Session 9 – Modification History

Revision	Date	Revision Description
V1.0	April, 1997	For issue
V2.0	7 September 2001	Updated for new syllabus V2/2001.

Session 9

Organisational DSS

Lecturer Guide

Session Specification

Duration

Allow approximately 1 hour 30 minutes for this session.

Objectives

By the end of this session the participant will be able to:

- define the differences between DSS and ODSS;
- discuss the concepts and frameworks of ODSS;
- understand the components which make up a typical ODSS;
- critique an actual ODSS.

Lecturer

The lecturer should be an experienced project manager or developer, who has been involved in the successful management and development of commercial decision/expert systems. He/she should also be aware of the theoretical aspects of decision making, software project life cycle, databases, model bases and human computer interaction and have read the corresponding chapters in Turban & Aronson.

Method of Presentation

This session should be lecture based, making extensive discussion using the material provided.

Material List

Visuals

V9.1 Introduction
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V9.5 ODSS Concept – 1
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V9.26 Summary

A Handout is also provided showing all the visuals presented during this session.

Equipment Required

The following equipment is required:

- Flipchart stand, flipchart and broad-tipped felt pens.
- PC projector and screen.
- Overhead projector and screen.

Bibliography

V S Jacob & H Pirkul, *Organizational Decision Support Systems*, International Journal of Man-Machine Studies, 36, 817-832, 1992.

Turban & Aronson, *Decision Support Systems and Intelligent Systems*, Prentice-Hall International, Inc., 5th Edition, 1998, ISBN 0-13-781675-8, Chapter 11.

Session Summary

Visuals Handout

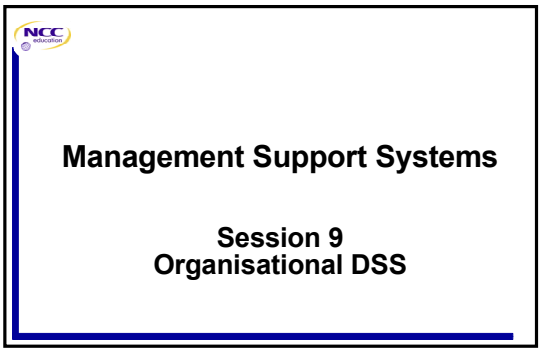
Session 9

Organisational DSS

1 Introduction

(5 minutes)

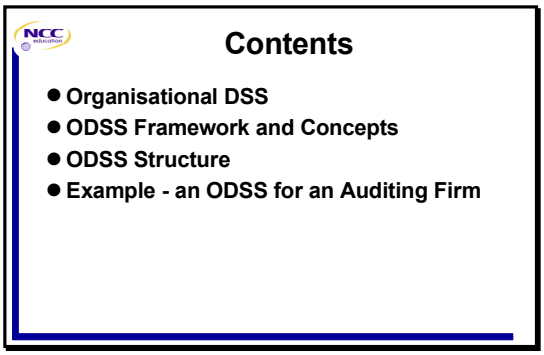
V9. 1



Inform students that a handout containing a full set of visuals will be provided to them at the end of this lecture.

1.1 Summary of Topics to be Covered

V9. 2

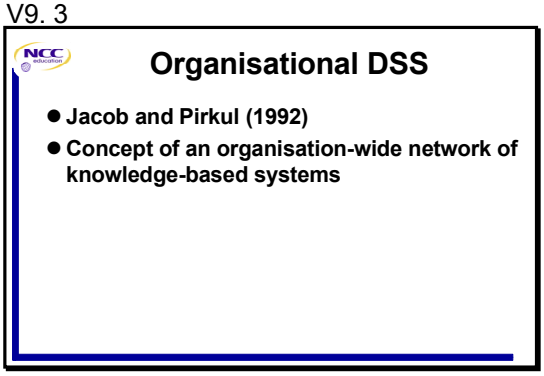


The topics detailed in the visual will be discussed during this session.

2 Organisational DSS

(5 minutes)

V9. 3



We have looked so far at DSS which support individual decision makers, and at those (GDSS) which support, typically, small-to-medium sized groups, perhaps working on a particular project. A third type of DSS that has been proposed in recent years is the ODSS – Organisational Decision Support System.

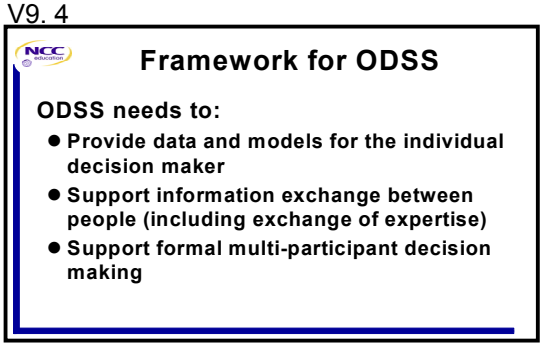
The idea here is that most individuals and project groups do not operate in isolation from the organisation in which they are located. For decision making in this context to be effective, decision support must include information and knowledge about organisational procedures, structures, communication channels, rules, *etc*.

A recent paper by **Jacob and Pirkul (1992**) sets out a framework for the design of an ODSS.

3 ODSS Framework and Concepts

(20 minutes)

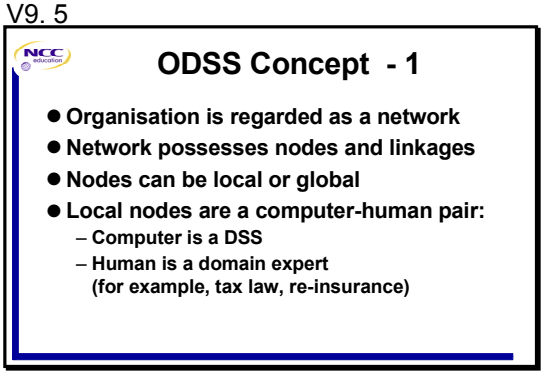
V9. 4



Jacob and Pirkul suggest that ODSS need to have these characteristics:

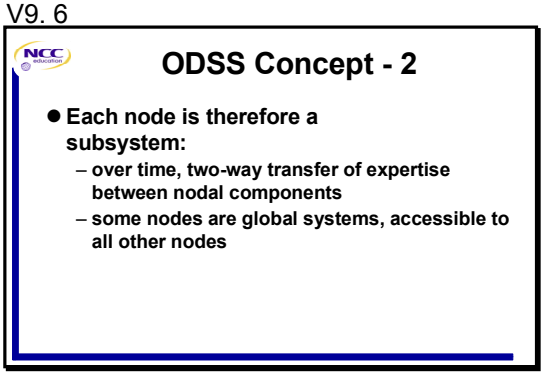
- Provision of data and models for support of the individual decision maker.
- Support for information exchange between people within an organisation, including the exchange of expertise.
- Support for formal multi-participant decision making. This implies both the kind of support available in a typical GDSS (hardware, specialised software for conflict resolution, *etc*. defined rôles and procedures) and support available outside meetings and aimed at specific problem situations. Typical GDSS do not provide support specific to different problem domains.

V9. 5



The basic idea of this framework is that the organisation is regarded as a network, the nodes of which are a DSS-human information processing pair. The human receives decision support from the local DSS, but is also regarded as an expert in some area (tax law or re-insurance strategy, for example), capable of providing decision support or expert knowledge to other nodes in the network.

V9. 6



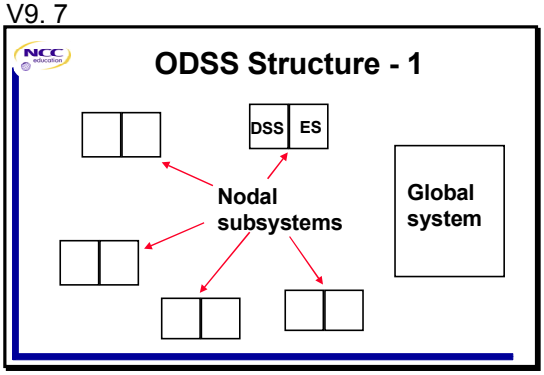
You can thus regard each node as a DSS (computer) and ES (human) synergistic system – a nodal subsystem.

In addition to these *nodal* subsystems, there are *global* systems, accessible to all nodes in the organisation. These might be, for instance a multi-participant DSS, supporting project team decision making.

4 ODSS Structure

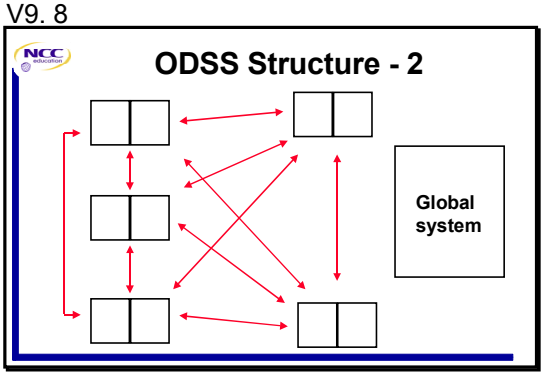
(40 minutes)

V9. 7



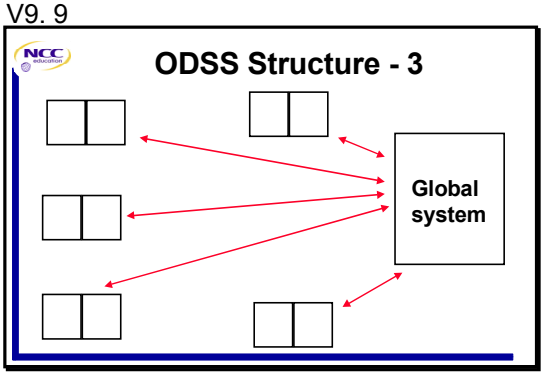
The precise structure of the ODSS will be influenced by the structure of the organisation itself. Many organisations are hierarchically structured – a single chief executive, several senior managers in charge of divisions, various layers of middle management, etc.

