
Chapter 1- “Diversity”

“In higher education they value
diversity of everything except
thought.” - George Will

Software engineering diversity



- ✧ There are many different types of software system and there is no universal set of software techniques that is applicable to all of these.

Software engineering diversity (cont'd.)



- ✧ The software engineering methods and tools used depend on the type of application being developed, the requirements of the customer, and the background of the development team.

Application types



1. Stand-alone applications

- These are application systems that run on a local computer, such as a PC. They include all necessary functionality and do not need to be connected to a network.

Application types (cont'd.)



2. Interactive transaction-based applications

- Applications that execute on a remote computer and are accessed by users from their own PCs or terminals. These include web applications such as e-commerce applications.

Application types (cont'd.)



3. Embedded control systems

- These are software control systems that control and manage hardware devices. Numerically, there are probably more embedded systems than any other type of system.

Application types (cont'd.)



4. Batch processing systems

- These are business systems that are designed to process data in large batches. They process large numbers of individual inputs to create corresponding outputs.

Application types (cont'd.)



5. Entertainment systems

- These are systems that are primarily for personal use and which are intended to entertain the user.

Application types (cont'd.)



6. Systems for modelling and simulation

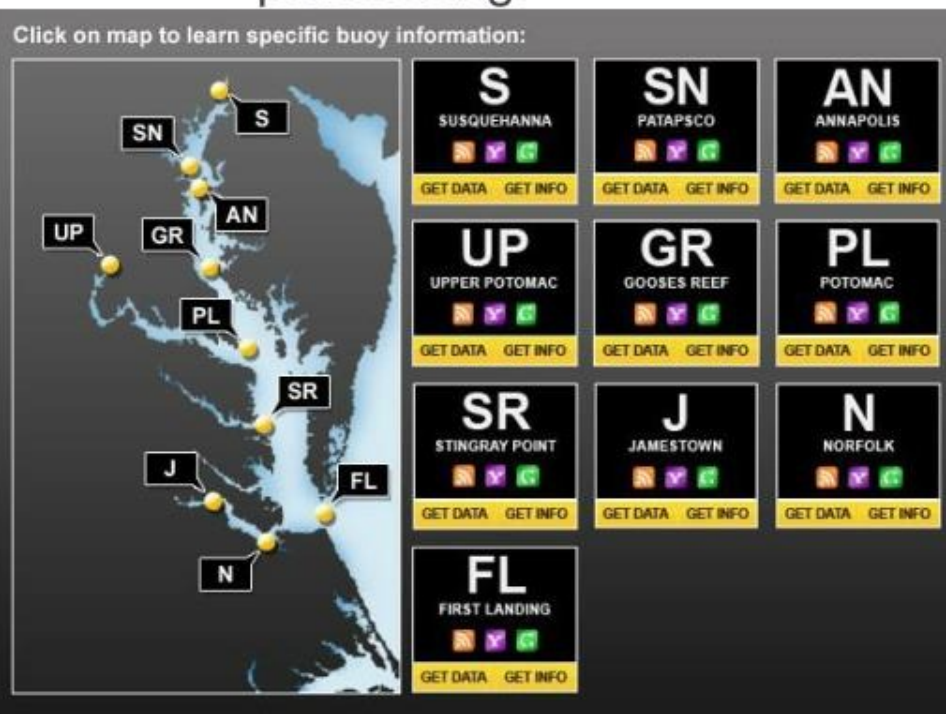
- These are systems that are developed by scientists and engineers to model physical processes or situations, which include many, separate, interacting objects.

Application types (cont'd.)



7. Data collection systems

- These are systems that collect data from their environment using a set of sensors and send that data to other systems for processing.

