FACTORS CONSIDERED IMPORTANT IN IMPLEMENTING LOCAL AREA NETWORKS (LANs)

BY

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This project is my original work and has not been submitted for a degree in any other university.

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This project has been sumitted for examination with my approval as the University supervisor

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Danny Fernandes

DEDICATED TO MY MOTHER

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ABSTRACT

Information Systems are fast becoming a common feature in many organizations as they attempt to exploit the numerous advantages these systems offer. Local Area Microcomputer Networks (LANs) are the result of the need for cost effective Information System.

LANs are a relatively new technology and therefore problems are bound to occur when implementing them. This project's objective was to identify factors that need to be considered when implementing LANs.

Views of organizations, vendors and consultants were sought. A questionnaire was administered to a sample of 30 organizations and 25 vendors and consultants.

The results of the analysis of the data collected indicated that the most important factors to be considered in implementing LANs are:

1. LAN is a novel and fast changing technology.
2. Information for planning a LAN is not widely available, even when available it is not always reliable.
3. Post implementation maintenance of LANs is challenging.
4. Organizational politics impact on LAN implementation.
5. Difficulty of appraising cost elements in a LAN.
6. Tendency to under-utilize LAN systems.
7. Implementing a LAN is part "selling" part technical operation.
8. Need for a comprehensive security policy regarding a LAN, over dependence on built in LAN security features should be avoided.
9. Optimizing components of disparate qualities in a LAN is challenging.
10. LAN maintenance is a continuous ongoing process.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS

CAD:	Computer Aided Design
CAE:	Computer Aided Manufacturing
CAM:	Computer Aided Manufacturing
CSMA/CD:	Carrier Sensing Multiple Access with Collision Detector
DBMS:	Data Base Management System
DDP:	Distributed Data Processing
EDI:	Electronic Data Interchange
IT:	Information Technology
IS:	Information System
JIT:	Just-In-Time
LAN:	Local Area Network
Mbs:	Mega Bits per Second
MIPs:	Million Instructions Per Second
OS:	Operating System
OSI:	Open Systems Interconnection
PC:	Personal Computer

SECTION 1

INTRODUCTION

1.1 BACKGROUND

The fact that information is a strategic resource that can provide competitive advantage has been widely demonstrated (Kojina *et. al.* 1988, Mcfarlan 1984, Selig & Nipper 1991, Clemons 1990). This has led to accumulation of information at an ever increasing rate by business organizations to gain this advantage such that a large proportion of labour force in the developed world is engaged in handling information. The information resource is different from other resources in that it is inexhaustible. It is not reduced by repeated use but increased. Such is its importance that Information Technology (IT) is a fundamental force that is shaping today's world. Today's ascendant corporations are not masters of the land and materials but of ideas and technology (Selig & Nipper 1991).

But IT value lies in its application to cause change in business performance. The volatile nature of business environments requires investment in research, science, marketing and computers for creation, acquisition and manipulation of information. Accuracy and efficiency of manual systems is quite low resulting in a need for more efficient means. IT has provided a solution to this - computer systems.

Distributed data processing (DDP), the decentralization of computer power and placing it in the hands of users, has been the result of this increased need for quality and timely information in an efficient and cost effective manner. The power behind this shift is best expressed by "...Decentralised computing is sweeping business like a wave rolling into a beach ..."(Donovan 1988). This push has been attributed to economies of scale. DDP promises

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to reduce costs, enhance competition and renew organization creativity (Donovan 1988). Also the emergence of confident and capable computer users has produced a powerful constituency favouring it.

1.1.2 From DDP to Networks

The initial trend in distributed system was to provide "stand alone" personal computers (PCs) to users. User departments had their own policies on acquisition of hardware and software. This led to proliferation of disparate computer systems that were incompatible. The result was "Islands of information systems" (FT October 13 1992). Thus while the goal of more information was attained, the anticipated benefits failed to materialize as most of the information was locked in these "Islands" of information namely departmental systems. Flint (1983) notes that DDP systems have acquired poor reputation as being unreliable, difficult to use, and meeting only part of users needs. DDP had been envisioned to play a pivotal role in resource sharing and providing unlimited computer power to a wide variety of users (Manaloor & Wells 1988).

To achieve the anticipated benefits of DDP a new strategy was required, a strategy to enable people to work together by connecting disparate information systems and environments, connecting people to the information they need, products with one another, people with people. This meant linking these systems together by communication lines or networking them. Computer networks are now the focal point in the search for better information.

"In the beginning computer was the system now network is the system, the general computer has just become a peripheral" (Lefkon 1986)

"Computer networking is now in sharp focus, serving as a powerful tool for distributed processing and resource sharing" (Mathur et. al. 1988)

"1990's is heralded as the decade for networks with power to workgroups as opposed to power to individuals in the 1980's" (FT October 22 1991).

A information network has been defined as a form of agreement that links groups of individuals who have agreed to share resources so that information needs of both actual and potential users are met (UNESCO report, 1985). Thus computer networking is linking of computers by communication lines for communication and resource sharing with aim of meeting information needs for actual and potential users.

Kashorda (1992) defines a computer network as two or more autonomous computers linked by a communication line for the purpose of sharing data and other computer resources.

The main emphasis in a computer network is communication and resource sharing. By doing this the network increases the value of the attached devices. Value of a network increases with number of devices it can support.

Networks are attractive in that they combine the advantages of both centralized and distributed processing systems (Stamper 1989), i.e localized processing with shared data base and with additional attraction of shared processing power. Shared storage allows independent guarantee of data integrity and lower storage costs due to economies of scale. This also avoids duplication and enhances security.

Networking promises to change the way businesses operate. In the fast changing and increasingly competitive business environment, computer networks will provide a strategic

weapon to those who will seize the opportunities they offer. They have already caused a revolution in the way business is done.

Networks have brought information, the most valuable resource in the current business environment to the "fingertips" of company strategists. The querying and summarising abilities of these networks have meant that executives no longer need a phalanx of aides to churn out reports. Such has been the effectiveness of the Executive Information Systems that cases of companies that have cut up to four layers of management have been reported (Financial Times, October 13, 1992).

