CHAPTER 1

Business Environment Factors

FACTOR	DESCRIPTION
Markets	Strong competition
	Expanding global markets
	Blooming electronic markets on the Internet
	Innovative marketing methods
	Opportunities for outsourcing with IT support
	Need for real-time, on-demand transactions
Consumer demand	Desire for customization
	Desire for quality, diversity of products, and speed of delivery
	Customers getting powerful and less loyal
Technology	More innovations, new products, and new services
	Increasing obsolescence rate
	Increasing information overload
	Social networking, Web 2.0 and beyond
Societal	Growing government regulations and deregulation
	Workforce more diversified, older, and composed of more women
	Prime concerns of homeland security and terrorist attacks
	Necessity of Sarbanes-Oxley Act and other reporting-related legislation
	Increasing social responsibility of companies
	Greater emphasis on sustainability

Managerial Decision Making

Management is a process by which organizational goals are achieved by using resources.

The Nature of Managers' Work (Mintzberg's 10 Managerial Roles)

- **Interpersonal**

1. Figurehead
2. Leader
3. Liaison

- **Informational**

4. Monitor
5. Disseminator
6. Spokesperson

- **Decisional**

7 Entrepreneur
8 Disturbance handler
9 Resource allocator
10 Negotiator

Business Pressures–Responses–Support Model

- **Business pressures** result of today's competitive business climate
- **Responses** to counter the pressures
- **Support to** better facilitate the process

Decision-making Process

Managers usually make decisions by following a four-step process (a.k.a. the scientific approach)

1. Define the problem (or opportunity)
2. Construct a model that describes the real-world problem.
3. Identify possible solutions to the modeled problem and evaluate the solutions.
4. Compare, choose, and recommend a potential solution to the problem.

The Concept of DSS

- DSS - interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems
- Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions.

A Framework for Business Intelligence (BI)

- BI is an evolution of decision support concepts over time
  - Then: Executive Information System
  - Now: Everybody's Information System (BI)
- BI systems are enhanced with additional visualizations, alerts, and performance measurement capabilities

Definition of BI

- **BI** is an umbrella term that combines architectures, tools, databases, analytical tools, applications, and methodologies
- **BI** is a content-free expression, so it means different things to different people
- **BI's** major objective is to enable easy access to data (and models) to provide business managers with the ability to conduct analysis
- **BI** helps *transform* data, to information (and knowledge), to decisions, and finally to action

The Architecture of BI A BI system has four major components

1. a data warehouse, with its source data
2. business analytics, a collection of tools for manipulating, mining, and analyzing the data in the data warehouse
3. business performance management (BPM) for monitoring and analyzing performance
4. a user interface (e.g., dashboard)

Analytics Overview

A Simple Taxonomy of Analytics (proposed by INFORMS)

1. Descriptive Analytics
2. Predictive Analytics
3. Prescriptive Analytics

CHAPTER 2

Decision Making: A process of choosing among two or more alternative courses of action for the purpose of attaining a goal(s)

Characteristics of Decision Making

1. Groupthink
2. Evaluating what-if scenarios
3. Experimentation with a real system!
4. Changes in the decision-making environment may occur continuously
5. Time pressure on the decision maker
6. Analyzing a problem takes time/money
7. Insufficient or too much information

Decision Style: The manner by which decision makers think and react to problems

1. perceive a problem
2. cognitive response
3. values and beliefs

Personality temperament tests are often used to determine decision styles

There are many such tests

1. Meyers/Briggs,
2. True Colors (Birkman),
3. Keirsey Temperament Theory, …

Decision-making styles

1. Heuristic versus Analytic
2. Autocratic versus Democratic
3. Consultative (with individuals or groups)

Phases of Decision-Making Process " رسمة سيمون مهمة ارجعولها سلايد ١٦ او ١٧هي تفصيل للمراحل "

Humans consciously or subconsciously follow systematic decision-making process - Simon (1977)

1) Intelligence
2) Design
3) Choice
4) Implementation
5) (?) Monitoring (a part of intelligence?)