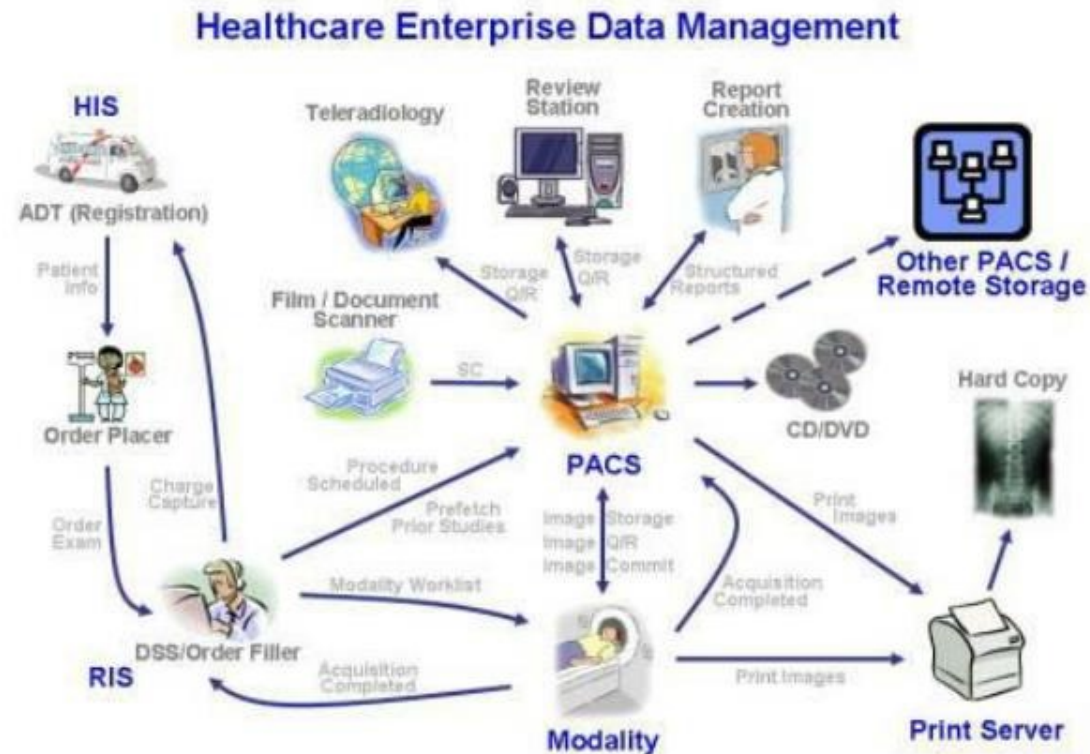


Application types (cont'd.)



8. Systems of systems

- These are systems that are composed of a number of other software systems.



Case studies



1. A personal insulin pump

- An embedded system in an insulin pump used by diabetics to maintain blood glucose control.

2. A mental health case patient management system

- A system used to maintain records of people receiving care for mental health problems.

3. A wilderness weather station

- A data collection system that collects data about weather conditions in remote areas.

