



Università degli Studi di Udine

## Strumenti di lavoro

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## Computer-aided software engineering

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Progettazione e Laboratorio  
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- Software tool support for software development
- CASE Technology
  - *Production-process support technology*
    - Tools to support development activities such as specification, design, implementation, etc.
  - *Process management technology*
    - Tools to support process modeling and management

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## Impact of CASE technology

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- CASE technology has resulted in significant improvements in quality and productivity
- However, the scale of these improvements is less than was initially predicted by early technology developers
  - *Many software development problems such as management problems are not amenable to automation*
  - *CASE systems are not integrated*
  - *Adopters of CASE technology underestimated the training and process adaptation costs*

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## CASE classification

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- CASE systems can be classified according to their
  - *Functionality - what functions do they provide*
  - *Process support - what software process activities do they support*
  - *The breadth of support which they provide*
- Classification allows tools to be assessed and compared

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## Functional tool classes

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Tool type	Examples
Management tools	PERT tools, Estimation tools
Editing tools	Text editors, diagram editors, word processors
Configuration management tools	Version management systems, Change management systems
Prototyping tools	Very high-level languages, user interface generators
Method-support tools	Design editors, data dictionaries, code generators
Language-processing tools	Compilers, interpreters
Program analysis tools	Cross reference generators, static analysers, dynamic analysers
Testing tools	Test data generators, file comparators
Debugging tools	Interactive debugging systems
Documentation tools	Page layout programs, image editors
Re-engineering tools	Cross-reference systems, program re-structuring systems

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## Activity-based tool classification

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Test data generation tools				•
Modelling and simulation tools	•			•
Program transformation tools			•	
Interactive debugging systems			•	•
Program analysis tools			•	•
Language-processing tools			•	•
Method support tools	•	•		
User interface management systems		•	•	
Data dictionary tools	•	•		
Diagram editing tools	•	•		
Prototyping tools	•			•
Configuration management tools	•	•	•	•
Document preparation tools	•	•	•	•
Text editing tools	•	•	•	•
Planning and estimation tools	•	•	•	•
	Specification	Design	Implementation	Verification and Validation

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## Integrated CASE

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- While individual CASE tools are useful, more leverage is obtained if tools can work together
- Specialised tools can be combined to provide wider support for process activities
  - *Integration of design tool with a documentation tool*
  - *Integration of specification, design and programming tools with a configuration management system*

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## Levels of integration

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- Platform integration
  - *Tools run on the same hardware/software platform*
- Data integration
  - *Tools operate using a shared data model*
- Presentation integration
  - *Tools offer a common user interface*
- Control integration
  - *Tools activate and control the operation of other tools*
- Process integration
  - *Tool use is guided by a defined process model*

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## Platform integration

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- Tools and systems run on the same hardware/software platform
- UNIX or PC running MS Windows are the most commonly used CASE platforms
- Major problems are heterogeneous networks
  - *Different types of machine on the network*
  - *Different operating systems installed on different machines*
- Lack of OS standards is a problem

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## Data integration

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- Shared files
  - *Tools communicate through a shared file format*
- Shared data structures
  - *Tools communicate through some internal representation of a shared notation*
- Shared repository
  - *Tools are integrated around an OMS (Object Management Scheme) which includes a public schema describing data entities and relationships*

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## Data integration - Shared files

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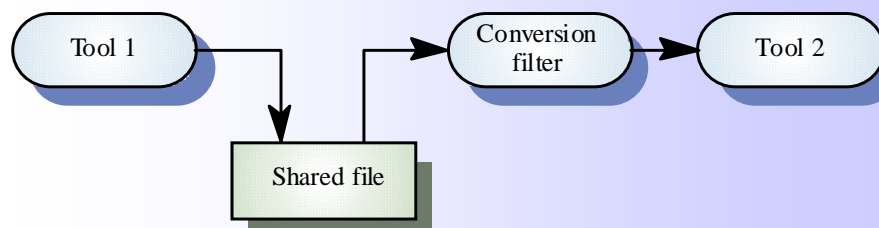
- Simple and straightforward approach to integration
- Most common form of data integration
- Requires tools to share a file format or to include translations from one file format to another