- **Decision Making: Intelligence Phase**

Potential issues in data/information collection and estimation

1) Lack of data
2) Cost of data collection
3) Inaccurate and/or imprecise data
4) Data estimation is often subjective
5) Data may be insecure
6) Key data may be qualitative
7) Data change over time (time-dependence)

Modeling: conceptualizing a problem and abstracting it into a quantitative and/or qualitative

- **Decision Making: The Design Phase " له نوعين من الموديلات"**

1) ***Normative models (= optimization)***

– Humans are economic beings whose objective is to maximize the attainment of goals
– For a decision-making situation, all alternative courses of action and consequences are known
– Decision makers have an order or preference that enables them to rank the desirability of all consequences

2) ***Heuristic models (= sub-optimization)***

– The chosen alternative is the best of only a subset of possible alternatives
– Often, it is not feasible to optimize realistic (size/complexity) problems
– Sub-optimization may also help relax unrealistic assumptions in models
– Help reach a good enough solution faster

3) ***Descriptive models***

– Describe things as they are or as they are believed to be (mathematically based)
– They do not provide a solution but information that may lead to a solution
– **Simulation -** most common descriptive modeling method (mathematical depiction of systems in a computer environment)

Decision Making: The Design Phase

Risk

1) Lack of precise knowledge (uncertainty)
2) Risk can be measured with probability

Decision Making: The Choice Phase

Search approaches

1) Analytic techniques (solving with a formula)

2) Algorithms (step-by-step procedures)
3) Heuristics (rule of thumb)
4) Blind search (truly random search)

Additional activities

1) Sensitivity analysis
2) What-if analysis
3) Goal seeking

How Decisions are Supported **Support for the Intelligence Phase**

1) Enabling continuous scanning of external and internal information sources to identify problems and/or opportunities
2) Resources/technologies: Web; ES, OLAP, data warehousing, data/text/Web mining, EIS/Dashboards, KMS, GSS, GIS,…
3) **B**usiness **a**ctivity **m**onitoring (**BAM**)
4) **B**usiness **p**rocess **m**anagement (**BPM**)
5) **P**roduct **l**ife-cycle **m**anagement (**PLM**)

Support for the Design Phase

1) Enabling generating alternative courses of action, determining the criteria for choice
2) Generating alternatives
   - **Structured/simple problems:** standard and/or special models
   - **Unstructured/complex problems:** human experts, ES, KMS, brainstorming/GSS, OLAP, data/text mining

Support for the Choice Phase

1) Enabling selection of the best alternative given a complex constraint structure
2) Use sensitivity analyses, what-if analyses, goal seeking

Support for the Implementation Phase

1) Enabling implementation/deployment of the selected solution to the system
2) Decision communication, explanation and justification to reduce resistance to change

Support for the Implementation Phase

1) Enabling implementation/deployment of the selected solution to the system
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DSS Classifications

(AIS SIGDSS) Classification

1. Communication-driven and group DSS
2. Data-driven DSS
3. Document-driven DSS
4. Knowledge-driven DSS
5. Model-driven DSS

Components of DSS

1. **Data Management Subsystem**
   - Includes the database that contains the data
   - Database management system (DBMS)
   - Can be connected to a data warehouse
2. **Model Management Subsystem** Model base management system (MBMS)
3. **User Interface Subsystem**
4. **Knowledgebase Management Subsystem** Organizational knowledge base

DSS Components: Data Management Subsystem

DSS database - DBMS - Data directory - Query facility

DSS Components: Model Management Subsystem

Model base - MBMS - Modeling language - Model directory - Model execution, integration, and command processor

DSS Components: User Interface Subsystem

1. **Interface :** Application interface - User Interface (GUI?)
2. **DSS User Interface:** Portal - Graphical icons " Dashboard " " Color coding "
3. **Interfacing with PDAs, cell phones, etc.**

