Corporate Social Responsibility

Chapter 5

Perspective of Decision Theory in Organisation

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INTRODUCTION

Decision made or taken by a manger governs the progress and sustainability of the organization, as right decisions will have a salutary impact, while the wrong ones may prove to be disastrous. The manager makes a decision every time on the use of resources, what to do and how to achieve effectiveness and efficiency at a minimum time frame. Most often, decisions made by managers are under uncertainty or lack perfect information.

Decision is an act of being committed to a course of action, decision-making is a process of choosing an option among alternative decisions. Decision theory provides a rational approach to the manager in dealing with problems confronting him under different situations such as certainty, risk and uncertainty.

FEATURES OF DECISION

In the act of making decision, there are some basic variables that are associated with the decision to be made:

i. The decision maker
ii. Objective of the decision
iii. Value system or behavior of the decision maker
iv. Alternative option available to choose
v. Condition, situation or environment under which the decision has to be made
vi. Result or outcome of the decision in relation to the condition which decisions are made
vii. Critical examination and evaluation of alternatives
viii. Choose best alternative

STEPS IN DECISION THEORY

There are four basic steps involved in decision theory in relation to the course of action to be taking in an organization.

1. List all possible alternative course of action that are under the control of the decision maker.
2. Identify the expected future events. These events might5 be state of nature which occurrence is completely not under the control of the decision maker,
3. Construct a pay off table for each possible combination of alternative course of action and its associated state of nature.
4. Select optimum decision criterion which is the result of the highest among alternative in the pay off table. This could be in economic, quantitative or qualitative depending on the objective of the decision maker.

CONDITIONS FOR DECISION-MAKING

There four condition or situation available for decision maker to make or take decision in order to solve problem confronting the organization.

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1. Decision making under uncertainty
2. Decision making under risk
3. Decision making under certainty
4. Decision making under conflict

DECISION MAKING UNDER UNCERTAINTY (DMUU)
In this condition, it may be said that the decision maker knows the sets of possible state of nature that will occur, but he do not have knowledge of about the probabilities of their occurrence. This means that the decision maker does not know the probabilities attached to each state of nature (event). He can not access the probability outcome with confidence, or no probability data are available. This decision environment is said to be under uncertainty.
Under extreme uncertainty, complete ignorance on the part of the decision maker is assumed, where the different states of nature that will occur is not or will not even be known. Hence, the decision rules or criteria that guide the manager in this condition are:

1. Maxi – Max (extreme optimist) by Hurwiez
2. Maxi – Min (extreme pessimist) by Wald
3. Mini – Max (salvage Regret Criterion)
4. Hurwiez (Lambda) criterion
5. Laplace – Bayes criterion (insufficient Reason)

MAXI MAX: This is an optimist condition which states that, you select the max figure payoff or amount from each row in the table, among the figure highest or max payoff selected, choose the max or highest among all alternative payoff.

Example: A production manager is contemplating on the possible decision to take concerning the worn out state of his factory machine, the available options are to; buy new, repair or hire. The possibility of these options depends on the sales of his product which may be high, low and no sales.

The naira payoff table for the three decision are under different conditions (market forces) which are summarized below.

Market forces (state of nature)

	A1 (High)	A2 (Low)	A3 (No Sales)
B1 (Buy)	₦28,000	₦23,000	₦12,000
B2 (Repair)	₦24,000	₦12,000	₦10,000
B3 (Hire)	₦25,000	₦18,000	₦15,000

Required: which of the decision will the manager take using maximax criterion?

Solution
B1 = 28,000 (max) B2 = 24,000 B3 = 25,000

Decision Rule: ₦28,000 is the max payoff, so the manger is expected to buy new machine since the market forces indicates high sales of his products.

MAXI MIN: This is a pessimistic condition. The rule states that you select the minimum possible payoff or smallest amount from one with the highest or max payoff among the alternatives selected. Using the same example to illustrate maximum

Market forces (state of nature)

	A1 (High)	A2 (Low)	A3 (No Sales)
B1 (Buy)	₦28,000	₦23,000	₦12,000
B2 (Repair)	₦24,000	₦12,000	₦10,000
B3 (Hire)	₦25,000	₦18,000	₦15,000

B1 = 12,000 B2 = 10,000 B3 = 15,000 (max)

Decision Rule: Among the alternative payoff, select the max which is B3 = 15,000. So the manger should hire a machine since the market forces indicates no sales.