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## Data integration Point-to-point tool integration

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## Shared data integration

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- Tools are tightly integrated around a shared data structure. All tools are aware of the organisation of this structure
- Hides the differences between individual tools - user is presented with a seamlessly integrated toolset
- However, very difficult to add new tools or extend the system in any way

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## Data Integration Language-oriented toolset

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- Compiler for language translation
- Static and dynamic program analysers
- Structure editing system where the program editor includes knowledge of the program syntax
- Prettyprinters and cross-referencers
- All share a common data structure

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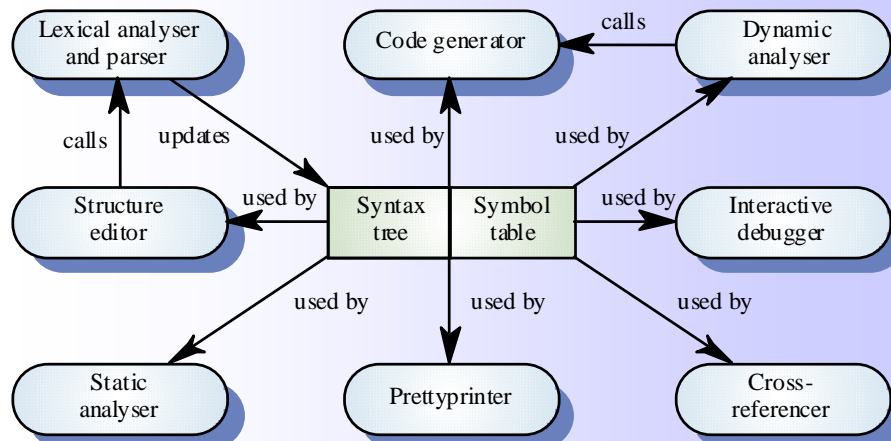




## Data Integration

### Integration through shared data

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## Data Integration

### Repository integration

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- Flexible form of data integration
- Tools access data through an object management system whose schema is public. Tools read and write data according to this schema
- Disadvantages are:
  - *Tools have to be specially written for a specific repository to make use of the schema*
  - *Customer must buy the OMS (Object Management System) as well as the CASE system*

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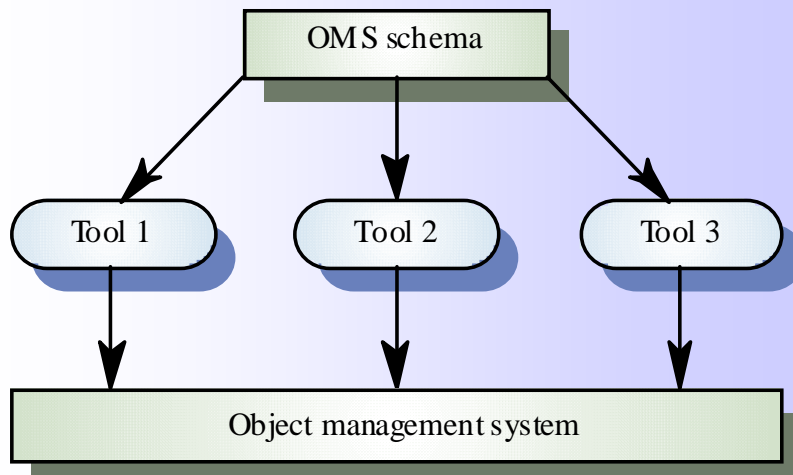






## Data Integration Integration through an OMS

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## Presentation integration

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- Window system integration
  - Tools use the same underlying window system and present a common interface for window manipulation commands
- Command integration
  - Tools use the same form of commands for comparable functions. The menus are organized in the same way and similar icons are used
- Interaction integration
  - The user interacts with graphical entities in the same way. The same direct manipulation operations are used

