Analytics to Manage a Vaccine Supply:

1. Cold Chain in Healthcare

- A **cold chain** is a **temperature-controlled supply chain** for transporting and storing vaccines and medicines.
- It consists of **three major components**:
    1. **Transport & Storage Equipment** – Refrigerators, freezers, and transport containers.
    2. **Trained Personnel** – Ensuring proper handling.
    3. **Efficient Management Procedures** – Monitoring and maintaining the cold chain.
- Vaccines must be stored at **35–46°F (2–8°C)** to maintain their potency.

2. Issues in Cold Chain Management

- **Improper storage & handling** can reduce vaccine effectiveness or even make them harmful.
- **Extreme temperatures (too hot or too cold)** can spoil vaccines.
- **Monitoring storage conditions** in real time is crucial to ensuring vaccine safety.
- **A CDC study** found that **75% of healthcare providers in the U.S.** had serious cold chain violations.

3. Magpie Sensing: A Smart Solution

- **Magpie Sensing** is a startup providing **cold chain monitoring and analytics**.
- It uses **wireless temperature & humidity sensors** to track vaccines during shipment.
- It provides **real-time, location-aware tracking** to ensure vaccines remain within safe temperature limits.
- Uses **analytics** to detect problems before they happen.

4. Types of Analytics Used by Magpie Sensing

Magpie Sensing applies three types of **analytics**:

1. **Descriptive Analytics**
    - Collects and displays real-time temperature data.
    - Uses **dashboards & graphs** to show storage conditions.
2. **Predictive Analytics**
    - Detects **temperature fluctuations** that might spoil vaccines.
    - Alerts users if storage units are incorrectly set up.
    - Predicts **power failures, human errors (like open doors), or equipment malfunctions**.
    - Sends alerts via **web interface, text message, or sound alerts**.
3. **Prescriptive Analytics**
    - Provides **recommendations** to optimize cold storage.
    - Helps set the **right temperature** to avoid freezing or spoilage.
    - Analyzes **storage efficiency** to improve business decisions.
    - Helps choose **better equipment** based on performance data.

5. Benefits of Magpie Sensing Analytics

- **Ensures vaccine safety** from manufacturing to administration.

- **Prevents waste** by reducing spoilage and extra manufacturing costs.
- **Improves compliance** with government safety regulations.
- **Reduces human error** by alerting users before issues occur.
- **Optimizes storage efficiency**, improving resource usage.

6. Other Applications of Real-Time Monitoring

- **Food industry** – Monitoring perishable food storage.
- **Medical supply chains** – Transporting temperature-sensitive drugs.
- **Blood banks** – Keeping blood at safe temperatures.
- **Chemical storage** – Ensuring hazardous materials stay within safe conditions.

Conclusion

- **Analytics plays a crucial role** in managing vaccine supply chains effectively.
- **Real-time monitoring & predictive analysis** help prevent costly losses.
- **Smart solutions like Magpie Sensing** improve healthcare safety and efficiency.

Changing Business Environments and Computerized Decision Support

Overview

Organizations are increasingly adopting computerized systems, including Business Intelligence (BI), to navigate complex and competitive business environments. The **Business Pressures-Responses-Support (BPR) Model** explains this process through three components:

1. **Business Pressures**: Challenges from the external environment.
2. **Organizational Responses**: Actions to address these challenges.
3. **Computerized Support**: Technology that enhances responses and decision-making.

