

Computer Aided Process Engineering (CAPE)

by

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Abstract

The advancement of information technology has the potential to significantly alter the operation and training of operators in the chemical industries.. From early 1980s, large computer-aided process design packages became available for installation on mainframe computers. Most recently, many commercial softwares are available on personal computers and they can also be utilised to enhance and simplify the learning methods. But all these softwares and technologies are either developed in foreign countries or developed locally by foreign experts.

A study was carried out in the development of packages for computer-based training (CBT) to be used by the local process industries for better operation in plants and effective training for safety. CBT is well received in all sectors of enterprises that involve training of all levels of staff from managers down to the operators. Three modules have been identified in the study - simulation, multimedia and chemical properties.

1.0 Introduction

Rapid developments of computer or information technology (IT) have significantly affect our way of life and greater sophistication of ideas are flowing in from both government and private sector. IT development has been identified as one of the five thrust research areas of the nation. The importance of IT was highlighted by the Prime Minister in his Vision 2020. He observed,

"In the information age that we are living in, the Malaysian Society must be information rich. It can be no accident that there is today no wealthy, developed country that is information-poor and no information-rich country that is poor and underdeveloped."

He stressed that *".....knowledge will not only be the basis of power but also prosperity", and for this reason, "computer literacy is a must if we want to progress and develop. No effort must be spared in the creation of an information rich Malaysian Society."*

In the nineties, knowledge and skills required will not be single discipline-based, but will be orientated towards a mix of technical, statistical and computer-based disciplines. This will equip future manpower to achieve the goal of becoming a fully developed nation by the year 2020. One of the thrust areas identified as an emerging technology is information technology. As such, manpower training in computer-based skills is important and training institutions must give greater emphasis to the production of these types of manpower.

Information society will begin to take shape through the process of education. It has been suggested that apart from the traditional three literacies of reading, writing and arithmetic, there is a need to inculcate two additional ones: IT literacy and information literacy(3).

IT literacy relates to the technological dimension where students need to acquire skills and proficiency in using IT systems. On the other hand, information literacy refers to the nature and value of the information content itself, especially in its diverse forms in the electronic media.

2.0 Computer in chemical engineering training

The use of computer aided design (CAD/CAE) is well established in process industries. Locally, industries such as the petrochemicals, fine-chemicals, petroleum and palm oil are using packages that are either bought from overseas or developed by foreign consultants. There is a need for research and development in this area to remedy the trend.

There is a universal trend in the recognition by universities of the fact that industry needs to rely on computer technique both in production and research and

development to an increasing extent that education cannot avoid responding adequately to this challenge.

Computers are widely used in process industries in the areas of modeling of fundamental phenomena, process design, process operations and control and process engineering information management. More research works are needed in these areas because computing technology are growing very rapidly.

3.0 The Main Features

As we move into the Information Age, developments in Information technology are bringing the availability of interactive technology as powerful tools for training and learning through the innovative application of computerware with hypertext and hypermedia capabilities.

Computers have been used widely in training for personnel in industries. In America, the US military, the Federal Aviation Administration (FAA) and the Nuclear Regulatory Commission (NRC) require their pilots and operators to be trained on dynamic computer-based simulators. All these three organizations depend on their employees to maintain the high standards of safety that the public demands. The chemical industry should demand the same attention to safety.

For trainees, the simulated process translates into a realistic dress rehearsal where they can get as much practice as they need. Complicated procedures can become second nature to simulator trainees. Mistakes are opportunities to learn rather than reasons for reprimands.

Emergencies and upsets can be introduced to the process for more advanced learning. No other type of training allows trainees to experience and react to dangerous situations. Operators may not realize that an upset is in the process and they must react instinctively whenever the unexpected does arise. Simulators help operators to develop proper safety instincts through relevant practice.

