Elements of Software Engineering and Information Systems

Operational Systems

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Mission of operational systems

- Operational systems are dedicated to support normal day-by-day automatic or interactive operations of the organization, with a large number of users
  - Examples:
    - The counter of a supermarket records all items sold by each customer, all the details about the operation including timestamp, fidelity card…
    - Autostrade records all vehicle passages through the entrance and exit gates
    - A web site records all accesses, clicks, visit time… of each user
- Typical use:
  - transaction recording
  - planning or control of operations
  - knowledge acquisition and organization
  - determination of the current state of one of the phenomena of interest of the organization

Operational systems

- Operational systems do apply *punctual* modifications to the state of information in the organization
  - Changes are related to the generation, the deletion, the update or the read of a single record or of a coordinate set of records that are related to a single operation, as part of a single piece of elementary information

- If the operational system is based on a relational database, operations might be intended as the execution of ordinary SQL queries manually or from programs, or of a SQL transaction, or of a chain of correlated SQL queries

Operational systems

- In general: *transactional systems*
  - A *transaction* is to be intended as a generic operation of a *relational database*
    - Notable exceptions: web site example, typically *non relational databases*

- These systems in general are classified in the OLTP (On Line Transaction Processing) category
  - Examples of popular EIS types:
    - ERP (Enterprise Resource Planning)
    - CRM (Customer Relationship Management)
    - SCM (Supply Chain Management)
    - HRM (Human Resource Management)
    - MIS (Manufacturing Information Systems)

Porter's value chain

- A model describing how value is created gives us directions

https://www.smartsheet.com/value-chain-model

Mission of the operational systems

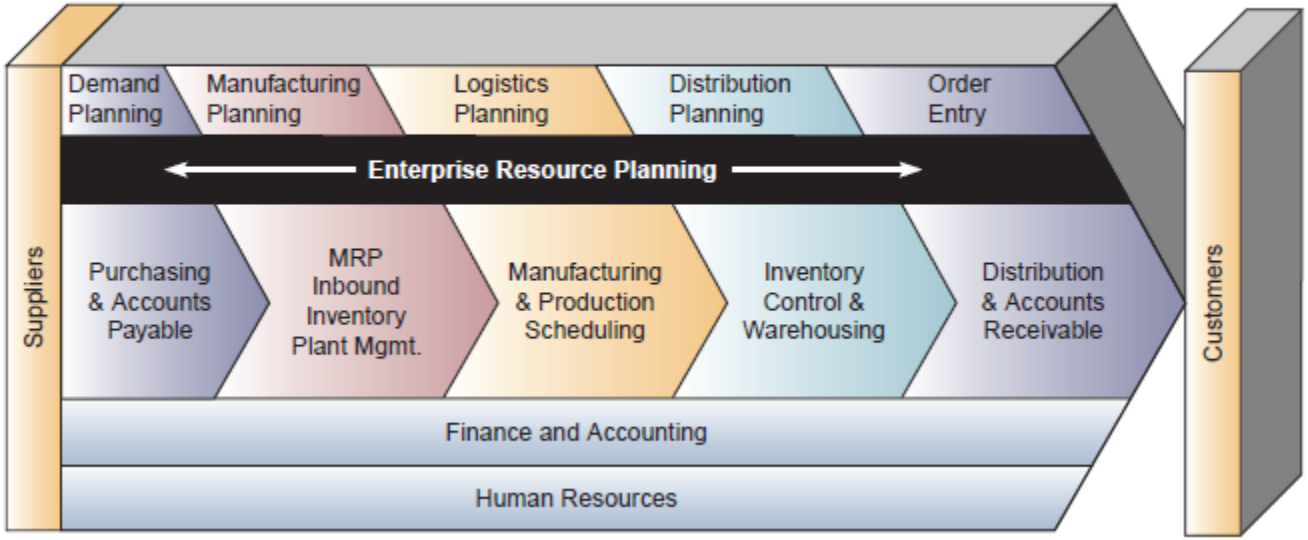
- Porter's value chain describes how and with which devices an organization (rectius, a company), builds value
- It provides a framework to describe each function of the company
- It shows that some of the functions are independent from the field in which the company operates
- It suggests a general structure of the organization, so that, as an organization and its EIS must fit each other, the EIS might be structured in the same way
- This framework suggests a modular approach to the part of the EIS that manages the resources of the organization: its Enterprise Resource Planning (ERP) system