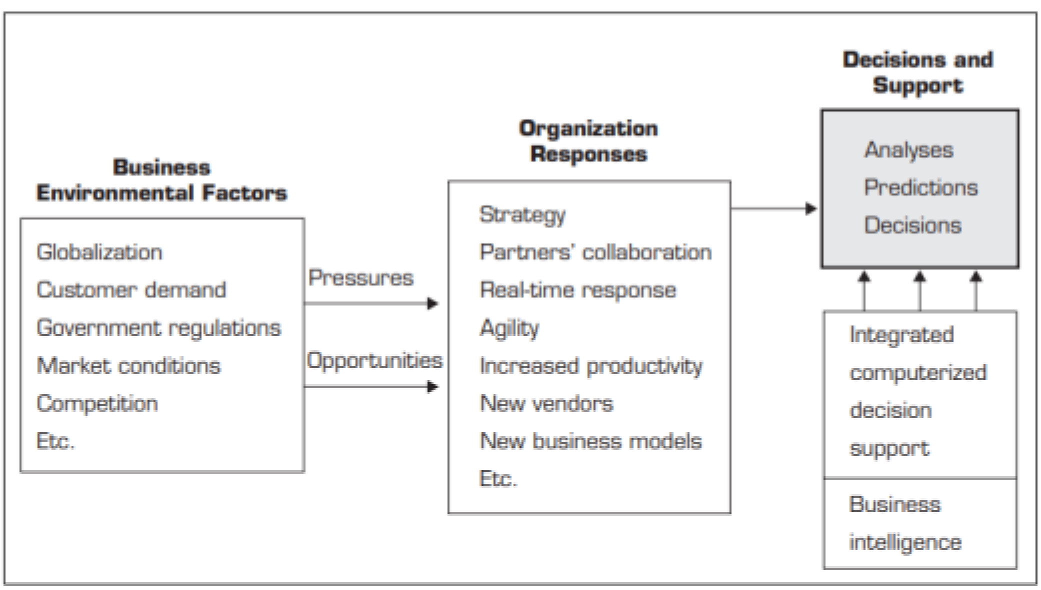

Figure 1.1 The Business Pressures–Responses–Support Model.

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1. Business Environment

The modern business environment is highly complex, offering both opportunities and challenges. Key factors driving this complexity include:

Business Pressures

- **Globalization**:
  - Opportunities: Access to global suppliers/customers.
  - Challenges: Increased competition.
- **Customer Demands**:
  - Desire for quality, speed, and customization.
  - Consumers are becoming more powerful and less loyal.
- **Technology**:
  - Rapid innovation and shorter product lifecycles.
  - Overload of information and adoption of new platforms (e.g., Web 2.0, social media).
- **Societal Changes**:
  - Stringent regulations.
  - Workforce diversification.
  - Emphasis on sustainability and corporate social responsibility.

Key Takeaway: These pressures demand that organizations respond quickly, innovate, and adapt to survive and thrive.

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2. Organizational Responses

Organizations adopt various strategies to tackle these pressures and seize opportunities. Examples include:

Proactive and Adaptive Measures

- Strategic planning and innovation.
- Adoption of new business models and restructuring processes.
- Leveraging partnerships and alliances.
- Enhancing customer service and relationships.
- Using social media and mobile platforms for e-commerce.

TABLE 1.1 Business Environment Factors That Create Pressures on Organizations	
Factor	**Description**
Markets	Strong competition Expanding global markets Booming electronic markets on the Internet Innovative marketing methods Opportunities for outsourcing with IT support Need for real-time, on-demand transactions
Consumer demands	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

- Transitioning to on-demand manufacturing and services.
- Automating tasks and decision processes.

Role of Technology

- **Improved Communication**: Enhances collaboration and decision-making.
- **Corporate Information Systems**: Facilitates better data access and analysis.
- **Business Intelligence (BI)**: Supports real-time responses and analytics.
- **Automation**: Reduces manual efforts and improves operational efficiency.

Key Takeaway: Many of these responses rely on computerized support, such as decision support systems (DSS).

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3. Computerized Decision Support

Computerized systems bridge the gap between current and desired performance by enabling:

- Data analysis and real-time insights.
- Better predictions and decision-making.
- Integration of various tools and systems for a cohesive strategy.

Closing the Strategy Gap

One primary goal of decision support systems is to close the gap between:

- Current organizational performance.
- Desired performance, as defined by the organization’s mission, goals, and strategies.

