Module

04

Decision-Making

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Contents

Introduction

Managers can make hundreds of decisions each day. These decisions vary from day-to-day ones, which are made quite frequently, to strategic ones, which are made quite infrequently. An example of a daily decision is the decision to stock (increase or decrease) merchandise. An example of a strategic decision is whether or not to invest in a new plant or product. Daily decisions have less impact compared to strategic decisions. A good decision will bring great benefits to the company. A bad decision, on the other hand, will result in a large or enormous loss. There are many examples of companies that have failed to make the right decisions. Here are some examples. IBM in the 1970s did not take the PC (personal computer) sector seriously. At that time, they relied on mainframe computers that were sold to large companies. PCs were seen as mere playthings. IBM then licenced the operating system to Microsoft and the processor to Intel. It turned out, PCs grew big and beat mainframe computers. Today, the market value of Microsoft, or Intel, has surpassed the market value of IBM. Another example is Yahoo, which was one of the pioneering internet companies. In 2008, Yahoo experienced some setbacks. Microsoft offered to buy Yahoo for about $45 billion. However, Yahoo refused. On July 25, 2016, Verizon Communications announced the purchase of Yahoo for $4.83 billion (excluding Yahoo's holdings in Alibaba and Yahoo Japan). In 2006, Motorola held a 22% share of the mobile phone market. However, Motorola was too late to enter the smartphone market. Motorola entered the smartphone market in 2010. Motorola's stock price has fallen from $75 per share in February 2006 to $12 per share in February 2009. There are many other examples.

The question is, can managers improve decision-making so that bad decisions can be avoided? This module examines decision-making with the aim of improving managers' decision-making processes. The module consists of two learning activities. Learning Activity 1 discusses decision-making characteristics, decision-making approaches, and improving decision-making effectiveness. Rational decision-making attempts to approach problems in a systematic way. In this method, the problem is evaluated, several alternative solutions are formulated, each alternative is evaluated, and the best alternative is selected. Unfortunately, the world is not as perfect as we imagine it to be. People are also not as rational as we would like them to be. The behavioral model shows that decision-making is heavily influenced by human behavioral biases. Decisions made by humans will not be the most optimal decisions. Learning Activity 2 discusses several analytical techniques that can help with decision-making, such as decision trees, PERT, break-even analysis, and linear programming analysis. These analyses can help managers make decisions. However, the final decision is up to the manager, who, according to the behavioral school, cannot make optimal decisions.

A new approach seeks to utilize the development of digital technology to make decisions. Big data analytics and artificial intelligence can be used to reduce human behavioral biases. If behavioral biases can be reduced, managers can make better decisions. These better decisions are expected to increase the number of correct decisions. A good decision is one that is produced through a good, systematic process. While the right decision is a decision that can bring added value to the company. Good decisions are expected to increase the probability of correct decisions.

Learning Activity 1

Decision-Making

Every manager will make decisions, from the simplest ones, such as whether or not to change the design of the workspace, to more serious ones, such as whether or not to open a new factory. Managers must make decisions on a regular basis. Managers must therefore improve their decision-making and problem-solving skills to support their decisions. This learning activity discusses decision-making by managers.

A. PROBLEMS AND OPPORTUNITIES

A decision starts with a problem or an opportunity. Some authors clearly differentiate between problems and opportunities. A problem can be defined as a condition that deviates from or is not in line with the predetermined expectations. Sales that do not meet the target are considered a problem. An opportunity is a condition that allows the organization to take advantage of an opportunity to obtain results that exceed the set goals or objectives. Consumers whose needs have not been met are an opportunity, because if the organization is able to provide products that meet the needs of these consumers, its sales will increase. Oftentimes, problems and opportunities are mixed together. What seems to be a problem is often an opportunity for the organization. For example, a consumer may complain about a product because the packaging is difficult to open. The consumer complaint is a problem. But if the organization is able to design packaging that is easy to open, it has the opportunity to meet this need. Satisfied consumers will buy the product, and this is an opportunity for the organization to increase sales.

The problem-finding process starts in the following situations:

1. **Deviation from past experience**. If the current year's sales are lower than past sales, then a problem exists in product sales. If this month's absentee rate is higher than last month's absentee rate, then a problem exists as well. The historical pattern in this case is interrupted because it is not in line with expectations.
2. **Deviation from plan**. Managers must have a plan before performing a task. If the results obtained are lower than expected, there is a problem. If the costs incurred are higher than budgeted, that is also a problem.

3. **Other people**. Consumers are usually a valuable source of problem information. Consumer complaints are a problem that must be addressed. Subordinates may complain because working hours are not up to their satisfaction. Dealers may complain that the delivery of goods is not on schedule.
4. **Environment**. The environment can inform problems in various ways. For example, if a competitor successfully launches a new product that competes with the organization's product, then a problem arises.

Opportunities and problems are often difficult to distinguish. When examined further, what appears to be a problem may turn out to be an opportunity. On the contrary, opportunities that are not well utilized will become problems. In general, opportunities are harder to see than problems. Problems are usually easier to see and are often the starting point for opportunities. One way to see opportunities is through brainstorming. In brainstorming, all alternative solutions to a problem are put forward. Then, alternatives are gradually narrowed down to more realistic ones. From the results of this analysis, opportunities are expected to be apparent. Another method is dialectical inquiry. In this method, the analysis is carried out by making certain assumptions. With these assumptions, alternative solutions to the problem are put forward. Then, the analysis is continued by refuting the assumption that the initial assumption cannot apply. Furthermore, alternative solutions to problems with incorrect assumptions are searched for. Such a method is expected to produce useful alternative solutions and be able to reveal opportunities that are not visible.

B. DECISION MAKING

1. Definition

Decision-making is essentially choosing one alternative from several alternatives. Decision-making is one of the broader steps of the decision-making process. The decision-making process begins with identifying problems, analyzing the relevant environment, developing decision alternatives, selecting the best alternative, implementing the decision, and monitoring the decision that has been made. The best alternative is the one that contributes the most to the achievement of organizational goals. Often, the evidence of the favorability or effectiveness of the decision is only seen after several years. This is often the case especially for strategic decisions which effects can only be seen after a period of time.

2. Types of Decision

Managers should be able to make various decisions. In general, decisions made by managers fall into two categories: (1) programmed decisions, and (2) non-programmed decisions.

a. Programmed decisions

Programmed decisions are decisions that are structured, occur repeatedly, or both. Since they occur repeatedly, organizations usually have rules, policies, and procedures in place to guide how these decisions are made. For example, in inventory issues, the decision of when to reorder an item occurs repeatedly. The company may have a guideline for when there are only a certain number of units in stock. The manager, in this case, simply makes the decision according to the guidelines. Sometimes programmatic decisions include somewhat complex ones. However, after analysing the decision, it can be transformed into a programmatic decision.For example, providing supplies ahead of Eid may be a complicated decision because the event does not occur every month. But further analysis of the decision shows that it can be classified as a programmed decision. Managers can make a forecast by analyzing relevant factors, then determine the amount of inventory for Eid. The decision can be programmed into multiple decisions using existing procedures.

Programmed decisions, to a certain degree, limit the freedom of the manager. A procedure or rule that dictates a reorder when inventory reaches 100 units, for example, requires the manager to reorder when inventory reaches 100 units. But programmatic decisions have the benefit of freeing managers from routine tasks. Thus, managers have more time to deal with other, more important issues. However, managers should not be unaware of exceptional situations. For example, dealing with the Eid situation is certainly not the same as dealing with events in ordinary months. For instance, an organization has a policy of spending a certain budget on promotion. If a competitor suddenly increases its promotion budget in the current period, the organisation must surely take appropriate anticipatory measures, such as increasing its own promotion budget.If there are no anticipatory steps, the organization may lose its customers.

b. Non-programmed decisions

Non-programmed decisions are unstructured, infrequent, or both. They stem from extraordinary or unusual problems. Since they are unstructured and infrequent, there are no guidelines that are detailed enough to handle the problem. Examples of such decisions are the decision to launch a new product, solving the problem of declining sales of a particular product, and handling a lawsuit against the company. Such circumstances are “exceptional” and must be handled with care. The manager’s experience and intuition are required to solve these problems, as there are no guidelines that specifically address such issues. Such problem-solving skills become increasingly important as management levels increase. As a result, promoting managers typically entails efforts to improve non-programmed problem-solving skills.Managers who are about to be promoted can be prepared to deal with such issues by teaching systematic problem solving and logical decision-making.

C. CERTAINTY, RISK, AND UNCERTAINTY

The situations faced by managers are often extremely diverse. Sometimes managers face situations that are relatively certain, where the consequences of decisions can be estimated with a relatively high degree of certainty. In other situations, managers are more likely to face situations with high uncertainty. In this case, it is not easy to estimate the consequences of the decision. Figure 4.1 depicts a continuum line extending from a specific situation to a very uncertain situation.Uncertain risk situations fall somewhere in the middle.

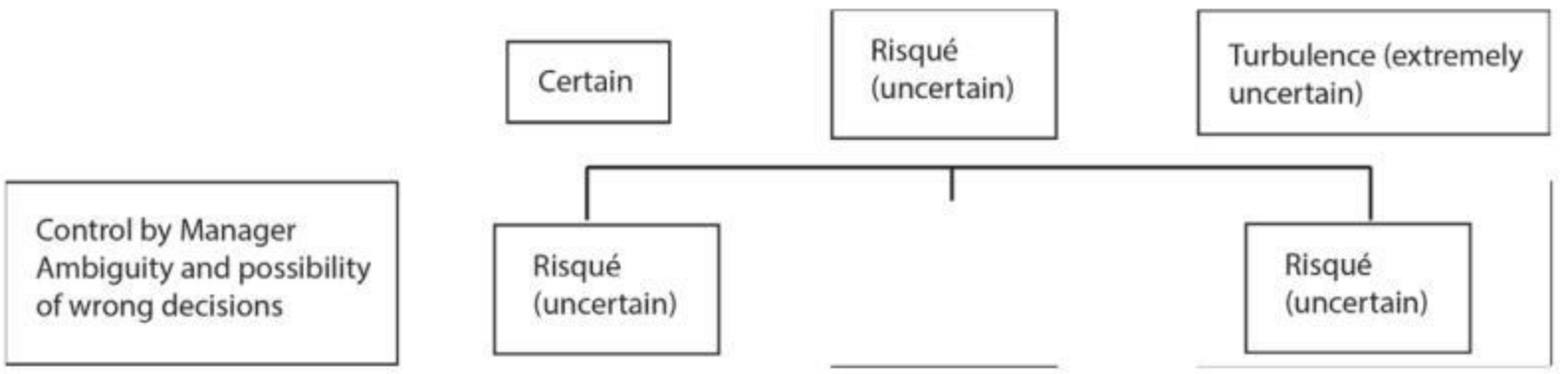


Figure 4.1
Conditions Faced by Managers

If the information obtained by management is sufficiently accurate and reliable and the consequences of decisions can be clearly estimated, managers face a condition of certainty. Perhaps absolute certainty will never exist, but suppose the organization obtains a contract from the government, then this condition has a fairly high degree of certainty. Managers can calculate the profit and loss after completing the contract because the government is less likely to violate the agreement. What is uncertain in the decision is the amount of expenditure that may differ from the plan. In a tender, the value of the contract is usually fixed, so the increase in costs is the risk of the tender's winner. In this regard, the decision to accept a contract from the government has an element of risk, especially in terms of expenditure. If the manager already has previous experience, the possibility of increasing costs can be calculated. This means that the manager calculates the probability of costs "deviating" from the budgeted amount. The concept of probability may often be heard, especially in statistics lessons. A coin that is tossed has a 1/2 probability of head and 1/2 of tail. The concept of probability is often used to explain the concept of risk. If the probability of spending less than the budget is high enough, then we say the probability of the event is high. With a number, we might say that the probability is 90 percent. The higher the probability, the better it is for the manager, as the certainty is higher. Suppose the probability of being able to reduce costs is only 10 percent as opposed to the first situation; the manager may have to think twice about accepting the government contract.

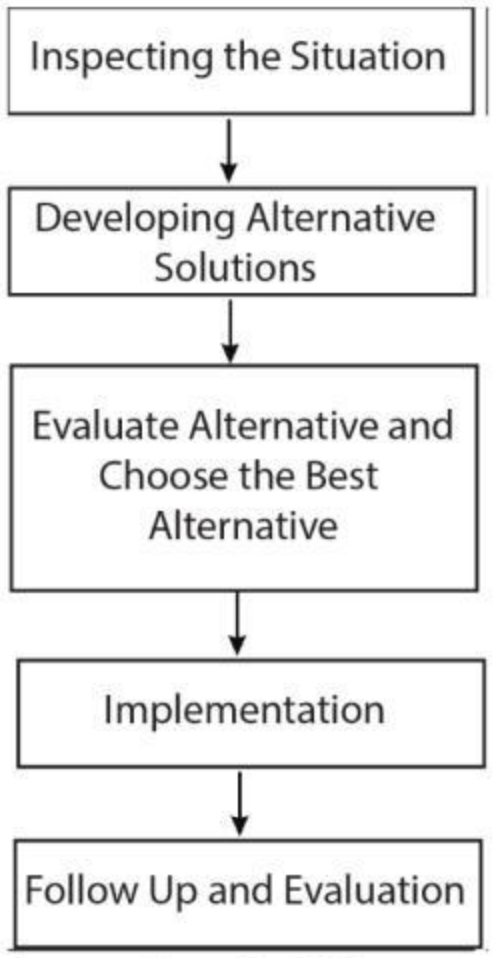
Another example is the decision whether or not to increase prices. The manager has historical experience regarding the consequences of the price increase. Based on this experience, the manager calculates the consequences of a price increase and develops

possible scenarios, for example: sales decrease on the one hand, but profit margins increase on the other. The manager can then perform probability calculations for each scenario, for example, sales remaining constant with a probability of 10 percent, sales decreasing by 10 percent with a probability of 20 percent, decreasing by 30 percent with a probability of 20 percent, and decreasing by 40 percent with a probability of 20 percent. Then, managers can use simulation to see the effect of their decisions on the company's profits. Managers also still have control over certain variables. Suppose the manager can increase promotion so that the price increase can be offset by promotion. Next, the manager can calculate the combination.

