Lesson 06

The Decision Process

Decision Process is more or less the fundamental process of Management. Whether a person works in a manufacturing organization or a services side organization, he or she would be asked to carry out the decision process. Normally the decision making process involves the following six important steps

1. Specify Objectives and the Criteria for decision making
2. Develop Alternatives
3. Analyze and compare alternatives.
4. Select the best alternative.
5. Implement the chosen Alternative
6. Monitor the results to ensure the desired results are achieved.

Operations Manager identifies the criteria by which the proposed solutions will be judged. The common criteria often relates to costs, profits, return on investment, productivity, risk, company image, impact on demand, or similar variables. The management is interested that the Operations Manager should be able to focus on parameters that will increase or decrease? Ideally the aim is that

1. Costs should decrease and Profits should increase
2. Return on Investment should increase along with increase in Productivity.
3. Risk should decrease along with increase in Company image.
4. Demand should increase for the product or service.
5. Monitor the results to ensure the desired results are achieved.

The Decision Process Example

The CEO of ABC Corporation has asked you (the VP Operations) to help the BOD reach a decision whether to introduce a new automobile model. The new model would have the following effects on important decision making process. Certain Parameters will increase and decrease?

- Costs decrease by 15 %
- Profits increase by 2%
- Return on Investment stays the same
- Productivity decreases by 5%
- Risk increases by 5 %
- Company image may increase or decrease
- Demand may increase or decrease for the product or service.

Solution

•Based on the above data, a Risk Averse Manager would forego the new project, A Risk taker would go for it. These factors alone do not present the overall big picture, most of the times in practical situations, the decision is based upon important factors like ROI, Productivity, Utilization of available resources, Profits and Costs in line with

organizations operational and organizational strategy and the mapping of the organization with respect to its competitors and competitive environment..

Causes of Poor Decisions

•Unforeseeable and uncertain circumstances , which in reality refers to a mistake or error in the decision making, remedial action is to have a STEERING COMMETIEE (comprising of senior management) to review the whole process and monitor the decision steps.

Decision Environments

•There are three degrees of Certainty, Risk and Uncertainty.

1. Certainty: Means that the relevant parameter such as costs, capacity and demand have known values.
2. Risk means that certain parameters have probabilistic outcomes.
3. Uncertainty means that the certain parameters have various possible future events.

Decision Environments often represent the same three scenarios of Certainty, Risk and Uncertainty. Let us consider the example where we are making a ball bearing which is to be used in ceiling fan and our marketing department comes with up three scenarios with different set of numbers. It costs us Rs 40 per unit to manufacture the ball bearing. The marketing department has through its market research noted that our organization can have a sale price of Rs. 90 per unit.

•Certainty: Profit per unit is Rs. 50. You have an order for 2000 units. The decision is under certainty as the Means that the relevant parameter such as costs, capacity and demand have known values.
•Risk There is a 25 % chance of demand of 2000 units, 50% chance of demand of 1000 units and 25 % chance of an order of 500 units.
•Uncertainty .There is no available data of demand forecasts means that the certain parameters necessary for decision making are absent.

DECISION THEORY

No discussion in Production Operation Management is complete without making a reference to Decision Theory. Decision Theory is in fact a general approach to decision making.

Decision theory consists of the following three elements.

1. A set of possible outcomes exist that will have a bearing on the results of the decision.
2. A list of alternatives to choose from.
3. A known payoff for each alternative under each possible future condition.

An operations manager would need to develop an understanding of decision theory knowledge and needs to employ the following.

1. Identify a set of possible future conditions called state of nature which includes the low, high, medium demand pattern and a working on the competitor's introduction of new product.
2. Develop a list of alternatives, one of which may be to do nothing.
3. Determine or estimate the payoff associated with each alternative for every possible future condition.
4. If possible estimate the likely hood of each possible future condition.
5. Evaluate alternatives according to some decision criterion e.g. maximize expected profit and select the best alternatives to choose from.

PAY OFF TABLE

•Payoff table summarizes the information of a decision and captures the expected payoffs under various possible states of nature.

•Let us consider an example, we are setting up a pharmaceutical factory and our state of nature indicates that If we built a small facility the return remains the same whether the demand is low or high, the medium facility indicates a constant return on moderate and high. If we build a large facility chances are that the return would only be good if we have a high demand or return.

Alternatives	**Possible Future Demands**		
	Low	**Moderate**	**High**
Small Facility	**Rs. 10 M**	**Rs. 10 M**	**Rs. 10 M**
Medium	**Rs. 5 M**	**Rs. 8 M**	**Rs. 12 M**
Large	**Rs. 1 M**	**Rs. 2 M**	**Rs. 15 M**

The states of nature are very important, for our decision making.

Decision Making under Certainty

Decision making under certainly is always simple but never available to the managers.