V9. 8



In many organisations, however, certain activities, especially problem solving, occur without reference to this strict hierarchy – people who need access to particular expertise will bypass official channels and approach the source of the expertise directly.

V9. 9



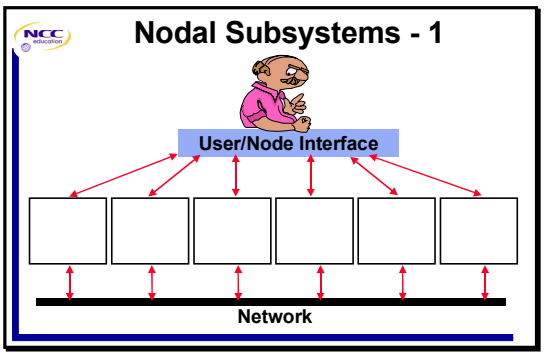
Jacob and Pirkul propose a ODSS structure which recognises and makes use of an existing hierarchy, but which also allows ad hoc and unconventional interaction patterns.

The three visuals show the different interactions possible between the nodal subsystems and the global systems.

*Emphasise that this is the view of **Jacob and Pirkul** who emphasise the significance of the ES component; others do not (ask students to read Chapter 11 in the course text for alternate opinions).*

4.1 The Nodal Subsystem

V9. 10



This has two rôles.

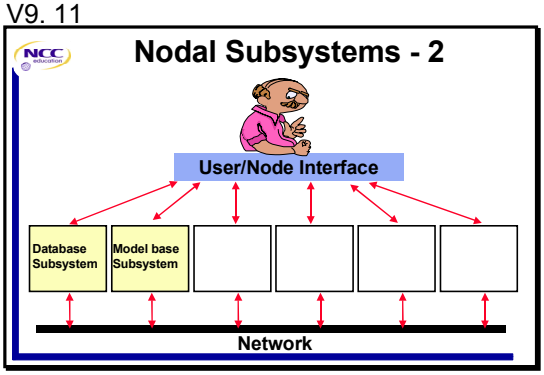
Firstly, it acts as a DSS to the human user at that node, allowing him or her to explore *what if?* scenarios and to run data through models in the model base.

Secondly, it acts as an Expert System – the expertise being provided by the human at the node, and the computer filtering and structuring the knowledge provided by the human and communicating it to other nodes in the network. The nodal system is therefore a Knowledge-Based System (KBS) acting as both a DSS and a ES.

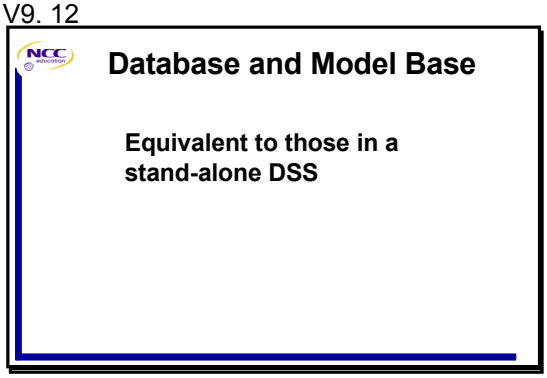
The following visuals progressively illustrate the components of a nodal subsystem.

4.2 The Data and Model Subsystems

V9. 11



V9. 12

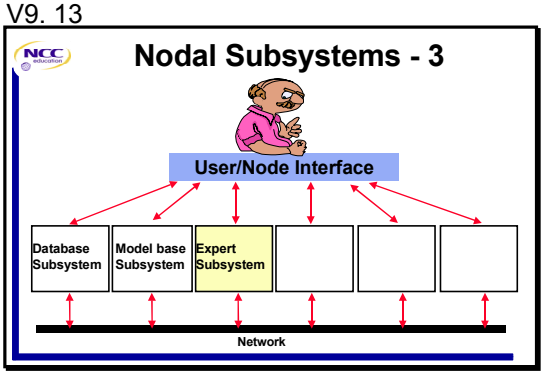


The data and model subsystems are equivalent to those in a conventional DSS.

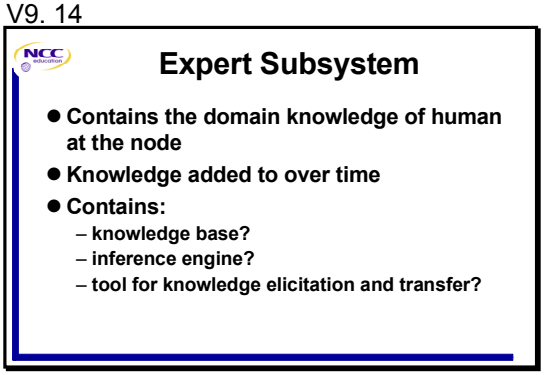
Take the opportunity to refresh the students' memories of these two components.

4.3 The Expert Subsystem

V9. 13



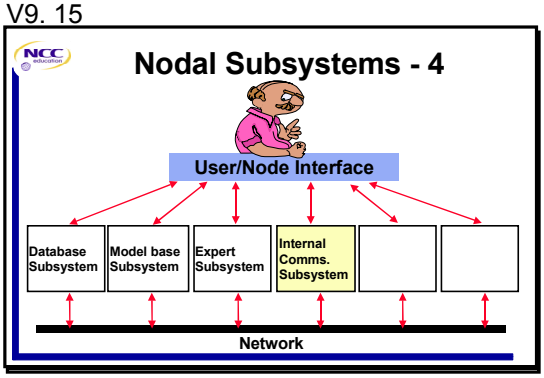
V9. 14



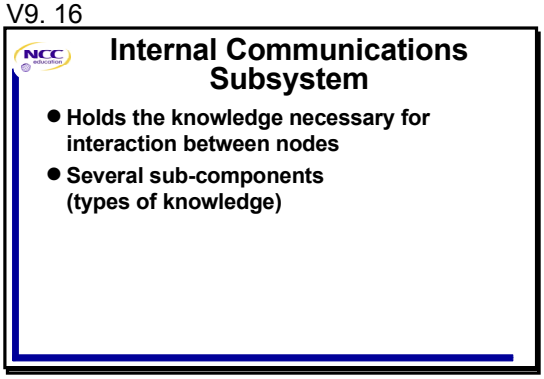
The Expert subsystem contains the expert domain knowledge of the human at the subsystem. The knowledge of the human is held locally in this component and added to over time. Although the authors do not define this component very clearly, it implies a knowledge base, an inference engine and a tool for transferring and structuring knowledge from the human to the system.

4.4 The Internal Communication Subsystem

V9. 15

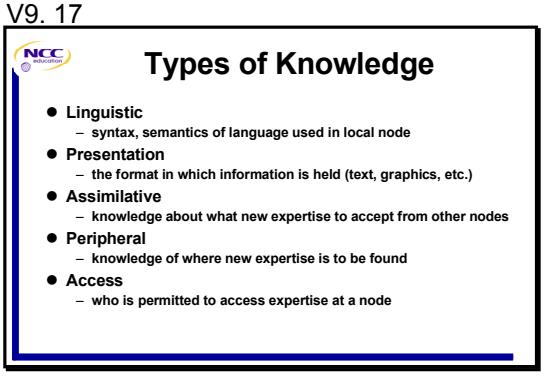


V9. 16



This contains the communication knowledge necessary for interaction between members of the organisation – between the nodes. This knowledge has several sub-components (or types of knowledge):

V9. 17



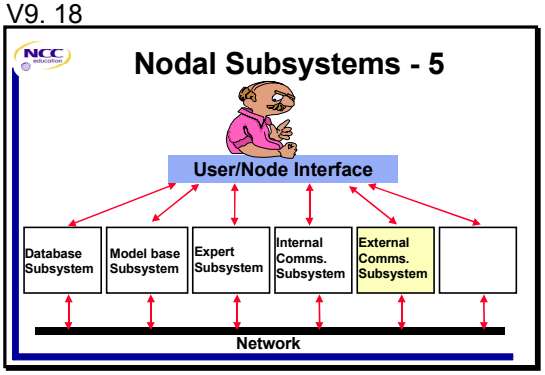
- *Linguistic* – the syntax and semantics of the languages used in the problem domains.
- *Presentation* – format of information (text, graphical, icons etc.).
- *Assimilative* – knowledge about what new knowledge to accept from external sources (i.e. contextual knowledge).
- *Peripheral* – information relating to a particular node's expertise and which needs to be accessed from another node in the organisation (i.e. a register of who has what knowledge; where particular knowledge is to be found).
- *Access* – who is allowed or permitted to access a particular node's knowledge.