Enterprise Resource Planning

- An ERP is composed of two sets of functionalities:
  - the *operational portfolio*: functionalities that are specifically related to the business field in which the company operates
    - production, engineering, field management, market driven processess…
    - these functionalities support the *primary activities* of the company
  - the *institutional portfolio*: functionalities that do not depend on the business field, but might depend on the country in which the company operates
    - HR management, finance, accounting…
    - these functionalities support the *secondary activities* of the company
- Functionalities are based on the same foundation, e.g. a RDBMS, and interact by means of proper protocols
- Processes might be *internal* to a functionality (/organizational area) or *cross-functional*

ERP: an example

FIGURE 8.10 The business processes and functions supported by the ERP system implemented by the Colgate-Palmolive Company.



- Typical areas (manufacturing):
  - Administration/accounting/finance/management control
  - Logistics (warehouses, parts, movements, stock levels, packaging)
  - Sales (outbound logistics, orders, customers, delivery, billing)
  - Procurement (inbound logistics, suppliers, orders, agreements)
  - Production (and production management and monitoring)

Enterprise Resource Planning

- An ERP is natively modular
  - Each organization might install only the modules it needs and of the type they need (operational portfolio)
  - Each module can evolve independently
  - The implementation of the ERP might be incremental
  - «Make or buy» for modules
- Generally, each software house in the market proposes its own product, with all the modules that are needed, and provides consultants, personalization ad-hoc solutions development
- Modules might be available in different product lines, to fit the scale of the company (from SME to multinational corporation)

ERP, organization and BPR

- An ERP is designed according to the experience gained from many business case
  - Generation of best practices
  - Big companies can invest, investments allow advancements that then become available to other customers
- Introducing an ERP in an organization might induce a better use of resources
  - If a good ERP is designed around the organization leveraging the best practices of success cases in its business field, it might push BPR and bring in those best practices
  - Introducing an ERP is not easy nor fast, as it impacts strongly on the organization and its procedures, and it might change its management style and require HR training
- Design: check software engineering practices

ERP II

- Extends the ERP paradigm beyond the borders of a single organization
- Virtual enterprise
- Coordinated with the single ERP systems

