KFUPM BUSINESS SCHOOL

كلية الأعمال
جامعة الملك فهد للبترول والمعادن

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

BUSINESS SCHOOL

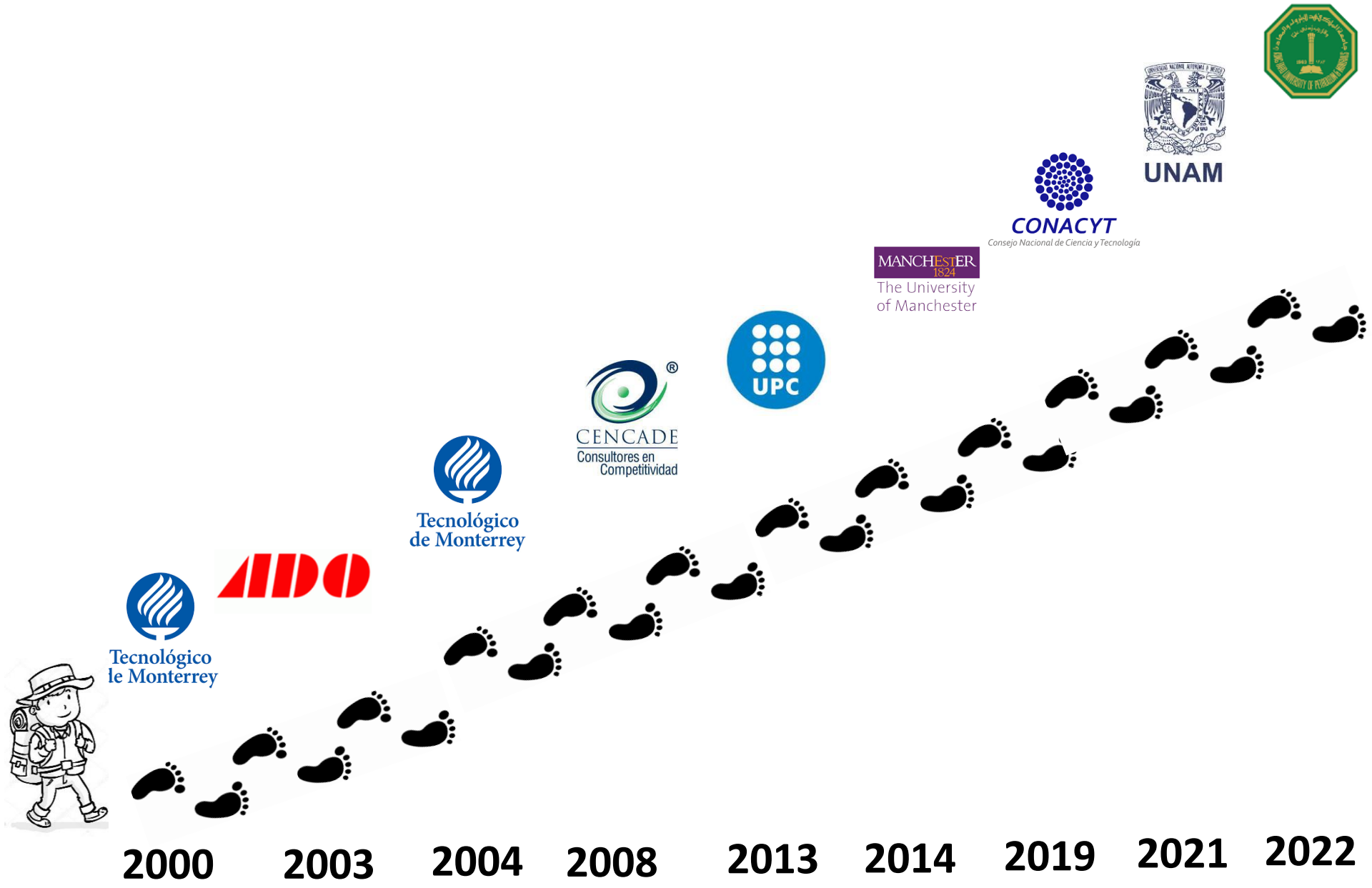
DEPARTMENT OF INFORMATION SYSTEM & OPERATIONS MANAGEMENT

MANAGEMENT SCIENCE OM 511

01 – Introduction to Management Science

DHAHRAN, SAUDI ARABIA

About Igor


Tecnológico
le Monterrey
ADO
Tecnológico
de Monterrey
CENCADE
Consultores en
Competitividad
UPC
MANCHESTER
1824
The University
of Manchester
CONACYT
Consejo Nacional de Ciencia y Tecnología
UNAM
2000
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2022


ESTADOS UNIDOS MEXICANOS


PRINCIPIA PUEBLA
TERMINA OAXACA


CAT
GAME DAY


ماراثون الرياض
سباق للجميع
RIYADH MARATHON
A RACE FOR ALL
PRESENTED BY
مقدّم من
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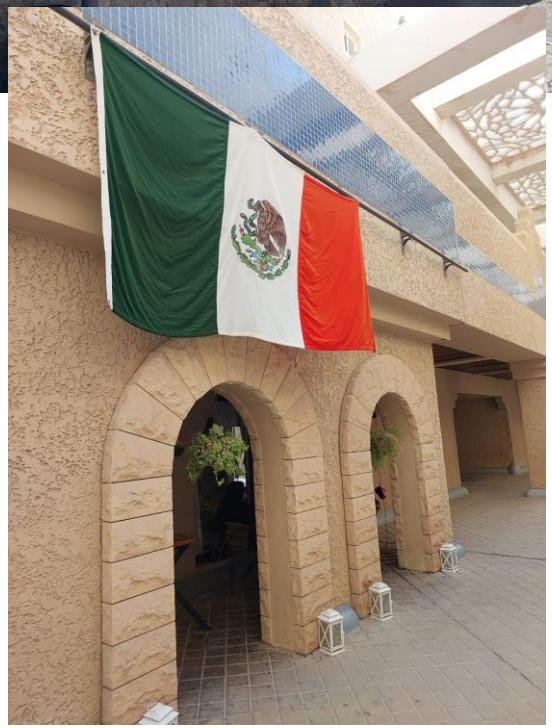
ماراثون الرياض
RIYADH MARATHON