4.0 Materials and Methods

Equipments used in the projects were, Macintosh II and LC, IBM PC compatible, scanner and MacRecorder. Authorware Professional® was used as the development package for CBT.

The structure of the programme is outlined in Fig.1. The user can choose any one of the available packages - Simulation, CBT and Properties Data Bank.

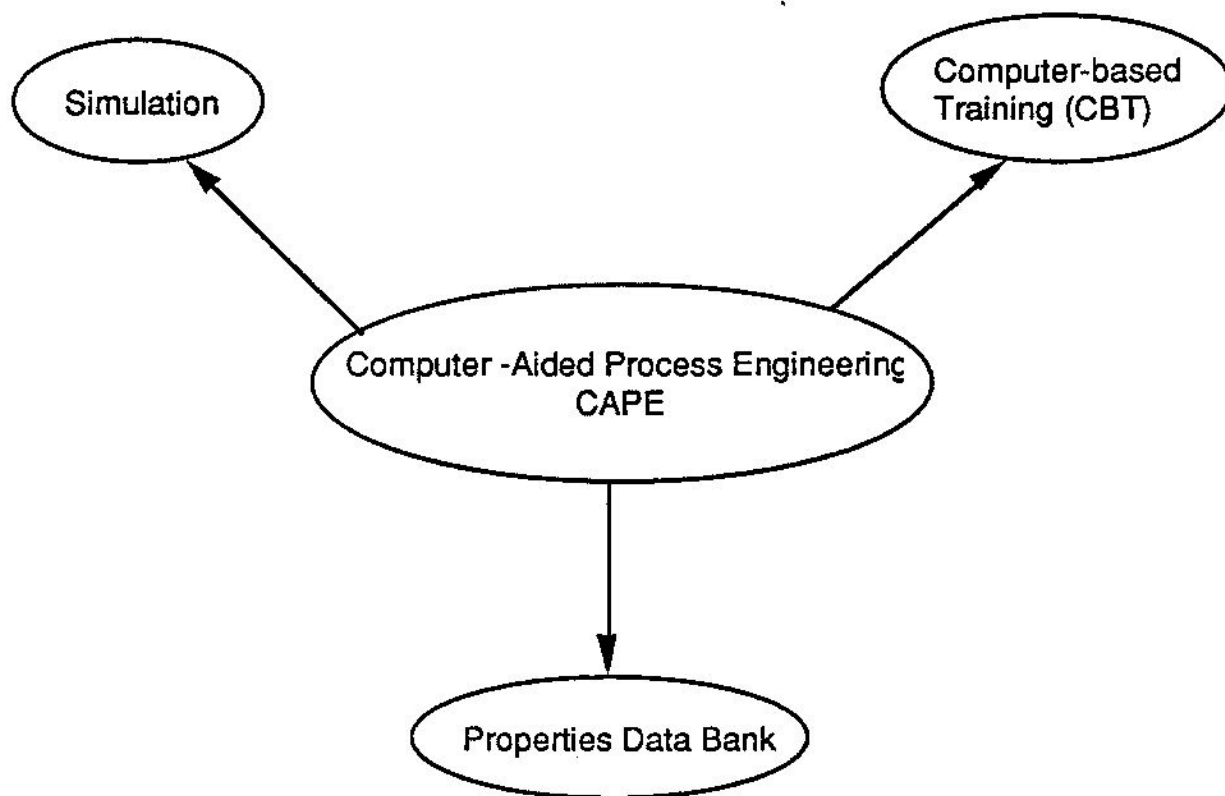


Figure 1. Scope of CAPE

Simulation. This module is used for training in plant operation, optimization and safety. Different unit operations such as distillation, reactor and extraction are incorporated in the module. Material and Energy Balances module is also included in this package.

Computer-based Training (CBT). The concept of multimedia is incorporated in the module. Elements such as text, graphics, sound, animation and video are integrated to produce the package. Equipments such as distillation, evaporation, extraction and centrifuge are chosen for the study.

