Lecture 3

The process of decision-making

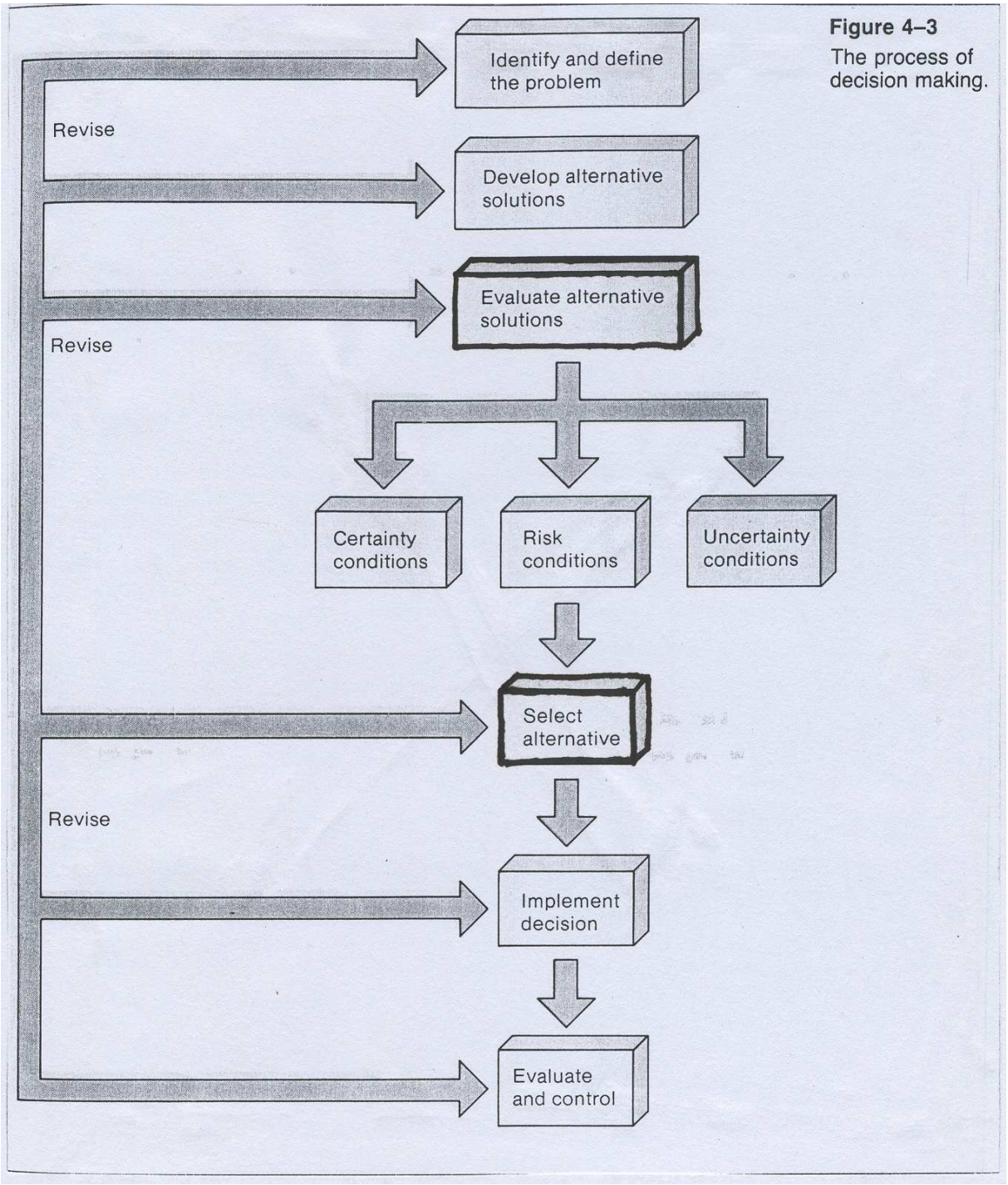

Figure 4–3
The process of decision making.

1. Structuring decision problem

Before deciding what best method to use, we need to structure the problem in the way that will allow us to analyze the problem and make the decision itself.

Every problem needs to be characterized by the following:

1. **List of alternatives** = possible decisions
    a. available
    b. mutually exclusive
    c. collectively exhaustive
2. **States of nature** = future conditions of events
    a. possible to happen
    b. mutually exclusive
    c. collectively exhaustive
3. **Degree of certainty** = the level of knowledge of decision maker about the states of nature.
4. **Decision criterion** = a factor relevant in a decision.
5. **Payoffs** = the value of decision criterion associated with each decision and state of nature.

Most of the methods use payoff matrices as the basis for the decision process.