Office Automation, Teleconfrencing, Electronic Mail, Electronic Bulletin Boards, Electronic Dairies are some of the aspects of networking that will have the biggest impact in the business environment in the years to come. Some other benefits offered by computer Networks are summarised in Table 1.1

Table 1.1: Benefits Of Networking Computers

Combines the advantages of both a centralised system and a decentralized system i.e. localized processing with shared database with additional attraction of shared processing power.
User groups can be located away from the data centre to an environment that best suits them.
Networks solves the need to meet the needs of many expanding users. Users can be easily added to the system.
Networks when connected to supplier and customers can allow alignment of operations cutting inventory and processing costs. Examples are use of EDI and JIT.
It allows distribution of intelligence to where it is used. A salesman in the field with a portable computer can hook to the computer network to obtain most current information
Networks have the capacity to integrate disparate computer systems allowing for enterprise wide information systems. This means that investments already made in computer systems are not jeopardized. Also allows one to choose the right machine for the right work (FT Oct 22 1991).
Networks have capacity to increase office and factory productivity tremendously. Use of CAD, CAE, CAM systems has allowed factory productivity, to increase by over 75 percent. (Financial Times, March 8 1991)
Need to accurately retain and trace critical data in business and research in a cost effective way has been expressed. (Perry, 1987). A LAN solution with hypertext and hypermedia application can be a powerful way of archiving data.

1.1.3 Why PC-LAN ?

Distributed data processing in the context of computer networks can be achieved through use of Mainframes, Minicomputers and Microcomputer (PC's) based systems. But there is a clear advantage of adopting a Microcomputer based Local Area Network (LAN) as opposed to say a multi-tasking (or multi-user) Mainframe. This is due to many advantages that are inherent in a LAN system (PC-LAN), cost of acquisition and maintenance being the primary factor. Cost of PC's are much lower than those of mainframes and are falling at a much faster rate and this trend is expected to continue[1]. The other major advantages of PC-LANs over Mainframe are summarised in Table 1.2 .

The realization of the advantage of LANs over mainframe and Minicomputer has already a sounded the death knell for mainframes as reflected in poor performance of the major main mainframe manufacturers[2]. PCs now dominate the computer industry accounting for 44.5 percent of revenues compared to 21.6 percent for mainframes and 23.4 percent for minicomputers.

Table 1.2: PC-LAN Advantages

PC-LANS	MAINFRAME
PC-LAN can grow in small increments as your needs grow.	Your acquire the whole processing capacity irrespective of whether you will utilize it all or not
Less danger of obsolescence, once a server capacity is exceeded it can be relegated to a lessor role and a new server incorporated	Once the capacity is exceeded the whole computer needs to be replaced.
Users are familiar with PC's. Thus user have a greater control of data. This encourages personal computing	Mainframe interfaces are not user friendly and many are unfamiliar with them. They also have been traditionally associated with centralization.

[1] In 1990 the cost of 1 MIPs for a Mainframe was US$ 100,000 compared to US$ 1000 for PCs. Prices of MIPs, Discs, Memory are dropping at a rate of 15 to 17 percent per year and 30 percent for minicomputer. Corresponding rate for PCs and Workstations has been 40 to 50 percent. (Financial Times, Winter, 1992).

[2] See "Sales Continue To Fall" Financial Times March 23 1993. As the big mainframe vendors sales continue to fall, IBM, ICL and Digital Equipment now all make more money from software and support services than from hardware.

A LAN is a natural evolution to increase the versatility and usefulness of many computers that sit on many desks in an organization (Bates & Fortino, 1987). A LAN is a means to an end, the end being the need for quality and timely information in a cost effective manner. The differing information needs of users has resulted in implementation of LANs that are different and at times unique using same technology (Thompson, 1987). The fast changing IT technology means that new products that get integrated into LAN's are coming into market rapidly e.g. Electronic note pads. Thus the definition of a LAN is difficult but various definitions have been given some of which include:

"A LAN is a communication system that carries one or more high speed digital channels around a building or facility in such a manner that devices may obtain brief or exclusive use of the channel from time to time" (Flint 1983)

"Interconnection of computers to gain the resource sharing of networking and parallelism of multi-processing" (Manaloor 1988)

The first definition emphasises communication while the second emphasises aspects of resource sharing. A better way of describing a LAN is perhaps looking at what are the characteristics of a LAN. In this way limiting definitions can be avoided. Some characteristics that make up a LAN are given in Table 1.3.

Table 1.3: LAN Characteristics

FEATURES	EXPLANATION
Limited geographical area	About 1 Km radius
Utilization of a number of applications	e.g. Wordprocessing, Database Management
High speed data transfer	1Mbs to 100Mbs
High reliability	Low error rates
Allows Sharing of resources	Several users can access the same computer resource e.g database, printer e.t.c.
Transparent interface	Users do not require any specialized training
Allows access to other networks	Bridges, Routers, Gates can connect it to other networks
Adaptability and flexibility to meet future requirements	Allows incorporation of new technology (products)
Can support a variety of devices	e.g. workstations, printers,facsimiles
Private Ownership	Owned by individual Firms

There is need to see LANs as not just a way of connecting computers but to see the potential of the multimedia networks they offer. They facilitate not just swapping files between users but the straight forward and often invisible means of sharing information and resources. A LAN is capable of providing an efficient, reliable and cost effective on-line system offering all the features critical to success of such a system.

A LAN is made up of four basic components, Nodes, Medium, Connectors and Software. Nodes cover a wide spectrum of devices from expensive high end workstations to relatively cheaper facsimiles. They include all devices that can be connected to the LAN. Common devices include PC's, printers, wordprocessors, e.t.c. A LAN medium serves to connect the various nodes and facilitate communication between them. There are four media that can be used- Twisted wire pair, coaxial cable, fibre optics and microwave link. Connectors provide an interface between the medium and nodes. They are hardware pieces that make nodes compatible. They include logic-cards and adapters. LAN software include application software and operating systems that make the network perform its functions e.g. the LAN OS, DBMS, e.t.c.

LAN Topology concerns the way the nodes are arranged and linked i.e. the geometry. The common topologies are Ring, Star and Bus. Two modes of communication are available in a LAN. The baseband transmission system involves having an original signal in digital format from a station forwarded unchanged over a single channel. The Broadband transmission system modulates original multiple signals in a Frequency Division Multiplexing (FDM) setup for transmission over multiple channels.

LAN access methods define the use of the transmission line. Two methods are available. In the CSMA/CD each node is "listens" to the line and if free sends a signal. If a collision with another signal being sent at the same time occurs then it waits a random length of time and re-transmits. In the Token Passing Method a packet signal (Token) circulates the transmission line at a high speed, a station wanting to transmit seizes the token and gets access to the line, after transmitting it releases the token to circulate.

