

Choosing The Best Factory Location

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Haldon Co.

Contents

Objective

Method

Decision Analysis

Ethics & Profit

Conclusion

Appendices

Objective

The company is looking to buy one of three new factories, in Australia, Bangladesh or Canada.

- Sarah Simmons

Find out which is the best, as objectively as possible.

Options

Clearly the possible answers are

- ▶ Australia (AUS)
- ▶ Bangladesh (BAN)
- ▶ Canada (CAN)

Why should we care?

- ▶ Money
- ▶ Image
- ▶ Company Policy!

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Drive your future

- Haldon

Contents

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Appendices

Breaking the problem down

Want to consider profit, and ethics simultaneously

... Use Decision Analysis!

Framework

Standard Decision Analysis Framework:

1. Define the context
2. Observe Possible Outcomes
3. Identify criteria
4. Score options against criteria
5. Decide the **value** of the criteria (weights)
6. Calculate Weighted Score
7. Accept the **highest** score

Contents

Objective

Method

Decision Analysis

Ethics & Profit

Conclusion

Appendices

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Criteria

- ▶ Profit
 - ▶ Short term
 - ▶ Long term
- ▶ Ethics
 - ▶ Child Labour
 - ▶ Number of Workers
 - ▶ Emissions (CO_2 , NO_x , Water)
 - ▶ Car Reliability
 - ▶ Bribery

subjective...

Contents

Objective

Method

Decision Analysis

Ethics & Profit

Conclusion

Appendices

Ethics versus Profit

Simplify the problem by grouping Ethics and Profit separately

Why?

- ▶ Much easier,
- ▶ Can interpret more information

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We can do some further investigation

Calculating Profits

By considering the following:

- ▶ Resource costs (per car);
- ▶ Car Production Capacity
- ▶ Investment Requirements
- ▶ OMEX
- ▶ Labour costs

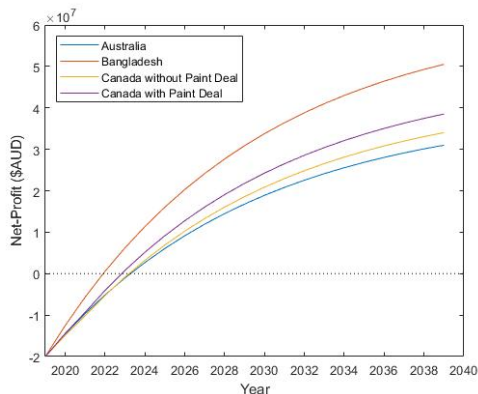
Assume we sell every car we can produce.

Calculating Profits

Using a pre-made
MATLAB script

Calculated potential Gross
Profits

(Thanks to Kate Bridges
for the script!)



Determining Profit Weights

Profit is split into

- ▶ Short term (defined as **10** years)
- ▶ Long term (defined as **25** years)

Information relates to 25 years in the future

Long term appears to be the main consideration

Profit Weight Table

	Weight	Aus	Ban	Can
Short Term	0.4	0.544	1	0.592
Long Term	0.6	0.623	1	0.676
Result	1	0.591	1	0.642

Defining Ethics

*If it could hurt people
- and we have a choice -
it is an ethical problem*

The information we have allows us to investigate:

- ▶ Child Labour
- ▶ Number of Workers
- ▶ Emissions (CO_2 , NO_x , Water)
- ▶ Car Reliability
- ▶ Bribery

Why do we care about Ethics?

But wait, why do we care?

"We're a big business! Why should we care?"

Why do we care about Ethics?

But wait, why do we care?

"We're a big business! Why should we care?"

Recall the company motto:

*Haldon's vision is to be the most responsible
car manufacturer in the world*

But... how much money is ethics worth?

Ethical Weighting

Unfortunately this is mostly **guess-work**

How **bad** is child labour?

Is it worse than Emissions?

Ethical Weighting

Unfortunately this is mostly **guess-work**

How **bad** is child labour?

Is it worse than Emissions?

We cannot really say.

Sarah gave insight to company policy

Use this to *guess* ethical weights

Ethical Weighting

"We flatly refuse to accept bribes"

"The other Ethical issues are all of importance to us"

Simplifying Ethics

We ignore the paint deal

The car reliabilities will be ignored as they are independent of company

Can encapsulate Child Labour and Number of Workers together

Similarly, consider Emissions together as one (equal weighting for each part)

Ethics in Decision Making

	Weight	Aus	Ban	Can
Human Rights	0.40	1	0.1	0.95
Emissions	0.50	0.81	0	1
Number of Employees	0.10	0.66	1	0.83
TOTAL	1	0.871	0.14	0.963

Comparison Table

Lets compare ethics against profit now!

	Weight	Aus	Ban	Can
Profit	0.4	0.591	1	0.642
Ethics	0.6	0.871	0.140	0.963
TOTAL	1	0.759	0.484	0.835

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So Canada is the best choice!

Wait...

Andrew, you just made all those numbers up!
Did you just pick those numbers because you like Canada?