In other situations, such as the launch of a new product, the situation faced by managers is more uncertain. Historical data for the new product does not yet exist, thus making calculations even more difficult. Managers can use information on new products launched by other companies or similar products, but the situation remains different, so the level of uncertainty remains high. In even more extreme situations, the level of uncertainty faced will be very high. Suppose an organization sells its products to a single consumer, such as a government agencies or large companies (producing tyres and selling them only to Astra). If, for some reason, the government agency or company cancels the purchase contract (the company goes bankrupt or finds a new supplier), then the manager is faced with a very uncertain situation. If the company continues to produce the same goods, then it faces the risk of not being able to sell its goods. If the manager decides to move to another business, it will face a completely new situation.

D. RATIONAL APPROACH TO DECISION-MAKING

Most managers will attempt to make decisions rationally and objectively. In such a way, it is expected that good and correct decisions will be obtained. The classic decision-making approach assumes a rational manager who always makes decisions to achieve organizational goals. In dealing with problems, managers will try to obtain complete and perfect information, eliminate elements of uncertainty, evaluate alternatives rationally and logically, and ultimately make the best decision. The following Figure 4.2 shows the sequence of the rational approach to decision-making. The model is especially suitable for unstructured problems. Unstructured models require analysis with logical and systematic steps.



Source: Hanafi, 2019

Figure 4.2
Rational Approach to Decision-Making

1. Inspecting Situations

The first thing a manager has to do is inspect and define the problem. Problems can only be recognized when a symptom or stimulus comes to the surface and attracts the manager's attention. These symptoms can be either negative or positive. Falling sales, for example, are a negative symptom, while excessive cash flow is more of a positive symptom. Managers must be able to distinguish between symptoms and actual problems. Oftentimes, the problem isn't obvious, while the symptoms are more apparent. For example, an apparent symptom is the declining productivity of employees. But after further investigation, the real problem is the poor relationship between supervisors and employees. Managers in this case must improve the poor relationship between employees and supervisors instead of increasing salaries or replacing machines.

Once the manager has recognized the real problem, he or she can investigate further to gain a more "solid" understanding of the problem. For example, the manager may ask several questions: Which external and internal factors are causing the problem? Who is involved in the problem? How do other people view the problem? Other people will have different views than the manager. By asking these questions, the manager will obtain different answers, which are then combined to get a more solid understanding of the situation and the problem.

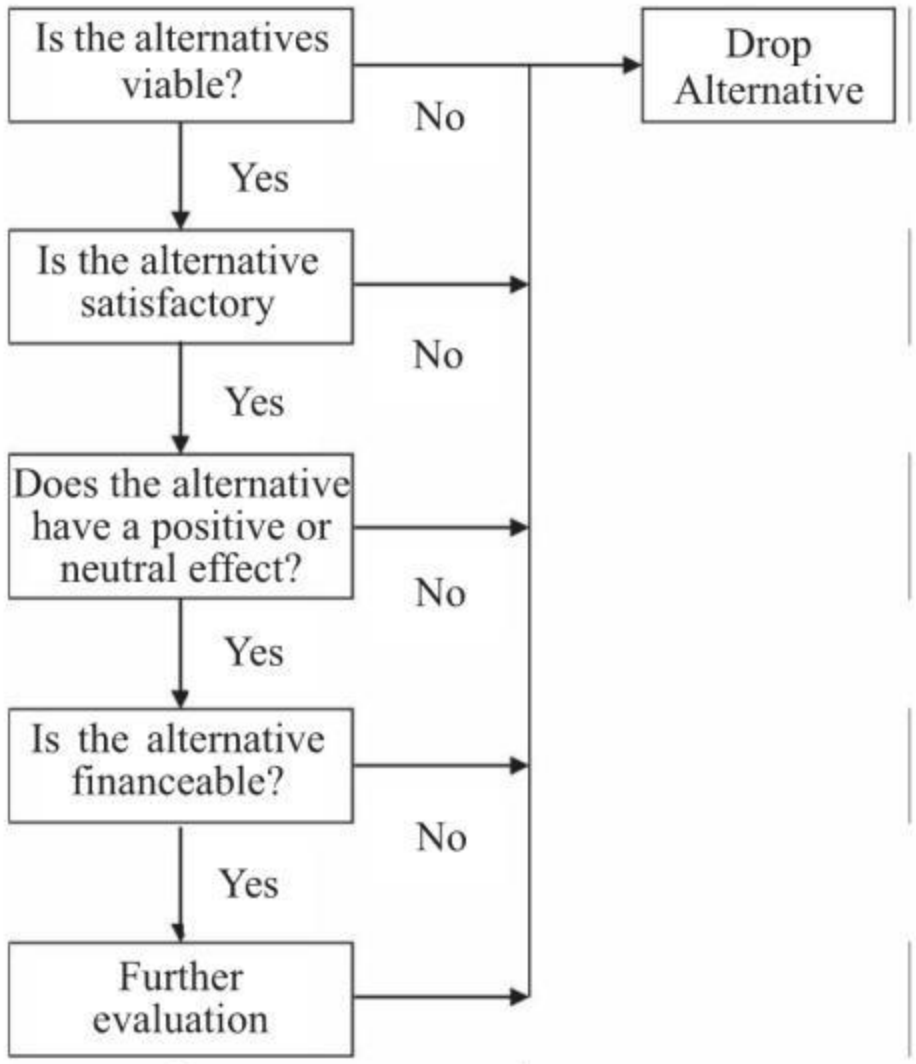
2. Developing Alternative Solutions

Once the problem is identified, managers can develop alternative solutions. Managers are expected to produce clear, practical, and creative alternatives. However, managers must remember some limitations in each alternative, such as those in legal,

ethical, and regulatory issues. Often the limitations come from within the organization, such as time constraints and limited resources within the organization. Such limitations must be included in the consideration of the alternatives. For routine or programmatic decisions, developing alternative solutions is an easy problem. But for non-programmed decisions, developing alternatives will not be as easy. In this case, other techniques, such as brainstorming, can be used. The technique basically brings managers together in a specific session, then they spontaneously develop creative alternatives without being shackled by existing realities or existing traditions or habits.

3. Evaluating Alternatives and Selecting the Best Alternative

Figure 4.3 below illustrates the steps in evaluating alternatives.



Source: Hanafi, 2019

Figure 4.3
Evaluation of Alternatives

The first question is whether the alternative solution is feasible and practical enough to do. Does the alternative not violate the existing constraints? If the alternative is not feasible, it is removed from consideration. If the alternative does pass, then the next question is: how satisfactory is the alternative? Alternatives are said to be satisfactory if they can solve existing problems. For example, if the problem waiting to be solved is improving productivity, and a new machine will improve productivity by 10 percent, it is likely that this alternative will not be satisfactory. The criteria for satisfaction will differ from one organization to another and from one time to another. Organizational

culture and tolerance for risk will differ from one manager to another. The next step is to ask questions regarding the effects of the alternatives being evaluated. For example, cutting the research and development budget will save money in the short term, but over the long term, it will make the company less competitive. Such an alternative will also affect other parts of the organization, such as the marketing department. The effect on the organization as a whole must be evaluated as well. If the effect is at least neutral, then the next question to ask is whether the alternative can be financed. The alternative of bringing in new machinery to increase productivity may not be financeable if the company does not have enough funds. Another alternative, for example, is to train employees to use existing machines in a more optimal way.

After an alternative has passed these screening questions, the next step is to determine the best alternative from the remaining alternatives. Ideally, the best alternative is the one with the highest score for each of the above screening questions. But in reality, managers will have to make compromises because it is unlikely to obtain an alternative with perfect screening scores. For example, bringing in a new machine may score highly in terms of the satisfactory factor for increasing productivity. But the alternative scores poorly on the financing feasibility factor. Managers can choose the most optimal alternative, which is the alternative that has the highest total score. Of course, in reality, these alternatives are difficult to quantify perfectly. In this case, the manager uses subjective judgement by estimating which alternative has the highest score for each question category.

4. Implementation

The next step is to implement the selected alternative. At times, the implementation of an alternative can be an easy job, but it is more often the case that the implementation of an alternative is not an easy job. Suppose the alternative chosen is a merger, then there are many follow-up tasks that must be done. Combining two organizations that have different characteristics is not an easy job. The values, culture, and habits of the two organizations must be harmonized. Managers should be aware that the decision will not be implemented on its own; thus, they must consider the possibility of anti-change in some employees. For example, some employees may not want to move to another city if the company decides to move the factory. Thus, the company will have to attract new employees, which will be quite expensive.

5. *Follow up* dan Evaluation

The final stage is to monitor and evaluate. This stage is carried out to ensure that the implementation of the decisions taken reaches the target or goal. If it turns out that the goal is not achieved, the manager can respond quickly, for example, by changing the decision or choosing the second-best decision and replacing the one that failed to work. The timing factor is often crucial because managers who react too slowly will end up causing the organization to be further away from achieving its goals. Managers can also go back to the first step, which is to redefine the problem, and so on. The decision-making process is a continuous one and a challenge.

E. ALTERNATIVES TO THE RATIONAL APPROACH

The rational model of decision-making assumes that managers are sufficiently rational, despite the fact that managers are often irrational in their decisions. It is estimated that the rational approach is used in less than 20 percent of total decision-making. However, the rational approach also does not guarantee the success of a decision. Many times a decision turns out to be wrong despite having been analyzed rationally. For example, after various market studies, a new product shows good prospects. But after launching the product, it turned out to be unsuccessful. On the other hand, a decision taken without rational consideration shows good results. The rational model does not seem to guarantee the success of a decision and is not fully used in practice.

1. Administrative Model

Herbert Simon (1947, 1982) tried to explain decision-making in terms of its behavior. According to him, in making decisions, managers face three things: (1) imperfect and incomplete information; (2) bounded rationality; and (3) complacency.

Managers usually face situations when information is incomplete. For example, when a new competitor enters the market, managers usually do not have complete information about the strength of the competitor or the effect of the competitor's product on the market. Due to incomplete information, managers often underestimate new competitors. As a result, managers act too late, which is after the competitor has become too strong. For example, when Japanese cars entered the US market in the 1970s, US car companies (Ford, General Motors, and Chrysler) did not have complete information about the strength of Japanese cars. Therefore, they tended to ignore the presence of Japanese cars. When Japanese cars became stronger, they realized the power of Japanese cars, but it was too late.

Managers' ability to act rationally is limited by their limited rationality.This limited rationality is caused by the manager's being shackled by his or her habits, abilities, and values. The manager actually wants to act rationally but has limited abilities. For example, a rational decision might be to change businesses because the current one does not have good prospects. But because the manager has been in business for a long time and the business has been passed down from his grandfather, his parents, and now to him, he refuses to close his business and switch business fields.

Fast satisfaction occurs because managers have a tendency to choose the first alternative that meets the minimum requirements. Managers in this case do not act rationally because they do not choose alternatives that maximize organizational goals. Managers are unwilling or reluctant to look for other alternatives that may not have visible prospects because they are complacent. For example, a manager wants to find a place to build a new factory. When he first finds an empty place, the manager immediately decides on that place for his new factory. If the manager had been patient enough to look at a few other places, he could have found a better one.

The administrative approach describes behavior that is very different from the rational approach. The rational approach describes an ideal model of how managers should behave in making decisions. Whereas the administrative approach describes more realistic behavior in decision-making. Both can be combined to gain a good and realistic understanding of the decision-making process.

2. Heuristic

Research by Amos Tversky and Daniel Kahneman (1974) developed Herbert Simon's idea of limited rationality. The results of their research show that people tend to use heuristic models or rules of thumb to simplify decision-making. A financial analyst, when analyzing a company's liquidity condition, might use the rule of thumb that says a healthy company's current assets to current debt ratio is 2:1, even though the rule of thumb often has no scientific justification as it is usually based on habit. Nevertheless, a rule of thumb can simplify problems and speed up decision-making. But overreliance on rules of thumb can lead to poor decision-making.

There are three kinds of heurisitic forms that are often used by humans in decision-making: availability, representation, and customization.

a. Availability

Events experienced by humans will be stored in the human brain's memory. These events are often used as references for decision-making. For example, if a manager experiences a large loss while working on a particular project, the event will be used as a reference for decision-making. In the future, the manager will most likely not want to do the job because of his bitter experience. The memory of the event will depend on its length and strength. For example, if the event happened ten years ago, it is likely to be forgotten. If the event was influential enough, people will tend to recall it. A major loss will be remembered by the manager, even though the event may have happened ten years ago.

b. Stereotype

Stereotypes often influence the way people perceive things. For example, people often assume that certain races are more diligent or smarter, despite the fact that it will depend on the person. Managers, in making decisions, often use these stereotypes as well. Managers, for example, use examples of other similar products to determine whether or not the prospects of a new product are promising. If the product used as a representative turns out to be a successful product, the manager concludes that the new product to be launched will also be successful.

c. Adjustment and anchoring

Humans usually judge things by comparing what's in their minds. For example, to assess high and low sales, managers will directly compare them with a certain number, such as past sales. Salary determination is often linked to the previous period's salary.