MINI MAX (savage Regret criterion): This decision criterion was introduced by L.J. savage. He noted that the decision make stands to regret at the end of his decision in relation to the occurrences of the state of nature. Hence the decision maker should ensure that he minimizes his regret before choosing a particular payoff alternatives options.

This condition is based on M – n (M is max or highest payoff, m is min or smallest payoff). It states that, subtract if from all other payoff in each column and choose the max (highest) from each row.

Using the above example for Mini Max

Market forces (state of nature)

	A1 (High sales)	A2 (Low sales)	A3 (No Sales)
B1 (Buy)	₦28,000	₦23,000	₦12,000
B2 (Repair)	₦24,000	₦12,000	₦10,000
B3 (Hire)	₦25,000	₦18,000	₦15,000

Solution: EXPECTED COST OF OPPORTUNITY LOSS TABLE

	A1	A2	A3
B1	0	0	3,000
B2	4,000	11,000	5,000
B3	3,000	5,00	0

B1 = 3,000 B2 = 11,000 (max) B3 = 5,000

Decision Rule: Among the selected payoff, B2 = 11,000 indicates to be the max payoff. Hence the manager should repair the factory machine since the market force indicates low sales.
Thus the expected opportunity loss/cost (EOLC) will be B2 = 11,000 or B1 = 3,000 if and only if the question was to pick or select the max or min payoff. The decision rules does not consider the cost of opportunity lost for taking the wrong option.

HURWIEZ (Realism Criterion): This is also known as the weighted average criterion. It is a compromise between the maximax (optimistic) and maximin (pessimistic) conditions. The condition is based on Hurwiez's concept of co efficient of optimism or pessimism. This concept allows the decision maker to take consider the maximum and minimum for each alternative option by assign each a probability weight according to the degree of optimism or pessimism. The alternative which maximizes the total sum of weighted payoff is chosen.

The rule for this condition states.
α M + (1 - α) m
Where: Alpha α M = Optimistic index or coefficient
(1 - α) m = degree of pessimism row wise
and choose the max alternative payoff.

Using the same example above

Market Forces (State of nature)

	A1 (High sales)	A2 (Low sales)	A3 (No Sales)
B1 (Buy)	₦28,000	₦23,000	₦12,000
B2 (Repair)	₦24,000	₦12,000	₦10,000
B3 (Hire)	₦25,000	₦18,000	₦15,000

Solution

Note that Alpha/Lambda is between 0 and 1, which means that it could be less than 0 and not be greater than 1, that is $0 < \alpha$, $\alpha < 1$. This simply means that lambda or alpha $\alpha = 0.6$. to explain further, αM mean alpha (0.6) multiple the max payoff row wise which is 28,000 and $(1 - \alpha)$m means 0.4 multiplying the min payoff of the same row 12,000

Therefore: $\alpha M + (1 - \alpha)m$ by row

HB1 = 0.6 (28,000) + (1 – 0.6) 12,000
0.6 (28,000) + (0.4) 12,000
16,800 + 4,800
₦21,600 (Max)

HB2 = 0.6 (24,000) + 0.4 (10,000)
14,400 + 4,000
₦18,600

HB3 = 0.6 (25,000) + 0.4 (15,000)
15,000 + 6,000
₦21,000

Decision Rule: The manger should buy new factory machine since HB, produces the highest payoff among alternative options.

LAPLACE (insufficient decision): This state that the probabilities for each state of nature are the same. Hence, since the total probability for all state of nature is 1; it is then now divided by all state of nature in the payoff table. This condition is known as the principle of insufficient reason, since the probability associated with the occurrence of various variable or payoff are unknown.