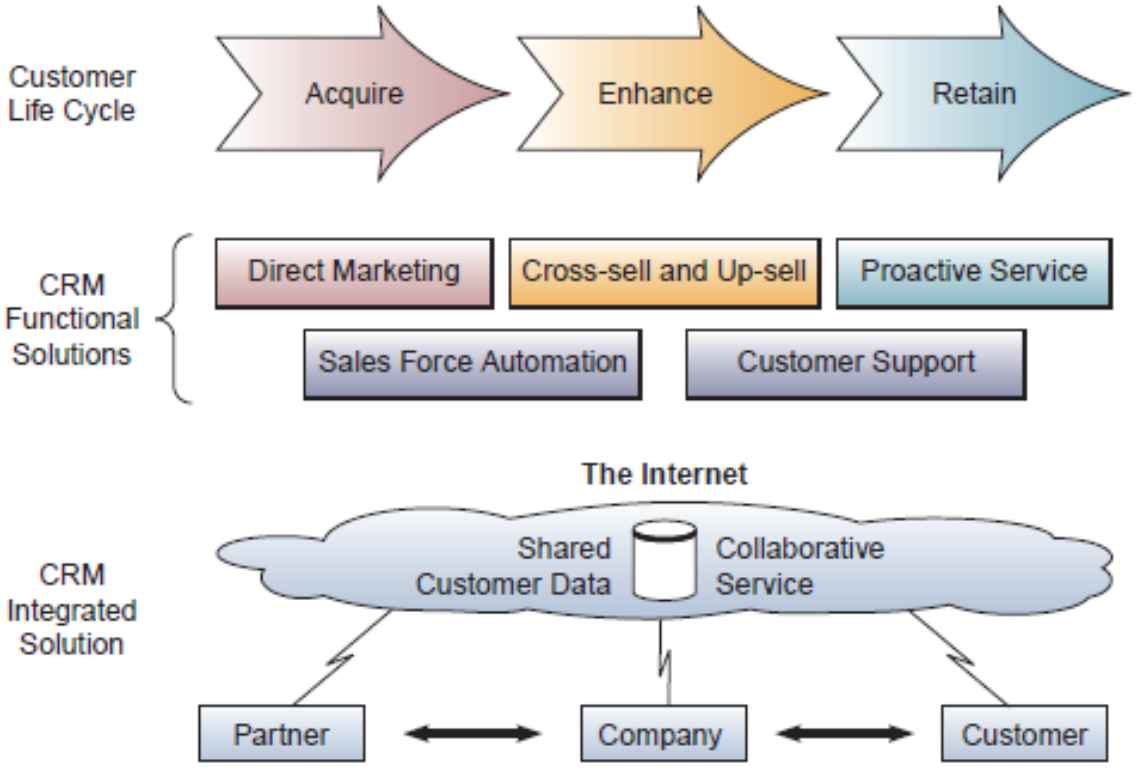
Managing customers: CRM

- An extension to ERP defined to manage customers
- Customers are seen as a unique view on all their data in the relevant perspectives by all employees according to their roles
- Purpose: to attract customers, to serve customers, to assist customers, to keep customers, to recall customers
  - e.g., all interactions with a single customer are tracked and presented as a history to the operator when there is a new contact
  - e.g., sales department can use cross-selling or other techniques to propose new deals to current or former customers in the same or another area of its catalogue of good or services
  - e.g., «Happy birthday, Mauro! In this special day for you, we...»
  - e.g., it costs 6x to sell to a new customer than to an existing one

The three phases of relationship

- CRM support the three phases of the relationship between an organization and a customer

FIGURE 8.5
How CRM supports the three phases of the relationship between a business and its customers.



CRM

FIGURE 8.6 Many companies are implementing CRM systems with some or all of these capabilities.

Types of CRM	Business Value
Operational CRM	• Supports customer interaction with greater convenience through a variety of channels, including phone, fax, e-mail, chat, and mobile devices • Synchronizes customer interactions consistently across all channels • Makes your company easier to do business with
Analytical CRM	• Extracts in-depth customer history, preferences, and profitability information from your data warehouse and other databases • Allows you to analyze, predict, and derive customer value and behavior and forecast demand • Lets you approach your customers with relevant information and offers that are tailored to their needs
Collaborative CRM	• Enables easy collaboration with customers, suppliers, and partners • Improves efficiency and integration throughout the supply chain • Allows greater responsiveness to customer needs through sourcing of products and services outside of your enterprise
Portal-Based CRM	• Provides all users with the tools and information that fit their individual roles and preferences • Empowers all employees to respond to customer demands more quickly and become truly customer-focused • Provides the capability to instantly access, link, and use all internal and external customer information

Source: Adapted from mySAP Customer Relationship Management, mySAP.com, 2001, p. 7; and Brian Caulfield, "Toward a More Perfect (and Realistic) e-Business," *Business 2.0*, January 2002, p. 80.

Example: evaluating a CRM

FIGURE 8.4 A proposed report format for evaluating the customer retention performance of Charles Schwab & Co.