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4. Business Pressures-Responses-Support Model

Components:

1. **Business Pressures**: Forces driving the need for change (e.g., globalization, customer demand, technology, societal factors).
2. **Organizational Responses**: Actions taken to mitigate challenges (e.g., automation, restructuring, use of BI).
3. **Computerized Support**: Tools like DSS and BI enhance decision-making and responsiveness.

Example: Vodafone New Zealand

Used BI to improve customer retention and revenue generation through:

- Better communication.
- Data-driven decision-making.

Key Takeaway: Computerized systems are essential for effective decision-making and organizational success in a dynamic environment.

Conclusion

Modern businesses operate in a challenging environment characterized by rapid technological changes, globalization, and shifting consumer demands. Computerized decision support systems (e.g., BI and DSS) play a critical role in enabling organizations to respond effectively, innovate, and close the gap between current and desired performance.

Information Systems Support for Decision Making

Computerized systems have evolved from basic payroll and bookkeeping functions to managing complex managerial tasks, such as designing automated factories and analyzing mergers. Key advancements include:

1. Modern Applications of Information Systems

- Shift from transaction processing to problem-solving and decision-making applications.
- Increased reliance on web-based and mobile-access technologies.
- Key tools: Data warehousing, data mining, online analytical processing (OLAP), dashboards, and web-based decision support.

2. Key Features Facilitating Decision Support

a. Group Communication and Collaboration

- Groups often involve members from multiple locations.
- Web-based tools and smartphones enable collaboration.
- Essential for supply chains to share information efficiently.

b. Improved Data Management

- Complex decisions require data from diverse sources.
- Data includes text, graphics, video, and multilingual content.
- Systems enable fast, secure, and transparent data storage and transfer.

c. Managing Large Data and Big Data

- Data warehouses contain vast amounts of data (e.g., terabytes to petabytes).
- Parallel computing organizes and mines this data efficiently.
- Big Data technologies provide deeper insights into organizational performance.

d. Analytical Support

- Alternatives evaluation, risk analysis, and forecasting are streamlined.
- Expert opinions can be gathered remotely at reduced costs.
- Tools support complex simulations and scenario analysis.

e. Overcoming Cognitive Limits

- Human cognitive ability is limited in processing vast, diverse information.
- Computerized systems expand problem-solving capacities by accessing stored data.

f. Knowledge Management

- Organizations maintain extensive knowledge databases, both structured and unstructured.
- Knowledge management systems (KMS) provide informal and formal decision-making support.

g. Anywhere, Anytime Support

- Wireless technologies allow managers to access and analyze data from any location.
- Rapid processing aligns with the fast-paced expectations of modern businesses.

3. Historical Context and Trends

- Since the 1960s, computerized decision support systems have evolved significantly.
- The mid-1990s saw rapid growth in mobile technologies, social media, and analytical tools.

4. Future Focus Areas

- Integration of decision support systems with business intelligence.
- Expanding the role of analytics in organizational decision-making.

<u>The concept of Decision Support Systems (DSS):</u>

Type of Decision	Type of Control: Operational Control	Managerial Control	Strategic Planning
Structured	1 Accounts receivable Accounts payable Order entry	2 Budget analysis Short-term forecasting Personnel reports Make-or-buy	3 Financial management Investment portfolio Warehouse location Distribution systems
Semistructured	4 Production scheduling Inventory control	5 Credit evaluation Budget preparation Plant layout Project scheduling Reward system design Inventory categorization	6 Building a new plant Mergers & acquisitions New product planning Compensation planning Quality assurance HR policies Inventory planning
Unstructured	7 Buying software Approving loans Operating a help desk Selecting a cover for a magazine	8 Negotiating Recruiting an executive Buying hardware Lobbying	9 R & D planning New tech development Social responsibility planning