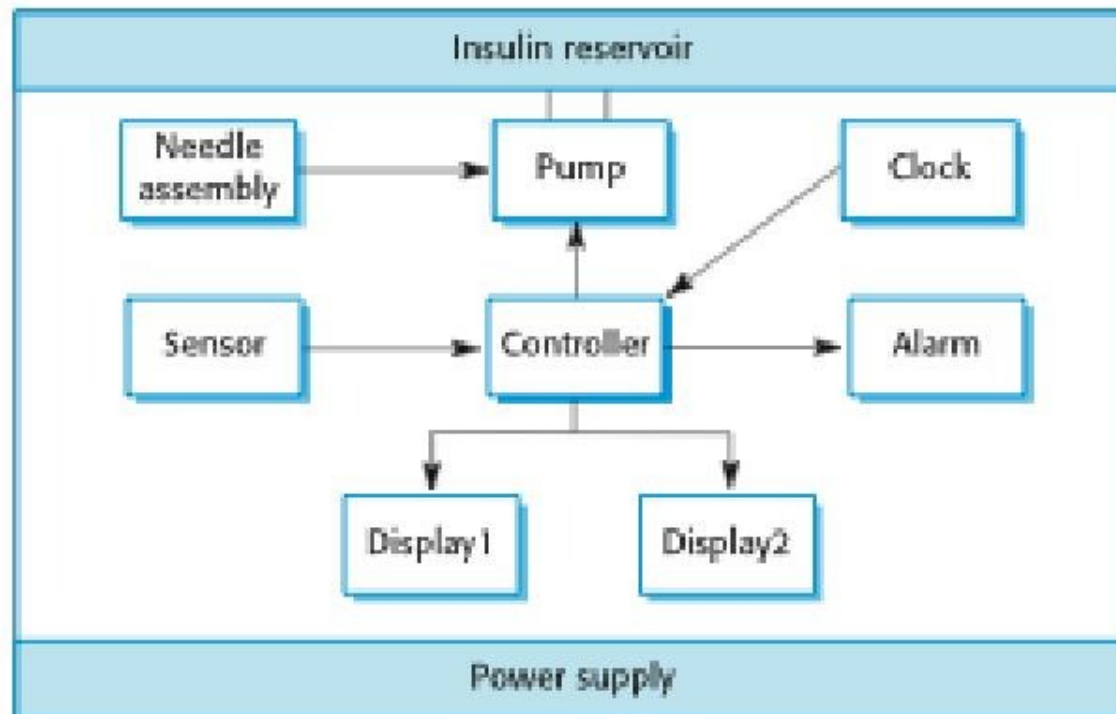
1. A PERSONAL INSULIN PUMP

Insulin pump control system

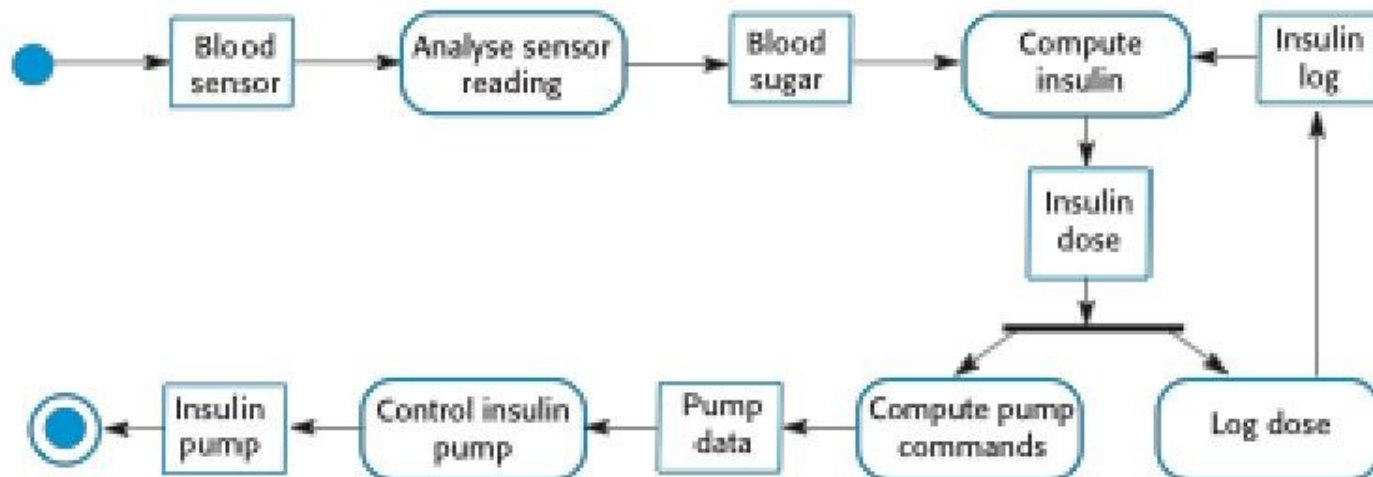


- ✧ Collects data from a blood sugar sensor and calculates the amount of insulin required to be injected.
- ✧ Calculation based on the rate of change of blood sugar levels.
- ✧ Sends signals to a micro-pump to deliver the correct dose of insulin.
- ✧ Safety-critical system as low blood sugars can lead to brain malfunctioning, coma and death; high-blood sugar levels have long-term consequences such as eye and kidney damage.

Insulin pump hardware architecture



Activity model of the insulin pump



Essential high-level requirements

- ✧ The system shall be available to deliver insulin when required.
- ✧ The system shall perform reliably and deliver the correct amount of insulin to counteract the current level of blood sugar.
- ✧ The system must therefore be designed and implemented to ensure that the system always meets these requirements.