Requests for information can be regarded as a mapping of the peripheral knowledge of one node to the access knowledge of another. If one node (A) requests information from node B, it will be granted if A belongs to the access knowledge set of B; and if the information requested is actually held by B.

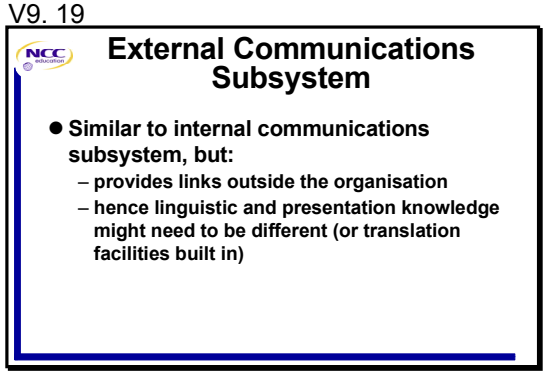
The internal communication system can also contain other media of communication – fax, voice messaging and real-time video.

4.5 The External Communication Subsystem

V9. 18



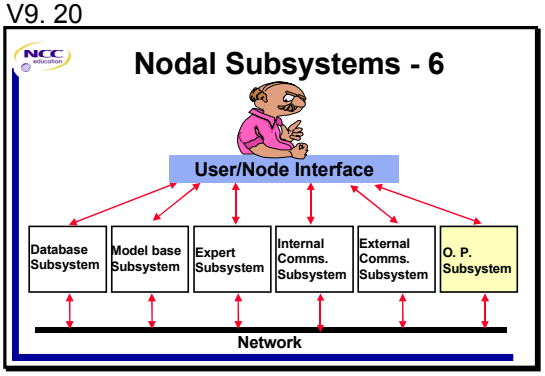
V9. 19



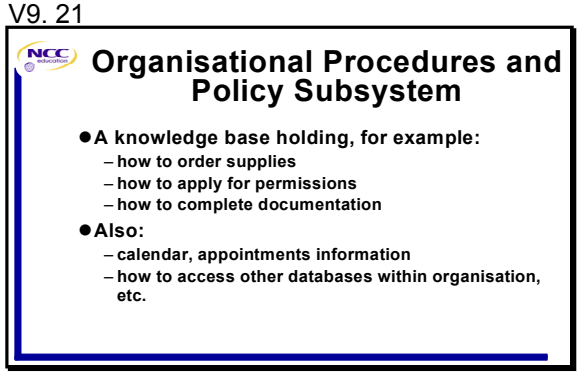
This functions similarly to the internal communication subsystem, but provides links to entities outside the organisation. This might mean that the linguistic and presentation knowledge need to be different.

4.5.1 The Organisational Procedure and Policy Subsystem

V9. 20



V9. 21



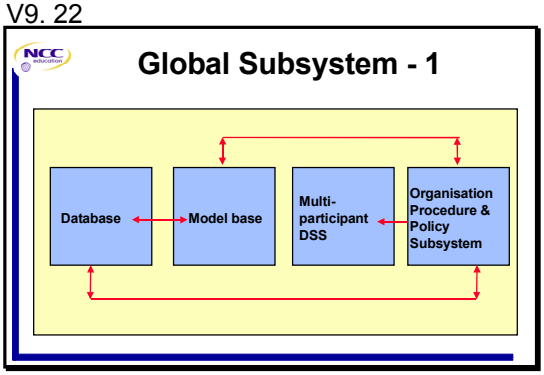
This is a knowledge base holding material on standard procedures and policies of the organisation, for example, how to:

- order supplies;
- apply for permissions;
- complete forms, etc.

It also provides calendar and appointments information, and ways of accessing databases within the organisation which might be accessible via the network but are not part of the ODSS.

4.6 Global Subsystems

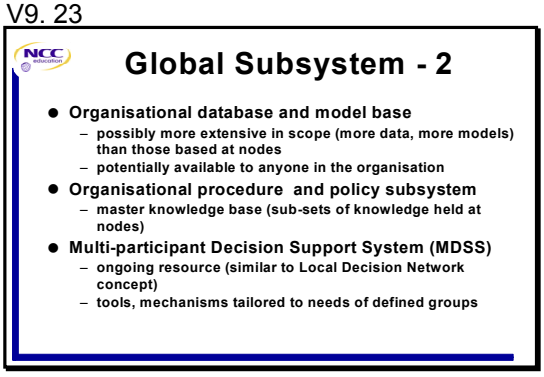
V9. 22



These include 4 components, which are effectively resources available to everyone in the organisation:

- *Organisational database and model base* – These two components are similar to a conventional DSS, except that they are available over a network to anyone in the organisation.

V9. 23



- *Organisational procedure and policy subsystem* – This is a master system holding all the organisation's rules, procedures, access rights, ways of doing things, etc. Sub-sets of this knowledge are kept at particular nodes.

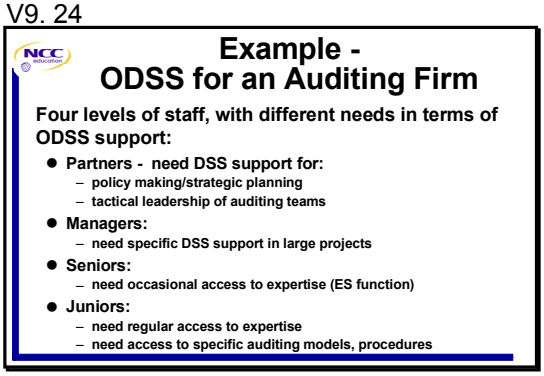
- *Multi-participant Decision Support System (MDSS)* – This is similar in principle to the Local Decision Network concept of a GDSS. Rather than providing support in a meeting lasting a few hours, it is an ongoing resource. Also, rather than provide generic support for group decision making, it holds tools and mechanisms tailored for the group decision making needs of defined teams within the organisation (for example, group-specific and task-specific knowledge).

  The MDSS works closely with the existing network of local nodes.

5 Example – an ODSS for an Auditing Firm

(20 minutes)

V9. 24



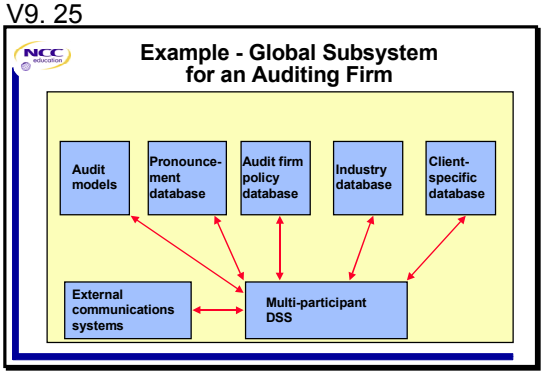
Auditing firms are typically hierarchical in structure, while a lot of the actual decision making is done in teams. There are typically 4 levels of people involved:

- *Partners* – They need decision support of two kinds. Firstly, in terms of the policy making and strategic planning for the firm; and secondly as leaders of several auditing teams, bearing final responsibility for the quality of the work.
- *Managers* – They might also be members of several audit teams, having responsibility for a segment of the work on large audits, and taking a review rôle in small audits.
- *Seniors* – These may also be members of several teams, with varied responsibilities within each team. They may need access to particular expertise from time to time.
- *Juniors* – These people have little specific expertise and generally carry out structured tasks. They need guidance and also access to specific expertise, statistical models and procedures.

The *nodal subsystems* in an ODSS for such an organisation contain support appropriate to the work of the people at each node. Not everyone will need to communicate outside the organisation (for example, to clients), so the external communication subsystem may be a function of a global subsystem. The database and model base at each node will contain data and models appropriate to the specific work being done there. The expert system component is seen as something constantly being developed – people in an auditing firm acquire skills and knowledge as they progress in their careers.

The internal communication system is important here, particularly the access and peripheral knowledge components.

V9. 25



The *global system* will possess a database common to all participants, including things like:

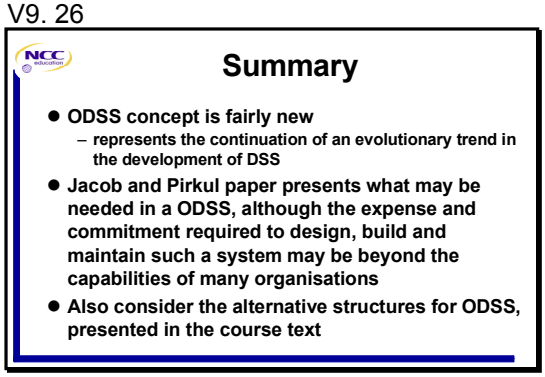
- client information;
- organisational policy;
- information and rules from external regulatory authorities.

It will also handle communications external to the organisation, as well as providing mechanisms to support communication, problem-solving techniques, etc. in ways analogous to a GDSS.

6 Summary

V9. 26

(5 minutes)



The concept of an ODSS is fairly new, but represents the continuation of an evolutionary trend in the development of DSS.

The **Jacob and Pirkul** paper presents an interesting and plausible model of what may be needed in a ODSS, although the expense and commitment required to design, build and maintain such a system may be beyond the capabilities of many organisations at present.

Students should also consider alternative structures for ODSS, presented in the course text.