CHAPTER 3

- ***What is a Data Warehouse?*** A physical repository where relational data are specially organized to provide enterprise-wide, cleansed data in a standardized format
- "The data warehouse is a collection of integrated, subject-oriented databases designed to support DSS functions, where each unit of data is non-volatile and relevant to some moment in time"

Characteristics of DWs (Data Warehouses)

- Subject oriented | Integrated | Time-variant (time series) | Nonvolatile | Summarized
- Not normalized | Metadata | Web based, relational/multi-dimensional | Client/server, real-time/right-time/active...

Data Mart A departmental small-scale "DW" that stores only limited/relevant data

1. Dependent data mart; A subset that is created directly from a data warehouse
2. Independent data mart; A small data warehouse designed for a strategic business unit or a department

DW Architecture

1. Three-tier architecture
   - Data acquisition software (back-end)
   - The data warehouse that contains the data & software
   - Client (front-end) software that allows users to access and analyze data from the warehouse
2. Two-tier architecture

Ten factors that potentially affect the architecture selection decision

1) Information interdependence between organizational unit
2) Urgency of need for a data warehouse
3) Strategic view of the data warehouse prior to implementation
4) Compatibility with existing systems
5) Technical issues
6) Upper management's information needs
7) Nature of end-user tasks
8) Constraints on resources
9) Perceived ability of the in-house IT staff
10) Social/political factors

Data Warehouse Development

❖ **Data warehouse development approaches**

1) Inmon Model: EDW approach (top-down)
2) Kimball Model: Data mart approach (bottom-up)

Representation of Data in DW

1) **Dimensional Modeling**; A retrieval-based system that supports high-volume query access
2) **Star schema;** The most commonly used and the simplest style of dimensional modeling **AND** Contain a **fact table** surrounded by and connected to several **dimension tables**
3) **Snowflakes schema;** An extension of star schema where the diagram resembles a snowflake in shape

OLAP vs. OLTP

TABLE 3.5 A Comparison Between OLTP and OLAP

Criteria	OLTP	OLAP
Purpose	To carry out day-to-day business functions	To support decision making and provide answers to business and management queries
Data source	Transaction database (a normalized data repository primarily focused on efficiency and consistency)	Data warehouse or data mart (a nonnormalized data repository primarily focused on accuracy and completeness)
Reporting	Routine, periodic, narrowly focused reports	Ad hoc, multidimensional, broadly focused reports and queries
Resource requirements	Ordinary relational databases	Multiprocessor, large-capacity, specialized databases
Execution speed	Fast (recording of business transactions and routine reports)	Slow (resource intensive, complex, large-scale queries)

OLAP Operations

1) **Slice** - a subset of a multidimensional array
2) **Dice** - a slice on more than two dimensions
3) **Drill Down/Up** - navigating among levels of data ranging from the most summarized (up) to the most detailed (down)
4) **Roll Up** - computing all of the data relationships for one or more dimensions
5) **Pivot** - used to change the dimensional orientation of a report or an ad hoc query-page display

Failure Factors in DW Projects

1) Lack of executive sponsorship
2) Unclear business objectives
3) Cultural issues being ignored " Change management
4) Unrealistic expectations
5) Inappropriate architecture
6) Low data quality / missing information

7) Loading data just because it is available

Concerns about real-time BI

1) Not all data should be updated continuously
2) May be cost prohibitive
3) Mismatch of reports generated minutes apart
4) May also be infeasible

Traditional versus Active DW

Traditional Data Warehouse Environment	Active Data Warehouse Environment
Strategic decisions only	Strategic and tactical decisions
Results sometimes hard to measure	Results measured with operations
Daily, weekly, monthly data currency acceptable; summaries often appropriate	Only comprehensive detailed data available within minutes is acceptable
Moderate user concurrency	High number (1,000 or more) of users accessing and querying the system simultaneously
Highly restrictive reporting used to confirm or check existing processes and patterns; often uses predeveloped summary tables or data marts	Flexible ad hoc reporting, as well as machine-assisted modeling (e.g., data mining) to discover new hypotheses and relationships
Power users, knowledge workers, internal users	Operational staffs, call centers, external users

CHAPTER 4

What is a **Business Report**? A written document that contains information regarding business matters.