1. Definition of DSS:

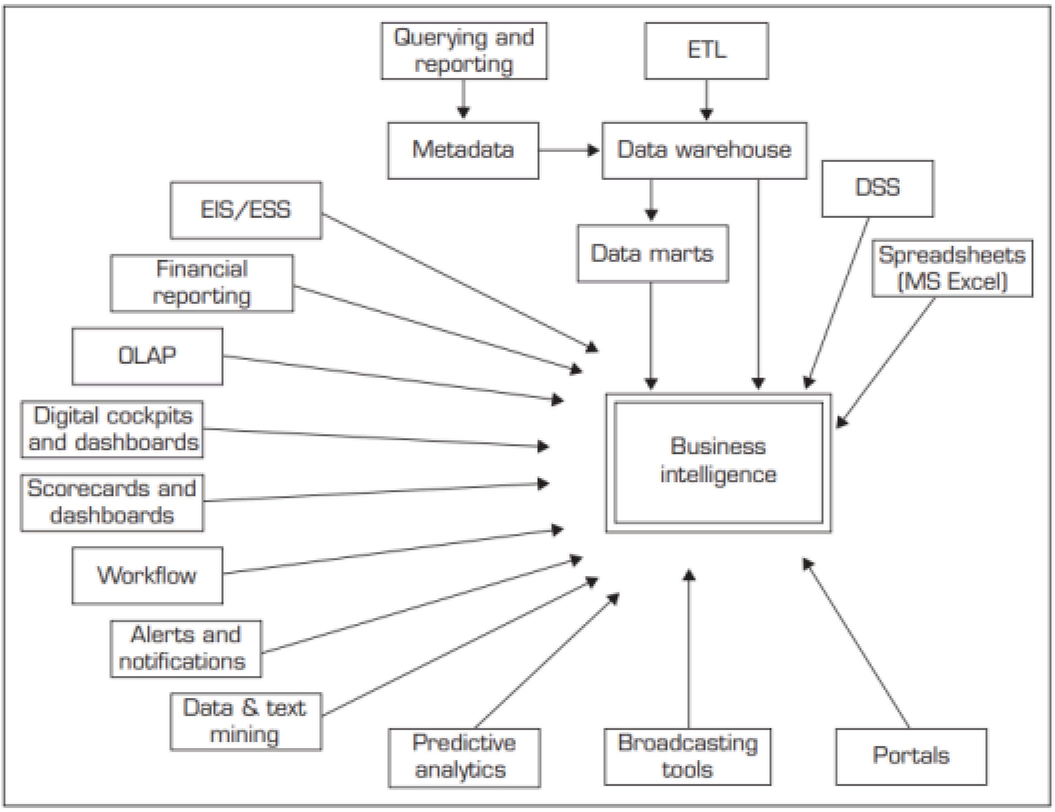
- **DSS (Decision Support Systems)** are interactive, computer-based tools designed to help decision makers use data and models to solve unstructured problems.
- Early definitions:
  - Scott-Morton (1970s) defined DSS as systems that assist decision makers in using data and models.
  - Keen and Scott-Morton (1978) described DSS as tools that combine human intellect with computer capabilities to improve decision-making.
- **Important Note:** DSS is a broad term that means different things to different people. It can be viewed either as a general methodology or as a specific decision support tool.