LANs may be viewed from two perspectives. From the point of view of acquisition two categories result, Proprietary system and General purpose systems. With proprietary systems everything is bought from one vendor. A LAN is acquired as a single unit. These systems are best suited for special purposes e.g. Computer Aided Manufacturing (CAM). The general purpose LAN supports a wide variety of equipment from many vendors. They tend to evolve rather than be acquired. These LANs can support many applications and are of most interest to business organizations.

A second perspective is from functionality level. These approach results in three classifications;

l) Office automation systems - To enhance productivity of office workers and facilitate resource sharing.

2) Design systems - for design and simulation purposes - to increase Productivity of designers e.g. CAD

3) Industrial systems - Include Computer Aided Manufacturing process control and robotics. These aim to improve factory productivity.

These divisions should not be seen as restrictive but as a way of better trying to appreciate LANs. In practice it is possible to integrate two or more of these systems to produce a hybrid system.

1.2 THE STATEMENT OF THE PROBLEM

Local Area Networks (LANs) are fast becoming a common feature in many business organizations as they hope to exploit the opportunities this relatively new technology offers. This trend is best summed by the statement:

It is impossible to think of computers in modern business without also thinking about computer networks. The marriage of computers and telecommunications is at the heart of Information Technology (IT) and networks are the "Circulatory" system which provides the mechanism for moving data from one computer to another. (Financial Times, April 20 1993 p. 14)

It is expected that by 1994, more PC's will be connected to LAN's than there were PC's in 1989. Further by the end of 1993 it is predicted that 60 percent of the PCs will be connected to LAN.(Financial Times, October 22, 1991). This trend towards networking is also reflected here in Kenya[3].

But the shift towards networking has not been without some drawbacks. Problems have been experienced and these have been documented especially in literature emanating from the developed world. A classic example is the project TAURUS[4] of the London Stock Exchange. The project which was to automate the ownership and transfer of shareholding was finally abandoned after 5 years and a total expenditure UK£ 75 million.

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[3]This has been confirmed through conversations with LAN vendors in Nairobi. They all report a large increase in the number of LAN installations over the last 6 years.

[4]See "Death of a Runaway Bull" FT March 19, 1993.
TAURUS stands for Transfer and Automated Registration of Uncertified Stock

Literature on local experience with computer networks is sparse and what is there is more general in nature. The articles aim is to sensitise managers as to what LANs are and what they offer. The articles do not delve deep into problems of implementation[5].

In Kenya, computer projects implementation has been cited as an important area that needs urgent attention. As at the moment it is in a confused state with no standards as yet formulated.(Daily Nation, Business Week, Feb 16 1993).

1.3 OBJECTIVES AND SIGNIFICANCE OF THE STUDY

Thee objective of the study is to identify the important factors to be considered when implementing microcomputer based local area networks.

The study will serve to sensitise would be implementors of PC-LANs as to the problems they are likely to encounter. This will help them in devising an appropriate strategy when implementing LANs.

[5]See a series of articles written by Insight (K) Ltd starting on January 18 1993 in The Standard newspaper.

SECTION 2

LITERATURE REVIEW

2.1 PC-LAN IMPLEMENTATION - THE IMPORTANCE

The many advantages and opportunities a LAN offers can only be obtained if the implementation[6] process is successful. The fact that many Information Systems projects fail (Laundon & Laundon, 1990) require that critical attention is given to this area. The importance is underscored by the complexity of LANs and the general lack of skilled staff in implementing and running of these systems. Further, many activities require significant lead times e.g. training. This means that LANs cannot be implemented "overnight" (Large, 1986).

The earlier cited project TAURUS is a classic case of implementation failure. The project hired the best consultants and IT Professionals but still failed after a great deal of resources had been wasted. The major cause of failure was attributed to widespread case of myopia and failure to take a broad look at the whole project. Short term self interest and internal politics turned the project in to a technological nightmare. The project consisted basically of 400 distributed databases linked together by a communication network. Fundamental mistakes were made in implementation of the project. First there was no overall design of the system i.e. lack of an underlying architecture or logical design and there was wrong judgement in choice of software. Further there was no effective monitoring of the project.

The issues involved in implementation can be divided into four categories:

- The issues concerning planning of LANs
- The issues concerning organizational impact of LANs
- Issues concerning LAN technology
- Issues relating to LAN management

[6] Implementation is taken to refer to all aspects of organizational activities involved in adoption, management and routinization of a LAN. (Laundon & Laundon 1990) p. 610

2.2 THE PLANNING ISSUES

LAN are of strategic value and can give a competitive advantage and are thus of interest to management. Top management need to formulate plans as concerns LAN but herein lies the problem. Senior managers, who have knowledge of business plans are largely technologically illiterate. Information technology professionals on the other hand, have poor understanding of business plans. This leads to a situation where plans of LANs are done in "corporate vacuum", either totally isolated from or only tenuously linked to the corporate business planning process (Large, 1986). This situation has been summed as:

A technology based approach to planning and decision making that has resulted in failure to estimate what IT can achieve, time required and costs involved (Selig & Nipper 1990).

The critical aspects of LAN planning have been the lack of information, difficulty in defining information requirements , lack of independent advice and profiteering nature of LAN vendors/suppliers.

Predicting information requirements is a challenging undertaking. The difficulties on deciding on requirements arise from the fact that individuals have different decision making styles and thus attach different values to a given piece of information (Laundon & Laundon 1990). It is also difficult to decide what information helps and what gets in the way (Piercy 1984). There is also the issue of demands arising once a system is installed. Further, the initial demand might wane off after the excitement fades (Keen & Woodman 1984). All these compound the problem of predicting usage. As noted by Piercy (1984), identifying information needs is difficult and in many cases near impossible.

The critical lack of information can be mostly attributed to the novelty of LAN technology. LAN technology is still evolving and what you install now may not be current in three years

time (Bates & Fortino 1987). The novelty and evolving nature of the technology has led to a situation where it is difficult to obtain independent advice due to limited experience of many vendors and consultants (Ford 1989, Muriithi 1989, Flint 1983). The profit considerations of vendors/suppliers make them hide relevant information. This situation is expressed by the following statements:

"The really difficult issue in networking will continue to be hidden in advertising hyperbole" (Phillips 1988).

"Suppliers are always bound to exaggerate the capabilities of their equipment (Ford, 1989).