	Navigation	Performance	Operations	Environment
Customer Retention	Customer retention rate Household retention rate Average customer tenure	Retention rate by customer cohort Retention rate by customer segment Customer loyalty rating	Percentage of customers who are active Web users Percentage of customers who interact via e-mail Decline in customer activity Propensity to defect	Competitors' offers Share of portfolio Comparative retention Comparative customer tenure
Customer Experience	Satisfaction by customer segment Satisfaction by cohort Satisfaction by customer scenario	Customer satisfaction by: • Task • Touchpoint • Channel partner End-to-end performance by scenario Customer satisfaction with quality of information provided	Elapsed time for commonly performed tasks Accuracy of Web search results Percentage of trades executed with price improvement Percentage of e-mails answered accurately in one hour	Comparative satisfaction: Competitors: • Other online brokers • Other financial service firms • All products and services
Customer Spending	Average revenue per customer Average profitability per customer Growth in customer assets Customer lifetime value	Revenues per customer segment Profits per customer segment Growth in customer assets per segment	Daily log-ins at market opening Revenue trades per day Percentage increase in customer assets Cost to serve by touchpoint	Total brokerage assets Growth in brokerage assets

CRM failures

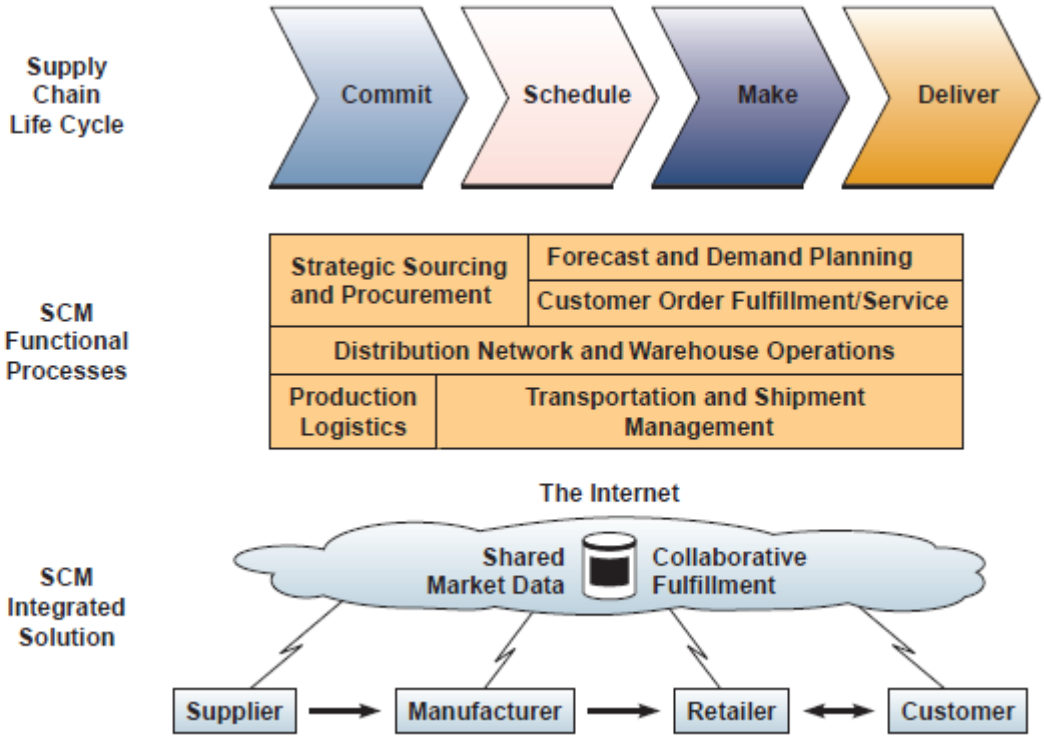
- The common wisdom of why CRM systems fail includes:
  - Lack of senior management sponsorship
  - Improper change management
  - Elongated projects that take on too much, too fast
  - Lack of or poor integration between CRM and core business systems
  - Lack of end-user incentives leading to poor user adoption rates