The heuristic approach discussed above can lead to biases in decision-making. These biases include: taking an example of something that is easy to remember, even though something that is remembered is not a good example for decision-making; under-adjustment, for example, means that salary adjustments based on previous salary standards may be insufficient because there are many other factors that determine the appropriateness of the current salary standard; For an easy search, for example, if the manager wants to get information about management information systems, his memory will immediately focus on people in the management information systems department. If it turns out that people in the management information systems department cannot provide the information needed, the manager immediately stops looking, even though the information may be obtained from other departments or from outside the organization. It can be concluded that the heuristic approach is an approach that simplifies the decision but carries risks as it can lead to biases that render the decision non-optimal.

d. Prospect theory

One of the popular framing theories is the prospect theory. The prospect theory was developed by Daniel Kahneman and Amos Tversky (1979) as an alternative to the standard (rational) utility theory. Based on their observations, the two academics proposed a theory of how humans evaluate losses and gains. Human evaluation of gains and losses isn't symmetrical. Figure 4.4 below shows this evaluation.

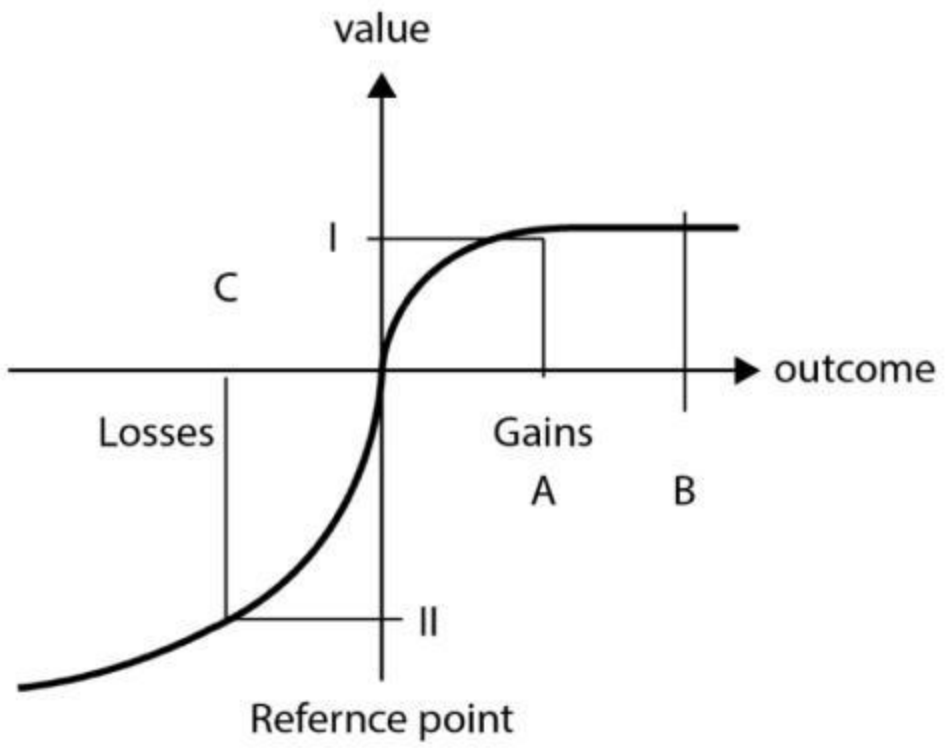


Figure 4.4
Prospect Theory

Notice that Figure 4 above shows that the value function has an S-shape, which passes through a certain reference point. The S-shape indicates that the value function has a non-symmetrical shape. The value function is concave in the region of gains, or to the right of the reference point, and convex in the region of losses, or to the left of the reference point. The function is also steeper for the loss region than for the gain region.

The following are the implications of the figure: Gains for a person will increase their value. For example, if a person earns a profit of A, his utility will increase by I. If the person's profit doubles, his utility will increase by I. If the person's profit doubles (to B), the person's value increases by a smaller amount. On the other hand, if he suffers a loss of C (which is equal to A), then his utility decreases by II. The decrease in utility due to the loss is greater than the increase in utility (value) due to the gain. In other words, the loss will cause excessive harm, outweighing the benefits of the gain.

Basically, the harm of the loss will outweigh the joy of the gain. For example, let's say I have invested in stocks. Suppose I get a 20% profit. I would be thrilled. My satisfaction goes up by, say, 100 units (assuming satisfaction can be measured quantitatively). I will be all smiles for two days. Then, the other investment results in a 20% loss. I would be devastated. Sadness, for example, reduces satisfaction by more than 100. Note that the decrease in satisfaction due to the loss is greater than the increase in satisfaction due to the gain (150 > 100). I would cry for seven days. Humans will thus tend to avoid loss (or any other negativity) because it will be very painful. In investment language, this is often referred to as the "loss aversion phenomenon."

The phenomenon of loss aversion (avoiding losses because losses become too painful) can be shown through an experiment when respondents are given the following question. Suppose the respondent is given the following two choices.

Table 4.1
Prospect Theory

First Decision	
A	Gain a definite profit of $2,500
B	Get a chance to earn a profit of $10,000 with a probability of 25%, and a chance to earn a profit of 0 (no profit) with a probability of 75%.

Second Decision	
C	Obtain a definite loss of $7,500
D	Get a chance of a loss of $10,000 with a probability of 75%, and a chance of a loss of 0 (no loss) with a probability of 25%.

In the first decision, both statements (A and B) provide the same expected value, which is a $2,500 profit (the expected value for choice B is (0.25 * 10,000) + (0.75 * 0) = 2,500). In the second decision, the expected loss between C and D is also basically the same, that is, a loss of $7,500 (for choice D, the expected value is (0.75 * 10,000) + (0.25 * 0)).

But most respondents will choose A in the first decision and choose D in the second decision. In the first decision, respondents are risk-averse, hence they choose a certain profit. In the second decision, respondents become risk-seekers and accept gambling. Note that under alternative D, she could lose more ($10,000) with a probability

of 75%. In the second decision, it can be seen that respondents are not willing to accept a definite loss right away. In other words, they do not like losses. Losses are more painful. Meanwhile, gains do not produce joy that is comparable to the pain of the loss. The decrease in utility due to losses is greater than the increase in utility due to gains.

Note that by framing the questions differently, respondents will be fooled and give different answers than they should (respondents should give equal answers to the two statements).

The loss aversion phenomenon seems to occur in other business decisions as well. For example, in the 1980s, Apple Computer launched a palm electronic product named the Newton. Apple's managing director, John Sculley, had the vision and commitment to develop the product. The product was described as an electronic personal digital assistant and was considered an important step towards the convergence of three industries: computing, communications, and entertainment.

Development of the Newton began in 1987. The product was launched in 1993 with a price tag of $1,000. This price was too expensive for the general public. In addition, there was a problem at the beginning of the product launch, which was a defect in handwriting recognition ability (could not read perfectly). The failure was made into a joke by a magazine through a cartoon illustration, even though the magazine has a fairly wide readership.

By 1994, it became apparent that Newton was a failed product. Newton sales were disappointing. But Apple did not stop the project. In fact, in 1995, Apple added blue features such as a backlit screen. In 1997, Apple spun off Newton as one of its divisions. But these efforts did not help. Apple regained control of the division. John Sculley was then replaced by Gil Amelio, who was then replaced by Steve Jobs. In January 1998, Steve Jobs finally announced his decision to discontinue the Newton product.

The illustration above shows that in the actual business world, the phenomenon of loss aversion seems to occur as well. Apple does not want to admit losses because they might be too painful (Shefrin, 2007).

3. Intuition and Escalation of Commitment

Managers often act on intuition. The manager's intuition has certainly been formed based on long experience in decision-making. Sometimes a decision based on intuition can produce an optimal decision. For example, when a walkman (a small portable radio) was about to be launched, market studies showed that the walkman would not sell well. But Sony's managers launched the product anyway because their intuition told them it was a good one. History shows that the Walkman is one of the most successful products in the history of electronic products. Of course, the use of intuition has great risks, especially for managers who do not have much experience in the field.

In an escalation of commitment, managers often put too much commitment into the decisions that have been made. Decisions that have been made will be very difficult to reverse. Many people have stated that these tendencies are harmful. By the time the

manager finally withdraws the decision, it is too late, as the losses are already too great. For example, Nabisco co. once tried to launch smokeless cigarettes that were expected to dampen criticism of cigarettes (as detrimental to health). Research had been done for a long time and did not show satisfactory results. But managers did not want to stop the project. By the time the manager withdrew the project, the losses were already substantial.

4. Political and Ethical Influences

Politics is another example of factors that influence manager behavior. In this context, the word "politics" refers to a broader sense, but it is not related to government. For example, risk-averse managers may be unwilling to make risky decisions. As a result, the entrepreneurial spirit is reduced, and the company becomes less innovative. Shareholders may not like such a situation. Shareholders can force managers to take risky decisions. A government company (state enterprise) is an example of an organization that is described as being under strong pressure from the government bureaucracy. Since the objectives of state enterprises include both economic and social objectives, their decisions are a mix of both. In addition, since government enterprises fall under the government bureaucracy, government bureaucrats may exert a strong influence over the organization. Large companies are often subject to strong pressure from various parties. In such situations, managers' decisions are unlikely to be purely rational.

Ethics are also one of the influences on a manager's decision. For example, if the rational decision is to lay off a large number of employees, can the company afford to do so at once? What about the fate of employees who have worked for the company for a long time? The form of the adjusted decision will be determined by a delicate compromise between the rational decision and the ethical factors in this situation.

F. IMPROVING THE EFFECTIVENESS OF DECISION-MAKING

The effectiveness of a decision will be determined by two things: 1) the quality of the decision, and 2) the implementation of the decision or who implements the decision. A good decision carried out by incapable people will certainly not be able to achieve organizational goals effectively. Even worse is a poor-quality decision that is implemented by incompetent people. The following section will discuss ways to improve decision effectiveness.

1. Individual Level

To improve decisions, it is necessary to first understand what factors hinder effective decision-making. There are four factors identified by Irving L. Janis and Leonn Mann (1977).

a. ***Relaxed Avoidance.*** Managers tend to be unwilling to act once they know the consequences of inaction are not too great.

b. ***Relaxed change.*** Managers tend to act only after understanding that the consequences of inaction are quite serious. Managers will tend to choose the first alternative they find, rather than looking for the most optimal alternative.

c. ***Defensive avoidance.*** As the manager has failed to solve problems in their past experiences, he decides to let someone else make the decision and thus bear the consequences of the decision. The manager is likely to choose the safest alternative, which has the least risk.

d. **Panik**. Due to considerable stress and time constraints, managers tend to be irrational in choosing alternatives. Managers make decisions irrationally or unrealistically.

In all four situations, managers will tend to choose the incremental adjustment method. This method generates decisions that make minimal changes to the current policy. As a result, the decision taken is not the optimal one. The long-term goals of the organization are likely to be sacrificed.

To avoid these obstacles, managers can use the rational approach to decision-making, as discussed earlier. With this approach, it is hoped that managers can actively seek alternative solutions, increasing the possibility of obtaining the best alternative. Besides this method, there are several other ways to avoid these obstacles.

a. Setting priorities

Prioritization allows managers to determine the more important things and allocate time and energy according to the order of priority. The highest priority will get the largest allocation of time and energy.

b. Finding relevant information

This information is used to analyze existing problems, generate creative alternative decisions, and consider the consequences of each alternative and future events that might affect the decision.

c. Watch out for heuristic approaches and biases

With these methods, managers' decisions are expected to be more effective.

2. Group Level

Groups are another alternative to individual decision-making. Group decision-making has advantages and disadvantages as shown in Table 4.2. below.

Table 4.2
Advantages and Disadvantages of Group Decision

Advantages	Disadvantagws
• More information and knowledge. • More possible alternatives can be generated. • The acceptance of the end result will be greater. • Better communication will be established	• Extended time and greater cost due to the extra loss of time. • Compromises are likely to emerge. • One or a few people may dominate the group. • Group pressure will arise and limit individual creativity

In utilizing groups, managers must consider the advantages and disadvantages of the group itself. Adjustments can be made to minimize the disadvantages of group decision-making. For example, to avoid prolonged time, a deadline can be set; to avoid the dominance of certain people, people who are expected to dominate are not required to be appointed, or several dominant people are appointed so that there is a balance in the group; to avoid group pressure, managers can remind group members that creativity is highly valued and there is no right or wrong in the discussion.

Some examples of groups

The simplest example of a group is to gather several people with different backgrounds into one group. Then, the group is tasked with solving a particular problem. For example, for a new product committee, a group consisting of marketing, production, finance, research, and development managers could be formed. The committee will then meet and discuss the new product. Intensive interaction will occur between group members; hence, it is called an "interacting group."

Delphi groups are another variation of group formation. This method was developed by the Rand Corporation of the United States. This method uses the consensus of experts who contribute individually. Suppose a manager wants to forecast the potential market share for a new car using the Delphi method. Experts are identified, for example: marketing academics, economists, marketing executives, and automotive observers. Each expert is then asked, separately, for their opinion on the potential market for a new car, with their name withheld. Then, they gave their answers, which were collected by a coordinator. The coordinator will then calculate the average of the answers. Experts who gave answers that were significantly different from the average were asked for further information regarding the reasons for their answers. These reasons are then shared with the other experts in the group. They are then asked to revise their predictions. When the predictions are stable enough (with little variation), they become the group's answer. The method is time-consuming and costly, so it is only appropriate for non-routine matters. The method is sufficient for predicting technological breakthroughs from Boeing (a US aeroplane manufacturer), potential new products for General Motor (a US automaker), and future economic conditions by the US government.

Another group model is the nominal group. Unlike the Delphi method, in nominal groups, names are not disguised. In addition, in contrast to interaction groups, nominal groups limit the interaction between group members. For example, to analyze a new product, a nominal group can be formed by gathering all group members. Each is asked to provide as many alternatives as possible. The alternatives are recorded on the paper provided. Then, the coordinator will write the alternatives on the blackboard. The discussion at this stage is still limited to the explanation of alternatives that are not yet clear. Then, after all alternatives are written, a more open discussion is held.

Finally, group members will vote by ranking the written alternatives. The highest rank is considered the choice of the group.

Exercise

To understanding of the material above, please complete the following exercise!