"Vendors will not tell about hidden costs of installing a LAN" (Financial Times, March 20, 1993)

The strategic dimension further complicates the issue. It is difficult to measure competitiveness or strategic value of an information system. Traditional financial appraisal methods are inappropriate for use in evaluating LANs (Large 1986).

Hayward (1987) has proposed a model for IT planning that addresses the various issues of planning. Maruchek and Suleck (1991) have proposed a model for LAN technology planning. Bates & Fortino (1987) and Lefkon (1986) have suggested methodologies for determining information requirements.

2.3 THE ORGANIZATIONAL CHALLENGES

The very act of introducing a LAN within an organization has an immediate and profound impact on it. A LAN is not just a technical solution, it redefines configurations, job activities and power relationships. The introduction of a LAN has subtle implications on the organization's structure with great potential for disruptive change. The impact has is best summed by the statement:

"Introduction of something simple as electronic mail can produce a significant cultural shock within an organization".(Financial Times, April 20 1993)

A LAN effectively flattens the structure of the organization, through change of information flow. By introducing a new information flow, it effectively redistributes power within the organization. It opens up new information channels and these directly influence structures. Information in an organization is never neutral - it gives influence, status and even power (Piercy, 1984). The most hit by these redistribution are the middle managers.

"IT assumes many of the coordination and control functions that middle managers perform" (Applegate *et. al.* 1988)

Networks can lead to a removal of a whole tier of middle management and also reduce the role of management[7] (Piercy 1984) Thus the potential of middle management to sabotage even the most elaborately designed system is real.

There is also the question of increased control as a result of "flattening" of the structure. A LAN by summarising and communicating information faster allows increased central control and exercise of control over areas where it was previously impossible (Bruns & Macfarlan 1987). But increased control is resisted with consequent harm to the organization (Piercy, 1984).

Another aspect of LAN organizational impact is that it can reduce quality of working life of employees through deskilling - many decisions and processes can be automated. This then means likelihood of resistance from these workers.

The impact of a LAN on organization structure and people is such that it will have a persistent long term effects on satisfaction and performance of employees. This makes LAN

[7]Cases of where up to 4 layers of middle management have been cut have been reported (Financial Times, October 13 1993)

implementation acquire a political dimension. The implementation process is unavoidably mixed up with organization politics (Storey 1988).

To soften the impact of LAN and overcome user resistance various actions have been proposed. The most advocated for approach has been user involvement in the implementation process (Laundon & Laundon 1990, Parkinson 1988, Wightman 1987, Buss 1985). Use of project champions has also been proposed (Parkinson 1988, Scarbrough 1988, Piercy 1984)

2.4 LAN TECHNOLOGY

LAN technology is an issue as it is still immature and unreliable. The result is widespread incompatibility of LAN products. This problem has been expressed as:

Incompatible computers and software has resulted in an electronic "tower of babel" that denies management the ability to create enterprise wide communication leading to derived fewer benefits from investment. (Financial Times October 13 1992)

The extent of incompatibility is such that even equipment from the same manufacturer can at times be incompatible (Hayward 1987). This state of affairs has led Van Name & Catchings (1989) to conclude that "... LAN world is rife with inconsistent technology..."

A LAN in many cases is an evolution of many hardware pieces spanning many different generations . These have been acquired over period of time, many bought without any thought of connectivity. (Hebert & Dobson, 1988).

The immature nature of a LAN poses some technical challenges in handling the technology. When connecting high quality equipment with low quality equipment it is difficult to predict behaviour of such a system (Ford 1989). System sizing in the context of a LAN is difficult

and even an optimal solution may not last for long (Uma, 1988) .These and other technological challenges are compounded by lack of manpower skilled in LAN technology (Muriithi 1989, Rao 1988, Flint 1983, Stamper 1989).This is a serious issue as lack of experience with technology has been attributed to failure of Information Systems (Laundon & Laundon 1988).

In summary, the technical challenge is to develop a robust system that gives a high performance. A system that is fault tolerant. A network that does not lock you from technological advances. As summarised:

"The cost effective evolution of a network that is flexible in physical architecture - in terms of physical media, rules and protocol - providing product platform that while being totally compatible with existing base provides flexibility to fit with future advances in architecture." (Jackson 1988).

In dealing with LAN technology, adoption of open systems standards (ISO/OSI) in acquisition of LAN equipment has been proposed . Asynchronous Transfer Mode (ATM) standards that are supported by many telecommunication companies have also been proposed (Financial Times October 13 1992). Evaluation of LAN products should put as much emphasis on communication as on processing power (Donovan 1988).

2.5 THE LAN MANAGEMENT CHALLENGE

Management of a LAN is one of the most vexing problem of implementation[8]. A fact that requires attention as many organization are never prepared for the LAN.

"Connectivity brings with it problems of management and resource control, problems which are frequently considered only after the network is installed" (Ford, 1989).

Management of LAN includes day to day operation, monitoring and diagnosis, implementing security procedures and system maintenance.

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[8]The biggest challenge confronting the IT industry will depend on more effective management. Further the issues to be faced in the 1990's will be how to manage large data networks. (Financial Times October 13 1992).

To achieve the desired level of service on day to day basis requires control, monitoring, diagnosis, evaluation and maintenance of the LAN on a continuous basis. Monitoring and diagnosis of a LAN is complicated by the presence of a medley of equipment and applications derived from a variety of vendors. Difficulties arise from the fact that vendors have neglected tools to help in diagnosis and monitoring (OIC/JICA Report, Stamper 1989, Donovan 1988).Diagnosis which has been described as invaluable in checking the health of a network (Spandberg & Cote 1987) is difficult. Saal (1989) notes,

"While a network is fantastic when it is working well it is exceedingly complex when you have to decide what needs fixing. When something needs fixing it is difficult to locate the problem whether it is in hardware, software, cables e.t.c. or the system simply requires upgrading"

There are also difficulties in configuring a LAN to operate in a most efficient manner.

"...although the system worked from almost the moment hardware was completed considerable amount of bug finding, tuning and enhancement has been undertaken..." (Smith & Duickworth 1987).

Inexperienced users are of concern in the LAN environment as their presence requires closer supervision to solve problems of "amateurs who do not know what they don't know" (Keen & Woodman 1984). Problems of administering a LAN are further compounded by lack of high level skills required to administer a LAN[9].