Criterion	States of nature Assesment of degree of certainty	
Alternatives	Payoffs	Alternative's score (according to the method used)

Profit	S_1	S_2	S_3	S_4	
	P_1	P_2	P_3	P_4	
A_1	V_{11}	V_{12}	V_{13}	V_{14}	V_{12}
A2	V_{21}	V_{22}	V_{23}	V_{24}	V_{23}
A_3	V_{31}	V_{32}	V_{33}	V_{34}	V_{31}
A_4	V_{41}	V_{42}	V_{43}	V_{44}	V_{44}
A_5	V_{51}	V_{52}	V_{53}	V_{55}	V_{53}

2. Methods of decision making

a. under uncertainty

Payoffs	S_1	S_2	S_3	S_4	Maximin	Maximax
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A_1	50	40	30	35	30	50
A_2	25	-30	65	40	-30	65
A_3	45	15	-10	55	-10	55

Opportunities lost	S_1	S_2	S_3	S_4	Minimax regret
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A_1	0	0	35	20	35
A_2	25	70	0	15	70
A_3	5	25	75	0	75

Payoffs	S_1	S_2	S_3	S_4	Insufficient reason (row averages)
	0,25	0,25	0,25	0,25	
A_1	50	40	30	35	38,75
A_2	25	-30	65	40	25,00
A_3	45	15	-10	55	26,25

Maximin = conservative strategy

- selecting the best alternative of the worst payoffs;
- pessimistic view because the decision maker must assume that the worst will occur;
- it may be viewed as the protection against the worst, even though you neither expect them nor want them to occur.

Maximax = optimistic strategy

- selecting the best alternative of the highest payoffs;
- you choose the alternative with the best possible payoff.

These two methods don't use all possible information. Their weakness is the inability to factor row differences ⇒ possibility of poor decision.

Minimax Regret

- takes all payoffs into account
- based on **opportunity loss matrix** to determine how much you would miss by not having chosen the alternative that would have yielded the best payoff if
  that particular state of nature occurs;
- selecting the minimum value of maximum regrets (= opportunity lost) values for each alternative.

Principle of Insufficient Reason

- under uncertainty, there is now reason to treat the states of nature differently ⇒ no reason to focus on high or low payoffs;
- alternative states of nature are all equally likely;
- selecting the highest row average;

These rules are realistically best used for one-time major decisions.

b. under risk

Payoffs	S_1	S_2	S_3	S_4	Expected payoff	
	0,20	0,50	0,15	0,15		
A_1	50	40	30	35	39,75	50 * 0,2 + 40 * 0,5 + 30 * 0,15 + 35 * 0,15
A_2	25	-30	65	40	5,75	25 * 0,2 –30 * 0,5 + 65 * 0,15 + 40 * 0,15
A_3	45	15	-10	55	23,25	45 * 0,2 + 15 * 0,5 – 10 * 0,15 + 55 * 0,15

Opportunities lost	S_1	S_2	S_3	S_4	Minimax regret
	---	---	---	---	
A_1	0	0	35	20	8,25
A_2	25	70	0	15	42,25
A_3	5	25	75	0	24,75

Payoffs	S_1	S_2	S_3	S_4	Expected payoff under certainty (EPC)		EMV	EVPI
	0,20	0,50	0,15	0,15				
A_1	50	40	30	35	48	50*0,2+40*0,5+65*0,15+55*0,15	39,75	8,25
A_2	25	-30	65	40				
A_3	45	15	-10	55				

Expected (monetary) value

- takes into account the weighted average payoff for each alternative

$$EMV_i = \sum_{i=0}^{k} P_j * V_{ij}$$

- selecting maximum average payoff;

Expected opportunity lost

- the same approach as with EMV only opportunity loss matrix is used;
- selecting smallest expected loss.

These rules are realistically best used for an ongoing decision strategy = one-time repeated decisions.

Expected value of perfect information

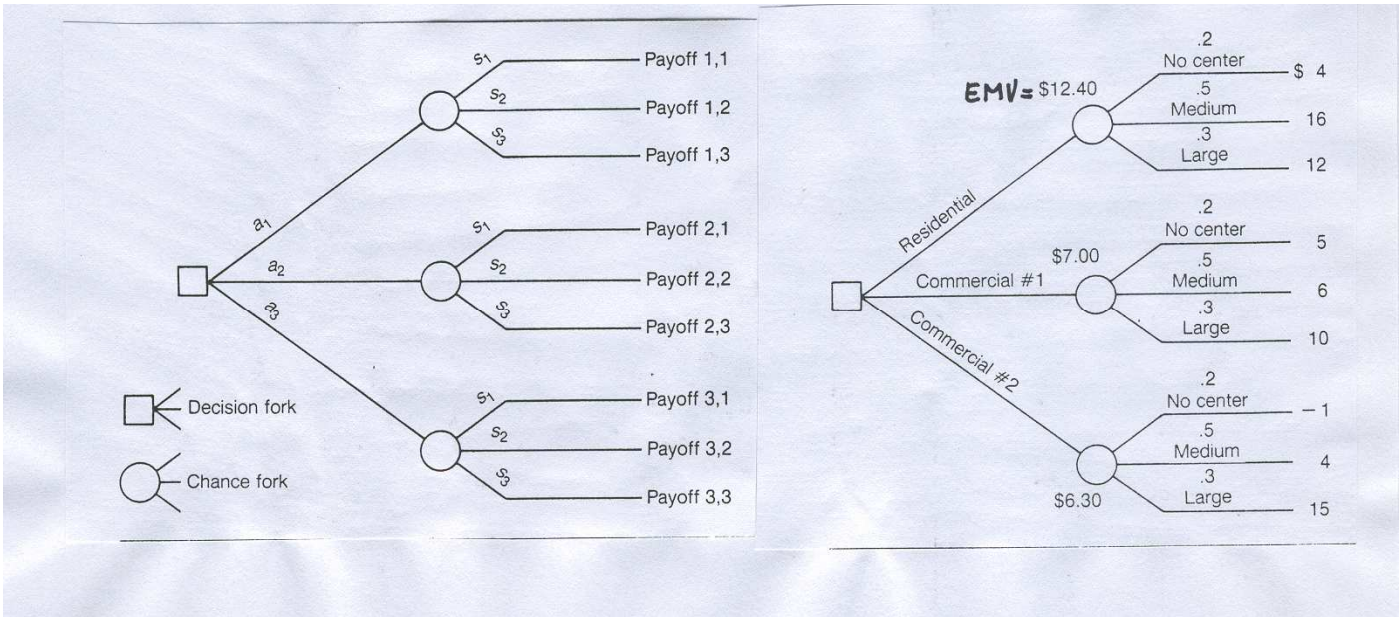
- represents an upper bound on the amount of money a decision maker would be justified in spending to obtain perfect information.