Organisational DSS - 9.1

Management Support Systems

Session 9
Organisational DSS

V2.0

Organisational DSS - 9.2

Contents

- Organisational DSS
- ODSS Framework and Concepts
- ODSS Structure
- Example - an ODSS for an Auditing Firm

V2.0

Organisational DSS - 9.3

Organisational DSS

- Jacob and Pirkul (1992)
- Concept of an organisation-wide network of knowledge-based systems

V2.0

Organisational DSS - 9.4

Framework for ODSS

ODSS needs to:

- Provide data and models for the individual decision maker
- Support information exchange between people (including exchange of expertise)
- Support formal multi-participant decision making

V2.0

Organisational DSS - 9.5

ODSS Concept - 1

- Organisation is regarded as a network
- Network possesses nodes and linkages
- Nodes can be local or global
- Local nodes are a computer-human pair:
  - Computer is a DSS
  - Human is a domain expert (for example, tax law, re-insurance)

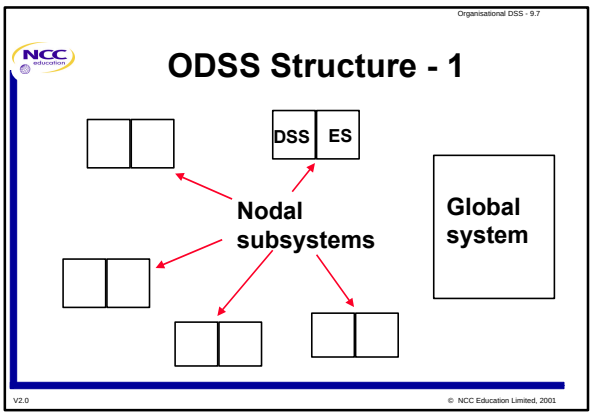
V2.0

Organisational DSS - 9.6

ODSS Concept - 2

- Each node is therefore a subsystem:
  - over time, two-way transfer of expertise between nodal components
  - some nodes are global systems, accessible to all other nodes

V2.0


Organisational DSS - 9.7
ODSS Structure - 1
DSS
ES
Nodal subsystems
Global system
V2.0
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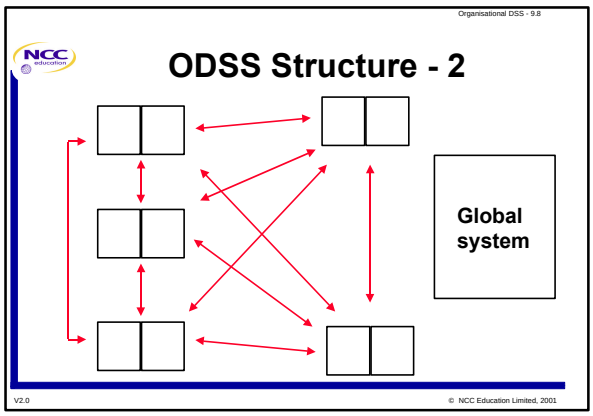
Organisational DSS - 9.8
ODSS Structure - 2
Global system
V2.0
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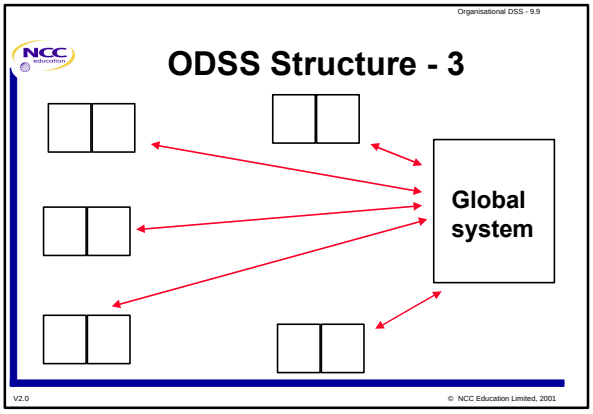
Organisational DSS - 9.9
ODSS Structure - 3
Global system
V2.0
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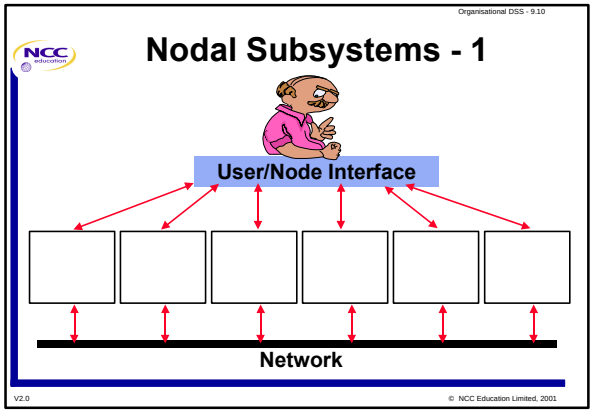
Organisational DSS - 9.10
Nodal Subsystems - 1
User/Node Interface
Network
V2.0
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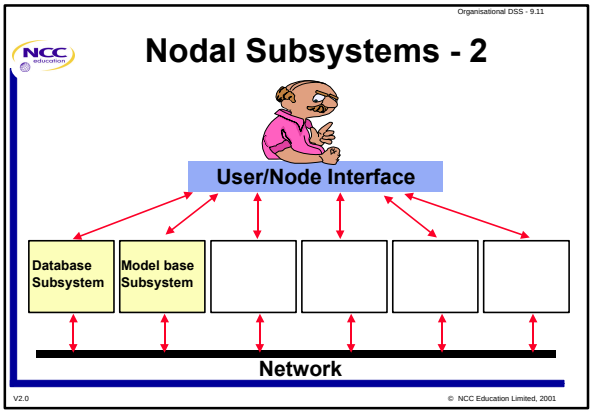
Organisational DSS - 9.11
Nodal Subsystems - 2
User/Node Interface
Database Subsystem
Model base Subsystem
Network
V2.0
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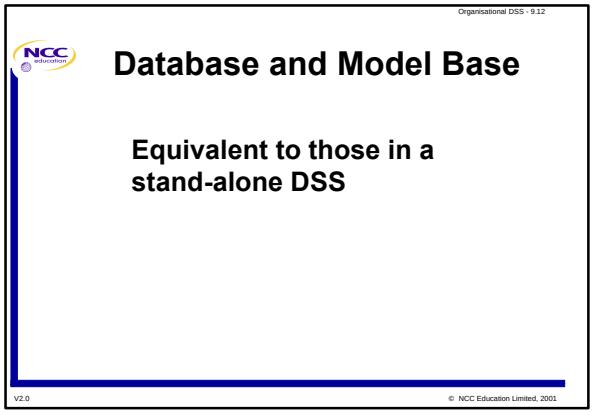
Organisational DSS - 9.12
Database and Model Base
Equivalent to those in a stand-alone DSS
V2.0
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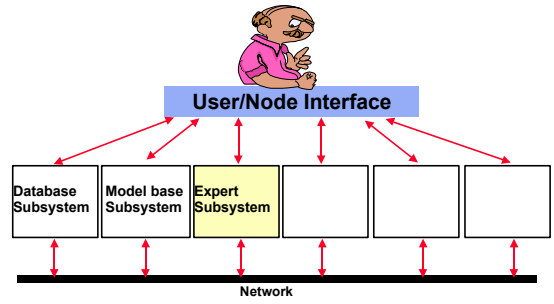
Organisational DSS - 9.13

Nodal Subsystems - 3



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Organisational DSS - 9.14

Expert Subsystem

- Contains the domain knowledge of human at the node
- Knowledge added to over time
- Contains:
  - knowledge base?
  - inference engine?
  - tool for knowledge elicitation and transfer?

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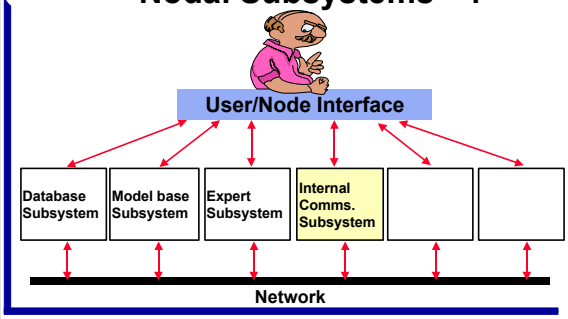
Organisational DSS - 9.15

Nodal Subsystems - 4



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Organisational DSS - 9.16

Internal Communications Subsystem

- Holds the knowledge necessary for interaction between nodes
- Several sub-components (types of knowledge)

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Organisational DSS - 9.17

Types of Knowledge

- Linguistic
  - syntax, semantics of language used in local node
- Presentation
  - the format in which information is held (text, graphics, etc.)
- Assimilative
  - knowledge about what new expertise to accept from other nodes
- Peripheral
  - knowledge of where new expertise is to be found
- Access
  - who is permitted to access expertise at a node

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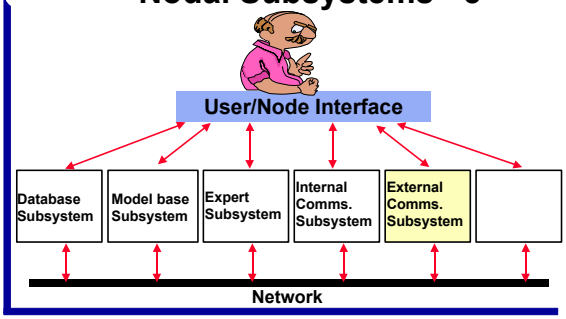
Organisational DSS - 9.18