Alternatives	Possible Future Demands		
	Low	Moderate	High
Small Facility	Rs. 10 M	Rs. 10 M	Rs. 10 M
Medium	Rs. 5 M	Rs. 8 M	Rs. 12 M
Large	Rs. 1 M	Rs. 2 M	Rs. 15 M

Decision Making under Certainty

- It is known with certainty that the demand will be low, moderate and high.
- In the example, we just select the best or highest payoff for all the states of nature.

Decision Making under Uncertainty

- In the absence of clear information, An Operations Manager would need to carryout decision making under uncertainty. This is the usual pattern when managers working at assembly plants, services, oil refineries or chemical processing plant end up facing a dilemma to evaluate the alternative of payoffs..

1. Maximin
2. Maximax
3. Minimax Regret
4. Laplace

MAXIMIN

- Maximin determines the worst payoff for each alternative; the operations manager chooses the best worst alternative. Meaning the least (best) of the worst.
- It is a pessimistic approach.
- Ensures a guaranteed minimum.

MAXIMAX

- Maximax determines
- the best possible outcome
- Choose the Alternative with the best possible payoff.
- It does not take into account any other alternative then the best payoff.
- An optimistic approach.

- Go for it strategy.

LAPLACE

- Determines the Average payoff for each alternative
- And chooses the alternative with the best average.
- This is a cautious approach
- Laplace approach treats the states of nature as equally likely.

Example to calculate Maximin, Maximax and Laplace

Alternatives	**Possible Future Demands**		
	Low	Moderate	High
Small Facility	Rs. 10 M	Rs. 10 M	Rs. 10 M
Medium	Rs. 5 M	Rs. 8 M	Rs. 12 M
Large	Rs. 1 M	Rs. 2 M	Rs. 15 M

Example to calculate Maximin, Maximax and Laplace

- Maximin , the worst payoff for alternatives
- Pick the Minimum (Least) of the maximum
- Small Facility Rs 10 M since the payoff table shows that

–Small Facility Rs. 10 M
–Medium Rs. 12 M
– Large Rs. 15 M

Example to calculate Maximin, Maximax and Laplace

- Laplace , the best payoff of the average for each alternatives
- Small Facility Rs 10 M since the payoff table shows that

–Small Facility Rs. 30/3= Rs. 10 M
–Medium Rs. 25/3= Rs. 8.33 M
– Large Rs. 18/3= Rs. 6 M

Decision Making under Uncertainty

- Minimax Regret
- Determines the worst regret for each alternative
- Chooses the alternative with the best worst.
- This approach seeks to minimize the difference between payoff that is realized and best payoff for each state of nature.

Example to calculate Minimax Regret

•Minimax Regret ,

•Step I ; Construct the Table of Opportunity Losses or Regrets.

–Subtract the column entries by subtracting the entry from that of the highest column value

–Repeat the process for all columns

•Step II. Select the maximum regret value of each row (alternative meaning small, medium and large scale)

Example to calculate Minimax Regret

Alternatives	**Possible Future Demands**		
	Low	Moderate	High
Small Facility	Rs. 10-10=0	Rs. 10-10=0	10-15=-5
Medium	Rs. 5-10= -5 M	Rs. 8-10= -2 M	Rs. 12-15= -3 M
Large	Rs.1-10= -9 M	Rs. 2-10= -8 M	Rs. 15-15= 0 M

EXPECTED MONETARY VALUE CRITERION

- Decision Making under Risk
- The area between the certainty and uncertainty is known as Risk.

- Expected Monetary Value Criterion (EMV)which refers to the best expected value among the alternatives
- We use the payoff table with probabilities low =0.3, moderate =0.5 and highest=0.2.These probabilities must add to 1,mutually exclusive and collectively exhaustive)

•EXPECTED MONETARY VALUE CRITERION

•EV small = 0.3(10)+0.5(10)+0.2(10)
= Rs. 10 M
•EV medium= 0.3(5)+0.5(8)+0.2(12)
= Rs. 7.9 M
•EV large = 0.3(1)+0.5(2)+0.2(15)
= Rs. 4.3 M

We select the smallest facility as it has the highest value

- Expected Value of Perfect Information
- In certain situations, it is possible to ascertain which state of nature (level of demand) will occur with certainty. E.g. If you want to construct a restaurant or trauma centre on a motorway highway chances are you would get a great ROI.
- Expected value of perfect information = Expected payoff under certainty - Expected payoff under risk

Visual tool for analyzing Decision Problems

Two visual tools used for analyzing decision problems include
- Decision Trees
- Graphical Sensitivity Analysis