When a new product cannot be accepted by the market, it indicates that the decision was made incorrectly. Oftentimes, a decision turns out to be wrong, even after rational analysis. Your task is to identify irrational decision-making models.

Key Ideas for Exercise Answer

Read Learning Activity 1 on decision-making. Understand each of the decision-making approaches, such as the heuristic and administrative models.

Summary

Managers will never be separated from the process of decision-making. Decision-making departs from problems and/or opportunities. Decision-making is basically the process of selecting the best alternative from a series of alternatives. There are two types of decisions: programmed decisions and unprogrammed decisions. Unprogrammed decisions are aimed at solving problems that do not arise routinely, while programmed decisions are aimed at solving routine problems. In decision-making, the situations faced by managers can vary from certain to highly uncertain.

The rational approach to decision-making is aimed at reducing uncertainty. The sequence in the approach is to research the situation, develop alternative solutions, evaluate alternatives, choose the best one, implement it, and then follow up and evaluate it. Besides the rational approach, there are several models that are more realistic. Administrative, heuristic, intuition, and escalation models, as well as political and ethical influences, are among these models.These models show that managers are not always rational in their decision-making. Decision-making effectiveness can be increased by improving individual and group effectiveness. Group decision-making has advantages and disadvantages over individual decision-making.

TERM INDEX

Problem	Rational approach	Adjustment and Anchoring
Opportunity	Evaluation of alternatives	Intuition
Brainstorming	Administrative model	Escalation of commitment
Dialectical inquiry	Bounded rationality	Relaxed Avoidance
Decision	(Unbounded rationality)	Relaxed Change
Programmed	Satisfice	Defensive Avoidance
Unprogrammed Decision	Heuristic	Delphi Group
Availability	Committee	Internal Group
Uncertain conditions	Representative (Stereotype)	Decision Making
	Nominal Group	Uncertain Condition

Formative Test 1

Choose the correct answer!

1) The analysis of opportunity starts with making certain assumptions. With these assumptions, alternative solutions to the problem are put forward. The analysis continues by disproving the assumption. Next, alternative solutions to problems with incorrect assumptions are sought. The technique is called ....
   A. brainstorming
   B. dialectical inquiry
   C. heuristic
   D. rational approach

2) The decision to reorder inventory if the existing inventory has reached the lower limit. The decision is made repeatedly. The decision falls into the category of ....
   A. unprogrammed decisions
   B. programmed decisions
   C. nominal decision
   D. rational decision

3) Managers face limited rationality (bounded rationality), which makes them unable to make rational decisions but rather satisfying decisions, as proposed by ....
   A. Amos Tversky
   B. Daniel Kahneman
   C. Rand Corp
   D. Herbert Simon

4) A company demands that new hires have a GPA of 3 or higher, even though research shows there is no strong relationship between GPA and performance. These requirements are an example of ....

A. rational because there is a scientific basis
B. rule of thumb because it simplifies the problem
C. delphi because it has been discussed with other analysts
D. impulsive because the idea usually comes instantly

5) Asians in the United States are smart and diligent learners. This conclusion is an example of ....

A. rational
B. stereotype
C. consensus
D. scientific

6) The method of decision-making that is done through the consensus of experts who contribute individually, whose names are not disguised, and where interaction is limited is called ....

A. nominal *group*
B. *agreement*
C. *delphi group*
D. *expert group*

Use key answers for Formative Test 1 which is located at the end of this module to determine the correctness of your answer. To make sure your mastery of the learning materials use the following formula.

$$\text{Level of mastery} = \frac{\text{Number of correct answers}}{\text{Number of test item}} \times 100$$

Level of master is as follows

<70%	70% - 79%	80% - 89%	90% - 100%
lower than expected	adequate	good	very good

When you attain level of mastery 80% or more, very good, you may continue to Learning Activity 2. Otherwise you have to review the material of Learning Activity 1. Pay attention to parts which you don't master yet.

Learning Activity 2

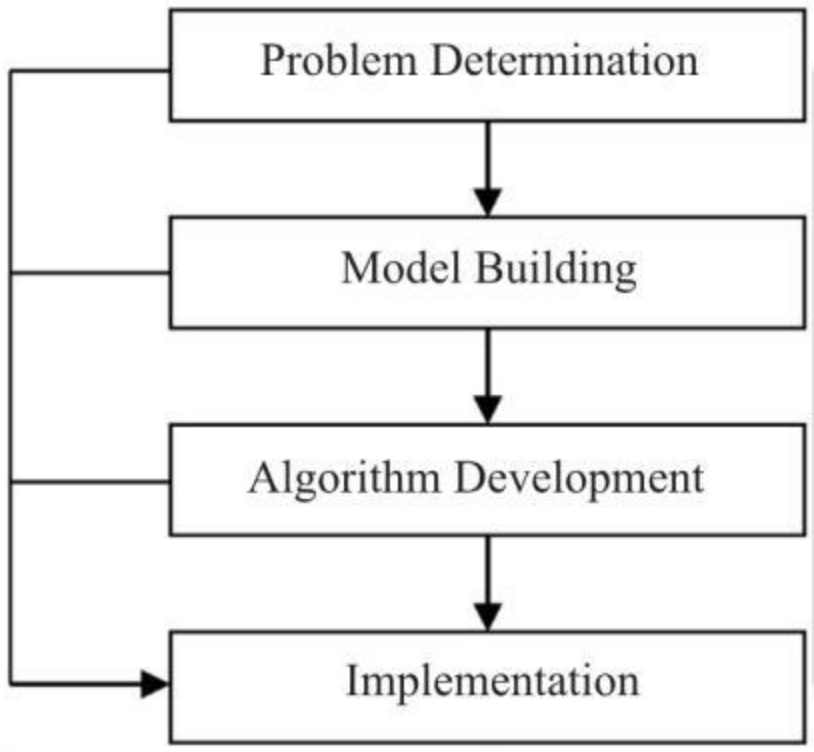
Planning and Decision-Making Tools

Analytical tools with statistical or mathematical models are very useful to help managers do their jobs. Management is getting more and more sophisticated; therefore, managers need tools that can help them with their work. It takes thousands of components to build an airplane. To build the Polaris submarine (United States), 3,000 contractors and agents were involved. The work that needs to be accomplished during the process is numerous and interrelated, and it must be done simultaneously. Coordination is critical throughout the process.The models discussed in this Learning Activity will be very useful in assisting managers in conducting planning.

A. SCIENTIFIC MANAGEMENT APPROACH

The use of planning tools continues to increase. There are several reasons why this is happening. First, the organization's environment is becoming more complex day by day. The global economy and the rapid development of technology are making the environment change faster, and the environment is becoming more unstable and difficult to predict. Scientific management helps management master the environment by making better predictions of the environment. Second, as mentioned above, organizations are becoming larger and more complex. Without tools, managers would be overwhelmed trying to make and execute decisions. These two things make tools such as scientific management even more necessary.

Scientific management is basically developed through the following process Figure 4.5.



Source: Arranged by the Author

Figure 4.5
Scientific Management Process

The first step is problem definition. Although problems seem to be everywhere, managers may not always be able to define or explain the problem. Thus, managers must learn to formulate and/or see the real problem. Information systems are frequently created to assist managers in answering the problem's formulated questions. Once the problem has been formulated, the next step is modeling. A model is defined as a representation (simplification) of the real world. The real world is very complex; therefore, in order to analyze it, it needs to be simplified. Otherwise, the real world is impossible to analyze. The model can be a simple one; for example, the management process consists of planning, organizing, staffing, leading, and controlling. Other models can consist of mathematical formulas that explain the relationship between various variables.

Once the model is formulated, the next step is to develop an algorithm. Algorithms are the steps needed to solve a problem. Algorithms can be verbal ones, such as recipes, as well as mathematical ones. For example, if a manager wants to make a sales forecast, he can create a cause-and-effect model. Then, let's say that in the model, the marketing budget affects sales. Once done with the model, the manager then develops a forecasting algorithm, for example, by using a regression model. The manager can use existing software such as SAS, Microstat, or TSP. The algorithm can be boiled down to the process of inputting data into the software and reading the output. If no software is available, managers may develop their own algorithms. If a computer is used, a programmer can also help. Once the algorithm has been formulated, a solution is obtained.

The next step is the implementation phase. Recommendations are given to those who will do the implementation, training of potential users, and preparation of manual documentation. There are several factors to consider to ensure a successful model formulation: (1) the users of the model must be involved during the development of the model, (2) management support is required, (3) training, (4) development is evolutive, using feedback to change the model.

B. FORECASTING TOOLS

1. The Definition of Forecasting

Forecasting is a systematic process of estimating (or "forecasting") future conditions using past information and other relevant information, intended for planning and decision-making. Managers perform forecasting as a basis for planning and decision-making. For example:

a. Managers forecast sales that will occur in the upcoming year. The sales forecast will be useful for planning the company's activities for the upcoming year, for example, how much raw material input should be ordered, as well as how many machine hours are required and how much profit is expected. The financial control module talks about budgeting, which departs from sales forecasting. Note that the word "sales" does not limit the notion of forecasting to corporate organizations. Non-profit organizations also require "sales" forecasting. For example, a hospital organization will forecast how many patients it will have in the upcoming year; a university will forecast how many students it will have in the upcoming academic year.

b. Managers forecast changes in social, economic, political, and technological variables that are expected to affect the organization. If the organization can forecast changes in these variables and is able to make appropriate anticipations, it is able to take advantage of the situation. For example, forecasting demographic composition can be useful for planning and decision-making. If family planning is successful, the number of children under five is expected to decrease. Therefore, the need for toddler products will decrease. For example, elementary schools will already be short of students. In contrast, the teenage generation will be larger because they were born before family planning began. Organizations can focus on products that the teen generation needs. The strategic planning module discusses strategic planning management, such as the example given.

c. Technology forecasting is also important, especially for organizations with a dynamic technology environment. For example, a chemical company is being built using conventional chemical processes. Before the plant is completed, another chemical company successfully develops a new, more efficient chemical process. Obviously, the company under construction will not be competitive against this new chemical process. Thus, managers must always actively follow relevant technological developments.

2. Forecasting Methods

The following are some forecasting methods that are frequently used.

Table 4.3
Some Forecasting Methods

Type		
Quantitative	Time series	Moving Average model Exponential smoothing model Box-Jenkins model
	Causal	Single or multiple regression models Econometric model
Qualitative	*Jury of Selection Method* *Sales-force-composition* *Delphi Method* Multicriteria Method Customer Evaluation Method	

Source: Arranged by the Author

Notes: The Box-Jenkins model is a complex time-series model, which incorporates prediction error analysis in forecasting. It will not be discussed in this Learning Activity. Forecasting books usually discuss these models.

3. Quantitative Forecasting

Quantitative forecasting uses numerical (quantitative) data to estimate future conditions. There are two types of quantitative forecasting: time-series forecasting and causal forecasting. In time-series forecasting, past conditions are assumed to affect future conditions without any external influence. In causal forecasting, other factors are expected to influence a variable. Let's take future sales as an example. In time series, it is assumed to be influenced only by past sales. In causal forecasting, future sales are expected to be influenced by other factors, for example, promotions, the number of salesmen, and economic conditions.

a. Time series

Time-series forecasting is especially useful when the manager has a large amount of data and the pattern of movement of the variables is relatively stable. The method works by sorting the data in time order, then forecasting future conditions. The time-series model is relatively simple and suitable for analyzing time-series data that is relatively stable and does not have considerable trend or seasonal fluctuations. There are several ways to forecast time-series data, namely the moving average method and the exponential smoothing method.

1) Moving Average Method

For example, the company has the following annual historical data.

Table 4.4
Sales Data

Budget	Sales	2. Period Moving Average	3. Period Moving Average	Eror (1)	Eror (2)
(1)	(2)	(3)	(4)	(5)=(2)-(3)	(6)=(2)-(4)
2500	12500				
2500	13500				
2450	14000	13000		1000	
4500	14500	13750	13333.33	750	1166.67
4000	13500	14250	14000.00	750	500.00
5000	15000	14000	14000.00	1000	1000.00
5500	15500	14250	14333.33	1250	1166.67
6000	17000	15250	14666.67	1750	2333.33
6500	18000	16250	15833.33	1750	2166.67
7000	18500	17500	16833.33	1000	1666.57
7500	17000	18250	17833.33	1250	833.33
7000	17500	17750	17833.33	250	333.33
8000	19000	17250	17666.67	1750	1333.33
8000	19500	18250	17833.33	1250	1666.67
7500	22500	19250	18666.67	3250	3833.33
Forecasting		21000	20333.33		
Absolute Error				1307.692	1500

Notes: Error(1) and Error(2) are calculated by turning the numbers into absolutes. For example, the number -750 becomes 750

Using the two-period moving average method, the sales forecast for the next period is 21,000. The figure is obtained through (19,500 + 22,500)/2. When using the three-period moving average method, the sales forecast is 20,333.33. The figure is obtained through (19,000 + 19,500 + 22,500)/3. The next two columns are the absolute error, which is the absolute difference between the actual sales and the forecasted sales. Then the last row shows the average absolute error for the two different moving average methods. That kind of error is a measure of the accuracy of the forecasting method.

In the above model, each period is given equal weight. If the manager believes that the weights should be different, the manager can use variations when weighting for each different period. Usually, more recent observations are given a higher weight. For example, if the weight for period t-1 is 70% and period t-2 is 30%, the sales forecast for the next period is (19,500 x 0.3) + (22,500 x 0.7) = 21,600.

2) Exponential Smoothing Method

In the previous model, the forecasting error is not included in the analysis as feedback. The exponential smoothing method incorporates past forecasting errors as future forecasting input. The exponential smoothing model can be written as follows.

$$Ft = w.\ At\text{-}1 + (1 - w)\ Ft\text{-}1$$

where Ft = forecasting for period *t*
At-1 = the actual data for period *t-1*
Ft-1 = forecasting for period *t-1*
W = a constant (0-1) that becomes a weighting agent forecasting the above model reads as follows.