Software selection is an aspect of LAN management that requires critical attention. An operating system if not efficient can become a bottleneck to the system. The selection of OS is a key issue in a LAN. Given that most LAN OSs' do not offer adequate networking features (Thurber 1988, Derfler 1986), care is needed in LAN OS selection.

So far as application software is concerned, most software packages behaviour can be unpredictable in a networked environment as the number of multi-user options available increases (Davis 1987). As central control is lost in the LAN environment, the prospect of

[9]High level skills such as those required for network management remain in great demand even amid rising unemployment (Financial Times October 13 1992).

users writing application that do not conform to a common standard and being inadequately documented is real.

Security of data is a matter of great interest to many especially, the fraud aspect[10]. The concern with fraud can not be underestimated:

"... with proliferating computer crimes and data piracy the need for security cannot be underestimated..." (Manaloor & Wells 1988).

When PC's are networked the security threat is serious. First, control is compromised, as in a PC-LAN system a user with PC has access to a vast quantity of data. Secondly, if the system is inter-networked the threat of "hacking" is now real[11]. Further, the very nature of a LAN is that security is not a major issue in its design (Manaloor 1988, Ford 1990). LANs are designed to use PCs which are easy to operate and user friendly. The security threat is further compounded by the emergence sophisticated computer criminals.

Computer viruses are a threat given the rate of proliferation. The nature of a LAN makes their introduction by users through diskettes easy. Internetworking and E-mail make control of virus contagion difficult.

Employees are a threat to data integrity if inexperienced. A disgruntled employee is perhaps the most serious security threat given the resources available to him/her.

System malfunction is a threat to data integrity. The most dreaded episode is the crash of the network file server or electronic failure of the hub communication controller as this can result in wiping out of tremendous amount of data (Adney et. al. 1989). An aspect of security

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[10]Computer based fraud is estimated at US $4 billion a year. (Financial Times March 23 1993).

[11]Hackers have already developed an intrusion mechanism that disables password protection of the most popular LAN Operating System Novell's Netware with 70% of the market.(Financial Times, March 23 1993)

normally overlooked is out-sourcing of maintenance. The loyalty of non-employees is questionable. (Financial Times, April 20, 1993).

LAN security needs to be looked from a wide perspective. There is need for comprehensive security policy for LANs. But this has in most cases been lacking[12]. Network maintenance is a continuous process:

Installation of a LAN is like getting married. After the honeymoon, maintenance becomes a daily task. (Jones et. al. 1987)

Network management problems can be alleviated through hiring of competent staff and equipping them with adequate tools and resources to aid them in their duties. Software selection should be made independent of hardware decisions. On security, various measures have been proposed. First security goals and related potential network problems need to be defined (Barbic & Muftic 1988). Weak points need to be identified and appropriate measures designed. It is important that security features do not inhibit broadcast capabilities[13] (Manaloor & Wells 1988)

[12]Survey has shown that few companies conduct risk analysis, developed security guidelines set-up security configuration, co-ordinate security training or periodically reviewed security compliance for networked PC's. (Financial Times October 13 1992).

[13]Encryption lowers the speed of a network by up to 45 percent (Financial Times March 23 1993)

SECTION 3

RESEARCH METHODOLOGY

In LAN implementation process three parties are in many cases involved. They are the management of the firm , the consultants, and the vendors. To get a broad perspective of the factors important in implementation of LANs the collective view of these parties are important. Therefore a research design that captured the various perspectives offered by the different parties was required. A questionnaire (see appendix 1) was administered to these parties.

3.1 THE RESEARCH FRAMEWORK

The primary objective of the project was to come up with factors that are considered important in implementation of LANS. Therefore a descriptive study was the appropriate research framework. A descriptive study varies from simple data gathering to investigating possible relationships between two or more variables (Peterson 1982). Both these objectives were sought in the study. A descriptive study presupposes much prior knowledge about the phenomena being studied (Churchill 1983). This was fulfilled by the fact that the issues in the questionnaire were documented extensively in the literature.

Descriptive studies fall into two categories, longitudinal study and cross-sectional study. The cross-sectional design was adopted. In a cross-sectional design a number of characteristics of the elements or sample members are measured at a single point in time. Two types of cross-sectional studies exist, the field studies and field surveys. The basic difference is the greater scope of survey and greater depth of field study (Churchill 1983). The objective of this study

was search for interrelationship of a number of the factors. Field study was the appropriate design.

The framework used is termed as "one-shot framework". It can be diagrammed as;

X O

Where:

X represents the exposure of the object being studied to a particular variable or event

O represents the specific process of observation or measurement.

3.2 DATA SPECIFICATION

The data collected was non-causal. The data was descriptive permitting only inferences about the relationship. No cause and effect inferences can be made. The source of data was primary in nature. Data was collected by the researcher personally administering the questionnaire to the respondents. Data was collected at a single point in time and is thus cross-sectional. The form of data is overt.

3.3 DATA COLLECTION MODE

The questionnaire was divided into two parts. The first part had 12 questions with the objective of classifying LAN users. This was only administered to LAN users. The second part had 47 statements relating to the basic information sought by the study. This was administered to all respondents.

The second part of the questionnaire had been arrived at by extracting from the literature statements that reflected the research problem. Further interviews with experienced individuals in the area of LANs allowed the researcher to develop additional statements. The initial

questionnaire had 87 statements covering extensively and intensively the various aspects of the phenomena under study. After pre-testing, interviews and consultations with experienced groups, the number of statements were reduced to a manageable 47 without much loss of content.

The final questionnaire contained structured undisguised close-ended statements. The purpose of the study was explained by the covering letter. What was not obvious to the respondents was the underlying dimensions or factors that were being investigated.

The questionnaire investigated 4 dimensions in LAN implementation namely:

- Planning of LANs
- The organizational impact of LANs
- LAN technology
- LAN management

Several statements relating to each of the 4 aspects (dimensions) were made. To make the flow logical the questions relating to a particular dimension followed one another sequentially. However there was no break, to indicate that a new dimension is now being investigated.

The questionnaire employed a Likert scale to measure the responses to the statements provided. A Likert scale is a type of summated rating scale. The Likert scale used consisted of a declarative statement and a list of five response categories ranging from "Strong Disagree" to "Strongly Agree".