2. A MENTAL HEALTH CASE PATIENT MANAGEMENT SYSTEM

A patient information system for mental health care



- ✧ A patient information system to support mental health care is a medical information system that maintains information about patients suffering from mental health problems and the treatments that they have received.
- ✧ Most mental health patients do not require dedicated hospital treatment but need to attend specialist clinics regularly where they can meet a doctor who has detailed knowledge of their problems.
- ✧ To make it easier for patients to attend, these clinics are not just run in hospitals. They may also be held in local medical practices or community centres.

MHC-PMS



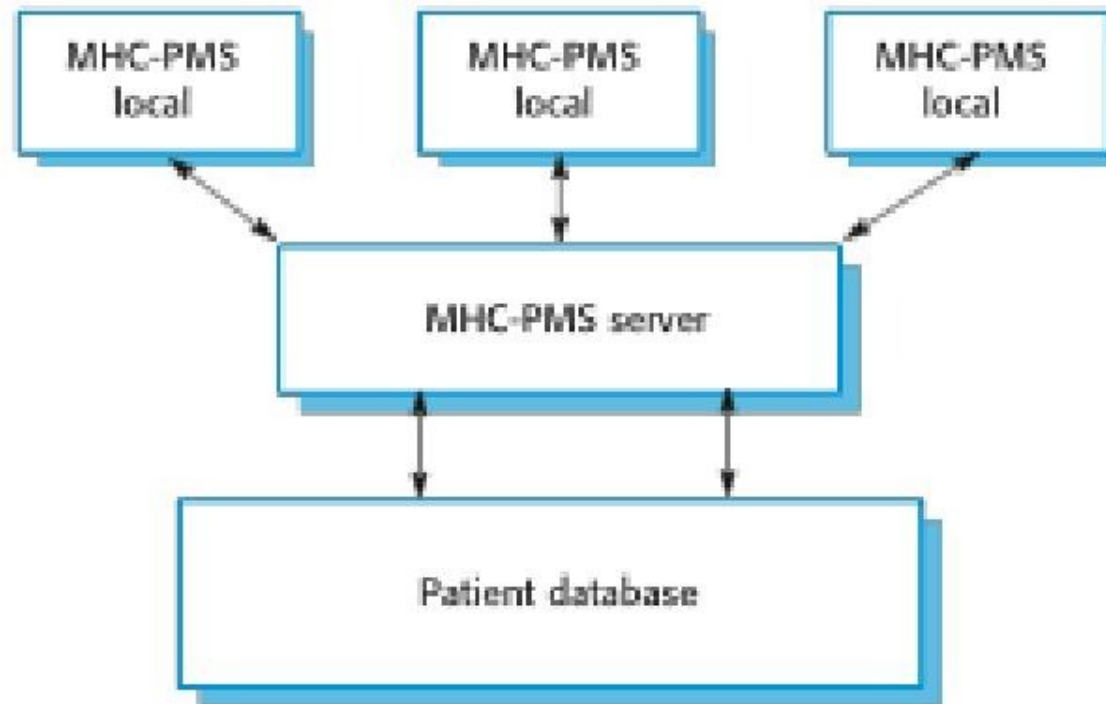
- ✧ The MHC-PMS (Mental Health Care-Patient Management System) is an information system that is intended for use in clinics.
- ✧ It makes use of a centralized database of patient information but has also been designed to run on a PC, so that it may be accessed and used from sites that do not have secure network connectivity.
- ✧ When the local systems have secure network access, they use patient information in the database but they can download and use local copies of patient records when they are disconnected.

MHC-PMS goals



- ✧ To generate management information that allows health service managers to assess performance against local and government targets.
- ✧ To provide medical staff with timely information to support the treatment of patients.

The organization of the MHC-PMS



MHC-PMS key features



1. Individual care management

- Clinicians can create records for patients, edit the information in the system, view patient history, etc. The system supports data summaries so that doctors can quickly learn about the key problems and treatments that have been prescribed.

2. Patient monitoring

- The system monitors the records of patients that are involved in treatment and issues warnings if possible problems are detected.

3. Administrative reporting

- The system generates monthly management reports showing the number of patients treated at each clinic, the number of patients who have entered and left the care system, number of patients sectioned, the drugs prescribed and their costs, etc.