New forecast = (Actual data x weights) + (Current forecast x weights).
The above model is written as follows.

$$Ft = At\text{-}1 + (1 - w)\ (Ft\text{-}1 - At\text{-}1)$$

The model can be read as follows.
New forecast = (Actual data) + (Past period deviation x weights).

For example, the previous period's forecast (Ft-1) is 20,000, and w = 0.7. The sales forecast for the next period is Ft = (0.7 x 22,500) + ((1 - 0.7) x 20,000) = 21,750.

To evaluate the accuracy of the model, absolute deviations or errors can be used. More complex smoothing models are sometimes used to analyze more complex data.

b. Causal forecasting

In time-series forecasting, it is assumed that there are no factors outside the system that affect the variable being forecast. In causal methods, factors outside the system are assumed to affect the observed variable. Causal models include regression methods and econometric methods.

1) Regression Model

Suppose we have the belief that marketing budget affects sales, then marketing budget can be used as the independent variable, while sales can be used as the non-independent variable. The relationship model between the two can be written as follows.

$$Y = a + b.\ X$$

where Y = sales
a = *intercept*
b = regression coefficients
X = marketing budget

a and b are parameters to be found based on existing data. The most commonly used method to find these parameters is the least square method. This method, using the available data, tries to minimize the squared error or the difference between the actual data and the data from the regression line plot.

Note that the relationship between X and Y is linear, therefore, the model is often called a linear regression model. Using this method, the following regression equation is obtained (left/right average).

$$\text{Sales} = 9.243 + (1.27 \times \text{Marketing Budget})$$

The above equation is interpreted as follows. For every 1 dollar increase in marketing budget, sales are expected to increase by (1 x 1.27) dollars. Note the positive relationship between the two, the higher the marketing budget, the higher the expected sales. For example, in the following year, the marketing budget is set at 9,000, the next year's expected sales are: (idem)

$$\text{Sales} = 9.243 + 1{,}27\ (9.000) = 20.673$$

If the data does not show a linear pattern, non-linear regression is used. Suppose the data plot shows a picture like this (see Figure 4.6).

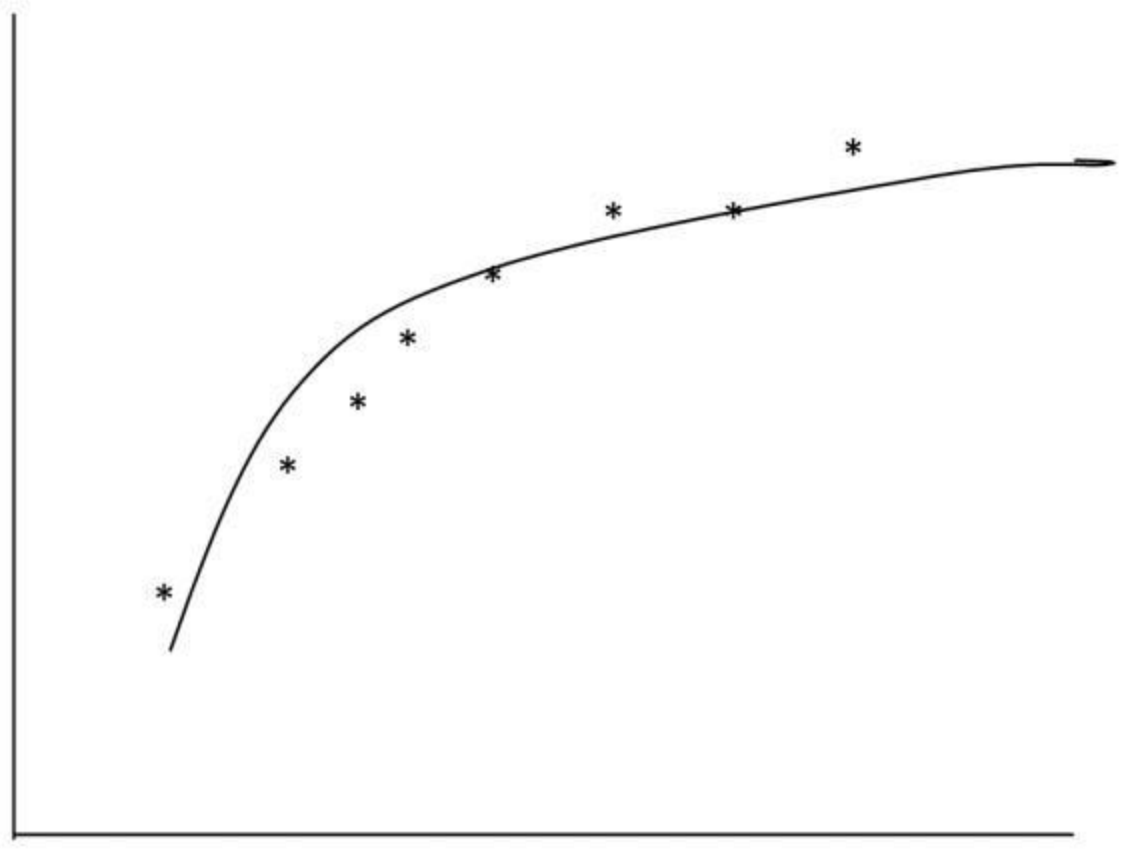


Figure 4.6
Non-Linear Data Plot

It appears that the relationship between the two variables is not linear. A non-linear model such as the following would be more appropriate than the usual linear model.

$$Y = a + b.\ X + c.\ X2$$

The last component tries to capture the non-linearity between variable X and variable Y. (idem)

It is often possible to identify more than one independent variable. There are many factors that affect sales, from marketing budget, people's income, number of salesmen, economic conditions, and so on. To forecast, we can focus on a few variables that are expected to have a strong influence on our observed independent variables. For example, for sales, we can identify four independent variables: marketing budget, salesman commission, community income, and industry marketing budget (marketing budget of all companies in the industry). The model can be written as follows.

$$Y = a + b1.\ X1 + b2.\ X2 + b3.\ X3 + b4.\ X4$$

where
- Y = sales
- a = intercept
- b1 = regression coefficient for marketing budget
- X1 = marketing budget
- b2 = regression coefficient for salesman commission
- X2 = salesman commission
- b3 = regression coefficient for community income
- X3 = community income
- b4 = regression coefficient for industry marketing budget
- X2 = industry marketing budget

Multiple linear regression models are expected to increase forecasting accuracy, in addition to being able to see the relationship or influence between several observed variables and the sales variable.

2) Econometric Model

The econometric model is basically a combination of several regression models that form a system of regression equations. These models are interrelated with each other and can consist of dozens or even hundreds of regression equations. Computers must obviously have been used in the calculation of this model. These econometric models can be used to predict many things, from future economic conditions to population migration or company sales. For example, if we want to predict national consumption, we can develop a model where consumption is a function of income. Thus, consumption

is affected by income. Then economic theory says that national income is affected by consumption. Consumption and income affect each other. We know that in the calculation of national income, consumption and investment are summed up. Economic theory says that the interest rate affects national investment. Based on the information above, we can formulate the national consumption model as follows:

$$C = a0 + a1.\,Y$$
$$Y = b0 + b1.\,C$$
$$Y = C + I$$
$$I = c0 + c1.\,i$$

where C = national consumption
Y = national income
I = investment
i = interest rate
a0, a1, b0, b1, c0, c1 are the parameters in the regression.

Then, the parameters in the system are searched simultaneously. The parameters then become the regression coefficients. In an ordinary regression model, the parameters would be found individually, not simultaneously.

4. Qualitative Forecasting

Qualitative forecasting uses judgement and the knowledge and experience of individuals or groups rather than sophisticated mathematical and statistical analysis. There are several forecasting methods that will be discussed below.

a. Jury of executive opinion method

In this method, managers are gathered and asked for their opinions on future sales. The resulting opinion is a combination of individual opinions.

b. Delphi method

The method is named after the Greek oracle in the city of Delphi. The method solicits the opinions of a group of experts on a specific topic in order to gain insight into future events.For example, a group of experts is assembled and polled to determine what will happen in the world in 25 years.

This method was developed by the Rand Corporation of the United States. This method uses the consensus of experts who contribute individually. Suppose a manager wants to forecast the potential market share for a new car using the Delphi method.

1) Experts are identified, for example, marketing academics, economists, marketing executives, and automotive observers.
2) Each expert was asked separately, with names redacted, to provide their opinion on the potential market for a new car. Then, they provide answers, which are collected by a coordinator.

3) The coordinator then averaged the answers. Experts who gave answers that differed significantly from the average were asked for their reasons. These reasons are then shared with the other experts in the group.
4) They are then asked to revise their predictions.
5) When the prediction is stable enough (with little variation), the answer becomes the group's answer.

The method's success is dependent on three factors: selecting experts in the field to be forecasted; using brainstorming instead of critically analysing alternatives; and limiting contact between individuals to avoid too rapid consensus building or "group think," which prevents creative ideas. The method is time-consuming and costly and should only be used for non-routine matters. The method has been used successfully by the US government to forecast technological breakthroughs from Boeing (an American plane manufacturer), potential new products for General Motors (an American automaker), and future economic conditions.

c. Sales-force-composition

In this method the organization's salesmen, rather than managers, are used. Salesmen have direct contact with consumers and can use this contact as a basis for predicting future sales.

d. Multicriteria analysis or multi-attributes analysis

This analysis is intended to prevent the human tendency to focus on the single most attractive alternative and overlook other important attributes. The decision to select a factory site may be dominated by site selection alone, despite the fact that other factors, such as proximity to raw materials and markets and the surrounding workforce, have an important influence as well. To reduce such tendencies, organizations can develop multicriteria analysis.

The steps in the analysis are:

1) a group of people who will be affected by a decision are selected from different fields;
2) they are each asked to write down the success factors for a specific decision;
3) then, in a group meeting, the list is evaluated and grouped into broad categories;
4) they are then asked to assign weights to the attribute categories, and the categories are discussed within the group until consensus is reached;
5) the weights are then used to quantitatively analyze the project.

For example, in plant site selection, the attribute categories and weights can be determined as follows:

Table 4.5
Multicriteria Analysis

Category	Weight		Location	
		A	B	C
Distance to raw materials	0.3	60	70	50
Distance to market	0.2	40	80	30
Infrastructure condition	0.3	80	50	40
Labor force	0.15	90	60	90
Social conditions	0.05	60	80	80
Total value		66,5	65	50,5

From the analysis above, it appears that alternative C is the least attractive. Thus, alternatives A and B can be analyzed further. Multicriteria analysis can be used to resolve disagreements or at least clarify the source of disagreement. The analysis can also detect the sensitivity of a category. If a change in the weights in a category leads to very different results, then the category may receive more attention. The analysis is quite flexible and can be used for a wide range of decision-making situations.

e. Customer evaluation

The evaluation is more than a salesman group analysis and is carried out by collecting data directly from customers. Customers provide information on the need for goods or services that the organization produces in the future. Managers then combine, interpret, and act on the basis of this information. This method, however, has disadvantages: customers are not very interested in giving answers, so they may answer randomly, and new customers (potential customers) are not included in the analysis.

Choosing a forecasting model is as important as applying the model. Some models have advantages in certain situations. For example, sales force composition would be appropriate for sales forecasting, while the Delphi method is more appropriate for forecasting new products or new technologies. The Delphi method is also time-consuming and costly. Econometric models require extensive use of computers, while other methods such as sales force composition require little mathematical analysis. The situation, experience, preferences of the manager, and availability of resources will determine the forecasting method chosen.

5. The Accuracy of Forecasting Methods

Statistical science in forecasting is becoming increasingly sophisticated. Do more complex statistical methods guarantee better forecasting accuracy?

The answer turns out to be interesting. The sophistication of statistical methods does not guarantee better accuracy. Simple statistical methods are no worse than sophisticated statistical methods. Accuracy that involves qualitative considerations will likely improve forecasting because statistical methods will appear more mechanical.

The following table shows the results of accuracy research using several methods using data from 1978 and 1979.

Table 4.6
Accuracy of Forecasting Methods

Forecasting Method		Ranking	
Analyst Consensus	1		1
Individual Analyst	2		2
Linear Trend Model	3		4
Classic Exponential Model	5		5
Modified Exponential Model	4		3

From Table 4.6. It can be seen that analyst consensus, that is, the estimates of several analysts combined, is the most accurate method. Analysts will use a lot of qualitative considerations in addition to quantitative methods. These methods are always ranked first. More sophisticated statistical methods, such as the exponential method, are no more accurate than simpler statistical methods, such as the linear trend.