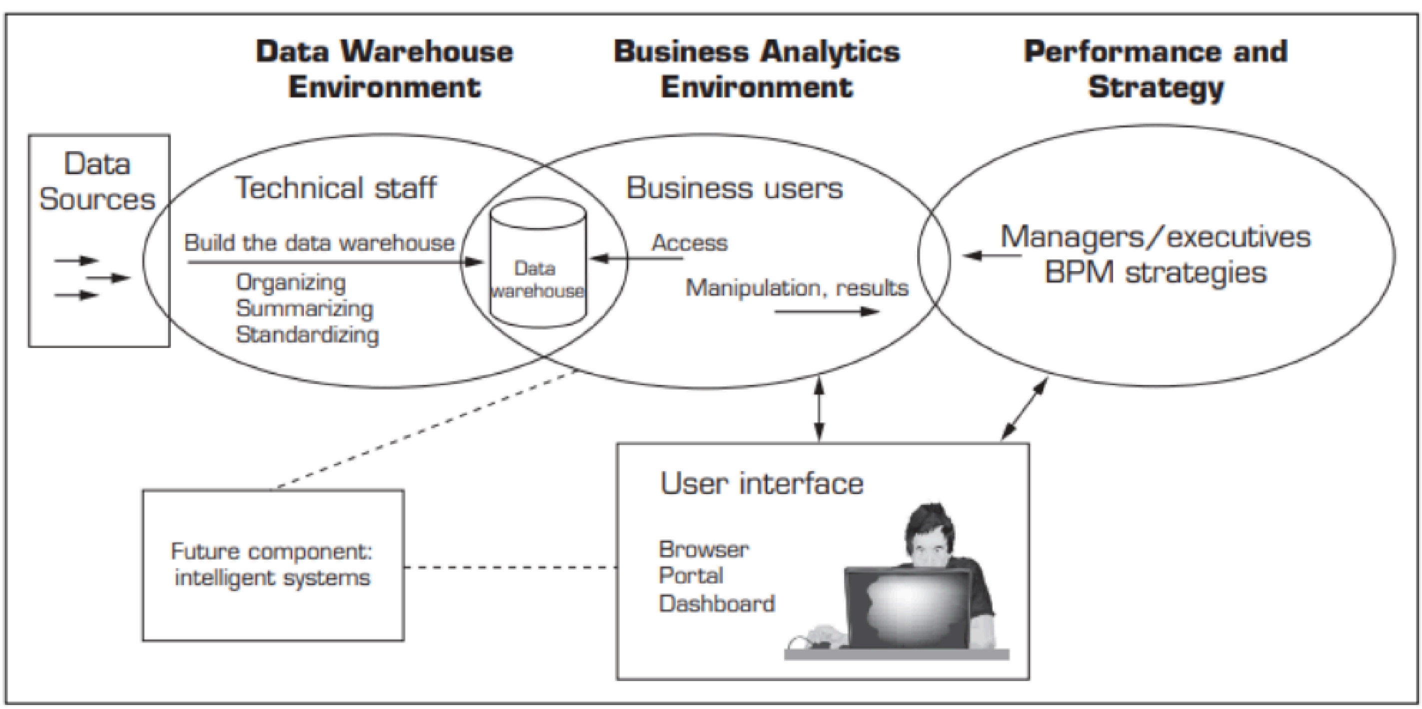
2. DSS as an Umbrella Term:

- DSS can describe any computerized system that helps decision-making within an organization. This could include:
  - Knowledge management systems
  - Marketing, finance, and accounting support systems
  - Supply chain management (SCM) systems
  - Rule-based systems (e.g., product repair diagnostics)
- In essence, any system that supports decision-making in an organization can be considered a DSS.

3. Evolution of DSS into Business Intelligence (BI):

- Initially, DSS tools were mainly used by managers' staff for analysis.
- As personal computer (PC) technology advanced, managers became more comfortable with computing, understanding that it could help make faster and better decisions.
- New tools like **OLAP (Online Analytical Processing)**, **data warehousing**, **data mining**, and **intelligent systems** emerged, helping managers make decisions quicker.
- In the 1990s, these tools were branded as **Business Intelligence (BI)** and **business analytics**, incorporating web technologies for easy access to tools and data.





<u>Business Analytics Overview</u>:

1. Analytics as a Term:

- The term **"analytics"** has replaced older terms used for computerized decision support technologies, such as Business Intelligence (BI).
- **Analytics** is about developing actionable decisions or recommendations based on insights generated from historical data.

2. Definition and Initiatives:

- The **Institute for Operations Research and Management Science (INFORMS)** defines analytics as a combination of **computer technology**, **management science techniques**, and **statistics** to solve real-world problems.
- Other organizations, like **SAS Institute**, have proposed different models to organize analytics.