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## Control integration

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- Concerned with providing mechanisms for one tool to control the activation of other tools
- Tools should be able to start and stop other tools and request particular services provided by other tools

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## Process integration

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- The CASE system has embedded knowledge about process activities, their phasing, constraints and the tools used
- An explicit model of the process must be defined which is enacted by a process engine
- The process should be guided rather than prescribed by the process model

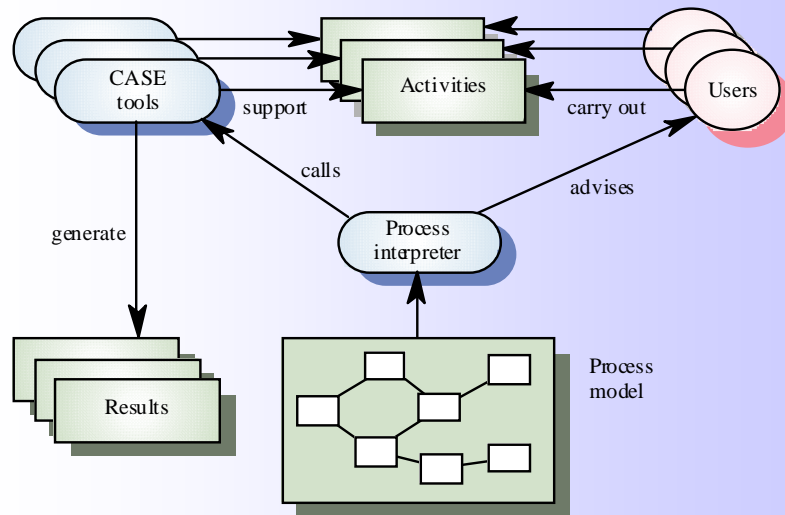
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## Process integration

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## Process integration Process model creation

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- Identify process activities.
- Identify the deliverables or products of the process.
- Define activity coordination and activity dependencies.
- Allocate engineers to each activities.
- Specify tool support for each activity.

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## Process integration Process models

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- Software processes are complex and difficult to model
  - *There is a high process programming cost*
  - *Software engineers dynamically change the process to cope with unexpected circumstances*
  - *It is hard to specify cooperative working in current approaches to process modelling*
- Process-driven CASE systems are mostly still experimental systems

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## The CASE life cycle

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- Procurement
- Tailoring
- Introduction
- Operation
- Evolution
- Obsolescence

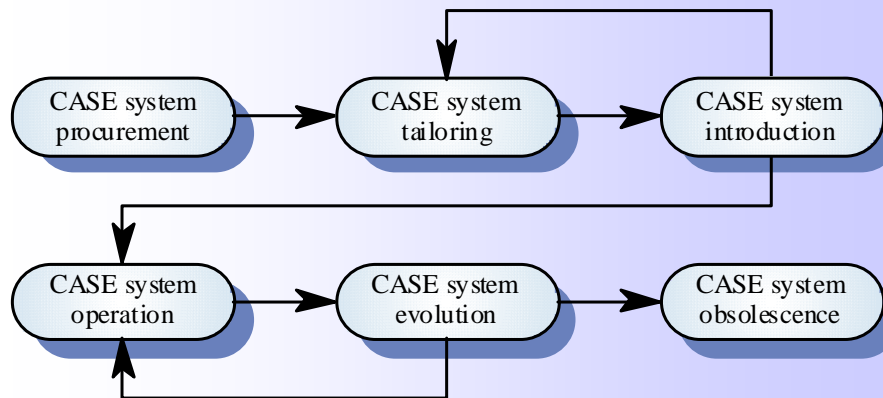
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## A CASE life cycle model

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## CASE life cycle CASE procurement

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- Existing company standards and methods
  - *The environment must support existing practice*
- Existing and future hardware
  - *The environment must be compatible with existing hardware. It should run on industry-standard machines*
- The class of application to be developed
  - *The environment should support the principal type of application developed by an organisation*
- Security
  - *The environment should provide appropriate access control facilities*

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## CASE life cycle CASE system tailoring