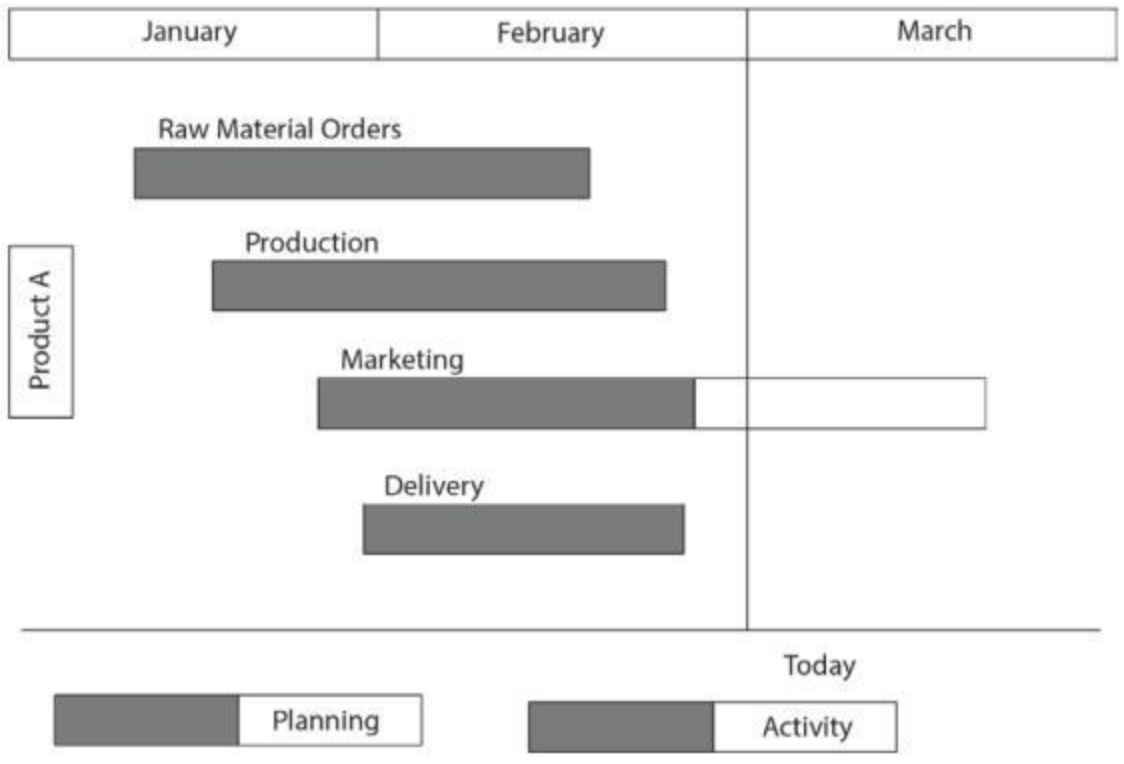
If simpler statistical methods are not worse than sophisticated statistical methods, why are sophisticated statistical methods still used? Agency problems in this case may be the answer. Academics prefer sophisticated statistical methods because they illustrate the severity and rigour of an article or paper. Severity will be valued more highly by academics, even though it may not seem necessary.

C. SCHEDULING TOOLS

1. Gantt Chart

The Gantt chart was developed by Henry L. Grantt (1861-1919),[1] considering a module on the development of management theory. The chart is used to schedule the activities to be carried out by the organization. An example of a Gantt Chart can be seen in Figure 4.7 below.

1 Some of Gantt's books can be accessed through the following websites: https://mosaicprojects.com.au/Resources_Papers_158.html



Source: Arranged by the Author

Figure 4.7
Gantt Figure

The plan is made with a special symbol, and then the implementation is marked by filling in the activity boxes. From the schedule, it can be seen that the marketing activities are a little late because the filling is behind the current day line.

Gantt charts are useful for monitoring simple and less complex activities. For complex activities, when the activity components are interconnected, Gantt charts can no longer be used. It is better to use the PERT method.

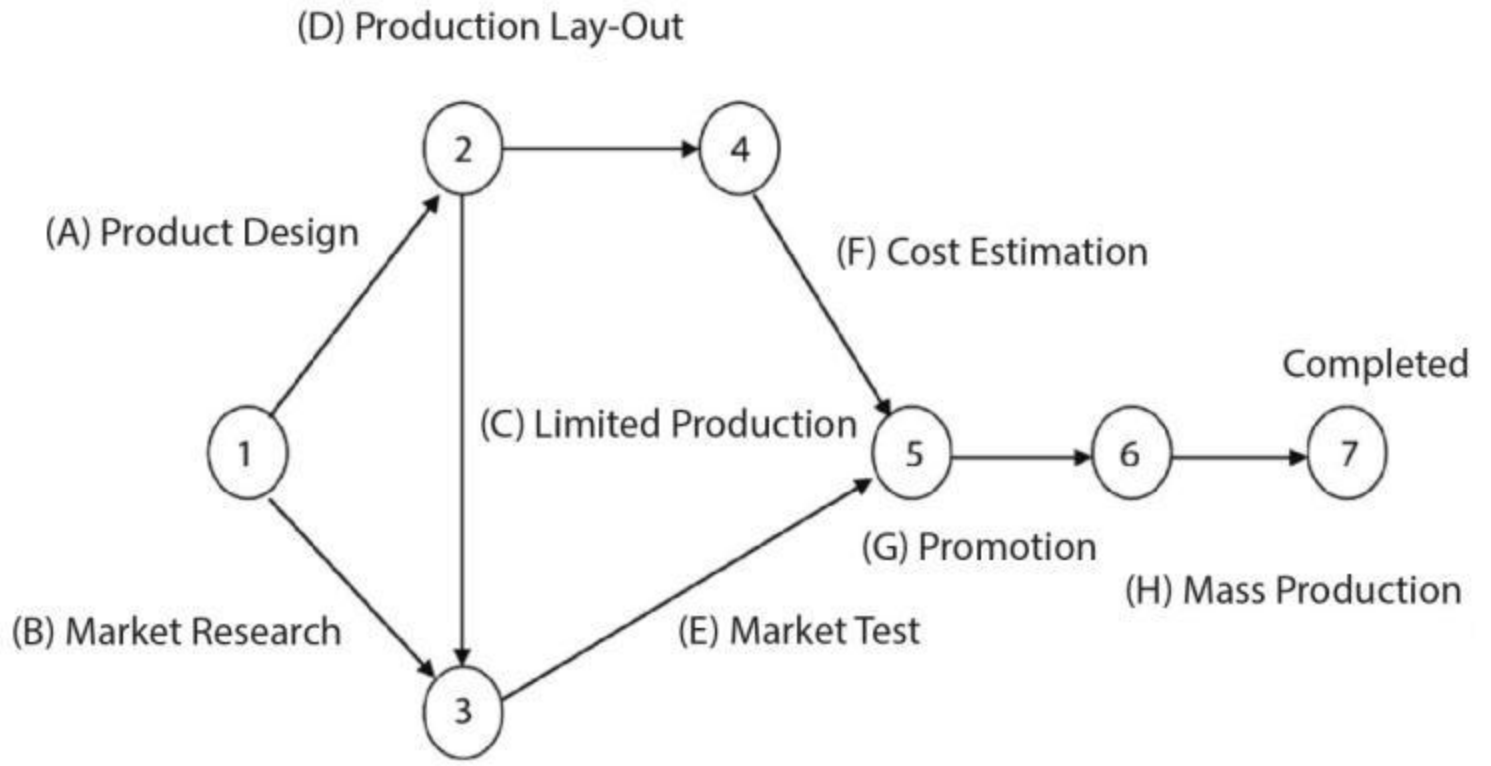
2. PERT (Program Evaluation and Review Technique)

The PERT method was developed when the United States Navy was developing submarines in the 1950s. More than 3,000 contractors and agents were involved, and many were doing multiple jobs. All work had to be coordinated. To cope with the task, the Navy project team with Lockheed and management consultants Booz, Allen & Hamilton developed the PERT method for planning and controlling the project activities. In PERT, the required steps are as follows.

a. Identify the activities to be performed that are required to complete a project.
b. Develop a network that shows the links between these activities. The order of activities is determined at this stage—which work comes first, and which work can be completed independently of other work?
c. Calculating the time required to complete a particular job. There are usually three kinds of time: optimistic, reasonable, and pessimistic. The expected time is then calculated by combining the three kinds of time estimates.
d. Draw a work network. In the network, circles represent events, which will be connected by arrows, forming paths.
e. The work network is then analyzed. Possible bottlenecks are identified. The longest path is also identified. This is called the critical path. The other paths are referred to as subcritical paths.

f. Using the network for project control.

An example of PERT can be seen in Figure 4.8 below. The PERT is used to supervise a project to manufacture a new product.



Source: Arranged by the Author

Figure 4.8
PERT

Table 4.7 below summarizes the activities required and the estimated time, which consists of an optimistic time, a pessimistic time, and the most probable time. Then, the expected time is calculated by weighting the three as follows:

$$\frac{Output\left(self\right)}{} =<> \frac{Output\left(others\right)}{}$$

For product design, the expected time is (2 + (4 x 2,5) + 3)/6 = 2,5.

Table 4.7
Activity Time in PERT

Activities	Explanation	Previous Activity	Optimal Time	Pessimistic Time	Probable Time	Expected Time
Product Design	-	-	2	3	2,5	2,5
Market Research	-	-	2	4	3	3
Limited Production		A	1	2	1,5	1,5
Layout Preparation		A	1	2	1,5	1,5
Production		D,C	3	5	4	4

Activities	Explanation	Previous Activity	Optimal Time	Pessimistic Time	Probable Time	Expected Time
Market Test		D	1	2	1,5	1,5
Cost Estimation		F	2	4	3	3
Promotion		G	2	4	2,5	2,7
Mass Production						

The critical path is A-C-E-G-H which has a total time of 13.7 months. The other sub-critical paths are identified as follows:

A-D-F-G-H = 11,2 months
B-E-G-H = 12,7 months

The project will be completed in 13.7 months at the earliest, which represents the time required to complete the critical path. The sub-critical path is a path that has more time slack because it takes less time compared to the critical path. If the resources on this path can be moved (when not in use) to the critical path, the critical path can be shortened. Overall project completion can be shortened, which means savings are obtained. In addition to savings, PERT is useful for coordinating the necessary activities.

D. DECISION-MAKING AIDS

1. Positive and Negative Picture (T-Chart)

A T-Chart, or Positive and Negative Picture, is a presentation of points related to a particular decision. A T-Chart, for example, can be represented by a list of the positives and negatives of a particular decision. By presenting the positives and negatives of a particular decision, all aspects related to the decision are expected to be included in our analysis.

To illustrate, let's say we are evaluating the purchase of a luxury car (Mercedes, BMW, or Lexus). We can present the positives and negatives of the car purchase, as in the following Table 4.8.

Table 4.8
Analysis of the Positives and Negatives of Car Purchases

Positives	Negatives
A car is a more comfortable and safer vehicle	Expensive maintenance
It may improve our reputation among our clients.	• Expensive and excessive need for gasoline • Expensive insurance • Less agile or practical due to its size

Once all the positives and negatives are written down, we can analyze them and decide whether or not to buy the luxury car.

Another alternative in the model is to compare two options and present the positives and negatives of each alternative. As an illustration, suppose a manager is considering whether to design an advertisement by himself or use the services of an advertising agency. The following Table 4.9 presents a summary that can be used to analyze the two alternatives.

Table 4.9
Analysis of the Positives and Negatives of Ad Design

Self-Design	Advertising Agency
Have a better understanding of the product's details and target consumers (market)	More professional and better ad design
Less expensive	Advertising Agency has broader experience
Less time-consuming	Advertising Agency has a better media network, so it can provide more appropriate media input
More consistent with other outgoing advertisements	

Source: Arranged by the Author

We can also add other variations, for example, by including more than two alternatives. In the preceding example, the manager may have three options: self-design, use of an advertising agency, or a combination of own staff and an advertising agency. Then, the positive side of each alternative can be presented. Another variation is to include the negative side of each alternative.

2. Multi-Criteria Matrix

With this technique, we will present a number of criteria related to a particular decision alternative, give a score to each criterion, and add up the scores. The alternative with the highest score is the most attractive alternative. As an illustration, suppose we are going out of town (from one city to another). There are three alternatives: taking an airplane, a train, or a bus. Next, we may develop the criteria that we will consider in relation to the trip. Suppose the criteria are convenience, time, cost, and safety. For each criterion, the maximum score is 100. Then, we score each criterion for the three alternatives above. The following Table 4.10 summarizes the results of the scoring.

Table 4.10
Multicriteria Scoring Analysis

Criteria	Maximum Score	Air Plane	Train	Bus
Convenience	100	80	85	60
Time	100	90	60	50
Cost	100	60	70	90

Criteria	Maximum Score	Air Plane	Train	Bus
Safety	100	80	85	70
	Total	**310**	**300**	**270**

Table 4.10 shows that airplanes have the highest score, while buses have the lowest. Thus, the alternative of taking an airplane is the most attractive one.

Further development can be done by giving different weights to each criterion (see the previous section on multicriteria). Suppose, in the example above, we give different weights for each criterion. For example, since this is a business trip, when we have a meeting at the head office the next day, the time criterion is the most important. The cost criterion is the least important criterion because the cost of the official trip is covered by the company.

Table 4.11
Multi-Criteria Analysis Using Weights

Criteria	Maximum Score	Air Plane	Train	Bus
Convenience	0,2	80	85	60
Time	0,5	90	60	50
Cost	0,1	60	70	90
Safety	0,2	80	85	70
Total	**1**	**83**	**71**	**60**

For each alternative, the total score can be calculated as follows.

Airplane = (0,2 x 80) + (0,5 x 90) + (0,1 x 60) + (0,2 x 80) = 83
Train = (0,2 x 85) + (0,5 x 60) + (0,1 x 70) + (0,2 x 85) = 71
Bus = (0,2 x 60) + (0,5 x 50) + (0,1 x 90) + (0,2 x 70) = 60

From these calculations, the airplane alternative retains the highest score. When compared to the other options, this one is the most appealing.

3. Pay-Off Matrix

Payoff matrices are useful to aid decision-making. The matrix consists of several alternative decisions and their possible outcomes. The risk or uncertainty of each decision alternative can then be analyzed. Here is an example of such a matrix.