Presentation of the class

Name

Age

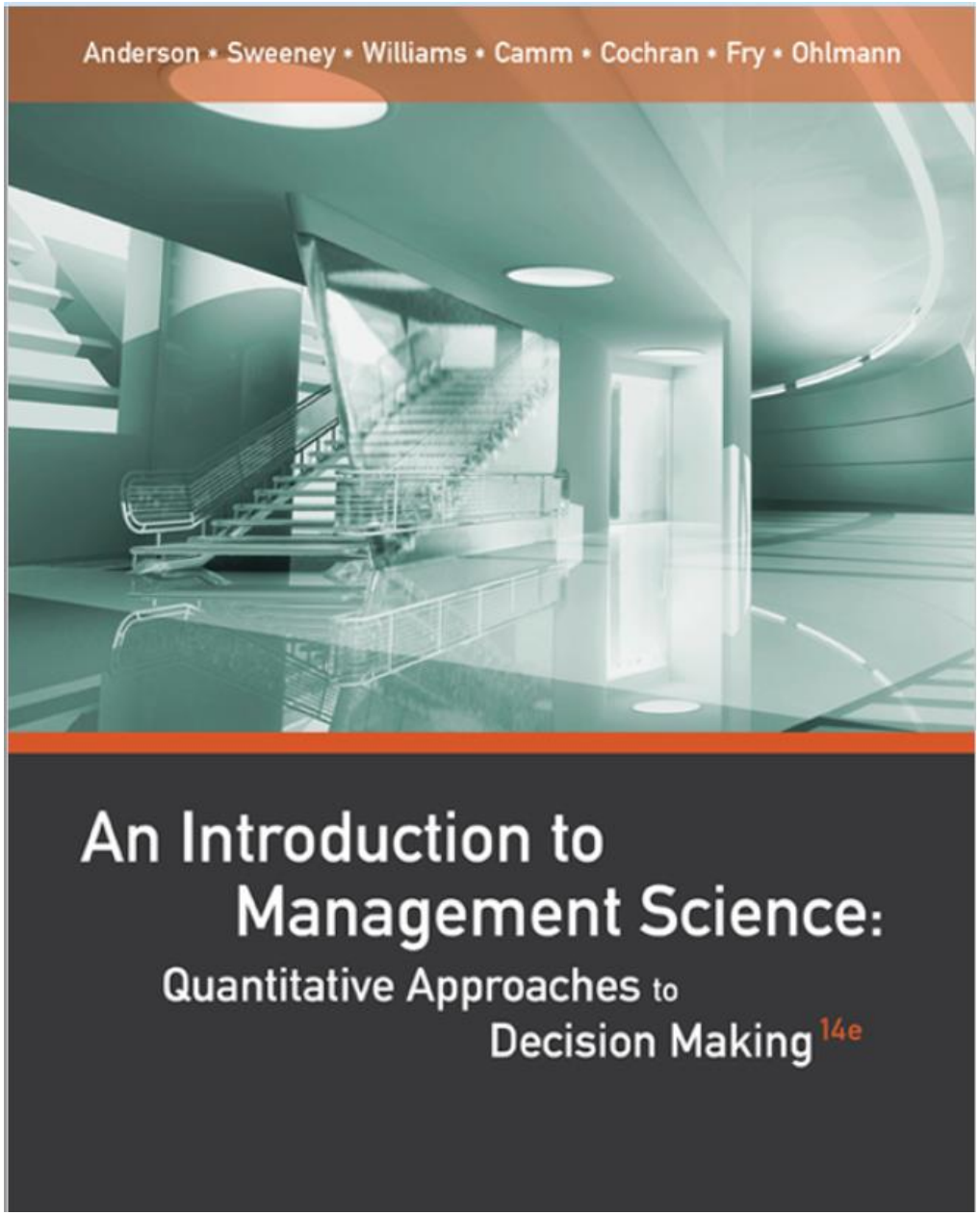
City of origin

Previous studies and preparation

Present position and related work experience)

Course expectations

Textbook 1


Anderson • Sweeney • Williams • Camm • Cochran • Fry • Ohlmann
An Introduction to
Management Science:
Quantitative Approaches to
Decision Making 14e