The data collection mode adopted for this study was personal interview. The questionnaire was administered personally by the researcher. The procedure was to select the subject

(Organization , Consultant or Vendor). The researcher went to the reception explained the purpose of the visit then requested to see the relevant, person. If the respondents had the time personal interview was done. This involved the respondent filling the questionnaire then the researcher explaining the underlying dimensions it sought to capture. Opinion of the respondents on the matter they wanted to add on was sought. If the respondent could not completely avail himself for personal interview a questionnaire was left with instructions for him/her to complete it and leave it at the reception from where the researcher could pick it at a later date. Great effort was made to get the questionnaire back. Telephones and personal visits were made to remind the respondents and impress on the urgency within which the questionnaire was required.

3.4 SAMPLING PLAN

3.4.1: Population

The population for the study consisted of all the entities involved in implementation of LANS in Nairobi. The population is made up of:

i) All companies that have implemented LANs within Nairobi Area.

ii) All LAN vendors in Nairobi

iii) Computer or IT Consultants in Nairobi who offer LAN consultancy services.

3.4.2: Sampling Frame

A preliminary survey was carried out to determine the status of LAN technology in Nairobi (See appendix 1). This sought to know the nature and location of LAN installations in Nairobi. The sites obtained from this survey were listed. Additional organization known by the researcher to have LAN installations were added to the list. The list then constituted the sampling frame for the LAN users.

As many LAN vendors also offer consultancy services no distinction was made between the two groups. They constituted one set of sampling units. The sampling frame was a list published in the East African Computer News (EACN) Magazine March 1993 edition. The list had both vendors and consultants listed, 29 vendors were listed and 30 consultants were listed. Most of the vendors also appeared in the consultants list. Large IT consultants mainly the auditing firms that were not listed in the EACN Magazine were added to the list to complete the sampling frame for vendors and consultants.

3.4.3: Sampling Procedure

Non probability sampling technique was employed. To cater for the two distinct classes quota sampling was used.

The sampling frame for Organizations had 50 organizations listed. A judgemental sample of 30 organizations was selected. Personal judgement was used to ensure that the sample reflected users in different sectors of the economy.

The sampling frame for the vendors and consultants had 39 organizations listed. A judgemental sample of 25 was selected from the combined list (15 vendors and 10 consultants).

The collection procedure for the data is summarised in the Table 3.1

Table 3.1: Data Collection Procedure

SUBJECT	No.	CONTACT PERSON
Organization	30	Computer Manager (Part A & B)
Consultant or Vendor	25	Consultant or Sales Representative (Part B)

3.5 DATA ANALYSIS AND PRESENTATION

Part A of the questionnaire was analyzed through use of descriptive statistics to describe LAN users. Part B was analyzed through use of factor analysis. Varimax rotation was employed.

3.5.1: Factor Analysis- An Overview

Factor Analysis (FA) concentrates on relationships within a single set of variables. It is used to reduce the dimensionality of the set of variables i.e. to describe the subjects (S's) in terms of their scores on a much smaller number of variables with as little loss of information as possible. If successful the new factors can be considered as providing a description of the "structure" of the original variables.

The basic FA Model is:

$$Z_{ij} = f_{j1}h_{i1} + f_{j2}h_{i2} + \ldots\ldots + f_{jp}h_{ip} + d_i u_{ij}$$

$$= \sum^{p}_{k=1} f_{ik}h_{ik} + du_{ij}$$

Where Z_{ij} is the subject i's z-score on original variable j;

h_{ik} is the subject i's score on hypothetical variable k; U_{ij} is the subject i's z-score on the unique (nonshared) variable associated with original variable j and f_{ik} and dj are coefficients which must usually be estimated from the data.

The primary goal of factor analysis is to reproduce as accurately as possible original intercorrelation matrix from a small number of hypothetical factors to which original variables are linearly related.

Factor analysis models have in common the explicit separation of unique variance from common variance and the assumption that intercorrelations among the *m* original variables are generated from a small number of latent variables. Depending on how explicit the researchers preconceptions about the nature of these underlying variables, each original communality (percentage of variance which is held in common with other variables) may either be produced as an off-shoot of the analysis or may have to be specified in advance in order to arrive at a factor analytic solution. A factor analytic solution includes a table (factor Structure) indicating correlation (loading) of each original variable on each latent factor.

A weakness of FA is that the factor structure represents a description of the original intercorrelations in terms of a particular frame of reference. The pattern of intercorrelations can be equally described by any other frame of reference i.e. the solution is not unique. Principal Factor Analysis (PFA) assures uniqueness of the factor structure by requiring that each successive factor accounts for the maximum possible percentage of the common variance while still remaining uncorrelated with the preceding factors.

PFA gives an initial solution or preliminary factor structure. This is then rotated until a factor structure that comes close to some *a priori* set of criteria for simple structure is found. A variety of rotation options are available. Rotations are performed so as to maximize the criteria.

$$G(l_{ij}) = \Sigma_{a=b} \left[\Sigma l^2_{ia} l^2_{ib} - Y/m \, \Sigma \, l^2_{ia} (\Sigma \, l^2_{ib}) \right]$$

Where l_{ia} is the loading of the original variable i on factor a and where Y is specified by the user.

The common rotations are shown in Table 3.2

Table 3.2: Standard Rotation Criteria

Type of Rotation	Y=0	Y=1/2	Y=1.0
Orthogonal	Quartimax		Varimax
Oblimin	Quartimin	Bi-quartimin	Covarimin
Simple Loading	Direct Quartimin		

The most common procedure for interpreting (naming) the factors resulting from FA is to single out for out for each factor those variables having the highest loadings in absolute value. The highly positive loadings will help define one end of the underlying dimension and negative loadings define the other end.

To perform factor analysis the STATGRAPHICS statistical package was used.

SECTION 4

DATA ANALYSIS, FINDINGS AND DISCUSSION

A total number of 55 questionnaires were sent out, 25 to vendors/consultants and 30 to organizations. The total number of responses were 18 for vendors and 19 for organizations. This represents response rates of 72 percent for vendors/consultants and 63 percent for organizations.

4.1 SURVEY OF LAN USERS CHARACTERISTICS

This analysis was done for the 18 usable responses. The results are summarised in the tables below:

Table 4.1: Period of Use of Computers.