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- Installation
  - *Set system dependent hardware and software parameters*
- Process model definition
  - *Define the activities that the environment is to support*
- Tool integration
  - *Describe what tools are to be part of the environment and how they are to be integrated*
- Documentation
  - *Provide appropriate, in-house documentation for using the environment*

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## CASE life cycle CASE introduction and operation

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- May require changes to working practice
  - *User resistance because of conservatism or a feeling that environments are for managers rather than engineers*
  - *Lack of training. Organizations often don't invest enough in training*
  - *Management resistance. Managers may not see how the environment will reduce project costs*
- Migrate projects slowly to the CASE system
  - *New projects should start with the environment after initial pilot projects have demonstrated its advantages*
  - *It is usually impractical to convert existing projects to the CASE system*

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## CASE life cycle CASE system evolution

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- As the system is used, new requirements arise
  - *Process requirements. Changes in the process model will be identified*
  - *Tool requirements. New tools will become available and will have to be incorporated*
  - *Data requirements. The data organization will evolve*
- An evolution budget must be available or the environment will become progressively less useful
- Forward compatibility must be maintained

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## CASE life cycle CASE system obsolescence

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- At some stage, an environment will outlive its usefulness and will have to be replaced
- Replacing an environment must be planned and should take place over an extended time period
- Currently supported projects must be moved to a new environment before their supporting environment is scrapped

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## CASE Tools

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- A set of tools which supports a particular phase in the software process
- Tools work together to provide comprehensive support
- Common services are provided which are used by all tools and some data integration is supported

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## Types of CASE Tools

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- Programming, design and testing systems covered here
- Other types of systems are
  - *Cross-development systems for host-target development*
  - *Configuration management systems*
  - *Documentation systems for producing professional system documentation*
  - *Project management systems.*

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## Programming tools

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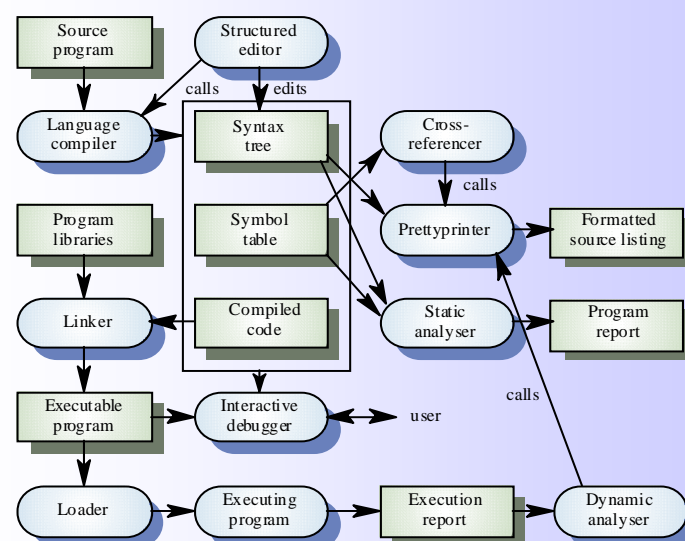
- A set of tools to support program development
- First CASE systems. Include compilers, linkers, loaders, etc.
- Programming systems are often integrated around an abstract program representation (the abstract syntax tree) which allows for tight integration of tools
- Integration around shared source-code files is also possible

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## A programming systems

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## 4GL Programming Tools

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- Provide facilities for developing 4GL programs
- Integrated around a database management system
- Components usually include
  - *Database query language*
  - *Form design system*
  - *Spreadsheet*
  - *Report generator*
- Very effective in developing business systems

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## Design and analysis tools

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- Support the generation of system models during design and analysis activities
- Usually intended to support a specific structured method
- Provide graphical editors plus a shared repository
- May include code generators to create source code from design information