Managing the supply chain: SCM

- An extension to ERP to manage the business or collaboration network of an organization
- The goal of SCM is:
  - to manage supply chain processes efficiently by forecasting demand
  - controlling inventory
  - enhancing the network of business relationships or collaborations a company or organization has with customers, suppliers, distributors, and others
  - receiving feedback on the status of every link in the supply chain
- SCM are *cross-functional interenterprise* systems using IT to help support and manage the links between some of an organization key processes and those of its suppliers, customers, and business partners

SCM

FIGURE 8.15
Supply chain management software and Internet technologies can help companies reengineer and integrate the functional SCM processes that support the supply chain life cycle.



SCM

FIGURE 8.17 The objectives and outcomes of supply chain management are accomplished for a business with the help of interenterprise SCM information systems.

SCM Objectives		SCM Outcomes
What? Establish objectives, policies, and operating footprint	**Strategic**	• Objectives • Supply policies (service levels) • Network design
How much? Deploy resources to match supply to demand	**Tactical**	• Demand forecast • Production, procurement, logistics plan • Inventory targets
When? Where? Schedule, monitor, control, and adjust production	**Operational**	• Work center scheduling • Order/inventory tracking
Do Build and transport	**Execution**	• Order cycle • Material movement

Source: Adapted from Keith Oliver, Anne Chung, and Nick Samanach, "Beyond Utopia: The Realist's Guide to Internet-Enabled Supply Chain Management," *Strategy and Business*, Second Quarter, 2001, p. 99.

SCM

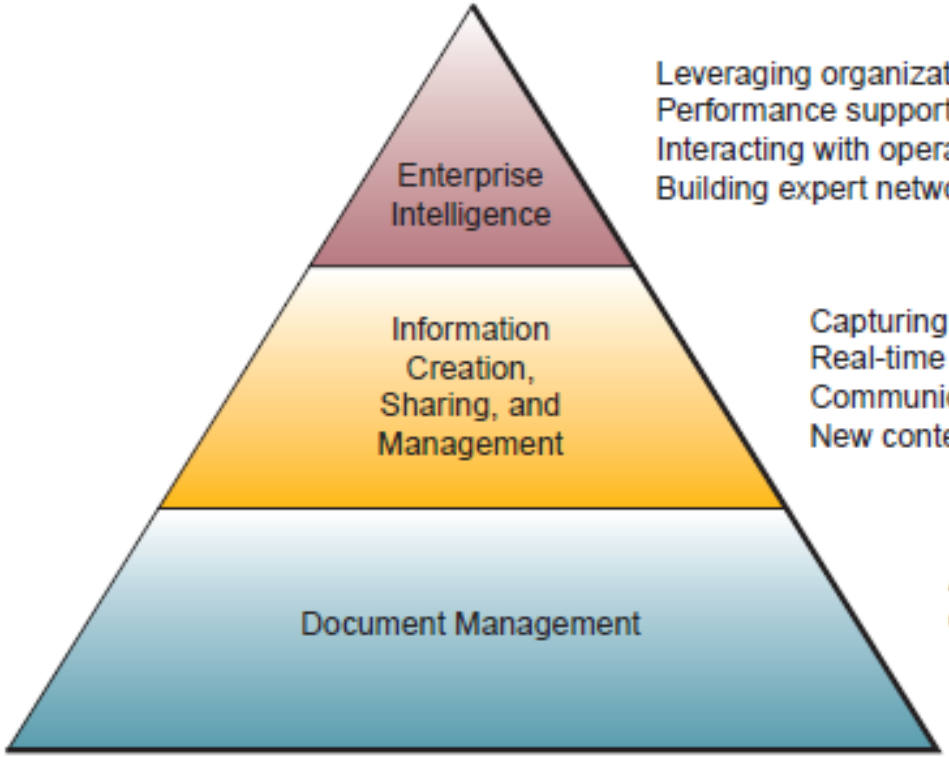
FIGURE 8.18 The supply chain management functions and potential benefits offered by the SCM module in the mySAP e-business software suite.