WAYNE L. WINSTON | S. CHRISTIAN ALBRIGHT

SIXTH EDITION

PRACTICAL Management Science

Software


Excel


python

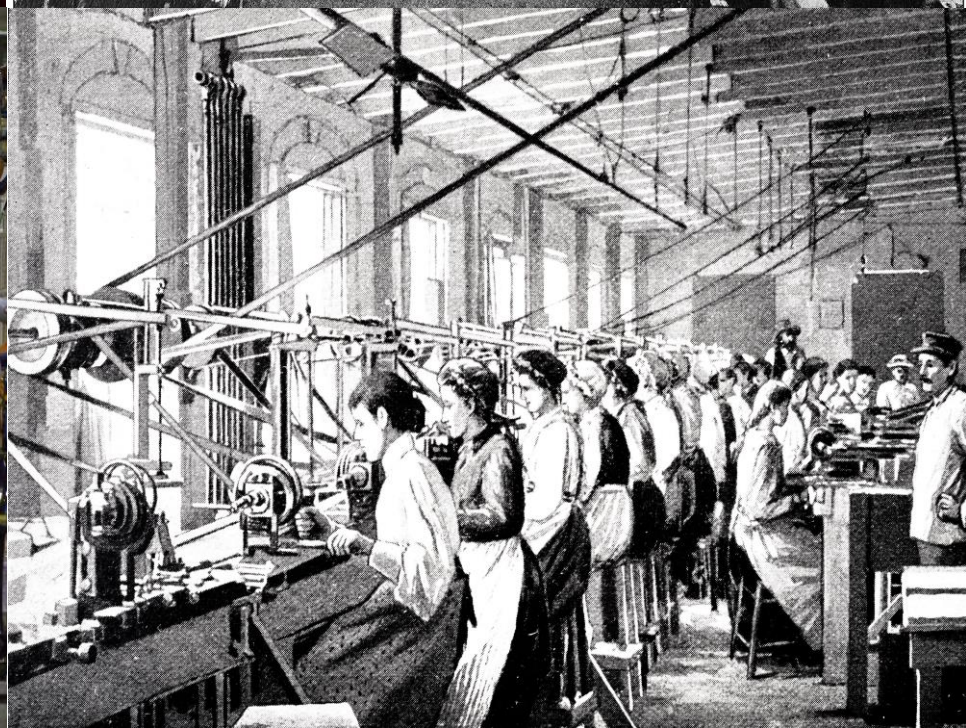

python
jupyter
ANACONDA

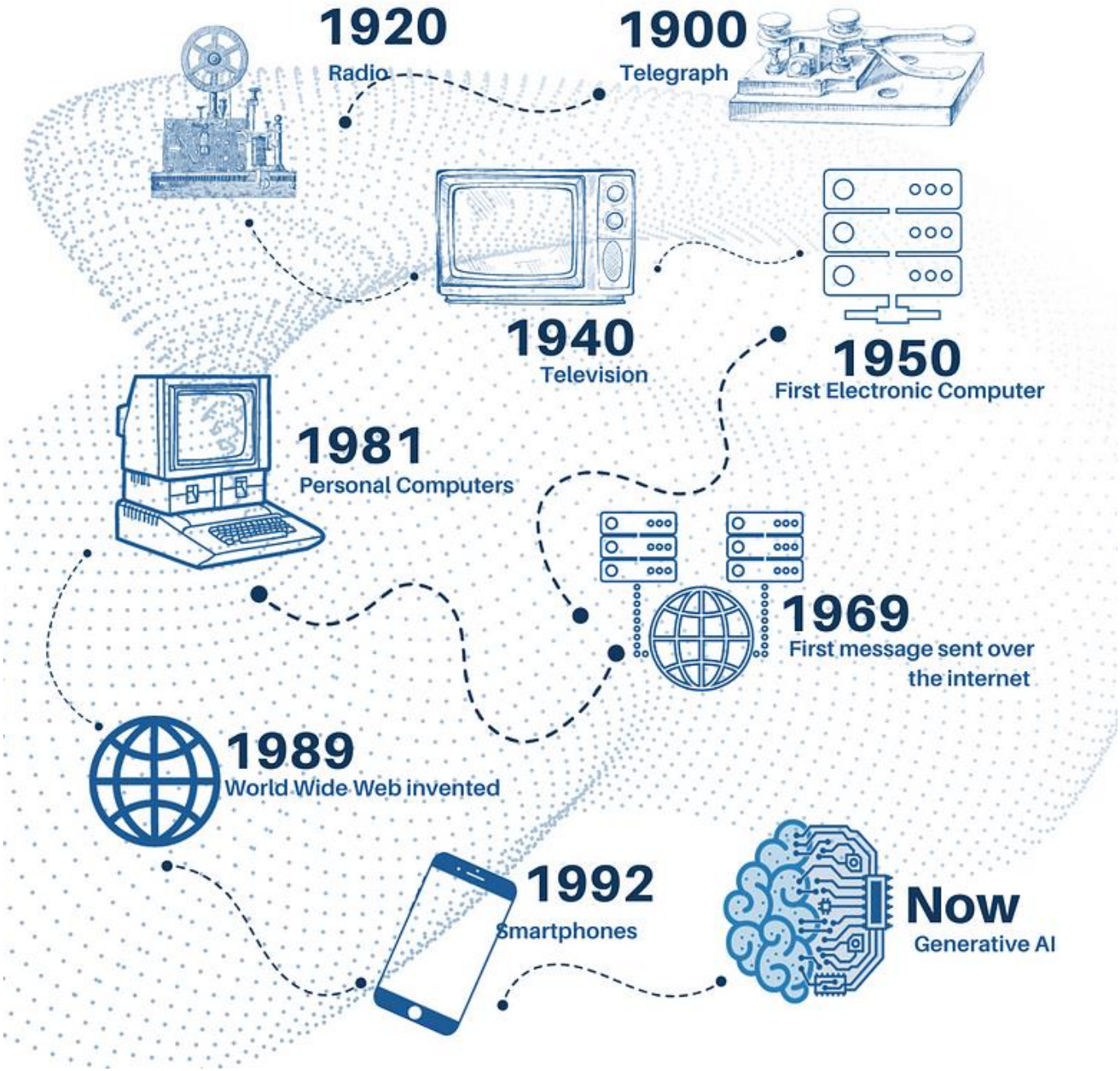

R Programming


R Studio

Introduction to management Science

- MS is an approach to decision making based on the scientific method. **It makes extensive use of quantitative analysis**
- The terms **management science, operations research,** and decision science interchangeably.
- The scientific management revolution of the early 1900s, initiated by **Frederic W. Taylor**, provided the foundation for the use of quantitative methods in management




1920
Radio
1900
Telegraph
1940
Television
1950
First Electronic Computer
1981
Personal Computers
1969
First message sent over the internet
1989
World Wide Web invented
1992
Smartphones
Now
Generative AI


Verbatim
A Kodak Company
MD2-D
Teflon® Protection
RMATTED for IBM PC's, XT's and
er 360 KB systems.
disk no:
DataLifePlus
®Teflon is a DuPont registered trademark
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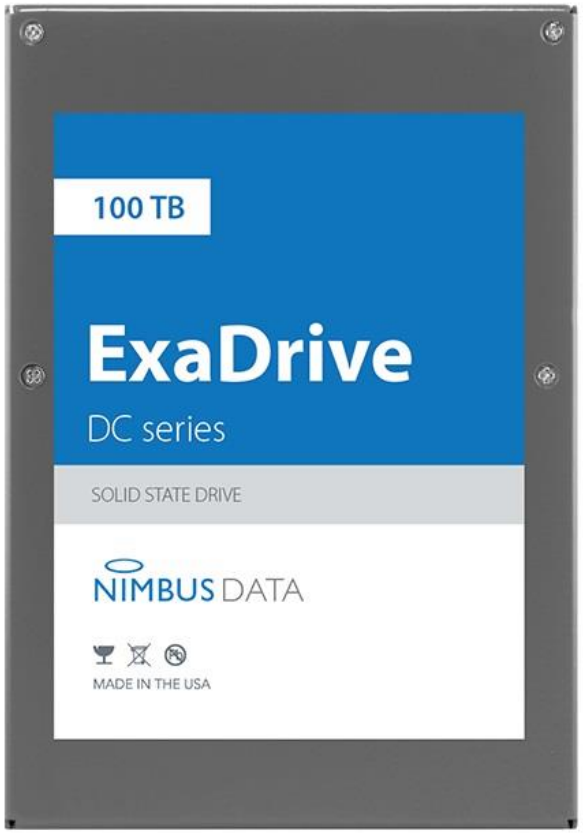


360 KB fits into 10 TB approximately 27,777,778 times

Introduction to management Science

F.W. TAYLOR (1856-1916)
Father of Scientific Management

Taylor believed that the industrial management of his day was amateurish, that management could be formulated as an academic discipline.

Best results would come from the partnership between trained and qualified management and a cooperative and innovative workforce.

Each side needed the other and there is no need for trade unions.

What Management science is?