Properties Data Bank. This module gives the physical and thermodynamic properties of substances. Properties given are either from published data or predicted from correlations. A wide variety of thermodynamic models are included in the package for calculating enthalpies, liquid densities and vapour and liquid densities. This package can be linked to the simulation package for properties calculation.

The development of the packages were based on several factors:

1. **Alterability** - package must be capable of modification and adaptation to different environments. This depends much on the authoring package used to create the original package.
2. **Relevance** - package should be relevant to the curriculum in which it functions. Designer has to know the need and also the environment of the industry in which his products will be used.
3. **Validity** - the content of package must be correct and it must find its best and most appropriate implementation on a computer.
4. **Motivation** - package should be able to capture the attention of the users. Principles considered include colour, sound, animation, quick reinforcement of actions taken, indeterminate outcomes, a competitive element and an opportunity to start over and over many times without fear of failure or discouragement from a peer or trainer.
5. **Friendliness** - package must be consistent in operation. The user interface has to be structured by designing an organisation for the user.

5.0 Discussion

Principles of interaction have been applied in the development of the learning packages. The principles include discovery learning, user pacing, repetition, allowance for trial and error testing, relationship seeking, linkage formation, hierarchical structuring, modular formatting, multiple knowledge levels and multimodal presentation.

Discovery learning. User can explore a subject to the breadth and depth that he is capable of and in the process acquire or come to understand concepts of the subject matter.

User-pacing. There are varying rates of learning between different trainees, and the same trainee goes through different sections of a topic at differing rates. Hence,

the provision of an environment where the rate of learning is user-paced is another means of enhancement of learning.

Repetitive review. The review of the various parts of a program are within the control of the user, and a section may be repeated as often as necessary for a complete understanding of the topic.

Multiple levels of knowledge The package is modular, with different levels of difficulty or specialised subjects. Passwords may be incorporated so that users are guided within a defined corridor or pathway of learning. Alternatively, it may be designed to be entirely free-form. Here questions may be set selectively at various portions of the program to gauge the understanding of the user and one can then cover the entire depth and breadth of the available material if one's responses are appropriate.

Flexibility of access. There should be multiple points of entry into (and exit from) a learning module. The trainer and the trainee should be able to alter and adapt a program for their customization.

Linkage formation. The recall of knowledge and memorised information depends in part on the extent of linkages formed between related topics.

Multimodal presentation. The presentation of the material to be learnt can be adapted for different types of learners in terms of their previous exposure to the package. Thus, a first-time user may well prefer to use a presentation in the guided tour mode, while more experienced users on returning to review the material may have a preference for browsing, fact collection, experimentation and simulation, or simply archiving. There has to be allowance for an output mode that produces a variety of multimedia formats for printouts such as text, videotapes or audio cassettes.

The production of computer softwares is a tedious development work. A systematic development process has to be developed through series of steps of optimization and close monitoring. Good service backup on the softwares and hardwares cannot be neglected. Lack of service support can delay the project for months

5.0 Conclusion

Modern training programmes are faced with the challenge of educating a wide range of employees. From dealing with experienced operators, who may need to learn new operating habits, to dealing with new employees who may not have scientific education, trainers must achieve a broad variety of objectives.

The rapid advances in hardware technology in the 70's and 80's have transported us from the mainframe era to the personal microcomputers which have the capabilities greater than the many of the original mainframes. With the latest technology of knowledge-based system, the personal computer is being transformed into a knowledge machine with artificial intelligence and expert systems. Full exploitation of these capabilities will only benefit the the whole nation and fulfil the requirement of Vision 2020.

Furthermore, the computing technology continues to grow at a very rapid pace and the importance of computer in process industries operation and training cannot be denied and efforts from all sectors are needed because the ability to design and control better chemical products and processes can only be made by chemical engineers who understand computers - not by computer scientists or by software engineers.

6.0 References

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