SCM Functions	SCM Outcomes
Planning	
Supply chain design	• Optimize network of suppliers, plants, and distribution centers
Collaborative demand and supply planning	• Develop an accurate forecast of customer demand by sharing demand and supply forecasts instantaneously across multiple tiers • Internet-enable collaborative scenarios, such as collaborative planning, forecasting, and replenishment (CPFR), and vendor-managed inventory
Execution	
Materials management	• Share accurate inventory and procurement order information • Ensure materials required for production are available in the right place at the right time • Reduce raw material spending, procurement costs, safety stocks, and raw material and finished goods inventory
Collaborative manufacturing	• Optimize plans and schedules while considering resource, material, and dependency constraints
Collaborative fulfillment	• Commit to delivery dates in real time • Fulfill orders from all channels on time with order management, transportation planning, and vehicle scheduling • Support the entire logistics process, including picking, packing, shipping, and delivery in foreign countries
Supply chain event management	• Monitor every stage of the supply chain process, from price quotation to the moment the customer receives the product, and receive alerts when problems arise
Supply chain performance management	• Report key measurements in the supply chain, such as filling rates, order cycle times, and capacity utilization

Knowledge management systems

- KMS are IS that manage organizational learning and business know-how
- The goal of KMS is to help knowledge workers create, organize, and make available (that is, access and use) important knowledge, wherever and whenever it's needed in an organization, including:
  - processes
  - procedures
  - patents
  - reference works
  - formulas
  - best practices
  - forecasts

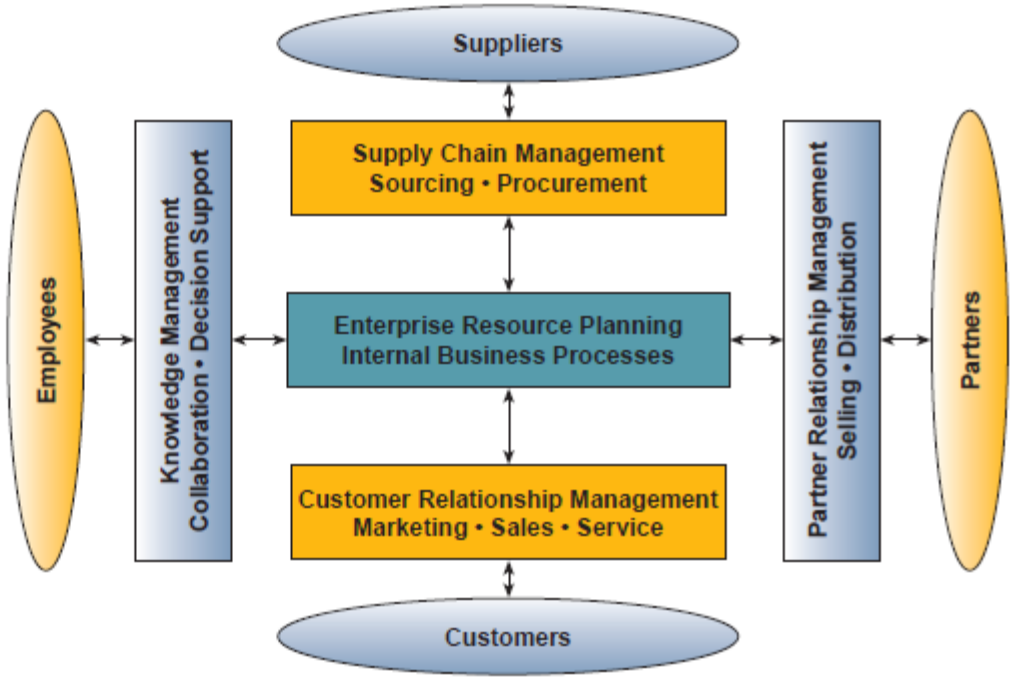
KMS hierarchical organization



Source: Adapted from Marc Rosenberg, *e-Learning: Strategies for Delivering Knowledge in the Digital Age* (New York: McGraw-Hill, 2001), p. 70.