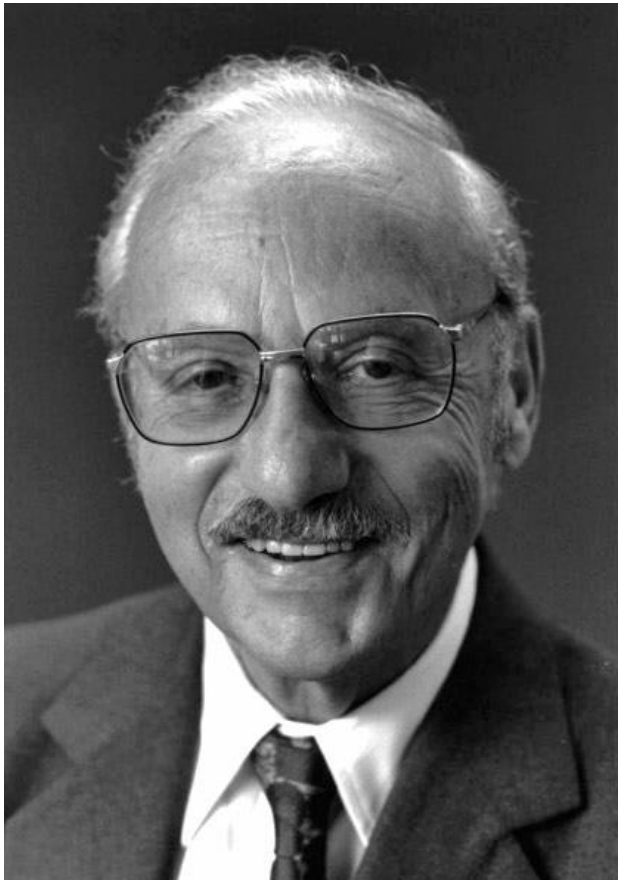
Introduction to management Science

Introduction to management Science

Developments that occurred during the post–World War II period led to the growth and use of **management science in nonmilitary applications**

The most significant development was the discovery by **George Dantzig**, in 1947 of the simplex method for solving linear programming problems.

The computer technology explosion continues; smart phones, tablets and other mobile-computing devices can **now be used to solve problems larger than those solved on mainframe computers in the 1990s**.



George Dantzig, (born Nov. 8, 1914, Portland, Ore., U.S.—died May 13, 2005, Stanford, Calif.), American mathematician who devised the simplex method, an algorithm for solving problems that involve numerous conditions and variables, and in the process founded the field of linear programming.

Management Science

Management Science is an interdisciplinary field that applies mathematical models, statistical analysis, optimization techniques, and other scientific methods to improve decision-making, efficiency, and productivity within organizations.

It focuses on developing and applying analytical models to solve complex business problems, manage resources effectively, and optimize processes to achieve organizational goals.

Management Science

Interdisciplinary: Combines various disciplines to address organizational challenges.

Analytical Models: Utilizes mathematical models and statistical analysis for problem-solving.

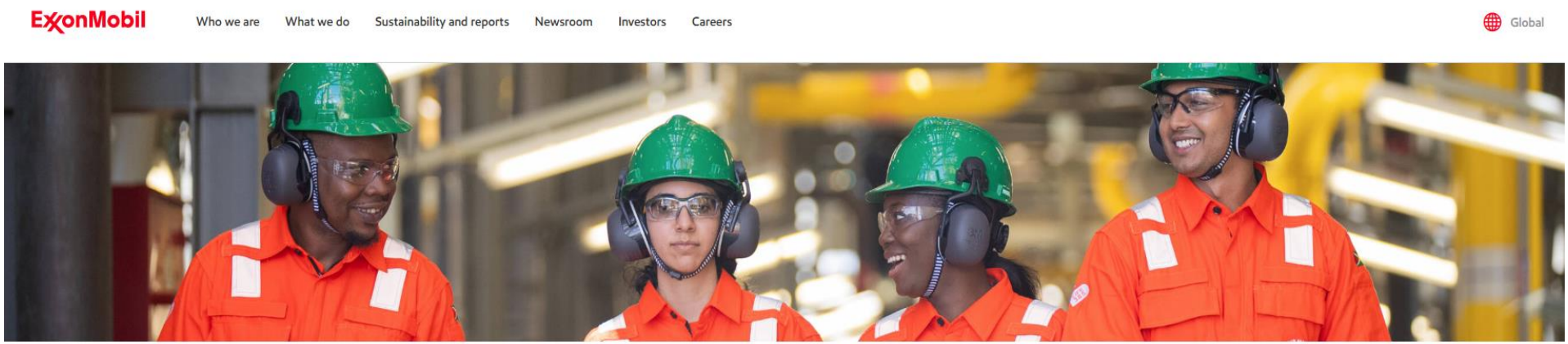
Optimization Techniques: Applies methods to enhance decision-making and efficiency.

Resource Management: Focuses on effective resource utilization within organizations.

Goal-Oriented: Aims to optimize processes to achieve organizational objectives.

Supply Chain Optimization

- ExxonMobil applied advanced supply chain optimization techniques.
- Achieved a reduction in transportation costs globally.
- Optimized crude oil transport from over 30 suppliers to more than 20 refineries by applying optimization models
- Shortened delivery times worldwide.
- Ensured more reliable product availability in key markets like North America and Asia.