$$EPVI = EPC - EMV$$

That leads to decision under certainty…

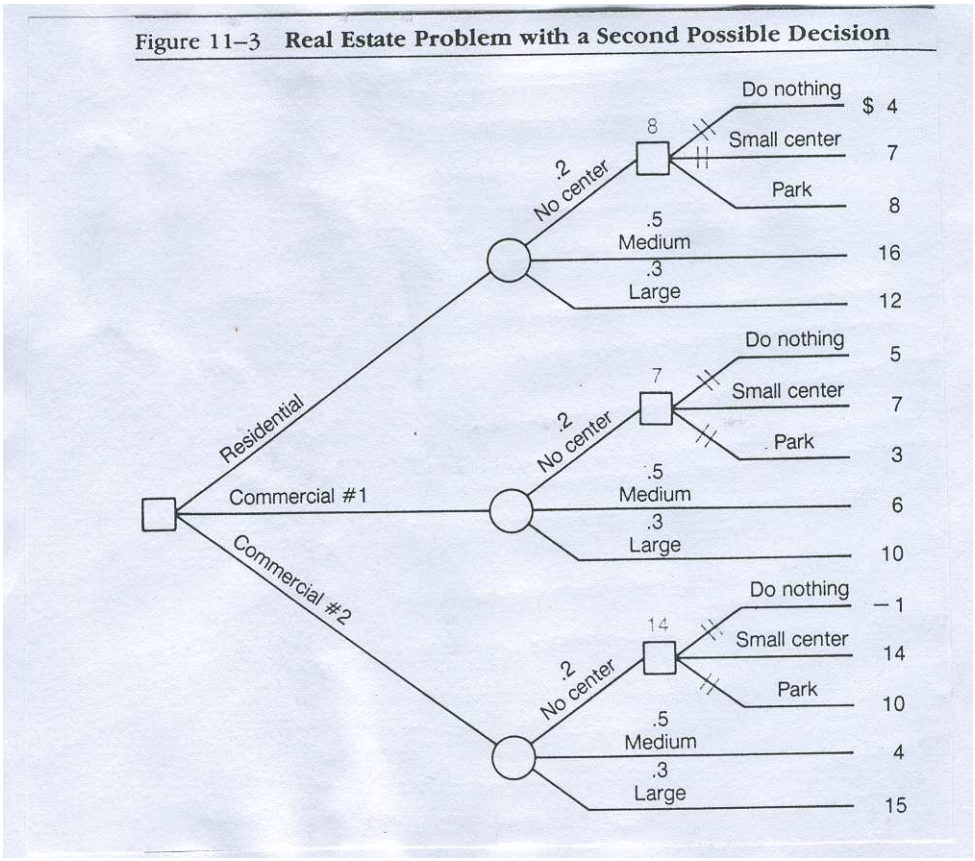
c. sequential decisions

Decision trees can be used instead of decision matrix in order to structure the decision problems.



Many problems in reality are very complex ones and so are the solutions to them. That's why decisions about these problems are typically phased, so that the problem is not being decided at once but in a series of chronological (sequential) decisions.

Decision trees are used as a method of portraying these sequential decisions.



Assignment 3

Reading for Lesson 3:

ROBBINS, S. P. *Management.* 4th ed. New Jersey : Prentice Hall, 1994. (ORG 126)

- ☐ Chapter 6, pp. 149 – 173

Review questions for Lesson 3

1. What is a decision? Outline the steps to the decision making process.
2. What are the limits to the rationality?
3. Differentiate certainty, risk, and uncertainty decision conditions.
4. What are advantages and disadvantages of group decisions?
5. What is the state of nature?