System of operational systems

FIGURE 7.3
This enterprise application architecture presents an overview of the major cross-functional enterprise applications and their interrelationships.

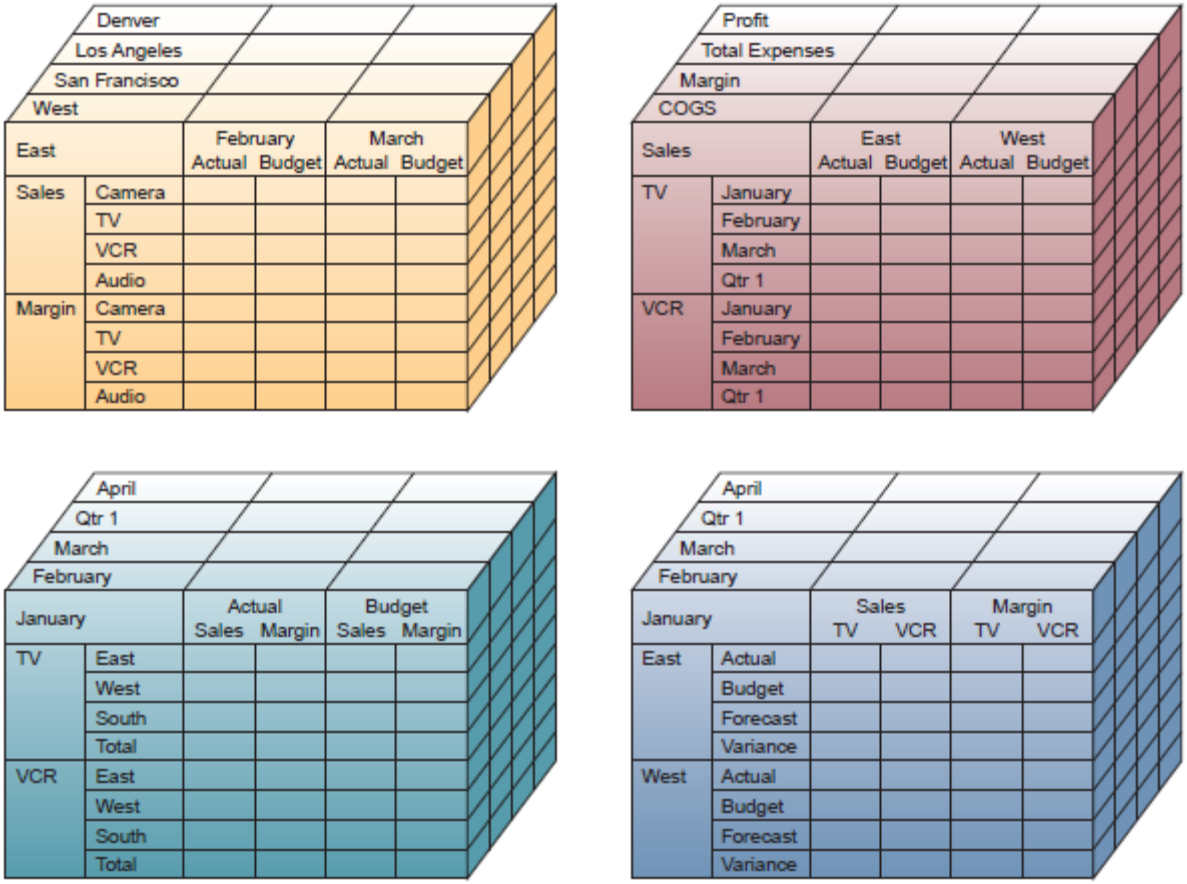


References

- O'Brien, Marakas cap. 7, 8
- Pighin cap. 4-10

Multidimensional organization

FIGURE 5.6 An example of the different dimensions of a multidimensional database.



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