	Frequency	Percentage
Less than 5 years	5	27.8
Less than 10 years but more than 5 years	8	44.4
More than 10 years	5	27.8
Total	18	100

Table 4.2: Period of Time since LAN was installed

	Frequency	Percent
Less than 1 year	4	22.2
Less than 3 years but more than 1 year	8	44.4
Less than 5 but more than 3 years	5	27.8
More than 5 years	1	5.6
Total	18	100.0

Table 4.3: Size of LAN

	Frequency	Percent
Less than 5 nodes	2	22.2
Less than 20 but more than 5 nodes	10	44.4
Less than 50 but more than 20 nodes	5	27.8
More than 50 nodes	1	5.6
Total	18	100.0

Table 4.4: Types Of LAN System

	Frequency	Percent
Proprietary	3	16.7
Non-Proprietary	15	83.3
Total	18	100

Table 4.5: No. of Different Vendors Equipment Supported

	Frequency	Percent
One Vendor	4	22.2
More than one	14	77.8
Total	18	100.0

Table 4.6: Position of Network Manager

	Frequency	percent
Yes	13	72.2
No	5	27.8
Total	18	100.0

Table 4.7: Reporting Relationship of LAN Manager (Supervisor)

	Frequency	Percent
Managing Director, General Manager	6	33.8
IT/IS Computer, Computer Manager, DP Manager,	6	33.8
Finance Manager	4	22.2
Other	2	11.2
Total	18	100.0

Table 4.8: Extent of LAN Integration Across Departments

	Frequency	Percent
Less than 25% of Depts. Networked	6	33.3
Less than 50% but more than 25% Depts.	0	0
Less than 75% but more than 50% of Depts.	4	22.2
More than 75% of Depts. networked	8	44.5
Total	18	100.0

Table 4.9: LAN Integration

	No.	Percent
Only one dept. networked	6	33.3
100% networked	4	22.2

Table 4.10: Written Acquisition policy

	Frequency	Percent
Yes	11	61.1
No	7	38.9
Total	18	100.0

Table 4.11: Retain LAN Consultancy Services

	Frequency	Percent
Yes	8	44.4
No	10	55.6
Total	18	100.0

Table 4.12: Change In Organizations Structure Due to LAN

	Frequency	Percent
Yes	6	33.3
No	12	66.7
Total	18	100.0

Table 4.13: Steps Taken To Ensure Smooth Implementation

	Frequency	Percent
Yes	16	88.9
No	1	5.6
No Response	1	5.6
Total	18	100.0

Several conclusions can be drawn from perusal of these tables.

It can be seen that most of the respondents had experience with computer technology, 72.2 percent had used computers for more than 5 years. The analysis shows that LAN technology is a relatively new phenomena. Most of the LAN systems had been implemented in the last 3 years or less (66.7%). Further, LAN technology is still relatively immature as seen that most LANs were relatively small (66.7% had 20 or less nodes).

The open systems movement seem to have been embraced by many. 83.3% of the systems were non-proprietary. Organizations have also gone ahead and utilized the flexibility offered by open systems and implemented multivendor equipment in their LANs.

The critical role of Network Manager has been appreciated by many firms. This is apparent from the fact that a high proportion of organizations have this position in their management structure. Further, in the traditional reporting relationship, the computer in-charge reported to the accounting/finance manager, Only 22.2 percent of the respondents followed this reporting structure. Thirty three percent reported to top management indicating the critical role networks are starting to play in organizational strategy.

The level of integration of network within the organization is quite high, 66.7 percent of the organizations had 50 percent or more of their departments linked to the network. Centralization that has been associated with computer systems has changed. Only 33.3 percent of the organization had a centralized structure where the system was linked to only one department.

The high proportion of organizations with a written computer acquisition policy indicates that although many have implemented Open Systems they are still cautious. To guard against acquiring incompatible systems most (61.1%) have an acquisition policy on LAN products.

Though LAN technology is still new, 55.6% of organizations are able to utilize a LAN without need for retaining consultancy services. The impact of LAN on most organization structures has been minimal. Of the 33.3 percent who reported restructuring to accommodate the LAN, majority mentioned the creation of a new post as the only major change.

Most organizations (88.9%) reported taking action to allow for smooth implementation of LAN. The most common cited action was training of employees on use of LAN. Other actions reported included:

- User education on what is a LAN and its benefits
- Parallel running
- Involvement of user
- Setting up demo LANs
- Constant user feedback

4.2 IMPLEMENTATION FACTORS

Factor analysis was performed for the second part of the questionnaire to determine the factor that are considered important in LAN implementation. Three analyses were done. One for organizations, one for vendors/consultants and one for the combined responses.

A summary statistics was first performed for the three categories. The results are shown in Table 4.14 and Table 4.15. A plot of mean scores is given in Fig. 4.1 (Page 34).