	A1 (High)	A2 (Low)	A3 (No Sales)
B1 (Buy)	₦28,000	₦23,000	₦12,000
B2 (Repair)	₦24,000	₦12,000	₦10,000
B3 (Hire)	₦25,000	₦18,000	₦15,000

Solution

Applying the rule, since there are 3 events or state of nature = $^1/_3$ = 0.3 or $^1/_3$

Therefore:

LB1 = $^1/_3$ (28,000) + $^1/_3$ (23,000) + $^1/_3$ (12,000)
$^1/_3$ (28,000 + 23,000 + 12,000)
$^1/_3$ (63,000)
₦21,000 (max)

LB2 = $^1/_3$ (24,000) + $^1/_3$ (12,000) + $^1/_3$ (10,000)
$^1/_3$ (24,000 + 12,000 + 10,000)
$^1/_3$ (46,000)

₦15,333 (max)

LB3 = $^1/_3$ (25,000) + $^1/_3$ (28,000) + $^1/_3$ (15,000)
$^1/_3$ (25,000 + 18,000 + 15,000)
$^1/_3$ (58,000)
₦19,333

Decision Rule: The manager should buy new factory machine, since LB indicates or produces the max or highest payoff among alternative options.

DECISION MAKING UNDER RISK: Decisions are often made under the condition of risk, where more than one state of nature exist and the decision-maker has perfect information on the possible state outcome and he assign probability value to each state of nature. Under condition of risk, a number of decision criteria are available which could be of help to the decision-maker.

EXPECTED VALUE APPROACH (EV_X)
This approach requires the calculation of expected value of each decision alternative which is the sum of the weighted payoffs for that alternative, where weights are the probabilities assigned to the state of nature that can happen. This is also known as expected monetary value (EMV) approach; it consists of the following step.

(a) Contract a conditional payoff table listing the alternative decisions and the various states of nature. Enter the conditional profit for each decision and event combination along with the associated probabilities.
(b) Calculated the expected movement value for each decision alternative by multiplying the conditional profits by assigned probabilities and adding the resulting conditional values.
(c) Select the alternative that yields the highest expected movement value.

Example: Using the example above, the market forces record indicates that the probability for high sale is 0.3, and 0.3 for low sales.

Required: Which decision will the manager take among the three alternative options, using the expected value approach and decision tree approach.

Solution
Probability distribution are represented as
$EV_x = x_1 P_1 + x_2 P_2 + x_3 P_3 + \ldots\ldots\ldots\ldots x_n P_n$
Where $P_1 + P_2 + P_3 + \ldots\ldots\ldots\ldots P_n = 1$
Note that the probability distribution could be:
P0.10 + P0.15 + P0.20 + P0.25 + P0.30 = 1.00
From the question only P_1 and P_2 probability are given, to get P_3, add P_1 and P_2 and subtract if from 1

0.3 + 0.3 = 0.6
0.3 + 0.3 + x = 1
1 - 0.6 = 0.4
x = 0.4 (P_3)

Therefore
EVB1 = $x_1 P_1 + x_2 P_2 + x_3 P_3$
= 28,000 (0.3) + 23,000 (0.30) + 12,000 (0.4)
8,400 + 6900 + 4800
20,100 (Max)

EVB2 = 24,000 (0.3) + 12,000 (0.30) + 10,000 (0.4)
7,200 + 3600 + 4000
14,800

EVB2 = 25,000 (0.3) + 18,000 (0.30) + 15,000 (0.4)
7,500 + 3600 + 4000
14,800

EVB3 = 25,000 (0.3) + 18,000 (0.30) + 15,000 (0.4)
7,500 + 5,400 + 6000
18,900

Decision Rule: The manager should choose to buy new factory machine, since the expected value of B1 indicates the max payoff among other alternative options.

DECISION TREE APPROACH

The decision tree approach is quite different from the other approaches simply because the others deals with a single stage decision making where payoff, alternatives, state of nature and the associated probabilities were not subject to change. But decision tree adopts a multiple stages of decision making. The decision tree is characterized by a sequence of decision with each decision stage influences the next stage. Such problems are also known as sequential decision problems can be better analyzed using decision tree.

A decision tree is a graphical representation of the decision process indicating decision alternatives, state of nature, probabilities attached to the state of nature and conditional benefits and loss. It consists of a network of nodes and branches. Two types of nodes are used such as: decision node represented by a square and a state of nature (chance or event) node represented by a circle.

Alternative course of action (strategies) originates from the decision node as main branches (decision branches). At the end of each decision in branch, there is a state of nature node from which emanates chance events in the form of sub-branches (chance branches). The probabilities associated with the chance event are shown alongside these braches. At the terminal of the chance branches are shown the value of the outcome (payoffs). A branch that forms the end of the decision tree that is not followed by a decision or chance node is called a terminal branch (Prem and Hira 2012).