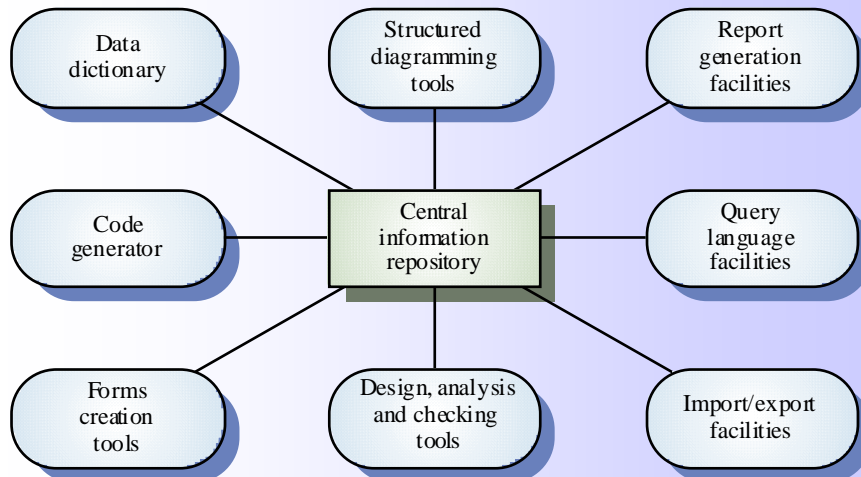
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## An analysis and design system

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## Design and analysis tools advantages

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- Generally available on relatively cheap personal computers
- Results in standardised documentation for software systems
- Estimated that productivity improvements of 40% are possible with fewer defects in the completed systems

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## Design and analysis tools drawbacks

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- These systems are usually closed environments with tight integration between the tools
- Import/export facilities are limited. ASCII and Postscript diagrams
- Difficult or impossible to adapt method to specific organizational needs
- Configuration management may either be excluded or specific to that system. Difficult to integrate with other systems in the organization

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## Testing tools

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- Testing is an expensive process phase. Testing workbenches provide a range of tools to reduce the time required and total testing costs
- Most testing tools are open systems because testing needs are organization-specific
- Difficult to integrate with closed design and analysis tools

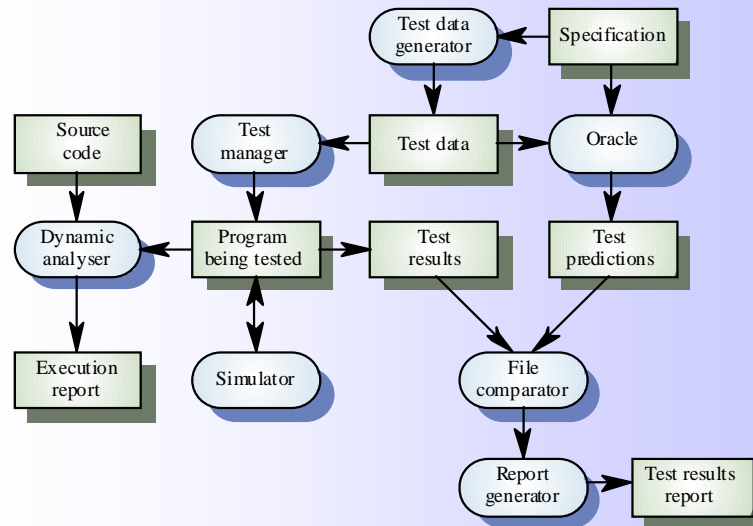
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## A testing system

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## Testing tools adaptations

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- Scripts may be developed for user interface simulators and patterns for test data generators
- Test outputs may have to be prepared manually for comparison
- Special-purpose file comparators may be developed

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## SE Environments

### Integrated environments

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- A software engineering environment (SEE) is a set of integrated hardware and software tools
- Can act in combination in an integrated way to provide support for **the whole of the software process** from initial specification through to testing and system delivery

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## SE Environments

### characteristics

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- The environment facilities are integrated - should provide
  - *Platform*
  - *Data*
  - *Presentation*
  - *Control*
  - *Process integration*
- The environment is designed to support team-based activities. Configuration management is fundamental to this
- Facilities are provided to support a wide range of software development activities

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