- ▶ Well yes...
- ▶ Cannot identify 'true' values for ethics

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Lets observe what happens when we change the weightings

Polarised Cases

Try setting the Ethics weighting to 0, price to 1
And vice-versa:

	Ethics Only	Profit Only
Aus	0.871	0.591
Ban	0.14	1
Can	0.963	0.642

Can look at all cases by plotting the linear interpolant

Variable Weighting

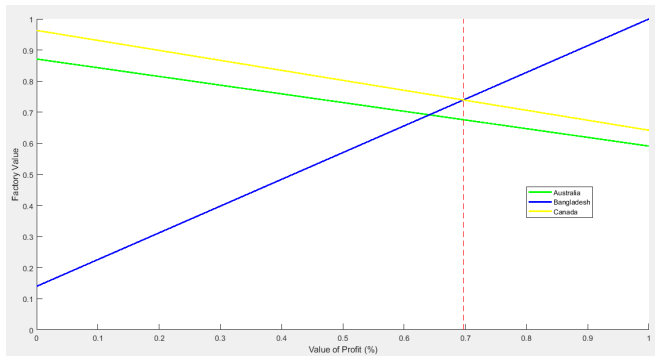


Figure: Effect of Variable Weighting on Factory Value

Intersecting at 69.7%.

The **largest** Factory value corresponds to the **best** factory.

Contents

Objective

Method

Decision Analysis

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Conclusion

Appendices

Final Recommendation

- ▶ Expected price weighting $\sim 40\%$.
- ▶ Choose Canada

Any Questions?

Contents

Objective

Method

Decision Analysis

Ethics & Profit

Conclusion

Appendices

Optimisation Code

```
%Constraint matrix
M=[400 500 520;
    50 70 40;
    70 80 150;
    30 40 50;
    1 1 1]; %A matrix
%w matrices are amount of resources allowed
wAus=[500000;50000;100000;50000;1000]; %b array for Aus
wBan = [500000;60000;80000;40000;1500]; %b array for Ban
wCan_1=[600000 ; 50000 ; 120000 ; 60000 ; 800]; %Before 2021: b array for Can
wCan_2=[600000 ; 50000 ; 120000 ; 60000 ; 1100]; %2021 and After: b array for Can

%Profit matrices
%These were pre-calculated on excel
cAus=[5356; 6010; 8116]; %Profit array for Aus
cBan = [6262; 8690; 10264]; %Profit array for Ban
cCan_NoPD = [4943.25 ; 5774.25 ; 7697.25]; %No Paint Deal: Profit array for Can
cCan_YesPD = [5288.25 ; 6234.25 ; 8272.25]; %Yes Paint Deal: Profit array for Can
%OPEX received in the handouts
OPEX_Aus = 1000000;
OPEX_Ban = 500000;
OPEX_Can = 1000000;
%Paint deal requires losing a single adventurer
SP_Adventurer = 16995;%Sale Price of Adventurer in Canada

%Australia
[max_val, max_arg_Aus] = Optimisation(M, wAus, cAus);
profit_Aus = max_val-OPEX_Aus;

%Bangladesh
[max_val, max_arg_Ban] = Optimisation(M, wBan, cBan);
profit_Ban = max_val-OPEX_Ban;

%For the Canada ones,
%The second case is after 2021
%as the production increases

% Canada No Paint Deal
[max_val, max_arg_Can_1_NoPD] = Optimisation(M, wCan_1, cCan_NoPD);
profit_Can_1_NoPD = max_val-OPEX_Can;
[max_val, max_arg_Can_2_NoPD] = Optimisation(M, wCan_2, cCan_NoPD);
profit_Can_2_NoPD = max_val-OPEX_Can;
```

Optimisation Code cont.

```
% Canada Yes Paint Deal
[max_val, max_arg_Can_1_YesPD] = Optimisation(M, wCan_1, cCan_YesPD);
profit_Can_1_YesPD = max_val-OPEX_Can-SP_Adventurer;
[max_val, max_arg_Can_2_YesPD] = Optimisation(M, wCan_2, cCan_YesPD);
profit_Can_2_YesPD = max_val-OPEX_Can-SP_Adventurer;
%Concatenate the canada cases
Profit_CanM = [profit_Can_1_NoPD, profit_Can_1_YesPD;
               profit_Can_2_NoPD, profit_Can_2_YesPD];
t = 20; %Number of years
Profit = zeros(4,t); %row 1=Aus, row 2=Ban, row 3= Can No PD, row 4 = Can Yes PD
Profit(:,1) = [profit_Aus;profit_Ban; Profit_CanM(1,1); Profit_CanM(1,2)];
Profit(:,2) = [0;0;Profit(3,1)+Profit(3,1)/(1.1); Profit(4,1)+Profit(4,1)/(1.1)];
for j=1:2
    for i=2:t
        Profit(j,i) = Profit(j,i-1)+Profit(j,1)/((1.1)^(i-1));
    end
end
for j=3:4
    for i=3:t
        Profit(j,i) = Profit(j,i-1)+Profit_CanM(2,j-2)/((1.1)^(i-1));
    end
end

Profit = [zeros(4,1),Profit] - 20000000;
plot((0:t)+2019,Profit(1,:), (0:t)+2019,Profit(2,:), (0:t)+2019,Profit(3,:), (0:t)+2019,Profit(4,:));
hold on
plot((0:t+1)+2019,zeros(t+2),'k:');
legend('Australia', 'Bangladesh', 'Canada without Paint Deal', 'Canada with Paint Deal','location','northwest');
xlabel('Year');
ylabel('Net~Profit ($AUD)');
xlim([2019,2040]);
hold off
```


Plot Code

```
hold on;
x=[0,1];
Aus = [0.871, 0.591];
Ban = [0.14, 1];
Can = [0.963, 0.642];

line (x, Aus,'Color', 'green', 'LineWidth', 2);
line (x,Ban, 'Color', 'blue', 'LineWidth', 2);
line (x, Can, 'Color', 'yellow', 'LineWidth', 2);
line ([0.6969, 0.6969], x,'Color', 'red', 'LineStyle', '--');

xlabel("Value of Profit (%)");
ylabel("Factory Value");
legend ("Australia", "Bangladesh", "Canada");
```