3. SAS Institute's Levels of Analytics:

- **SAS** defines **eight levels of analytics**, which range from basic reports to more advanced forecasting and decision-making models.
    - **Level 1:** Standardized reports providing a sense of what's happening in the organization.
    - **Level 2:** Customizable reports generated on-demand.
    - **Level 3:** OLAP (Online Analytical Processing) to dig deeper and find specific problems or opportunities.
    - **Level 4:** Automated alerts triggered when specific performance issues occur (e.g., sales, inventory changes).
    - **Level 5:** Statistical analysis to identify patterns.
    - **Level 6:** Forecasting models to predict outcomes like customer behavior.
    - **Levels 7 & 8:** Decision-making based on the analysis of the data.

4. Three Levels of Analytics (INFORMS):

- **Descriptive Analytics:** Understanding **what happened**. This involves gathering and analyzing data to identify trends and causes.
- **Predictive Analytics:** Understanding **what is likely to happen**. Using past data and statistical models to make predictions.
- **Prescriptive Analytics:** Understanding **how to make the best decisions** under specific circumstances. It helps organizations choose the best course of action.

5. Descriptive Analytics in Practice:

- **Descriptive analytics** focuses on understanding past events and trends.
- It involves consolidating data sources and making sure data is available for reporting and analysis.
- This is often done using **data warehouses** and tools for reporting, querying, and alerting.
- A key tool in descriptive analytics is **visualization**, which helps in gaining insights from data through graphical representations.

6. Application Examples:

- **Healthcare Analytics**: Visualization tools in healthcare applications can provide insights into operations, trends, and performance.

Big Data Analytics:

1. What is Big Data?

- **Big Data** refers to vast amounts of data that cannot be stored in a single storage unit.
- It includes **structured**, **unstructured**, and **streaming** data from various sources like:
  - Website clickstreams
  - Social media posts (e.g., Facebook)
  - Traffic sensors and weather data
- Examples of **Big Data applications** include **Google's search engine**, which indexes billions of web pages to provide relevant search results in real-time.

2. Challenges of Big Data:

- **Storage and processing** are the two main challenges:
  - Storing vast amounts of data is difficult on a single unit, and making it fault-tolerant is costly.
  - **Processing** such large data is also a challenge, as passing all data to a single powerful computer results in overhead.

3. Solutions for Big Data:

- **Storage Solution:** The **Hadoop Distributed File System (HDFS)** was developed to store data in chunks across multiple machines. Data is stored in multiple locations for fault tolerance.
- **Processing Solution:** Instead of sending data to a powerful computer, **MapReduce** pushes the computation to the data. This made processing Big Data more feasible and efficient.
  - **MapReduce** was developed at Google and later became part of the **Apache Hadoop** project.

4. The Hadoop Ecosystem:

- **HDFS** and **MapReduce** are central to Big Data storage, processing, and analysis today.
- Several **open-source solutions** and **commercial services** have emerged to assist with Big Data tasks, such as **HortonWorks**, **Cloudera**, and **Teradata Aster**.

5. Characteristics of Big Data (3 V's):

- **Volume**: The massive size of data.
- **Velocity**: The speed at which data is generated and processed (e.g., **algorithmic trading** that processes data in microseconds).
- **Variety**: The different forms of data (e.g., **sentiment analysis** using data from social media and customer responses).

6. Evolution of Big Data:

- Big Data applications have evolved over time to handle different types of data at different speeds, adding the 3 V's to the equation:
    - **Volume**: Large-scale data.
    - **Velocity**: Fast data processing needs.
    - **Variety**: Different forms of data for diverse uses.

7. Example Use Case:

- **Algorithmic Trading**: Involves using algorithms to trade shares on financial markets at microsecond speeds, requiring **fast data processing**.

8. Conclusion:

- Big Data has transformed into a combination of **technological solutions** and **business applications** that enable organizations to manage and process enormous volumes of data, often involving real-time analytics, large-scale storage, and diverse data types.