Nodal Subsystems - 5



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Organisational DSS - 9.19

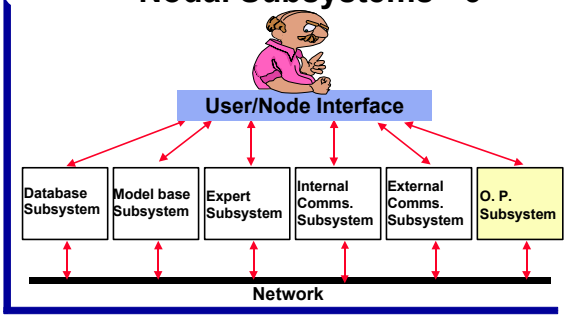
External Communications Subsystem

- Similar to internal communications subsystem, but:
  - provides links outside the organisation
  - hence linguistic and presentation knowledge might need to be different (or translation facilities built in)

V2.0

Organisational DSS - 9.20

Nodal Subsystems - 6



V2.0

Organisational DSS - 9.21

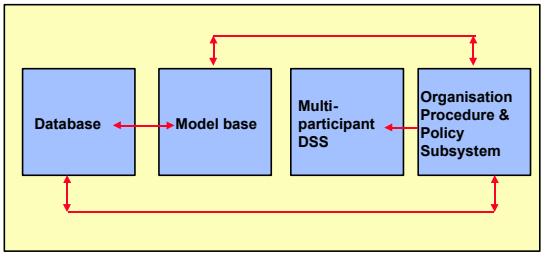
Organisational Procedures and Policy Subsystem

- A knowledge base holding, for example:
  - how to order supplies
  - how to apply for permissions
  - how to complete documentation
- Also:
  - calendar, appointments information
  - how to access other databases within organisation, etc.

V2.0

Organisational DSS - 9.22

Global Subsystem - 1



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Organisational DSS - 9.23

Global Subsystem - 2

- Organisational database and model base
  - possibly more extensive in scope (more data, more models) than those based at nodes
  - potentially available to anyone in the organisation
- Organisational procedure and policy subsystem
  - master knowledge base (sub-sets of knowledge held at nodes)
- Multi-participant Decision Support System (MDSS)
  - ongoing resource (similar to Local Decision Network concept)
  - tools, mechanisms tailored to needs of defined groups

V2.0

Organisational DSS - 9.24

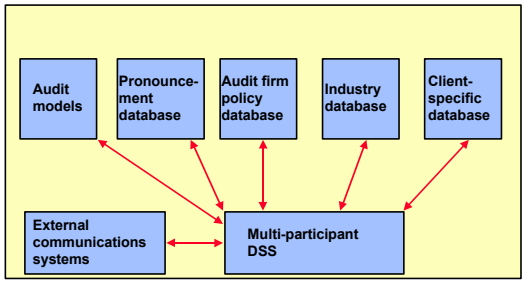
Example - ODSS for an Auditing Firm

Four levels of staff, with different needs in terms of ODSS support:

- Partners - need DSS support for:
  - policy making/strategic planning
  - tactical leadership of auditing teams
- Managers:
  - need specific DSS support in large projects
- Seniors:
  - need occasional access to expertise (ES function)
- Juniors:
  - need regular access to expertise
  - need access to specific auditing models, procedures

V2.0

Example - Global Subsystem for an Auditing Firm



Summary

- ODSS concept is fairly new
  - represents the continuation of an evolutionary trend in the development of DSS
- Jacob and Pirkul paper presents what may be needed in a ODSS, although the expense and commitment required to design, build and maintain such a system may be beyond the capabilities of many organisations
- Also consider the alternative structures for ODSS, presented in the course text

Management Support Systems

Session 10

Neural Computing and Decision Tables

Session 10 – Modification History

Revision	Date	Revision Description
V1.0	April, 1997	For issue
V2.0	7 September 2001	Updated for new syllabus V2/2001.

Session 10 Neural Computing and Decision Tables Lecturer Guide

Session Specification

Duration

Allow approximately 1 hour 30 minutes for this session, plus time for exercises.

Objectives

By the end of this session the participant will:

- be aware of the principles of neural computing;
- be aware of the major benefits and disadvantages of neural computing;
- be aware of the chief characteristics of the learning modes;
- be aware of areas of application of neural computing;
- appreciate the importance and usefulness of decision tables as aids to problem solving.

Lecturer

The lecturer should be an experienced project manager or developer, who has been involved in the successful management and development of commercial decision/expert systems. He/she should also be aware of the theoretical aspects of decision making, software project life cycle, databases, model bases and human computer interaction and have read the corresponding chapters in Turban & Aronson.

Method of Presentation

This session should be lecture based, making extensive discussion using the material provided.

Material List

Visuals

V10.1 Introduction
V10.2 Contents
V10.3 Neural Network Fundamentals
V10.4 Processing Elements
V10.5 Network
V10.6 Processing of Information in the Network
V10.7 Learning
V10.8 Testing
V10.9 Areas of Successful Application of ANNs
V10.10 Decision Tables – Use
V10.11 Types of Decision Table
V10.12 Limited Entry Tables – 1
V10.13 Limited Entry Tables – 2
V10.14 Redundancy in Decision Tables – Example 1
V10.15 Redundancy in Decision Tables – Example 2
V10.16 The ELSE Rule – Example 1
V10.17 The ELSE Rule – Example 2
V10.18 Extended Entry Table – 1
V10.19 Extended Entry Table – 2
V10.20 Extended Entry Table – 3
V10.21 Summary

Handouts

Handout 10.1 Artificial Neural Networks
Handout 10.2 Example and Questions
Handout 10.3 Answers
Handout 10.4 Problem
Handout 10.5 Problem Solution

A Handout is provided showing all the visuals presented during this session.

Equipment Required

The following equipment is required:

- Flipchart stand, flipchart and broad-tipped felt pens.
- PC projector and screen.
- Overhead projector and screen.

Bibliography

Turban & Aronson, *Decision Support Systems and Intelligent Systems*, Prentice-Hall International, Inc., 5th Edition, 1998, ISBN 0-13-781675-8, Chapter 17, pages 652-661 and 663-669 for neural computing.

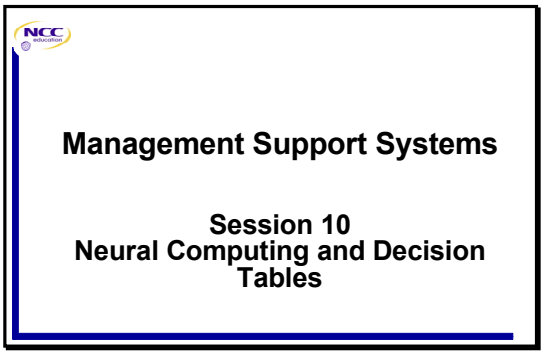
Session Summary

Session 10 Neural Computing and Decision Tables

1 Introduction

(5 minutes)

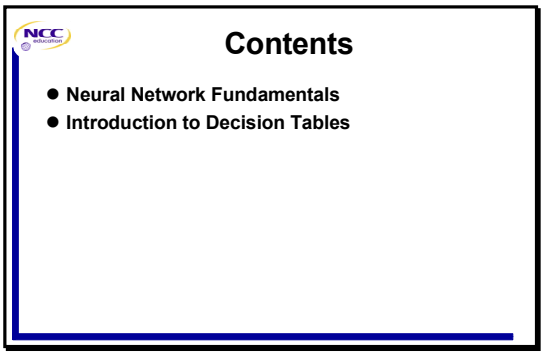
V10. 1



Inform students that a handout containing a full set of visuals will be provided to them at the end of this lecture.

1.1 Summary of Topics to be Covered

V10. 2



The topics detailed in the visual will be discussed during this session.

2 Neural Computing

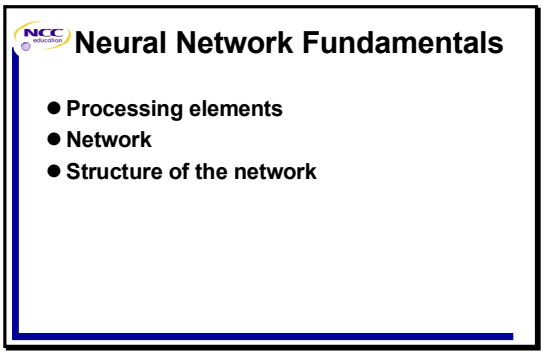
(15 minutes)

Neural Computing or the use of Artificial Neural Networks (ANNs) is so named because of its biological analogy.

See Chapter 17 pages 652 – 661 and 663 – 669 for a discussion of Neural Computing. Students are not expected to reproduce any of the diagrams or mathematics there but just a general understanding of the principles and attributes involved.