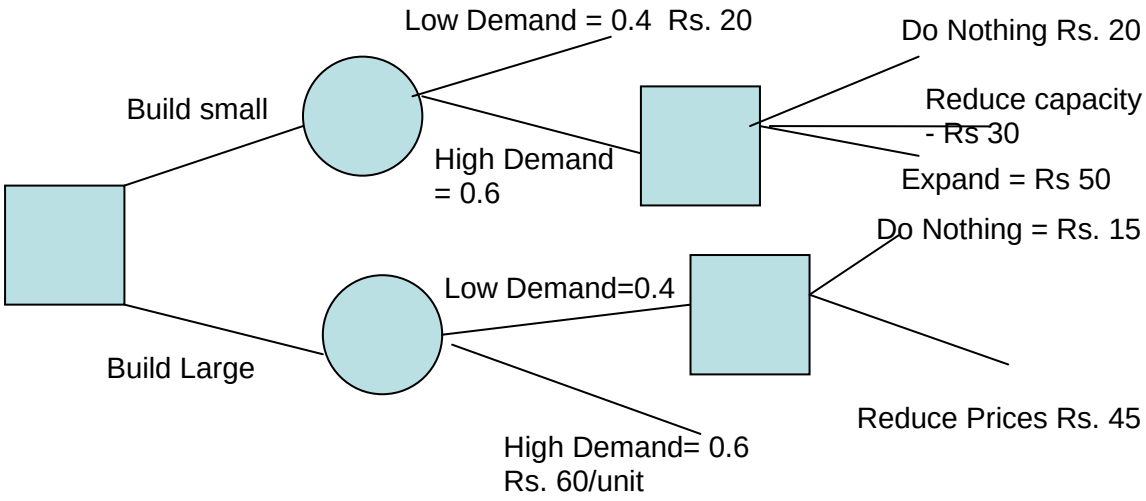
Decision Trees

A schematic representation of the alternatives and their possible consequences is presented graphically. You can refer.

- The diagram resembles a tree.
- Extremely suitable for analyzing and evaluating situations which involve sequential decisions.
- Decision Trees

- *Suppose the Pakistani government decides to operate a gas field. Initially the government had information that it can exploit 1 million cubic feet of gas but later studies indicate potential reserves of additional 10 million cubic feet. As an operations manager you may be ask to prepare a feasibility report to either expand or make a new facility using the new reserves.*

Decision Trees



Decision Trees

- The tree is read from left to right
- Square nodes represent decisions
- Circular nodes represent chance events.
- Branches leaving square nodes represent alternatives.
- Branches leaving the circular nodes represent the chance events (states of nature)

Decision Trees Analysis

•Step I. Analyze the decisions from Right to left
•Step II. Determine which alternative would be selected for each possible second decision.
–For a small facility with high demand there are three alternatives , select the highest payoff and multiply it with the probable outcome. Put a double slash on the alternatives which have lower value.
–Follow the same procedure for small facility with high demand
•Step III . Repeat the steps for both low and demand pattern for the larger facility.
•Step IV. Determine the product of chance probabilities
•Step V. Determine the expected value of each initial alternative.
•Step VI. Select the choice which has a larger expected value than the small facility.

Decision Tree Example Solution

Option I: Build Small Facility

- Low Demand = 0.4 X Rs. 20= Rs. 8
- High Demand=0.6 X Rs. 50= Rs. 30

Option II: Build Large Facility

- Low Demand = 0.4 X Rs. 45= Rs. 18
- High Demand=0.6 X Rs. 60= Rs. 54

Option III: Determine the Expected Value of each initial alternative

- Build Small Facility = Rs. 8+ Rs. 30= Rs. 38
- Build Large Facility=Rs. 18+Rs. 36= Rs. 54

Select the Larger Facility as it has a larger expected value than the small facility

Sensitivity Analysis

- Determining the range of probability for which an alternative has the best expected payoff.
- A graphical solution
- Makes use of Algebra
- Prime importance

CONCLUSION

Decision Making is a critical responsibility that stays with a manager throughout his active professional life. It goes without saying that, at the start of the service, the decision making involves low impact financial impact but with the passage of time, the decision making becomes more critical and highly finance focused. This very aspect gives the field of decision making a competitive edge over other important tools available to an operations manager. The related field of game theory is often used in conjunction with decision theory.

PAYOFF TABLE HOMEWORK

The following table shows profit payoffs. Calculate the results for the five rules and indicate for each rule the best and worst decision alternatives. All Cost and Revenue numbers in Rs. 000. d1,d2, d3 and d4 represent decision options and s1,s2,s3 and s4 show states of nature.

	0.30	0.25	0.10	0.35					
	S1	S2	S3	S4	**MAXIMIN**	**MAXIMAX**	**LAPLACE**	**EXPECTED MONETARY VALUE**	**MINIMAX REGRET**
d1	50	-20	75	60					
d2	80	30	100	-10					
d3	25	35	10	45					
d4	55	65	-15	40					

The following table shows cost payoffs. Calculate the results for the five rules and indicate for each rule the best and worst decision alternatives.

	0.40	0.15	0.10	0.35					
	S1	S2	S3	S4	**MAXIMIN**	**MAXIMAX**	**LAPLACE**	**EXPECTED MONETARY VALUE**	**MINIMAX REGRET**
d1	40	20	75	60					
d2	30	70	90	10					
d3	60	55	5	85					
d4	40	100	15	35					