MHC-PMS concerns



✧ Privacy

- It is essential that patient information is confidential and is never disclosed to anyone apart from authorized medical staff and the patient themselves.

MHC-PMS concerns (cont'd.)



✧ Safety

- Some mental illnesses cause patients to become suicidal or a danger to other people. Wherever possible, the system should warn medical staff about potentially suicidal or dangerous patients.
- The system must be available when needed otherwise safety may be compromised and it may be impossible to prescribe the correct medication to patients.

3. A WILDERNESS WEATHER STATION

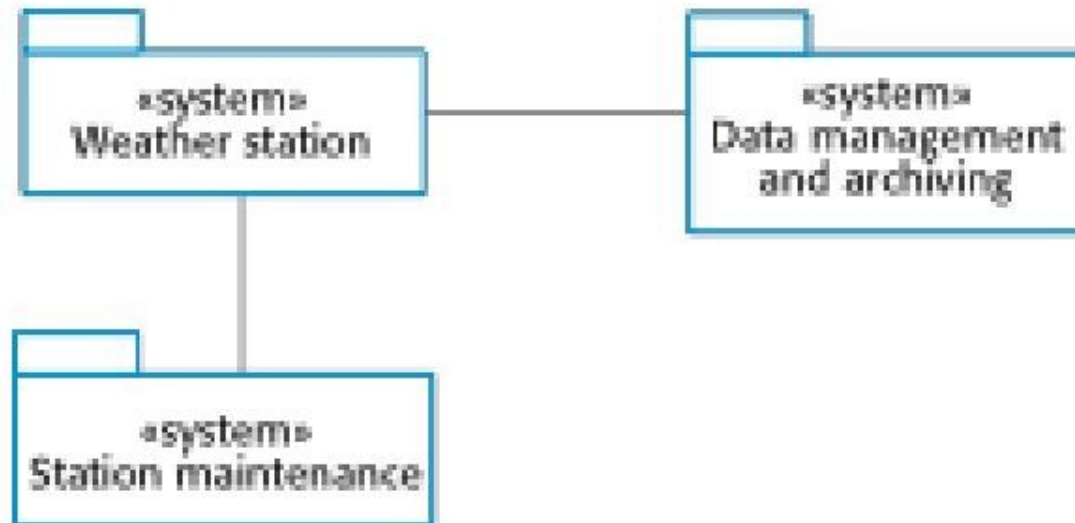
Wilderness weather station



- ✧ The government of a country with large areas of wilderness decides to deploy several hundred weather stations in remote areas.
- ✧ Weather stations collect data from a set of instruments that measure temperature and pressure, sunshine, rainfall, wind speed and wind direction.
 - The weather station includes a number of instruments that measure weather parameters such as the wind speed and direction, the ground and air temperatures, the barometric pressure and the rainfall over a 24-hour period. Each of these instruments is controlled by a software system that takes parameter readings periodically and manages the data collected from the instruments.



The weather station's environment



Weather information system



✧ The weather station system

- This is responsible for collecting weather data, carrying out some initial data processing, and transmitting it to the data management system.

✧ The data management and archiving system

- This system collects the data from all of the wilderness weather stations, carries out data processing and analysis, and archives the data.

✧ The station maintenance system

- This system can communicate by satellite with all wilderness weather stations to monitor the health of these systems and provide reports of problems.

Additional software functionality



- ✧ Monitor the instruments, power, and communication hardware, and report faults to the management system.
- ✧ Manage the system power, ensuring that batteries are charged whenever the environmental conditions permit but also that generators are shut down in potentially damaging weather conditions, such as high wind.
- ✧ Support dynamic reconfiguration where parts of the software are replaced with new versions and where backup instruments are switched into the system in the event of system failure.

KEY POINTS FROM CH. 1

Key points



- ✧ Software engineers have responsibilities to the engineering profession and society. They should not simply be concerned with technical issues.
- ✧ Professional societies publish codes of conduct which set out the standards of behaviour expected of their members.
- ✧ Three case studies are used in the book:
 1. An embedded insulin pump control system
 2. A system for mental health care patient management
 3. A wilderness weather station