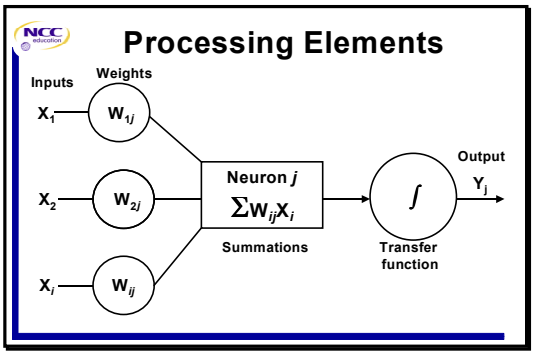
2.1 Neural Network Fundamentals

V10. 3

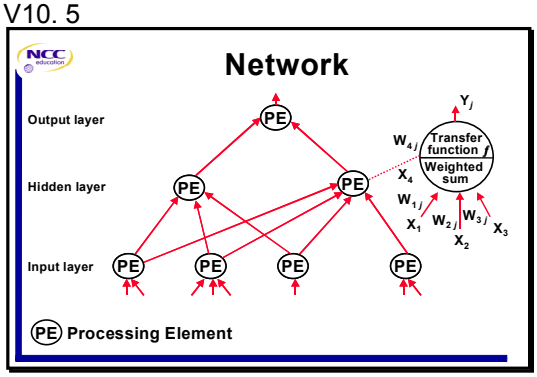


- Processing elements:
  - artificial neurons (Visual V10.4).
- Network:
  - collection of neurons grouped in layers (Visual V10.5).
- Structure of the network:
  - can be reorganised in different ways – parallel processing.

V10. 4

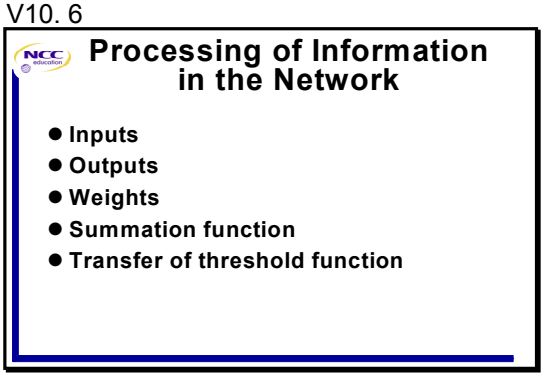


V10. 5



2.2 Processing of Information in the Network

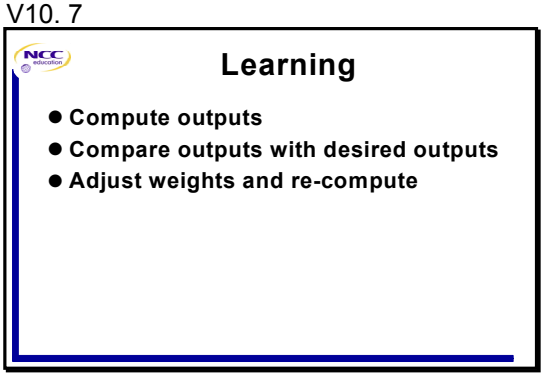
V10. 6



- Inputs:
  - might need pre-processing.
- Outputs:
  - the solution.
- Weights:
  - the relative strength.
- Summation function
- Transfer of threshold function

2.3 Learning

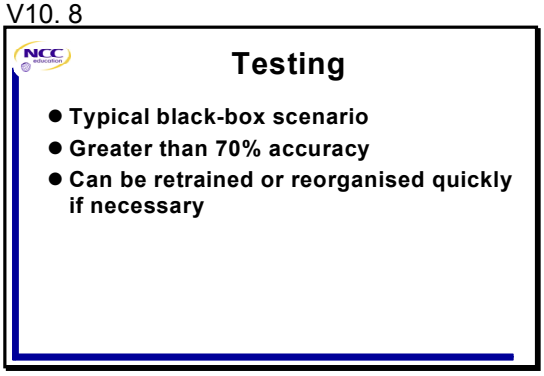
V10. 7



- Compute outputs.
- Compare outputs with desired outputs.
- Adjust weights and re-compute.

2.4 Testing

V10. 8



- Typical black-box scenario.
- Greater than 70% accuracy – This is about the best result available from more conventional statistical methods.
- Can be retrained or reorganised quickly if necessary.

3 Artificial Neural Networks

(20 minutes)

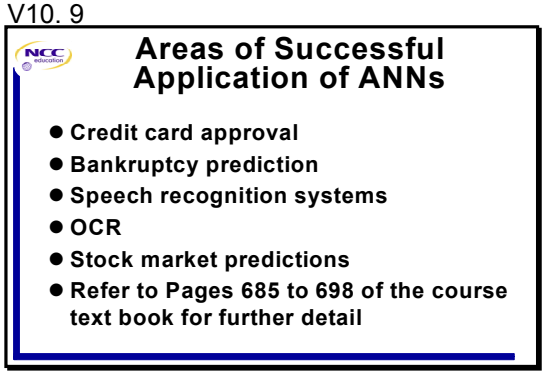
Issue and discuss Handout 10.1 which contains two tables:

- Major benefits/major limitations of Artificial Neural Networks.
- Characteristics of the learning modes of Artificial Neural Networks.

4 Areas of Successful Application of ANNs

(10 minutes)

V10. 9



4.1 Credit Card Approval

Credit card approval is a difficult management issue, because it is hard to check all customer information given on a credit card application against *further* information given in another application. This situation can lead to increased credit card fraud that costs banks billions of dollars a year. An ANN can support the decisions in this area by assisting in fraud detection by taking abstracted data and comparing the fields in the database with what is on the credit application.

4.2 Bankruptcy Prediction

If a lending institution were to take on all high-risk loans, it would have a much higher risk of going bankrupt itself (unless the interest rate reflects the risk). It needs to balance its risk by taking on a mixture of high and low risk loans. It also must adjust the financing charges for each loan according to the risk. A neural network can search for non-obvious patterns in a potential customer or group of customers' history. The results can be used to predict customer's likelihood of repayment (risk).

4.3 Other Examples

- Speech Recognition Systems.
- OCR.
- Stock market predictions.

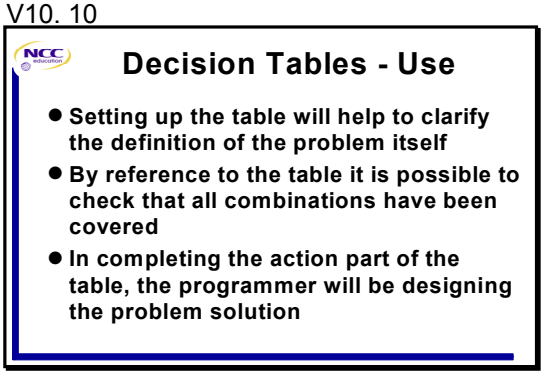
See Chapter 18, Pages 685 – 698 for a discussion of the above. Students are not expected to reproduce any of the diagrams or mathematics there but just a general understanding of the principles and attributes involved.

5 Decision Tables

(15 minutes)

Decision tables are a problem development and design technique that can be used as an alternative or supplement to program logic flowcharts. When faced with a complex set of conditions which can result in any one of a number of alternative actions being taken depending upon which conditions are satisfied at any one time, the use of such tables help in a number of ways:

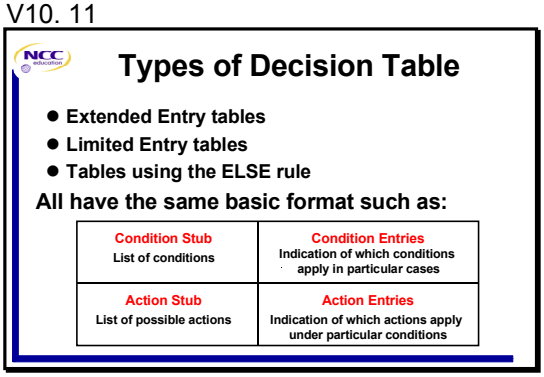
V10. 10



- The very act of setting up the table will help to clarify the definition of the problem itself.
- By reference to the table it is possible to check that all combinations have been covered.
- In completing the action part of the table, the programmer will be designing the problem solution.

Further to the above, a decision table is a concise method of communicating both problem and solution to anyone irrespective of their computer skills.

V10. 11



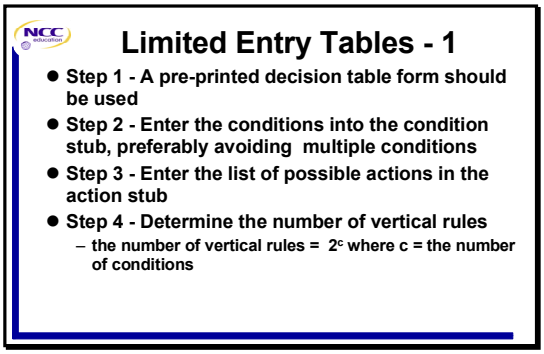
There are three variations of decision tables:

- Extended Entry tables.
- Limited Entry Tables.
- Tables using the ELSE rule.

All have the same basic format as shown in the visual.