Sustainability

Report

Jan. 8, 2024

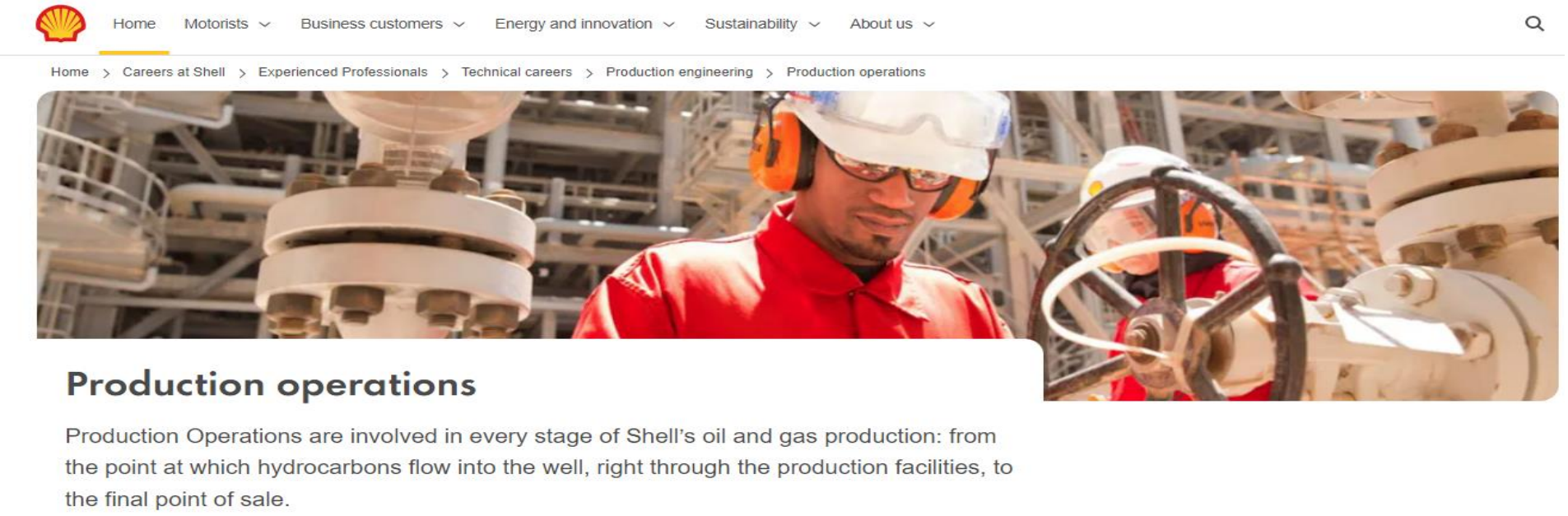
Working with our global supply chain

ExxonMobil applied advanced supply chain optimization

- Achieved a reduction in transportation costs globally
- Optimized crude oil transport from over 30 suppliers to more than 20 refineries by applying optimization models
- Shortened delivery times worldwide
- Ensured more reliable product availability in key markets like North America and Asia

Production Scheduling

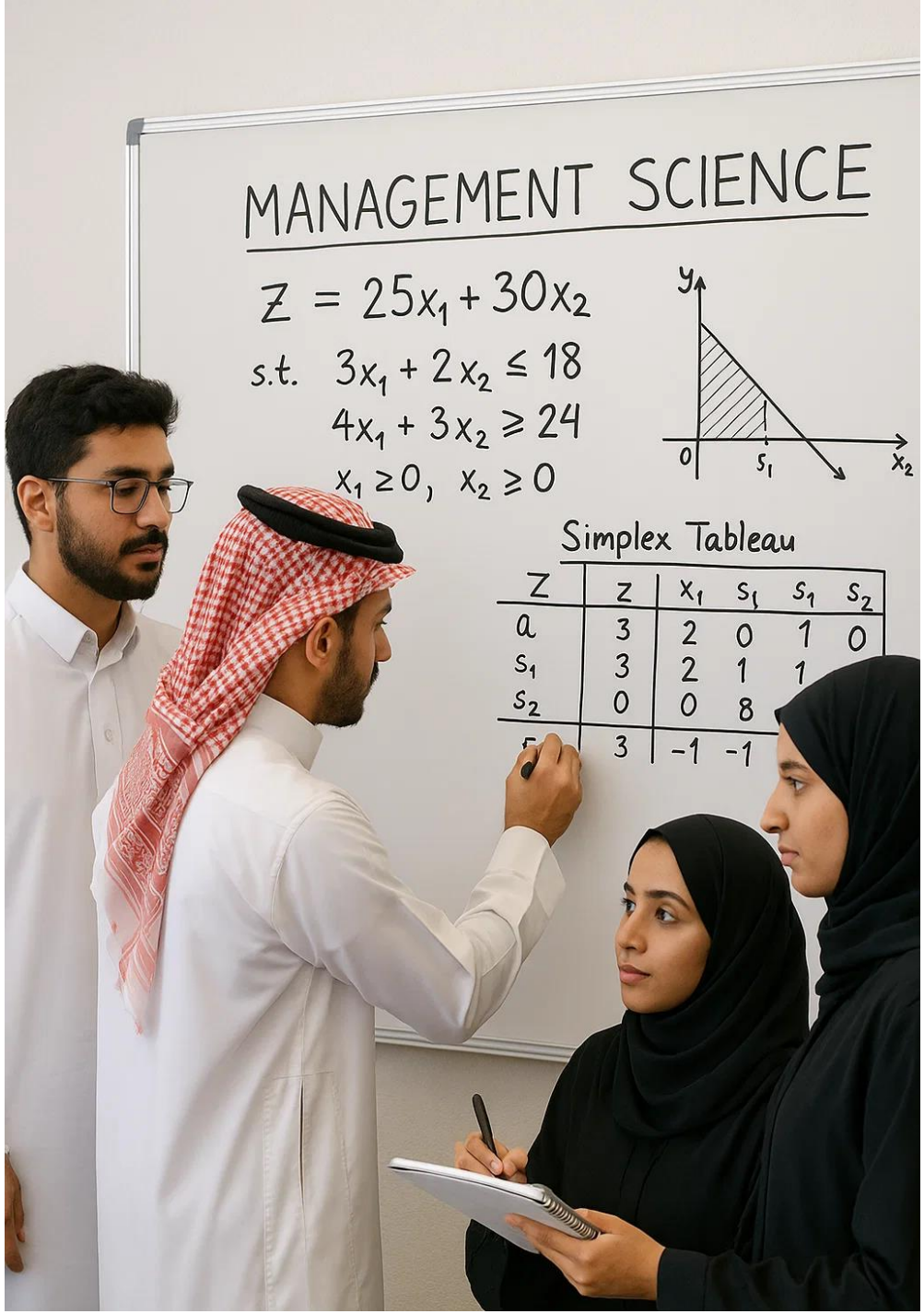
- Shell applied mixed-integer programming for production scheduling at its Pernis refinery in the Netherlands.
- The optimization led to an increase in refinery output without extra capital investment.
- Achieved a reduction in operational costs.
- Enabled the refinery to handle fluctuations in demand for petrochemical products like ethylene and propylene.
- Ensured consistent product supply to customers across Europe.



Risk Management

- Chevron used stochastic modeling and Monte Carlo simulations for risk analysis in a $5 billion investment.
- The analysis accounted for crude oil price fluctuations, ranging from $40 to $100 per barrel over the next decade.
- Thousands of potential scenarios were analyzed to balance risk and return.
- Chevron decided to proceed with the investment based on the analysis.
- The investment is expected to yield a 12% internal rate of return (IRR) under median market conditions.

How I can do Management Science?