Table 4.12
Sales Scenario

Economic Condition	Good	Moderate	Recession	Expected Result
Probability	25%	50%	25%	
Alternative 1	10.000.000	7.500.000	5.000.000	7.500.000
Alternative 2	25.000.000	10.000.000	2.000.000	11.750.000
Alternative 3	50.000.000	15.000.000	-5.000.000	18.750.000

Suppose the manager faces three kinds of alternatives, namely 1, 2, and 3. Then, there are three economic scenarios, namely good, moderate, and recession. The probability of each alternative is 25 percent, 50 percent, and 25 percent. For each alternative, the expected outcome is:

$$Alternative\,1 = (25\% \times 10.000.000) + (50\% \times 7.500.000) + (25\% \times 5.000.000) = 7.500.000$$

$$Alternative\,2 = (25\% \times 25.000.000) + (50\% \times 15.000.000) + (25\% \times -5.000.000) = 11.750.000$$

$$Alternative\,3 = (25\% \times 50.000.000) + (50\% \times 15.000.000) + (25\% \times -5.000.000) = 18.750.000$$

Alternative 3 appears to provide the highest expected profit of 18,750,000. Usually in such situations, there is a trade-off between gains and losses. High profits are accompanied by high risks. From Table 10 above, it appears that the fluctuation in the level of profit for alternative 3 (the highest level of profit) is the largest, while the fluctuation in profit for alternative 1 is the smallest. To formally calculate the fluctuation, the standard deviation can be used, which is calculated as follows:

Alternative 1

Variants:

$$25\% \times (10\,million - 7,5\,million)^2 + 50\% \times (7,5\,million - 7,5\,million)^2 + 25\% \times (5\,million - 7,5\,million)^2 = 1.562.500$$

Deviation Std= 1.250

Alternative 2

Variants:

$$25\% \times (25\,million - 11,75\,million)^2 + 50\% \times (10\,million - 11,75\,million)^2 + 25\% \times (2\,million - 11,75\,million)^2 = 69.187.500$$

Deviation Std = 8.318

Alternatif 3

Variants:

$$25\% \times (50\,million - 18,75\,million)^2 + 50\% \times (15\,million - 18,75\,million)^2 +$$
$$25\% \times (-5\,million - 18,75\,million)^2 = 392.187.500$$

Deviation Std = 19.803

It can be seen that alternative 3 has the highest standard deviation, which means it has the highest risk. The trickiest problem with this method is finding the right probability for each scenario. In this case, the historical method combined with the manager's judgement can be used.

4. Linear Programming

Linear programming is an optimization technique aimed at finding the optimal combination of materials or resources used to produce certain products. Linear programming is appropriate when we want to maximize something (for example, profit) with some constraints.

Suppose we have the following problem:

Table 4.13
Production Composition

Amount of required materials	Product X	Product Y	Supplies Maximum
Material A	10	6	150
Material B	4	4	80
Profit Margin	25	40	

The company will produce two products, X and Y, using two inputs, A and B. Input A has a 150-item inventory, while input B has an 80-item inventory. The company cannot use more than these inventories. The profit margin is 25 (product X) and 40 (product Y). To produce product X, 10 inputs A and 4 inputs B are required; for product Y, 6 inputs A and 4 inputs B are required.

The problem can be formulated as follows.

Maximum :	25 X + 40 Y	(Total profit margin)
Restrictions:	10 X + 6 Y <	= 150 (Material A restriction)
	4 X + 4 Y <	= 80 (Material B restriction)

The problem above can be solved using a graph, which can be depicted as shown in Figure 4.9 below.

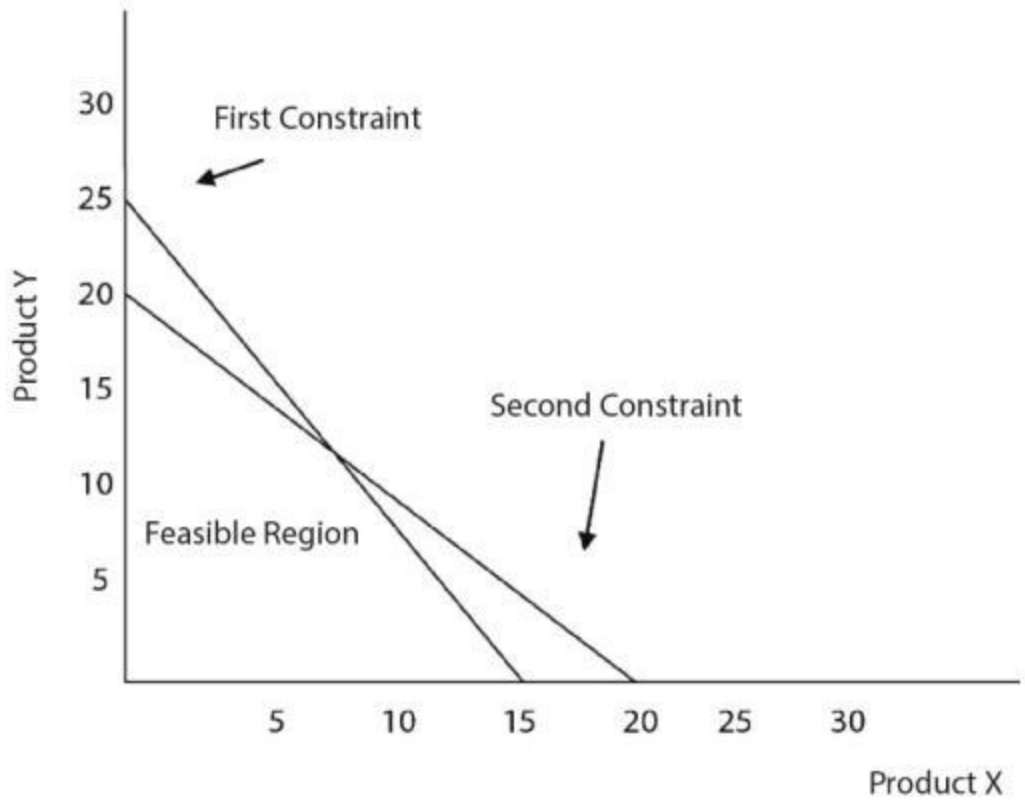


Figure 4.9
Programming Graph

From Figure 4.9 above, it can be seen that the feasible region is restricted by points C, E, and B, as well as the starting point. To find which point is the most optimal, we can calculate as follows:

Point C: (0 X and 20 Y), total profit margin = (0 x 40) + (20 x 30) = 600
Point E: (8 X and 12 Y), total profit margin = (8 x 40) + (12 x 30) = 680
Point B: (15 X and 0 Y), total profit margin = (15 x 40) + (0 x 30) = 600

From these calculations, point E is the optimal point, as it generates the maximum profit, which is 680.

The use of the graphical model is simple, but it can only be used for two products. If you have more than one product, you must use another method. To solve this problem, the simplex method can be used.

5. Break-Even Analysis

Break-even analysis aims to see to what extent or how many products must be sold in order to break even (total sales equal total costs, or profit equals zero). With such an analysis, managers can find out the minimum sales so that the company does not lose money. The formula for calculating the break-even point is:

$$\text{Break - even point} = \frac{\text{Total fixed Costs}}{\text{Sales Price / Unit - Variable Cost / Unit}}$$

For example, if the fixed cost is Rp100,000, the sales price per unit is set at Rp50, the variable cost per unit is Rp30, the break-even point is:

Break-Even point = 100.000 / (50 - 30) = 5.000 unit

If the company sells fewer than 5,000 units, it will incur a loss. If the company sells 5,000 units, the profit received is zero, as shown below.

Sales	$= 5.000 \times 50$	$= 250.000$
Total Cost	$= (5.000 \times 30) + 100.000$	$= \underline{250.000}$
Net profit		0

If the company manages to sell more than 5,000, it will make a profit. The more units sold, the higher the profit earned. Figure 4.10 below shows the break-even point analysis.

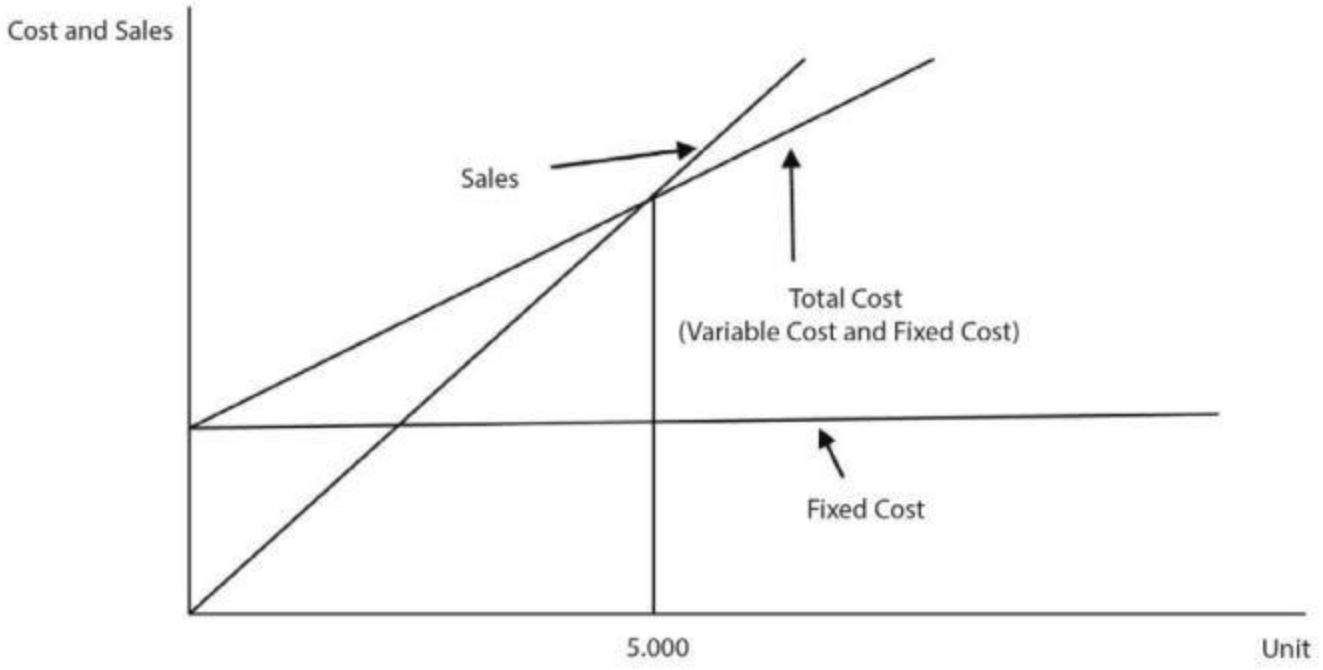


Figure 4.10
Break-Even Point Analysis

The break-even analysis is quite simple and is able to give an idea of how much product must be sold for the company to avoid making a loss. But the model has some drawbacks as its variables, such as costs, sales price, and fixed costs, are assumed to be constant for all sales levels. For some situations, this assumption is adequate. When production levels reach full capacity, variable costs may change. Fixed costs also often do not behave in a fixed manner. For example, if sales increase, new machinery or equipment must be brought in, and sales personnel must be increased. Sale prices can also change, for example, if there are price discounts or quantity discounts (bulk discounts). In practice, it is also not easy to determine the behavior of costs, whether they are fixed costs or variable costs. If production reaches more than one year, break-even analysis has the disadvantage of not considering the time value of money. The time value of money means that money received now is worth more than money received in the future.

6. Decision Tree

Decision trees are a useful technique for decisions that have a sequence. For example, a manager may face the alternatives of launching a sedan, a commercial car, or not launching a car, each with their own follow-up consequences. If the company makes a sedan, it can only utilize the domestic market; if it makes a commercial car, it can export the product. Figure 4.11 below shows a picture of such a decision tree.

