting size to account for time starting at t=0
total_npv = zeros(2,1);
for i = 1:2

    % Cash flow functions, note PFV & Loan Values change with stage
    cash_flow_1 = @(t,i) Loan(i) + Op_Cost(i) * (1 + Inflation).^t;
    cash_flow_2 = @(t,i) PFV(i) + Loan_Interest(i) + Op_Cost(i) * (1 + Inflation).^t;
    cash_flow_3 = @(t,i) PFV(i) + Op_Cost(i) * (1 + Inflation).^t;

    % Calculate NPV
    for t = 0:n  % Start from t = 0
        if t == 0 % Set Initial Investment
            npv(i, t+1) = I0(i);
        elseif t <= 3 && i == 1 % i = 1, Option 1
            npv(i, t+1) = npv(i, t) + cash_flow_1(t, i) / (1 + r)^t;
        elseif t <= 8 && i == 1 % i = 1, Option 1
            npv(i, t+1) = npv(i, t) + cash_flow_2(t, i) / (1 + r)^t;
        elseif t <= 2 && i == 2 % i = 2, Option 2
            npv(i, t+1) = npv(i, t) + cash_flow_1(t, i) / (1 + r)^t;
        elseif t <= 6 && i == 2 % i = 2, Option 2
            npv(i, t+1) = npv(i, t) + cash_flow_2(t, i) / (1 + r)^t;
        else % Same for both
            npv(i, t+1) = npv(i, t) + cash_flow_3(t, i) / (1 + r)^t;
        end
    end
    % Sum up the NPV values
    total_npv(i) = sum(npv(i,:));
end

% Plot NPV against time
plot(0:n, npv, 'b-o');  % Adjusting x-axis to start from t=0
xlabel('Time (year)');
ylabel('NPV ($)');
title('Net Present Value (NPV)');
grid on;
legend('New Facility', 'Facility OverHaul');
line_colors = {'red', 'blue'};
lines = findobj(gcf, 'Type', 'Line');
for i = 1:numel(lines)
    set(lines(i), 'Color', line_colors{i});
```

```
end

% Display total NPV on the graph
text(8, -70e6, sprintf('Total NPV (New Facility): %.2f Million', total_npv(1) / 1e6), 'Color', 'blue');
text(8, -100e6, sprintf('Total NPV (Facility OverHaul): %.2f Million', total_npv(2) / 1e6), 'Color', 'red');
```

Control Chart

```
close all;clear all; clc;
% Define the data
data1 = [203,202,203,204,204,204,203,204];
data2 = [204,204,204,192,205,206,204,206];
data3 = [203,203,202,202,203,203,204,202];

% Calculate the mean and standard deviation
mean1 = mean(data1);
std_dev1 = std(data1);

mean2 = mean(data2);
std_dev2 = std(data2);

mean3 = mean(data3);
std_dev3 = std(data3);

% Define the lower control limits (assuming normal distribution)
LCL = 203;

% Plotting control chart for data1
subplot(2,2,1);
plot(data1, '-o');
hold on;
plot([1,length(data1)], [LCL,LCL], '--r'); % Lower Control Limit
plot([1,length(data1)], [mean1,mean1], '-g'); % Mean
title('Control Chart for London');
xlabel('Sample Number');
ylabel('Planes Per Year');
ylim([201 205]);
xlim([1 8]);
legend('Data', 'LCL', 'Mean');
grid on;
hold off;

% Magnification plot for data1
subplot(2,2,3);
plot(data1, '-o');
hold on;
plot([1,length(data2)], [LCL,LCL], '--r'); % Lower Control Limit
plot([1,length(data2)], [mean1,mean1], '-g'); % Mean
xlim([1,length(data1)]);
ylim([202,205]);
title('Magnification Plot for London');
xlabel('Sample Number');
ylabel('Planes Per Year');
grid on;
hold off;
```

```
% Plotting control chart for data2
subplot(2,2,2);
plot(data2, '-o');
hold on;
plot([1,length(data2)], [LCL,LCL], '--r'); % Lower Control Limit
plot([1,length(data2)], [mean2,mean2], '-g'); % Mean
title('Control Chart for Windsor');
xlabel('Sample Number');
ylabel('Planes Per Year');
ylim([191 208]);
xlim([1 8]);
legend('Data', 'LCL', 'Mean');
grid on;
hold off;

% Magnification plot for data2
subplot(2,2,4);
plot(data2, '-o');
hold on;
plot([1,length(data2)], [LCL,LCL], '--r'); % Lower Control Limit
plot([1,length(data2)], [mean2,mean2], '-g'); % Mean
xlim([2,6]);
ylim([202,205]);
title('Magnification Plot for Windsor');
xlabel('Sample Number');
ylabel('Planes Per Year');
grid on;
hold off;
```

Salary Cost

```
close all; clear all; clc;

% Data for London
salary_london = 60000;
increase_london = 1.036;
planes_london = [203, 202, 203, 204, 204, 204, 203, 204];

% Data for Windsor
salary_windsor = 80000;
increase_windsor = 1.02;
planes_windsor = [204, 204, 204, 192, 205, 206, 204, 206];

% Calculate the left axis values
for i =1:8
    left_axis_london(i) = ( salary_london / planes_london(i));
    salary_london = salary_london*increase_london;
    left_axis_windsor(i) = (salary_windsor / planes_windsor(i));
    salary_windsor = salary_windsor * increase_windsor;
end

% Plot the histogram
yyaxis right;
y = [203 204; 202 204; 203 204; 204 192; 204 205; 204 206; 203 204; 204 206];
b = bar(y,'FaceColor','flat');
```

```
% Define colors for London (red) and Windsor (green)
london_color = [1 0 0];  % Red
windsor_color = [0 1 0]; % Green

% Assign colors to the bars
b(1).CData = london_color; % London bars
b(2).CData = windsor_color; % Windsor bars

ylim([190 300]);
ylabel('Number of Planes');

hold on;
yyaxis left;
plot(1:8, left_axis_london, '-or');
plot(1:8, left_axis_windsor, '-og');
ylim([260 500]);
ylabel('Salary*Increase/Planes');

xlabel('Year');
title('Individual Salary Per Plane For London & Windsor');

% Add legend
legend('London', 'Windsor', 'Location', 'northwest');
```