- **Purpose: to improve managerial decisions**
- **Source**: data from inside and outside the organization (via the use of ETL)
- **Format**: text + tables + graphs/charts
- **Distribution**: in-print, email, portal/intranet

Types of Business Reports

1) **Metric Management Reports** Help manage business performance through metrics (SLAs for externals; KPIs for internals) **(SLA = Service-level Agreement) , (KPL = Key Performance Indicator)**
2) **Dashboard-Type Reports** Graphical presentation of several performance indicators in a single page using dials/gauges
3) **Balanced Scorecard-Type Reports** Include financial, customer, business process, and learning & growth indicators

Components of Business Reporting Systems **Common characteristics**

- OLTP (online transaction processing)
- Data supply (volume, variety, velocity, …)
- ETL
- Data storage
- Business logic
- Publication medium
- Assurance

Performance Dashboards

- Performance dashboards are commonly used in BPM software suites and BI platforms
- Dashboards provide visual displays of important information that is consolidated and arranged on a single screen so that information can be digested at a single glance and easily drilled in and further explored

Dashboard design The fundamental challenge of dashboard design is to display all the required information on a single screen, clearly and without distraction, in a manner that can be assimilated quickly
Three layer of information Monitoring | Analysis | Management

Business Performance Management (BPM) is… A real-time system that alerts managers to potential opportunities, impending problems and threats, and then empowers them to react through models and collaboration.
BPM refers to the business processes, methodologies, metrics, and technologies used by enterprises to measure, monitor, and manage business performance.

BPM encompasses three key components

1) A set of integrated, closed-loop management and analytic processes supported by technology …
2) Tools for businesses to define strategic goals and then measure/manage performance against them
3) Methods and tools for monitoring key performance indicators (KPIs), linked to organizational strategy

A Closed-Loop Process to Optimize Business Performance

Process Steps 1. Strategize 2. Plan 3. Monitor/analyze 4. Act/adjust

Common tasks for the strategic planning process:

1. Conduct a current situation analysis
2. Determine the planning horizon
3. Conduct an environment scan
4. Identify critical success factors
5. Complete a gap analysis
6. Create a strategic vision

7. Develop a business strategy 8. Identify strategic objectives and goals

Plan: How Do We Get There?

Operational plan: plan that translates an organization's strategic objectives and goals into a set of well-defined tactics and initiatives, resources requirements, and expected results for some future time period (usually a year).

Monitor/Analyze: How Are We Doing?

A comprehensive framework for monitoring performance should address **two key issues:**

- What to monitor?
- How to monitor?

Act and Adjust: What Do We Need to Do Differently?

Success (or mere survival) depends on new projects: creating new products, entering new markets, acquiring new customers (or businesses), or streamlining some process.

Performance Measurement

Performance measurement system A system that assists managers in tracking the implementations of business strategy by comparing actual results against strategic goals and objectives

- Comprises systematic comparative methods that indicate progress (or lack thereof) against goals

KPIs and Operational Metrics

Key performance indicator (KPI) A KPI represents a strategic objective and metrics that measure performance against a goal

Distinguishing features of KPIs Strategy | Encodings | Targets | Time frames | Ranges | Benchmarks

Operational areas covered by driver KPIs

1) Customer performance
2) Service performance
3) Sales operations
4) Sales plan/forecast

Performance Measurement System

Balanced Scorecard (BSC) A performance measurement and management methodology that helps translate an organization's financial, customer, internal process, and learning and growth objectives and targets into a set of actionable initiatives