The general approach used in decision tree analysis is to work or move backward through the tree from right to left, calculate the expected value (also known as positive value) of each chance node. Choose a particular branch leaving a decision node which lead to the chance node with the highest expected value. This is known as roll back fold back process.

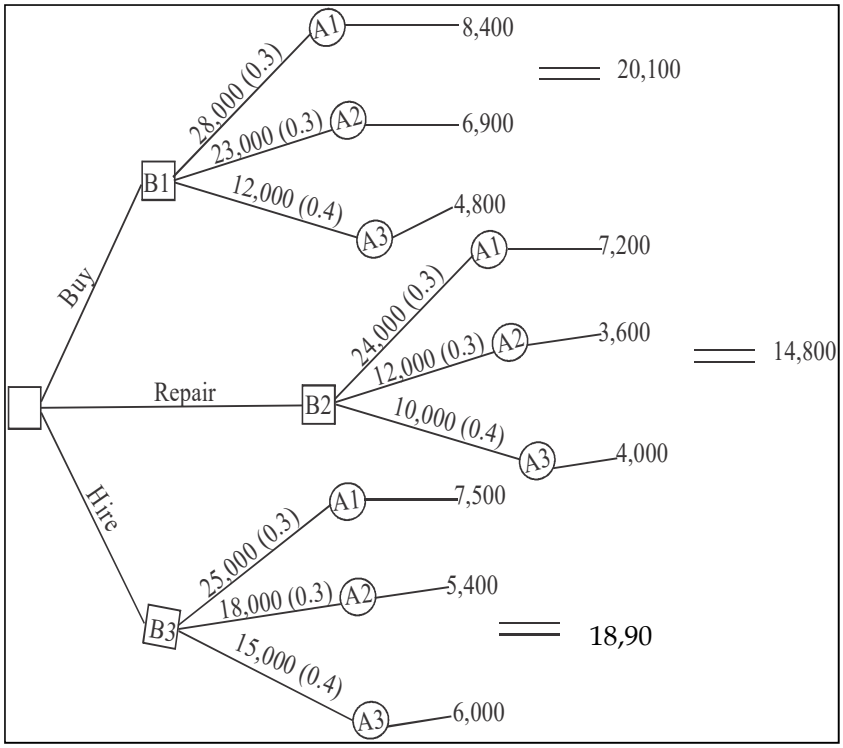
Example: Still using the example as above

	Market Forces (state of Nature)		
	A1 (High)	A2 (Low)	A3 (No Sales)
B1 (Buy)	₦28,000	₦23,000	₦12,000
B2 (Repair)	₦24,000	₦12,000	₦10,000
B3 (Hire)	₦25,000	₦18,000	₦15,000

Solution

Probability of 0.3, 0.3 and 0.4 respectively

First establish a square node as a starting stage and establish and action state for each state of nature for each node with each associated probabilities.



Decision Rule: The manager should choose to buy new factory machine, since the expected value of B1 indicates the max or highest payoff among other alternative options.

ADVANTAGE OF DECISION TREE

1. It structures the decision process and helps decision-making in an orderly, systematic and sequential order.
2. It requires the decision-maker to examine all possible outcomes, whether describable or undesirable.
3. It displays and express the logical relationship between parts of a complex decision and identifies the time required in various and subsequent events that would occur.
4. It can be use in different fields to introduce new product, make or buy decision and investment decisions.

LIMITATIONS OF DECISION TREE

1. Decision tree diagram becomes more complicated as the number of decision alternatives increases and more variables been introduced.
2. It assumes that the use of money based decision are only limited to risk associated with money.
3. The assignment of probabilities to state of natures is in consistent as different conditions.

VALUE OF PERFECT INFORMATION (VPI)

In decision making under risk, there is lack of information as to the occurrence of a particular state of nature; and future certainty cannot be predicted by the decision-maker. Hence, decisions are based on the outcome of the highest expected value. However, information can be obtained that can be used to predict which state of nature will prevail at any future time and the decision-maker can adopt a choice of strategy in order to obtain the maximum payoff under the prevailing state of nature.