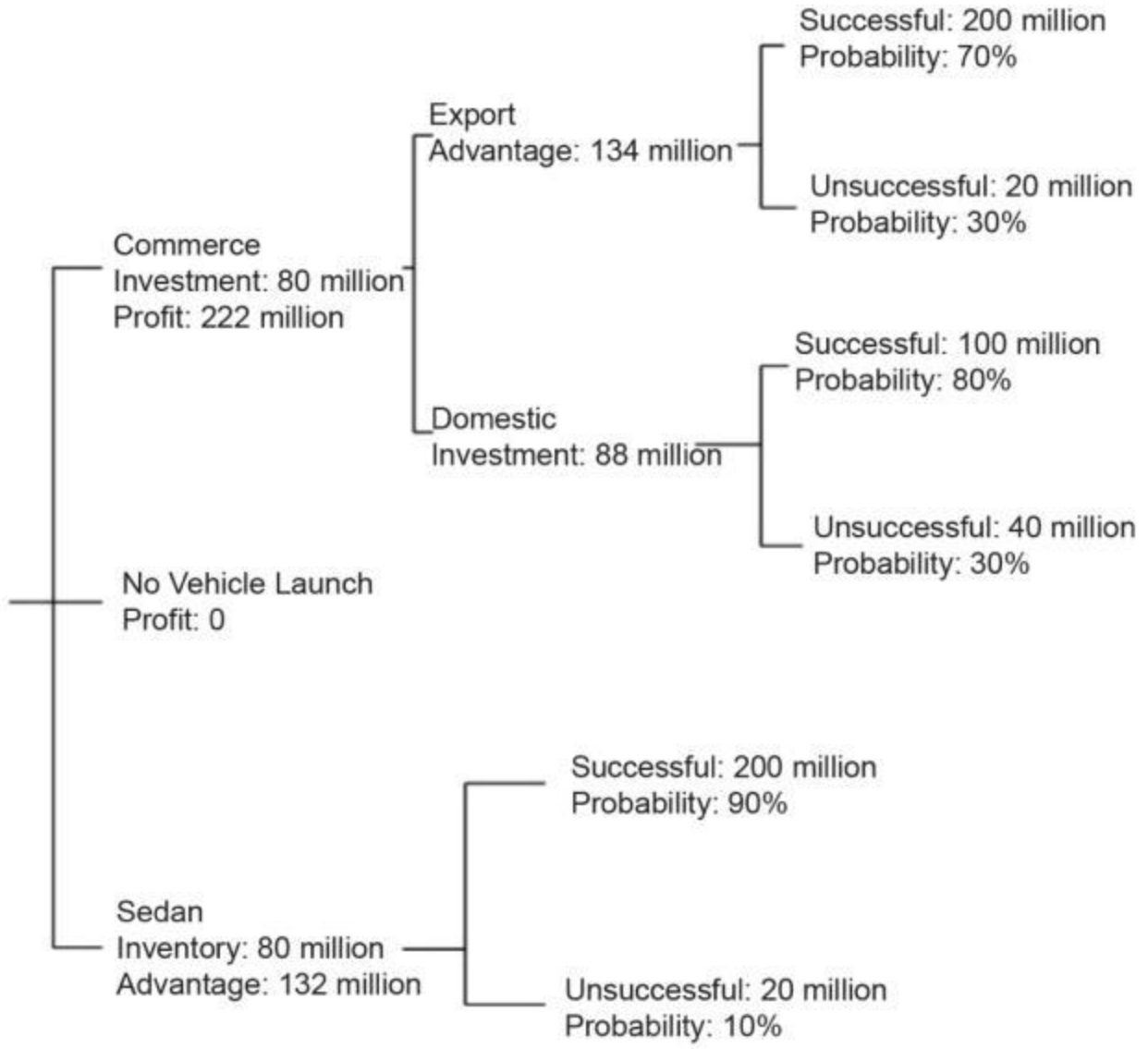


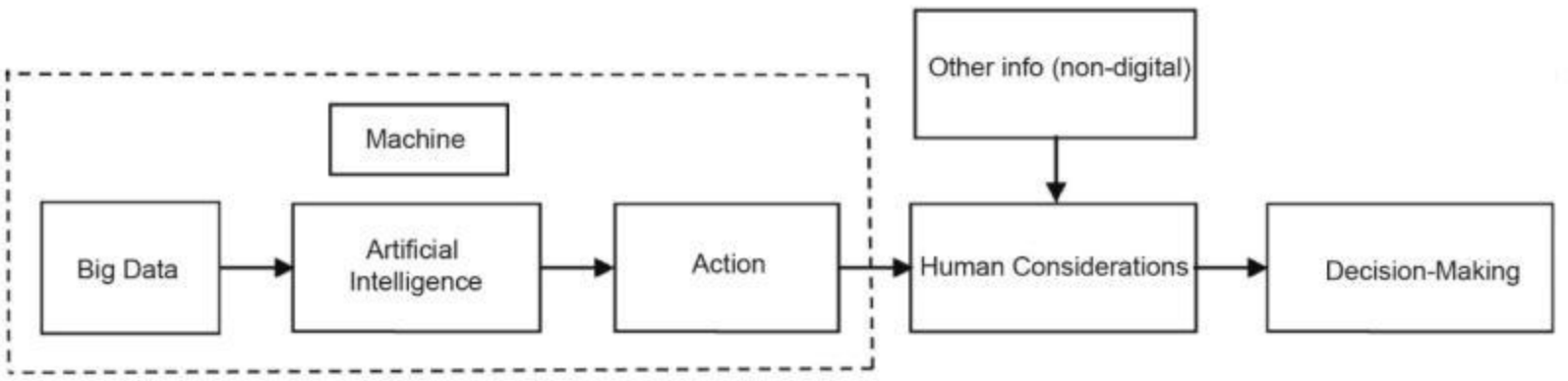
Figure 4.11
Decision Tree

Since the situation at hand varies, the probability of each scenario also varies. For commercial products, the expected profit from exports is 134 million, while the expected profit from the domestic market is 88 million. Thus, the total profit is 222 million. With an investment of 80 million, the net profit earned is 142 million. If the company produces sedans, the net profit level is 132 million - 50 million = 132 million.

Decision trees are useful because managers can estimate the effect of a decision on several possible future outcomes. The problem with such methods is the difficulty in determining the right scenario. For example, if the company makes commercial cars, it has the opportunity to penetrate the market further. Once the export market is dominated, managers have the opportunity to enter the sedan into the export market. The commercial market alternative thus becomes much more attractive. Another difficulty is determining the probability of occurrence, just like when using a payoff matrix.

7. Machine-Based Decision Making Model

As discussed earlier, humans are prone to many biassed behaviors. Can we reduce these biases so that more optimal decisions can be made? Nowadays, digital technology is growing. These technologies can be used to assist decision-making. These technologies can reduce human behavioral biases. Figure 4.12 depicts the model of involved decision-making.



Source: Colson, 2019

Figure 4.12
Decision-Making Model Involving Digital Machines

Figure 4.12 shows the combination of machines and humans to generate business decisions, which are expected to be superior. Current technology enables us to collect huge amounts of data. Furthermore, current technology has made it possible to dynamically process this large amount of data. For example, statistical software such as SAS can read up to 10 million rows of data. However, the characteristics of the database are static. Suppose we want to read data from social media and the internet, looking for topics that are trending. Certain software will read the data on the internet and social media, which contains enormous amounts of data. The same data also changes rapidly, making it dynamic. Tools (such as the internet of things) and software are now able to collect and process data on the internet and social media, so that current trending topics can be detected.

The picture above starts with a huge amount of data collected by machines. These machines, through various types of artificial intelligence, then filter information into simpler forms that can be managed by humans (managers). There are several ways that machines can utilise them, for example, by processing databases, both static and dynamic, using distributed ledger systems such as blockchain and others. AI (Artificial Intelligence) can process big data into simple and more useful information for managers. Artificial intelligence can process data into, for example, reorder points (concerning inventory), consumer distribution by geographic region, products, so that targeting strategies can be optimized, trending issues, and others. The summarized information can then be further processed with, for example, spreadsheets, dashboards, and other analytical tools. Afterwards, the summarized information can be used for decision-making and presented in a format that is more suitable for decision-making needs. The model above shows a data-driven workflow. The processed information will

then be combined with the manager's judgment to produce a business decision. Human judgment cannot be completely eliminated. The combination of objective decisions or suggestions generated by machines and managers' considerations, which are more subjective in nature, is expected to result in a better decision-making process. Some aspects are difficult for machines to enter, such as company values, vision and mission, ethics and morals, and other aspects. These aspects will be handled by the judgment and wisdom of the manager. The bias of human behavior can be reduced through data from machines, which is objective, while the wisdom and judgment of managers, which is subjective, can be maintained. The combination of the two is expected to result in a good decision-making process and the right decision.

Exercise

To understanding of the material above, please complete the following exercise!

1) Explain why the quantitative approach is becoming more beneficial!
2) Describe the scientific management process!
3) Explain how to use the moving average method!
4) Explain how to use the exponential smoothing method!
5) What does least square mean in regression?
6) Explain the difference between time-series forecasting and causal forecasting!
7) Explain the difference between regression and econometrics!
8) What does jury of selection method mean?
9) Explain the Delphi method! What type of situations is it suitable for?
10) Explain how a Gantt chart is created!
11) Explain how to use PERT! What are the benefits of PERT?
12) What are the benefits of pay-off matrix?
13) Explain how to use linear programming!
14) Explain what a decision tree is!
15) xplain how machines, through the use of artificial intelligence, can help with decision-making!

Key Ideas for Exercise Answer

You can answer these questions based on Learning Activity 2 of Module 4 as well as references from the internet.

Summary

Statistical and mathematical models can help managers perform their duties. An increasingly uncertain environment and complex organization cause managers to seek greater control over their environment. In this case, planning tools can help managers. The scientific management process begins with problem definition, modeling, algorithm development, and implementation. Some of the planning tools discussed in this Learning Activity assist managers in forecasting, scheduling, and decision-making activities.

Forecasting can be done both quantitatively and qualitatively. In quantitative terms, there are two types of forecasting: time series and regression. Time series assume no influence from outside the predicted variable, while regression assumes the influence of outside variables on the predicted variable. Forecasting can also be done qualitatively. Several methods can be used, including the jury of selection method, the sales force composition method, the Delphi method, multi-criteria analysis, and customer evaluation.

Scheduling can be done with a Gantt Chart, which can be used for simple jobs. For complex, interrelated work, PERT analysis can be employed. There are several kinds of decision-making tools, such as pay-off matrices, linear programming, break-even analysis, and decision trees. Each tool has its own advantages and disadvantages; the use of the tool depends on the situation at hand. The new model combines machines and managers' judgment to produce a good decision-making process and correct decisions..

TERMS INDEX		
Statistics	Delphi	Subcritical pathway
Mathematics	Multi-criteria	Expected time
Scientific management	Customer evaluation	Pay-off matrix
Forecasting	Causal Forecasting	Expected profit
		expected
Time series	Regression	Standard deviation
Moving average	Econometrics	Linear programming
Exponential smoothing	Least square	Break-even analysis
Box Jenkins	Gantt chart	Decision Tree
Jury of Selection	PERT	
Sales-force-composition	Critical path	
Analyst Consensus	Artificial Intelligence	

Formative Test 2

Choose the correct answer!

1) The following are examples of statistical programs (software), *except* ....
   A. SAS
   B. SPSS
   C. Microsoft Word
   D. Stata

2) The following is an example of a quantitative forecasting method using causal forecasting ....
   A. box-jenkins
   B. multicriteria
   C. moving average
   D. regression

3) Suppose our sales data for the last six years as follows:

Year	Sales
1	10000
2	12000
3	13000
4	14000
5	15000
6	17000

Using the two-year moving average method, what is the sales forecast for year seven?
   A. 11000
   B. 12500
   C. 11666.7
   D. 17000

4) The company formulates the regression of trend effect on sales as follows.

$$Y = 2000 + 1{,}5\ (\text{Year}) + e$$

Where the base value for year is the number of years, i.e. 2000, 2001, and so on. What is the sales forecast for 2020?
   A. 5030
   B. 2030

C. 2000
D. cannot be calculated

5) Promotions affect sales, but in setting promotions, companies use future sales targets. In other words, sales are also affected by promotions. The appropriate statistical method to solve the above problem is ....
A. moving average
B. econometrics
C. regression
D. exponential smoothing

6) The method in which managers are gathered and asked for their opinions on future sales is called ....
A. jury of executive opinion method
B. sales-force-composition
C. moving average
D. Gantt chart

7) In PERT analysis, the path that takes the longest time is called ....
A. critical path
B. subcritical path
C. standard path
D. substandard path

8) The statistical tool in which we seek the optimal output by resolving a specific objective with a number of constraints, is called ....
A. Linear Programming
B. Delphi
C. Regression
D. PERT

9) Suppose a company has fixed costs of Rp100 million, and the per-unit price and variable costs are Rp10 and Rp5, respectively. What is the break-even point?
A. 25.000.000 units
B. 20.000.000 units
C. 20.000.000 rupiah
D. 25.000.000 rupiah

10) The human-machine combination model for decision-making will be useful as it ....

A. can replace managers' judgment
B. generates huge amount of information
C. can reduce managers' behavioral biases
D. uses sophisticated and expensive machines

Use key answers for Formative Test 2 which is located at the end of this module to determine the correctness of your answer. To make sure your mastery of the learning materials use the following formula.

$$\text{Level of mastery} = \frac{\text{Number of correct answers}}{\text{Number of test item}} \times 100$$

Level of master is as follows

<70%	70% - 79%	80% - 89%	90% - 100%
lower than expected	adequate	good	very good

When you attain level of mastery 80% or more, very good, you may continue to the next module. Otherwise you have to review the material of Learning Activity 2. Pay attention to parts which you don't master yet.

CASE

RJ Reynolds' Smokeless Cigarettes

Tobacco companies are always trying to find ways to maintain and increase cigarette consumption. Usually, innovations are made around the standard cigarette, for example, by developing several cigarette brands or by changing the tar content of the cigarette. Tar is a compound produced when tobacco is burned. For example, there are clove cigarettes, white cigarettes, and others. Clove cigarettes have a higher tar content compared to white cigarettes.

In 1988, public pressure against smoking became stronger. In addition to active smokers, passive smokers (people who inhale cigarette smoke even though they do not smoke) are also expected to face the same risks as those who smoke. A US cigarette company, RJ Reynolds, decided to launch smokeless cigarettes with the brand name Premier. The company spent about $325 million to make the smokeless cigarettes.

Then, problems arose. First, the flavor of smokeless cigarettes was terrible. Some smokers did not like the taste of the cigarettes. Then, the cigarette was not easy to use. Lighting the cigarette was not easy as well. Puffing had to be done with force. There were also rumors that smokeless cigarettes could be used to smoke drugs. RJ Reynolds certainly did not want to be associated with a company that aided drug use. The public was also against the cigarette, as it was perceived as a modern device that would attract young people. The point is, smokers didn't like the cigarettes. Non-smokers also had no reason to use the smokeless cigarettes. In other words, there was no market for the smokeless cigarettes. In the end, Premier halted its production and marketing.

However, the smokeless cigarette story continues. In the mid-1990s, concerns over passive smoking led the company to believe there was still a market for smokeless cigarettes. In 1996, RJ Reynolds poured another $125 million into developing a new version of Premier. The version was branded Eclipse. The new cigarette produced less smoke than the standard cigarette. The cigarette does not burn tobacco. Instead, charcoal heats the tobacco. In this way, the smoke produced was only 10% of the smoke in normal cigarettes and promised lower levels of tar and nicotine.

The controversy continues. Some research suggests that Eclipse cigarettes are safer than standard cigarettes. However, other studies refute this. Eclipse cigarettes are just as harmful as other cigarettes. The research that claimed Eclipse was safer was funded by the company, so the company was seen as attempting to manipulate the research findings. In the end, Eclipse also failed to reach the market. RJ Reynolds tried to make a cigarette product that smokers didn't like, but it couldn't attract non-smokers to buy cigarettes with less smoke. RJ Reynolds should not have continued the Eclipse product after the failure of Premier.

Discussion Questions

1. Evaluate the decision-making process at RJ Reynolds for making smokeless cigarettes.
2. Why did RJ Reynolds continue a failed product, Premier cigarettes, with Eclipse cigarettes, which also end up failing in the market? Is there any behavioral bias among RJ Reynolds' managers?
3. What should RJ Reynolds have done to avoid such a bad decision?

Answer Key to Formative Test

Formative Test 1

1) B
2) B
3) D
4) B
5) B
6) A

Formative Test 2

1) C
2) D
3) A
4) A
5) A
6) A
7) A
8) B
9) C
10) C

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