Six Sigma A performance management methodology aimed at reducing the number of defects in a business process to as close to zero defects per million opportunities (DPMO) as possible

Comparison of Balanced Scorecard and Six Sigma

TABLE 4.1 Comparison of Balanced Scorecard and Six Sigma

Balanced Scorecard	Six Sigma
Strategic management system	Performance measurement system
Relates to the longer-term view of the business	Provides snapshot of business's performance and identifies measures that drive performance toward profitability
Designed to develop balanced set of measures	Designed to identify a set of measurements that impact profitability
Identifies measurements around vision and values	Establishes accountability for leadership for wellness and profitability
Critical management processes are to clarify vision/strategy, communicate, plan, set targets, align strategic initiatives, and enhance feedback	Includes all business processes—management and operational
Balances customer and internal operations without a clearly defined leadership role	Balances management and employees' roles; balances costs and revenue of heavy processes

CHAPTER 5

Definition of Data Mining; The nontrivial process of identifying valid, novel, potentially useful, and ultimately

Data Mining Characteristics/Objectives

1) Source of data for DM is often a consolidated data warehouse (not always!).
2) DM environment is usually a client-server or a Web-based information systems architecture.
3) Data is the most critical ingredient for DM which may include soft/unstructured data.
4) The miner is often an end user
5) Striking it rich requires creative thinking
6) Data mining tools' capabilities and ease of use are essential (Web, Parallel processing, etc.)

What Does DM Do? How Does it Work?

Pattern? A mathematical (numeric and/or symbolic) relationship among data items

Types of patterns

1) Association
2) Prediction
3) Cluster (segmentation)
4) Sequential (or time series) relationships

Data Mining Process

Most common standard processes:

1) **CRISP-DM** (Cross-Industry Standard Process for Data Mining)
2) **SEMMA** (Sample, Explore, Modify, Model, and Assess)
3) **KDD** (Knowledge Discovery in Databases)

Accuracy of Classification Models "مُهم يمكن يجينا سؤال عملي"

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN}$$

$$True\ Positive\ Rate = \frac{TP}{TP + FN}$$

$$True\ Negative\ Rate = \frac{TN}{TN + FP}$$

$$Precision = \frac{TP}{TP + FP} \qquad Recall = \frac{TP}{TP + FN}$$

Cluster Analysis for Data Mining "سؤال سابق كان مقارنة بين الكلستر والكلاسفكيشن"

- Used for automatic identification of natural groupings of things
- Part of the machine-learning family
- Employ unsupervised learning
- Learns the clusters of things from past data, then assigns new instances
- There is not an output variable
- Also known as segmentation

Data Mining Methods: Classification

- Most frequently used DM method
- Part of the machine-learning family
- Employ supervised learning
- Learn from past data, classify new data
- The output variable is categorical (nominal or ordinal) in nature

Cluster Analysis for Data Mining "تعداد الخطوات جات في امتحان سابق"

- *k*-Means Clustering Algorithm
- ***k*** **:** pre-determined number of clusters
- Algorithm (**Step 0:** determine value of *k*)

1) **Step 1:** Randomly generate *k* random points as initial cluster centers.
2) **Step 2:** Assign each point to the nearest cluster center.
3) **Step 3:** Re-compute the new cluster centers.

Association Rule Mining

- Finds interesting relationships (affinities) between variables (items or events)
- Part of machine learning family
- Employs unsupervised learning
- There is no output variable
- Also known as market basket analysis

Association Rule Mining **Apriori Algorithm** " سؤال عملي مهم جداً ارجعوا له"