The value perfect information obtained changes the decision environment from decision making under risk to decision making under certainty.

Therefore, VPI = EVPI – $EV_{(x)}$
Where EVPI means every value perfect information
How to derive EVPI = select the max from each state of nature using column wise and multiply it by their respective probabilities.
$EV_{(x)}$ is the highest or max expected value among the alternative payoffs of the decision tree or that which the decision maker is about to take.

Example: A sale force company who specializes in predicting market forces is offering their service to provide a guarantee prediction for the managers goods at the rate of ₦2,000. Should the production manager accept the offer?

Solution: Since the manger knows the EVPI and their associated probabilities, hence:
EVPI = 28,000 (0.3) + 23,000 (0.3) + 15,000 (0.4)
8400 + 6900 + 6000
21,300
Since the Expected Value $EV_{(x)}$ = 20,100
VPI = EVPI – $EV_{(x)}$
21,300 – 20,100
1,200
Decision Rule: Since the VPI is N1,200 which is much less than the service fee of N2,000 offered by the sales force, hence the manager should reject or not accept the offer.

DECISION UNDER CERTAINTY
Under this condition, the decision-maker has perfect and complete information of all possible payoffs of an event or state of nature. Meaning that only one state of nature exists; and the decision maker can simply pick the best payoff in that one column and choose the associated alternative. Under this condition, the particular state of nature is associated with probability of 1. This condition is also applicable to Linear Programming, Transportation and Assignment Model, and Economic Order Quantity Model.

Example
The marketing manager of Otavie Nigeria Limited wishes to lunch an advertisement and awareness program on the company's new product, targeted at maximizing increase in naira sale. Five different advertisement and awareness media are available in order to conclude the budget plan for approval. The mix of media are, Internet, Television, Radio, Hand bills/Fliers, and New papers provided below are the associated cost and sales volume for each media.

Strategies	Cost (₦)	Sales (₦)
Internet	1,800	5,000
TV	1,200	3,000
Radio	2,000	4,500
H/Bills	2,100	4,500
News Paper	1,000	3,100

Advice the manger on which strategic option to choose

Solution
Sales = Income

Strategies	Cost (₦)	Income (₦)	Payoff ($^{I}/_{C}$)
Internet	1,800	5,000	2.78
Television	1,200	3,000	2.5
Radio	2,000	4,500	2.25

Handbills	2,100	6,000	2.85
News Paper	1,000	3,100	3.10

Decision Rule: The optimum strategy that produces the highest payoff of 3.10 is Newspapers. The manager is advice to use newspaper in advertising and creating awareness for their product.

EXERCISES

1. Consider the following payoff (profit) matrix

	b1	b2	b3	b4
a1	15	12	0	18
a2	4	10	5	4
a3	2	6	13	-6
a4	7	11	9	0

No probabilities are known for the occurrence of the nature of state. Compare the solution obtained by each of the following criteria

a. Maximum
b. Hurwiez (Assume = 0.5)
c. Laplace
d. Salvage

2. A firm has developed a near product which can either be tested in the market. Details of the options are set out below:

Test market cost ₦100,000 and the likely outcomes are favourable (with 0.6 probability) or unfavourable/failure with 0.4 probability. If favourable, the project can either be abandoned or produced when demand is anticipated to be:

Low	prob = 0.25	Loss = ₦100,000
Medium	prob = 0.6	Profit = ₦150,000
High	prob = 0.15	Profit = ₦450,000

If the test market indicates failure, the project will be abandoned. Abandoned at any stage results in a gain of ₦30,000 from the special machinery used.

Required: Draw the decision tree and analyze it.

3. Explain the following concepts

(a) Decision
(b) Decision making under uncertainty
(c) Decision tree
(d) Nodes, state of nature
(e) Laplace

4. Suppose an investor has a certain amount to invest and considers for strategic actions for investment, S_1, S_2, S_3 and S_4. The expected payoffs of the four strategies under three different state of the economy (high growth, low growth and recession) are given in the following.

State of economy			
High Growth	Low Growth	Recession	
Strategies	30	14	5
S_1	20	15	11
S_2	40	18	12
S_3	28	20	16
S_4			

Construct a payoff matrix and find the most acceptable strategies.

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