5.1 Limited Entry Tables

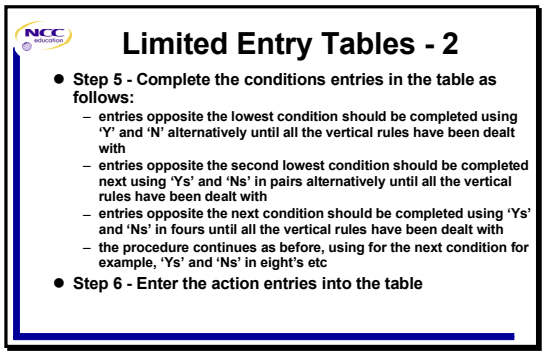
V10. 12



- *Step 1* – A pre-printed decision table form should be used whenever possible – otherwise construct one. The form should contain the form's title, the author's name and the date.

- *Step 2* – Given the stated problem, enter the conditions into the condition stub. Avoid, preferably, multiple conditions – enter each condition separately.
- *Step 3* – Enter the list of possible actions in the action stub – each action being entered individually.
- *Step 4* – Determine the number of vertical rules. A *vertical* rule is one combination of answers to the questions in the condition stub plus the indication of the actions which will be carried out in response to that combination of answers. The number of combinations of answers and therefore the number of vertical rules depends upon the number of conditions in the condition stub. The number of vertical rules = 2^c where c = the number of conditions.

V10. 13



- *Step 5* – Complete the *conditions* entries in the table as follows (in order to avoid omission or duplication):
  - Entries opposite the lowest condition should be completed using 'Y' and 'N' alternately until all the vertical rules have been dealt with.
  - Entries opposite the second lowest condition should be completed next using 'Ys' and 'Ns' in *pairs* alternately until all the vertical rules have been dealt with.
  - Entries opposite the next condition should be completed using 'Ys' and 'Ns' in *fours* until all the vertical rules have been dealt with.
  - The procedure continues as before, using for the next condition for example, 'Ys' and 'Ns' in *eights,* etc.
- Step 6 – Enter the *action* entries into the table. This is done by entering an 'X' for each vertical rule opposite each action which has to be carried out in that particular set of circumstances.

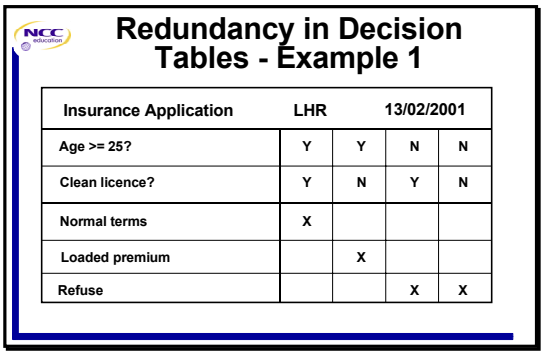
Issue Handout 10.2 which provides an example of a decision table followed by two questions.

Discuss the example in the handout before allowing time for the students to do the two questions.

Issue and discuss the suggested answers which are provided in Handout 10.3.

6 Redundancy in Decision Tables

V10. 14

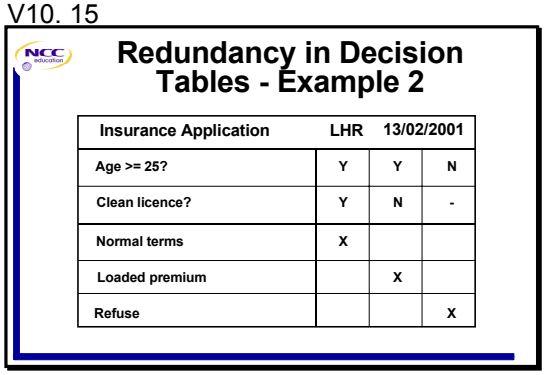


(5 minutes)

Consider the decision table shown in the visual, for dealing with applicants for motor insurance, where an application for insurance is refused if the age is less than 25.

The table is not as concise as it could be since the last *two* vertical rules result in the same action – the insurance is refused for all those under 25 *regardless* of the state of the licence. The condition *clean licence* is *redundant* in the last two rules.

V10. 15



Where two vertical rules have action entries that are *exactly* the same, and condition entries that differ in *one* respect only; they can be combined. Hence the two rules can be replaced by one, a *dash* being entered opposite the condition which is irrelevant in those circumstances. We therefore have the example shown in Visual V10.15.

Note: Some decision tables are not capable of reduction.

Issue Handout 10.4 which is a Question Sheet relevant to this topic.

Allow time for the students to answer the question, then issue and discuss the suggested answer which is provided in Handout 10.5.

Note: We can check whether the reduction is correct by counting the number of rules on the basis that one dash in a column means two rules, two dashes four rules etc. – we should achieve the same number of rules we started with. ***THE REDUCTION SHOULD ALWAYS BE CHECKED.***

7 The ELSE Rule

V10. 16

(5 minutes)

The ELSE Rule - Example 1

Employment Selection	LHR		13/02/2001			
Qualifications OK ?	Y	Y	Y	Y	Y	N
Experience OK?	Y	Y	Y	Y	N	-
Passed interview ?	Y	Y	Y	N	-	-
References OK?	Y	Y	N	-	-	-
Aptitude test OK?	Y	N	-	-	-	-
Offer programming job	X					
Refer to personnel manager		X				
Reject			X	X	X	X

Even after reduction a table might seem long-winded. Consider the reduced table shown in Visual V10.16 (obtained from 32 vertical rules) and yet where we are really only interested in the first two rules.

V10. 17

The ELSE Rule - Example 2

Employment Selection	LHR	13/02/2001	
Qualifications OK ?	Y	Y	ELSE
Experience OK?	Y	Y	
Passed interview ?	Y	Y	
References OK?	Y	Y	
Aptitude test OK?	Y	N	
Offer programming job	X		
Refer to personnel manager		X	
Reject			X

Using the **ELSE** rule we could rewrite it as shown in Visual V10.17, which is clearly much more succinct, but with the disadvantage that the final table cannot be checked.

8 Extended Entry Tables

(10 minutes)

V10. 18

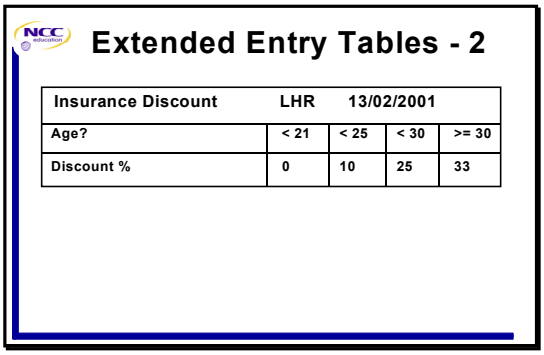
Extended Entry Table - 1

Insurance Discount	LHR		13/02/2001	
Age < 21 ?	Y	N	N	N
Age < 25 ?	-	Y	N	N
Age < 30 ?	-	-	Y	N
No discount	X			
Discount 10%		X		
Discount 25%			X	
Discount 33%				X

In limited entry tables we have been restricted to entering either ‘Y’, ‘N’, ‘-’ or ‘X’ , hence the term ‘limited entry’. Consider the limited entry table in the visual.

This can be written in extended entry form as shown in Visual V10.19.

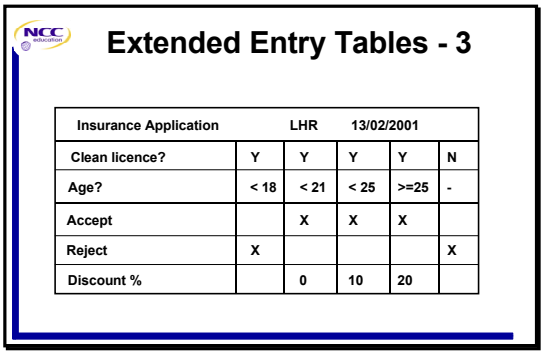
V10. 19



Thus extended entry tables can have entries other than 'Y', 'N', 'X' and '-'. It is in other words a *hybrid* table.

For example we could have (from an earlier example) a table as shown in Visual V10.20.

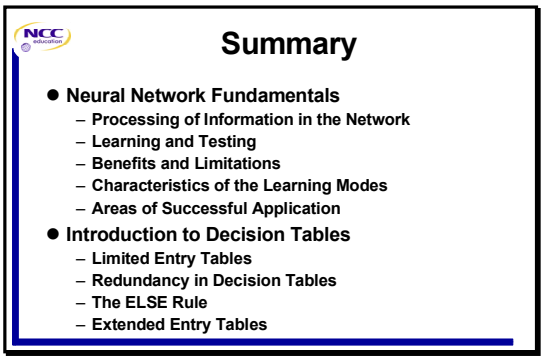
V10. 20



9 Summary

(10 minutes)

V10. 21



The topics detailed in the visual were discussed during this session.

Handout 10.1 – Artificial Neural Networks

Major Benefits	Major Limitations
Good at tasks that people are good at. Suitable for solving unstructured and semi-structured problems. Pattern recognition even from incomplete information. Classification, abstraction and generalisation. In theory at least, the processing can be computed in parallel resulting in faster computations. Ability to adapt to new data. Cope with fault-tolerance situations.	Not good at tasks that people are not good at. Not suitable for basic data processing or conventional arithmetic calculations. A more conventional computer system would be better here. Need a vast amount of data. Does not perform well on tasks that are not performed by people (for example, Arithmetic). Limited to classification and pattern recognition. Lack of explanatory capabilities. Not economically viable for parallel processing.