CHAPTER 6

السؤال العملي الموجود بالشابتر مهم جداً

Neural Network Concepts

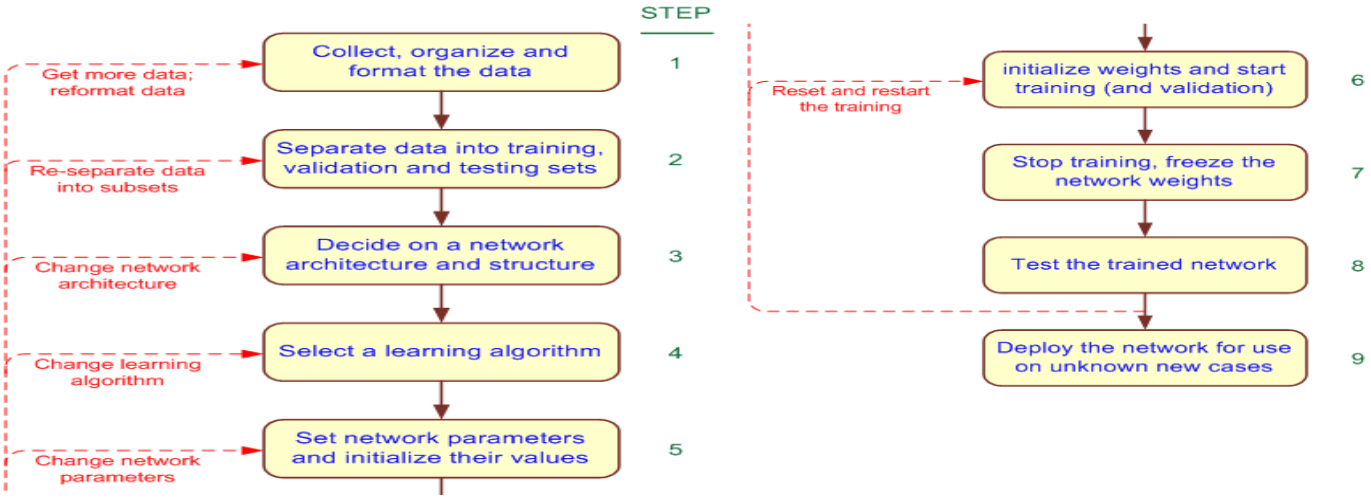
- **Neural networks (NN):** a brain metaphor for information processing
- Artificial neural network (ANN)
- Many uses for ANN for ; pattern recognition, forecasting, prediction, and classification
- Many application areas; finance, marketing, manufacturing, operations, information systems, and so on

Elements of ANN

1) **Processing element (PE)**
2) **Network architecture;** Hidden layers | Parallel processing
3) **Network information processing;** Inputs | Outputs | Connection weights | Summation function

Neural Network Architectures Classification, regression, clustering, general optimization, association, ….
Most popular architecture: Feedforward, multi-layered perceptron with backpropagation learning algorithm

Development Process of an ANN



AN Learning Process A Supervised Learning Process
Three-step process:
1. Compute temporary outputs.
2. Compare outputs with desired targets.
3. Adjust the weights and repeat the process.

The learning algorithm procedure
1. Initialize weights with random values and set other network parameters
2. Read in the inputs and the desired outputs
3. Compute the actual output (by working forward through the layers)
4. Compute the error (difference between the actual and desired output)
5. Change the weights by working backward through the hidden layers
6. Repeat steps 2-5 until weights stabilize

- **Goal of SVM:** to generate mathematical functions that map input variables to desired outputs for classification or regression type prediction problems.
- First, SVM uses nonlinear kernel functions to transform non-linear relationships among the variables into linearly separable feature spaces.
- Then, the maximum-margin hyperplanes are constructed to optimally separate different classes from each other based on the training dataset.

***k*-Nearest Neighbor Method (k-NN)**
- ANNs and SVMs à time-demanding, computationally intensive iterative derivations
- *k*-NN is a simplistic and logical prediction method, that produces very competitive results
- *k*-NN is a prediction method for classification as well as regression types (similar to ANN & SVM)
- *k*-NN is a type of instance-based learning (or lazy learning) – most of the work takes place at the time of prediction (not at modeling)
- *k* : the number of neighbors used