MANAGEMENT SCIENCE
Z = 25x1 + 30x2
s.t. 3x1 + 2x2 ≤ 18
4x1 + 3x2 ≥ 24
x1 ≥ 0, x2 ≥ 0
y
0
s1
x2
Simplex Tableau
Z z x1 s1 s1 s2
a 3 2 0 1 0
s1 3 2 1 1
s2 0 0 8
3 -1 -1


LOGISTICS ISSUE
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Problem solving in decision making

Identifying a difference between the actual and the desired state of affairs and then taking action to resolve the difference

1. Identify and define the problem.

2. Determine the set of alternative solutions.

3. Determine the criterion or criteria that will be used to evaluate the alternatives.

4. Evaluate the alternatives.

5. Choose an alternative.

6. Implement the selected alternative.

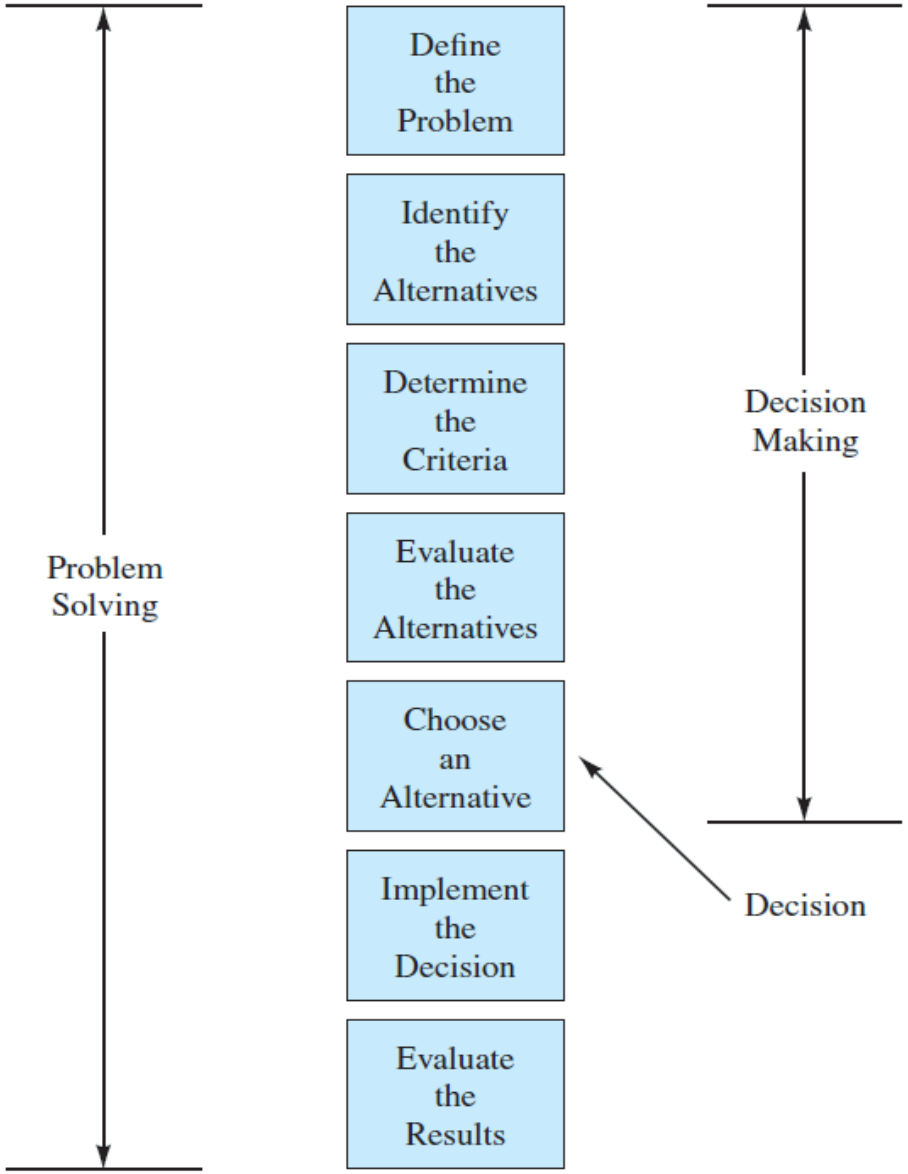
7. Evaluate the results to determine whether a satisfactory solution has been obtained.

Decision making

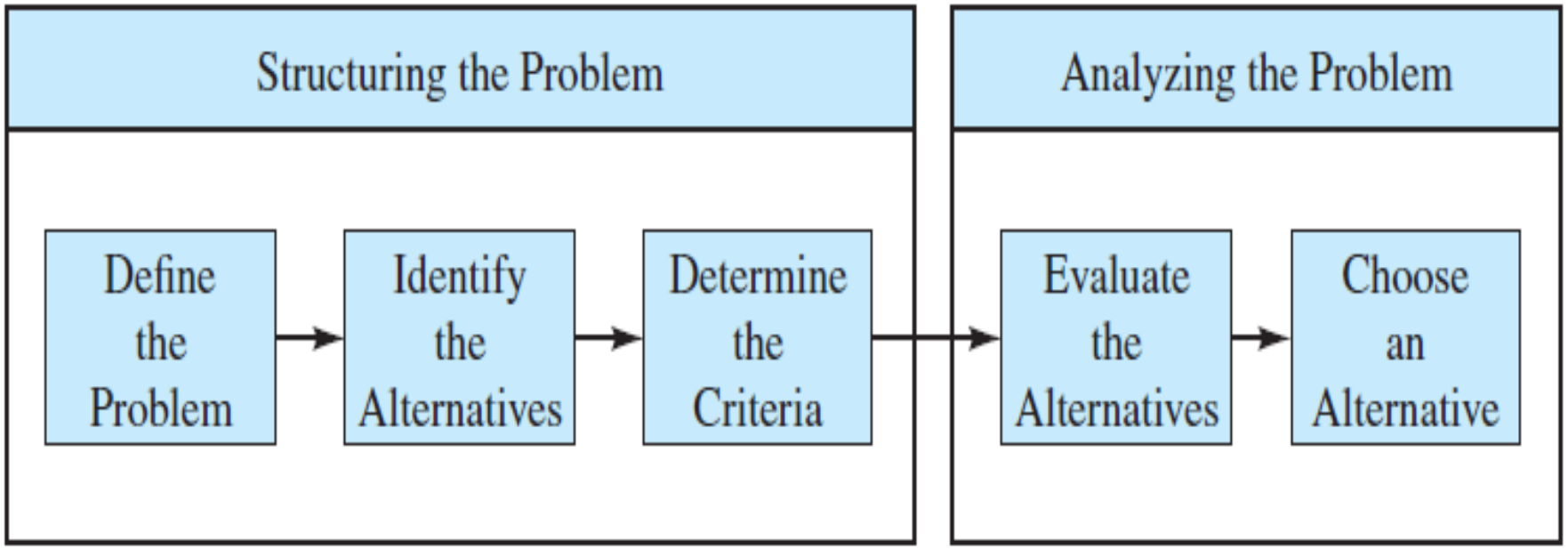
The **first five steps of the problem-solving process are related to decision making**. Its ends with the choosing of an alternative, which is the act of making the decision.