Characteristics of the Learning Modes	
Supervised	**Unsupervised**
Simpler. Desired output and the value of inputs are known. Both are presented to the ANN. All the algorithms that express relationships in the system are known. Possible to compute values of the output for given values of the weights. The difference between the actual and desired weights can be computed. This difference can be reduced (ideally to zero) by adjusting the values of the weights. The process of finding the ideal value of the weights is called the learning or training. Examples of this mode are the Backpropogation and Hopfield Networks.	Desired outputs are not specified and so not presented to the ANN. The process is only semi-automatic (a human must examine the result to determine when the training needs to stop). The weights and other parameters can be adjusted once the outputs are examined. Example of this mode is the Kohonen 'Self-Organising' maps.

Handout 10.2 – Example and Questions

Example

Students at a college are dealt with according to the following set of rules:

- A student who passes the examination and completes the coursework and project satisfactorily is awarded a pass. If the coursework and/or project work is not satisfactory, then this can be resubmitted provided the examination was passed. A student who fails the examination fails the course unless the coursework and project are satisfactory, in which case an examination resit is permitted.

The partially filled decision table would be:

Examination Regulations:	**LHR**						**13/02/2001**	
Exams passed?								
Coursework passed?								
Project passed?								
Pass								
Fail								
Redo project								
Resubmit coursework								
Resit exam								

In this example, since we are using only 'yes' or 'no' replies, there are no other possible combinations of answers to the questions and so the number of vertical rules is $2^3 = 8$. That is, we will have 8 columns containing 'Y', 'N' and/or 'X' etc. Our completed table, following the steps outlined previously is:

Examination Regulations:	**LHR**						**13/02/2001**	
Exams passed ?	Y	Y	Y	Y	N	N	N	N
Coursework passed ?	Y	Y	N	N	Y	Y	N	N
Project passed ?	Y	N	Y	N	Y	N	Y	N
Pass	X							
Fail						X	X	X
Redo project		X		X				
Resubmit coursework			X	X				
Resit exam					X			

Problem 1

Orders from new customers are accepted if they are for less than £100; otherwise reference has to be made to the supervisor. Orders from existing customers are accepted.

Problem 2

Candidates are accepted for employment if their qualifications and references are satisfactory, and they pass the interview. Where a candidate's references OR his/her interview (but not both) are unsatisfactory, he/she is offered a job for a probationary period. In all other circumstances the application is rejected.

Handout 10.3 – Solutions

Problem 1 Solution

Customer Orders:	**LHR**		**13/02/2001**	
New Customer ?	Y	Y	N	N
Amount < £100 ?	Y	N	Y	N
Accept	X		X	X
Refer to supervisor		X		

Note: The above answer is not the only one.

Problem 2 Solution

Employment Selection:	**LHR**						**13/02/2001**	
Qualifications OK ?	Y	Y	Y	Y	N	N	N	N
References OK ?	Y	Y	N	N	Y	Y	N	N
Passed interview ?	Y	N	Y	N	Y	N	Y	N
Accept	X							
Probationary period		X	X					
Reject				X	X	X	X	X

Note: Your answer may be slightly different from the above yet still be correct – for instance if you have entered the conditions or actions in a different sequence.

Handout 10.4 – Problem

Reduce the following decision table:

Discount Calculation	**LHR**							**13/02/2001**
Existing customer?	Y	Y	Y	Y	N	N	N	N
Cash sale?	Y	Y	N	N	Y	Y	N	N
Amount > £1000 ?	Y	N	Y	N	Y	N	Y	N
Discount 15%	X							
Discount 10%		X						
Discount 5%			X	X				
No Discount					X	X	X	X

Handout 10.5 – Problem Solution

Solution

- Rules 3 and 4 can be combined to form a new rule 3.
- Rules 5 and 6 can be combined to form a new rule 4.
- Rules 7 and 8 can be combined to form a new rule 5.
- The new rules 4 and 5 can themselves be combined. We thus have:

Discount Calculation: LHR				**13/02/2001**
Existing customer?	Y	Y	Y	N
Cash sale?	Y	Y	N	-
Amount > £1000?	Y	N	-	-
Discount 15%	X			
Discount 10%		X		
Discount 5%			X	
No Discount				X

Note: We can check whether the reduction is correct by counting the number of rules on the basis that one dash in a column means two rules, two dashes four rules etc. – we should achieve the same number of rules we started with. ***THE REDUCTION SHOULD ALWAYS BE CHECKED.***

Management Support Systems

Session 10
Neural Computing and Decision Tables

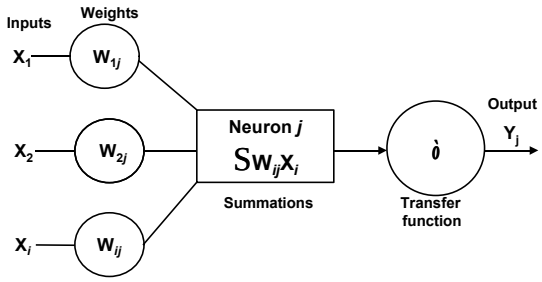
Contents

- Neural Network Fundamentals
- Introduction to Decision Tables

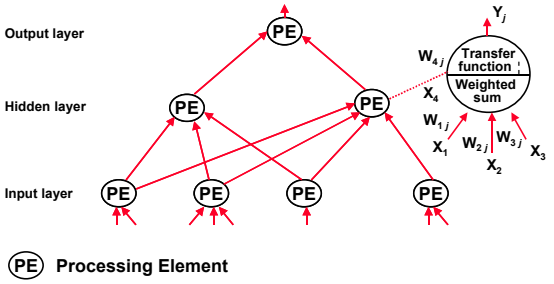
Neural Network Fundamentals

- Processing elements
- Network
- Structure of the network

Processing Elements



Network



Processing of Information in the Network

- Inputs
- Outputs
- Weights
- Summation function
- Transfer of threshold function

Learning

- Compute outputs
- Compare outputs with desired outputs
- Adjust weights and re-compute

Testing

- Typical black-box scenario
- Greater than 70% accuracy
- Can be retrained or reorganised quickly if necessary

Areas of Successful Application of ANNs

- Credit card approval
- Bankruptcy prediction
- Speech recognition systems
- OCR
- Stock market predictions
- Refer to Pages 685 to 698 of the course text book for further detail

Limited Entry Tables - 2

- **Step 5 - Complete the conditions entries in the table as follows:**
  - **entries opposite the lowest condition should be completed using 'Y' and 'N' alternatively until all the vertical rules have been dealt with**
  - **entries opposite the second lowest condition should be completed next using 'Ys' and 'Ns' in pairs alternatively until all the vertical rules have been dealt with**
  - **entries opposite the next condition should be completed using 'Ys' and 'Ns' in fours until all the vertical rules have been dealt with**
  - **the procedure continues as before, using for the next condition for example, 'Ys' and 'Ns' in eight's etc**
- **Step 6 - Enter the action entries into the table**

Redundancy in Decision Tables - Example 1

Insurance Application	LHR		13/02/2001	
Age >= 25?	Y	Y	N	N
Clean licence?	Y	N	Y	N
Normal terms	X			
Loaded premium		X		
Refuse			X	X

Redundancy in Decision Tables - Example 2

Insurance Application	LHR	13/02/2001	
Age >= 25?	Y	Y	N
Clean licence?	Y	N	-
Normal terms	X		
Loaded premium		X	
Refuse			X

The ELSE Rule - Example 1

Employment Selection	LHR			13/02/2001		
Qualifications OK ?	Y	Y	Y	Y	Y	N
Experience OK?	Y	Y	Y	Y	N	-
Passed interview ?	Y	Y	Y	N	-	-
References OK?	Y	Y	N	-	-	-
Aptitude test OK?	Y	N	-	-	-	-
Offer programming job	X					
Refer to personnel manager		X				
Reject			X	X	X	X

The ELSE Rule - Example 2

Employment Selection	LHR	13/02/2001	
Qualifications OK ?	Y	Y	ELSE
Experience OK?	Y	Y	
Passed interview ?	Y	Y	
References OK?	Y	Y	
Aptitude test OK?	Y	N	
Offer programming job	X		
Refer to personnel manager		X	
Reject			X

Extended Entry Table - 1

Insurance Discount	LHR		13/02/2001	
Age < 21 ?	Y	N	N	N
Age < 25 ?	-	Y	N	N
Age < 30 ?	-	-	Y	N
No discount	X			
Discount 10%		X		
Discount 25%			X	
Discount 33%				X

Extended Entry Tables - 2

Insurance Discount	LHR	13/02/2001		
Age?	< 21	< 25	< 30	>= 30
Discount %	0	10	25	33

Extended Entry Tables - 3

Insurance Application	LHR	13/02/2001			
Clean licence?	Y	Y	Y	Y	N
Age?	< 18	< 21	< 25	>=25	-
Accept		X	X	X	
Reject	X				X
Discount %		0	10	20	

Summary

- Neural Network Fundamentals
  - Processing of Information in the Network
  - Learning and Testing
  - Benefits and Limitations
  - Characteristics of the Learning Modes
  - Areas of Successful Application
- Introduction to Decision Tables
  - Limited Entry Tables
  - Redundancy in Decision Tables
  - The ELSE Rule
  - Extended Entry Tables