1. Identify and define the problem.
2. Determine the set of alternative solutions.
3. Determine the criterion or criteria that will be used to evaluate the alternatives.
4. Evaluate the alternatives.
5. Choose an alternative.

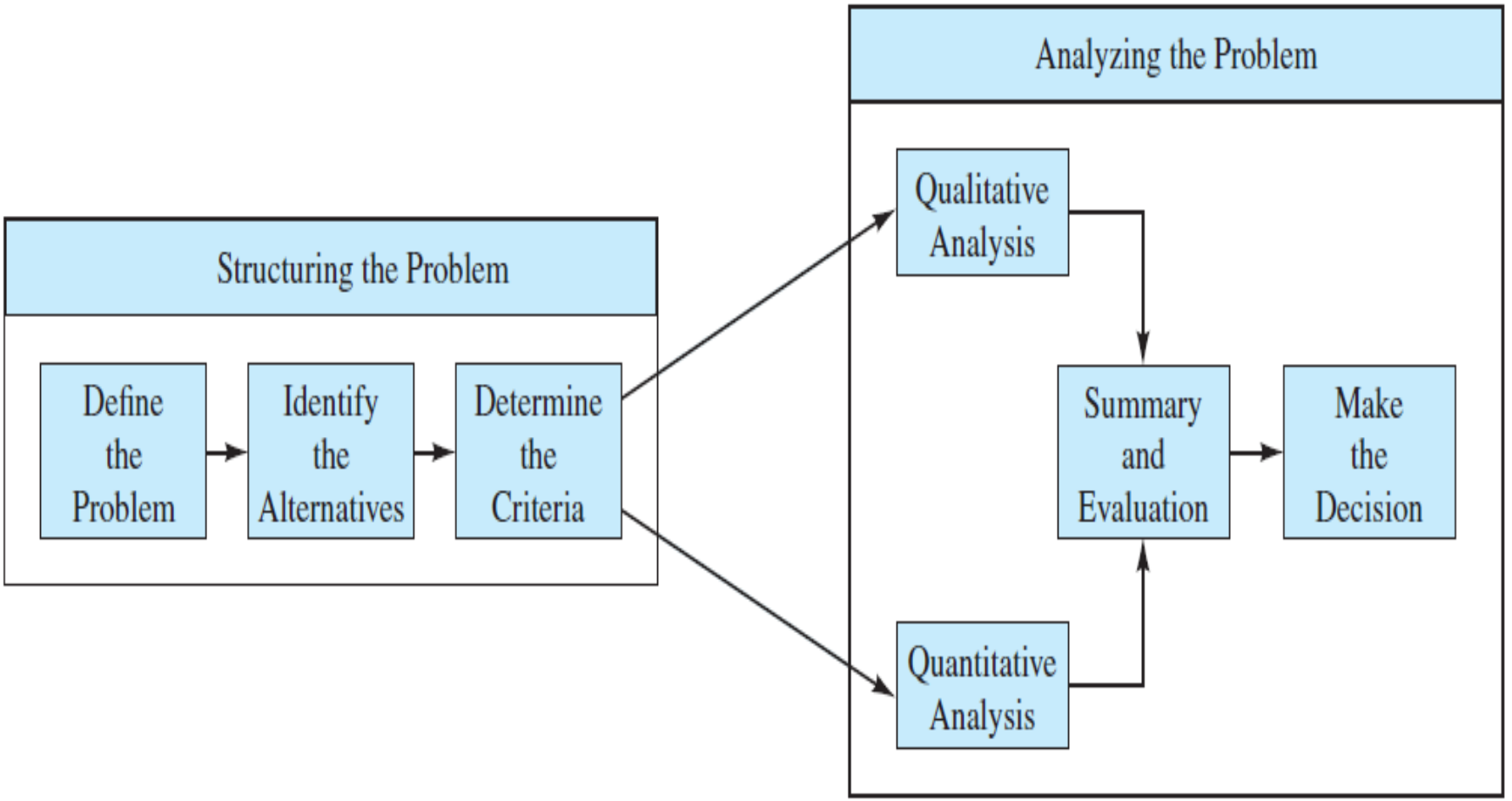
Problem solving and Decision making



Structuring and analysing the problem



Quantitative or Qualitative?



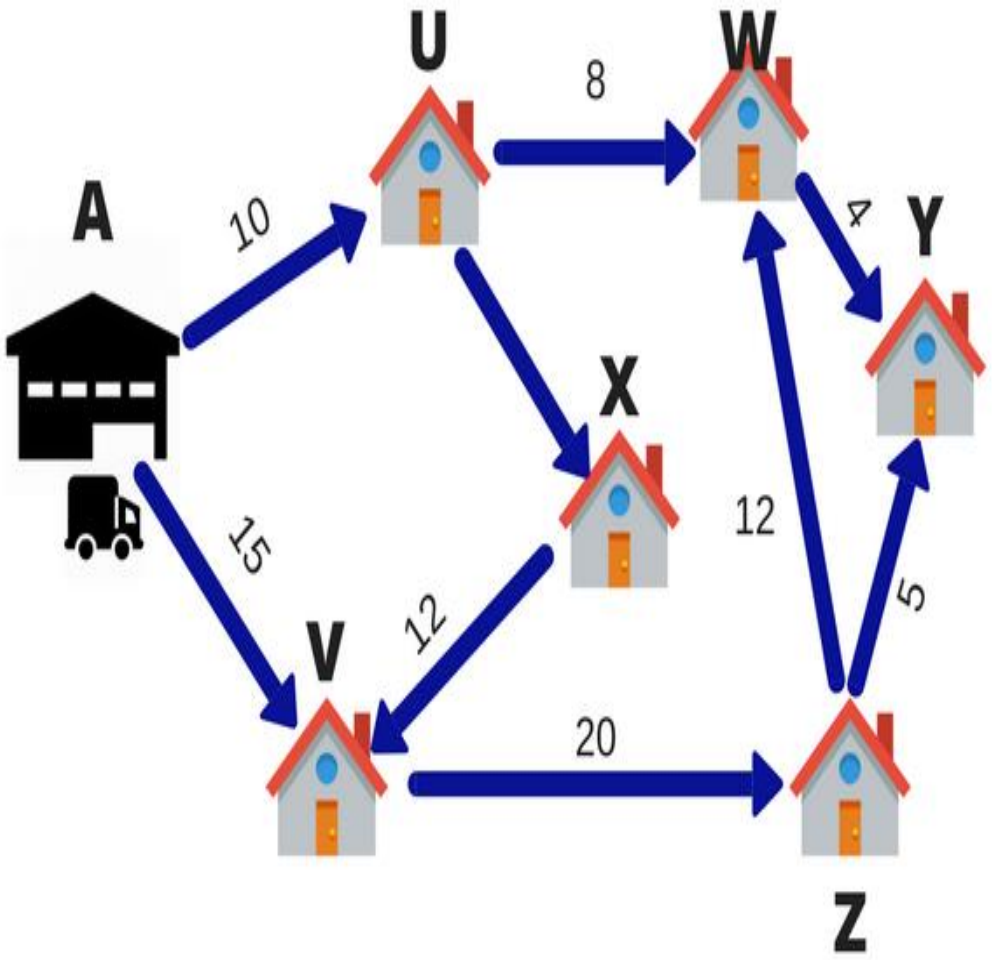
Structuring and analysing the problem

Let's say a FedEx has 6 packages to deliver in a day.

The warehouse is located at point A.

The 6 delivery destinations are given by U, V, W, X, Y, and Z. The numbers on the lines indicate the distance between the cities.

To save on fuel and time FedFex wants to take the shortest route.



Quantitative model

A quantitative model is composed by three basic elements

- Optimal value
- Mathematical expression / Objective function
- Constrains

Mathematical expression

It represents relations between criteria or alternatives through arithmetic operations and symbols

P=10x

$$A = \pi r^2$$

$$f(x) = \frac{P}{10}\pi x^2 + 10x$$

Constrains

The restrictions or limitations on the decision variables. They usually limit the value of the decision variables

$$10y + 20x < 250$$

$$500A + 150B < 560$$

Quantitative model

Par, Inc., is a small manufacturer of golf equipment and supplies whose management has decided to move into the market for medium- and high-priced golf bags. Par Inc.'s distributor is enthusiastic about the new product line and has agreed to buy all the golf bags Par, Inc., produces over the next three months.

After a thorough investigation of the steps involved in manufacturing a golf bag, management determined that each golf bag produced will require the following operations:

1. Cutting and dyeing the material
2. Sewing
3. Finishing (inserting umbrella holder, club separators, etc.)
4. Inspection and packaging

The director of manufacturing analyzed each of the operations and concluded that if the company produces a medium-priced standard model, each bag will require 7/10 hour in the cutting and dyeing department, 1/2 hour in the sewing department, 1 hour in the finishing department, and 1/10 hour in the inspection and packaging department. The more expensive deluxe model will require 1 hour for cutting and dyeing, 5/6 hour for sewing, 2/3 hour for finishing, and 1/4 hour for inspection and packaging. This production information is summarized in Table 2.1.

Par Inc.'s production is constrained by a limited number of hours available in each department. After studying departmental workload projections, the director of manufacturing estimates that 630 hours for cutting and dyeing, 600 hours for sewing, 708 hours for finishing, and 135 hours for inspection and packaging will be available for the production of golf bags during the next three months.

The accounting department analyzed the production data, assigned all relevant variable costs, and arrived at prices for both bags that will result in a profit contribution[1] of $10 for

Quantitative model

TABLE 2.1 PRODUCTION REQUIREMENTS PER GOLF BAG

	Production Time (hours)	
Department	**Standard Bag**	**Deluxe Bag**
Cutting and Dyeing	7/10	1
Sewing	1/2	5/6
Finishing	1	2/3
Inspection and Packaging	1/10	1/4

$$\frac{7}{10}S + 1D \leq 630 \qquad (2.1)$$

$$\frac{1}{2}S + \frac{5}{6}D \leq 600 \qquad (2.2)$$

$$\frac{1}{10}S + \frac{1}{4}D \leq 135 \qquad (2.4)$$

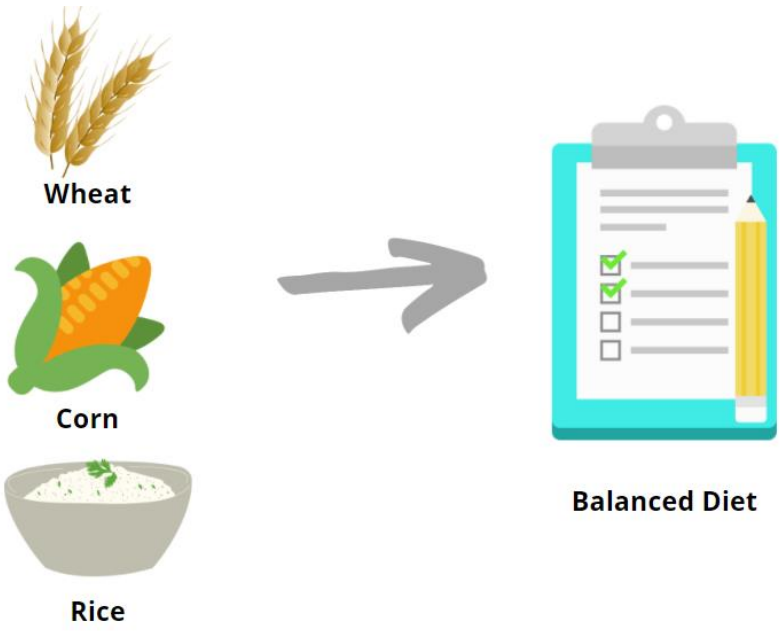
$$S \geq 0 \quad \text{and} \quad D \geq 0 \qquad (2.5)$$

Quantitative model

$$
\begin{aligned}
\text{Max} \quad & 10S + 9D \\
\text{subject to (s.t.)} \quad & \\
& \tfrac{7}{10}S + 1D \leq 630 \quad \text{Cutting and dyeing} \\
& \tfrac{1}{2}S + \tfrac{5}{6}D \leq 600 \quad \text{Sewing} \\
& 1S + \tfrac{2}{3}D \leq 708 \quad \text{Finishing} \\
& \tfrac{1}{10}S + \tfrac{1}{4}D \leq 135 \quad \text{Inspection and packaging} \\
& S, D \geq 0 \qquad (2.6)
\end{aligned}
$$

Management Science

We need to prepare 5,000 healthy meals by minimizing the cost



Nutrient	Wheat	Rice	Corn	Requirements per one meal
Proteins (gr/oz)	40	20	20	At least 27
Carbohydrates (gr/oz)	20	25	21	At least 240
Calories (gr/oz)	90	110	110	No more than 1250
Cost per oz	1.30	0.80	1.80	