Table 4.14 Summary statistics

Statement No.	Organizations				vendors/Consultants				Combined			
	Mean	Mode	S.D.	Var No.	Mean	Mode	S.D.	Var No.	Mean	Mode	S.D.	Var No.
1	3.56	4	1.219		3.39	4	1.46		3.46	4	1.32	
2	2.65	3	1.002		2.22	2	1.11		2.46	2	1.07	
3	3.32	4	0.82	1	3.44	4	1.15		3.38	4	0.98	
4	3	2	1.247		3.33	4	0.97	1	3.16	2.4	1.11	
5	2.79	2	0.487	2	2.61	2	1.09		2.7	2	0.94	1
6	3.32	4	1.057		3.56	4	0.98	2	3.43	4	1.01	
7	2.89	2,3,4	0.937		2.67	2	1.03		2.78	2	0.98	
8	2.79	4	1.03		3	2	1.03		2.89	2,4	1.02	
9	3.84	4	1.02		3.61	4	0.78	3	3.73	4	0.91	2
10	3.47	4	0.91		3.22	4	1		3.35	4	0.95	3
11	3.21	4	1.08	3	2.39	2,3	0.98		2.81	2	1.1	
12	3.63	4	0.96		3.06	4	1.21		3.35	4	1.11	
13	2.63	2	1.01		2.62	2	1.33		2.62	2	1.16	
14	3.32	4	1.49		3.27	4	1.18		3.3	4	1.33	
15	3.32	4	1		3.5	4	0.79	4	3.41	4	0.89	4
16	3.32	4,2	1.16		3.61	4	0.92	5	3.46	4	1.04	
17	2.63	2	1.12		3.17	2	1.1		2.89	2	1.13	
18	3.68	4	0.58		4.11	4	0.9	6	3.89	4	0.77	5
19	3.21	4	0.92	4	4.06	4	0.64	7	3.62	4	0.89	6
20	3.32	4	0.82	5	3.06	4	1.11		3.19	4	0.97	7
21	2.58	2	1.02		2	2	0.91		2.3	2	1	
22	2.47	2	0.93		2.11	2	0.83		2.3	2	0.91	8
23	3.05	2	0.85	6	3.5	4	1.44		3.3	4	1.04	
24	3.63	4	0.76	7	3.67	4	0.84	8	3.65	4	0.79	9
25	2.89	2	0.94		2.94	2	1.06		2.92	2	0.98	
26	3.42	4	0.96		3.83	4	0.86		3.62	4	0.92	10
27	2.63	4	1.16		3.39	4	1.2		3	4	1.22	
28	3.89	4	0.74	8	4.11	4	0.76	11	4	4	0.75	
29	3.11	2,3,4	0.94		3.33	4	1.08		3.22	4	1	
30	3.63	4	0.9	9	4.17	4	0.86	12	3.89	4	0.91	12
31	3.79	4	0.79	10	3.83	5	1.24	13	3.81	4	1.02	
32	3.32	4	1		3.56	1	1.2	14	3.43	4	1.09	
33	3.95	4	0.71	11	3.56	4,5	1.2	15	3.76	4	1.01	
34	3.37	4	1.07		3.22	2,3,4,5	1.35		3.3	4	1.44	
35	4.05	4	0.78	12	3.33	4	1.32		3.3	4	1.09	
36	3.16	2	1.16		2.72	2	1.27		2.95	2	1.22	
37	3.79	4	0.85	13	3.5	4	0.99		3.65	4	0.92	13
38	4.32	4	0.48	14	3.89	4	0.76	16	4.11	4	0.66	14
39	3.68	4	0.78	15	3.44	4	1.04		3.57	4	0.96	15
40	2.53	2	0.96		2.72	2	1.07		2.62	2		
41	3.16	4	1.01		2.72	2	1.07		2.95	2	1.05	
42	3.26	3	0.65	16	3.39	3	1.04		3.32	3	0.85	
43	2.94	2	1.31		2.89	2	0.96		2.92	2	1.14	
44	2.84	3	1.17	17	2.61	3	0.92		2.73	3	1.05	
45	3.42	4	0.9		3	3	0.91		3.22	4	0.92	16
46	3.05	4	0.97		2.94	3	0.8		3	4	0.88	17
47	4	4	0.78	18	3.39	4	0.92	18	3.7	4	0.94	18
48												

Fig. 4.1; Plot of mean score

(Responses of companies & Vendors)

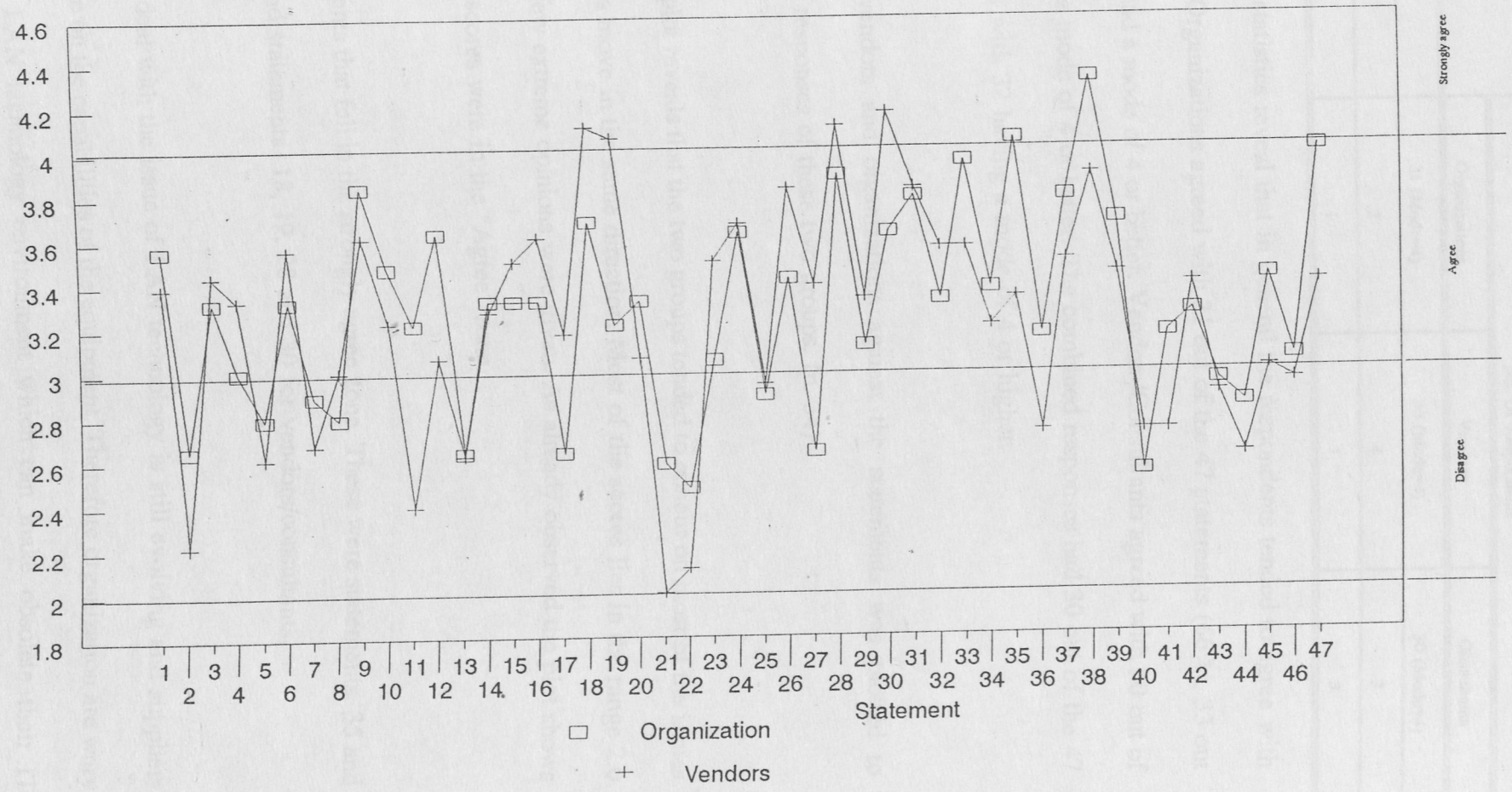

Fig. 4.1; Plot of mean score

(Responses of companies & Vendors)

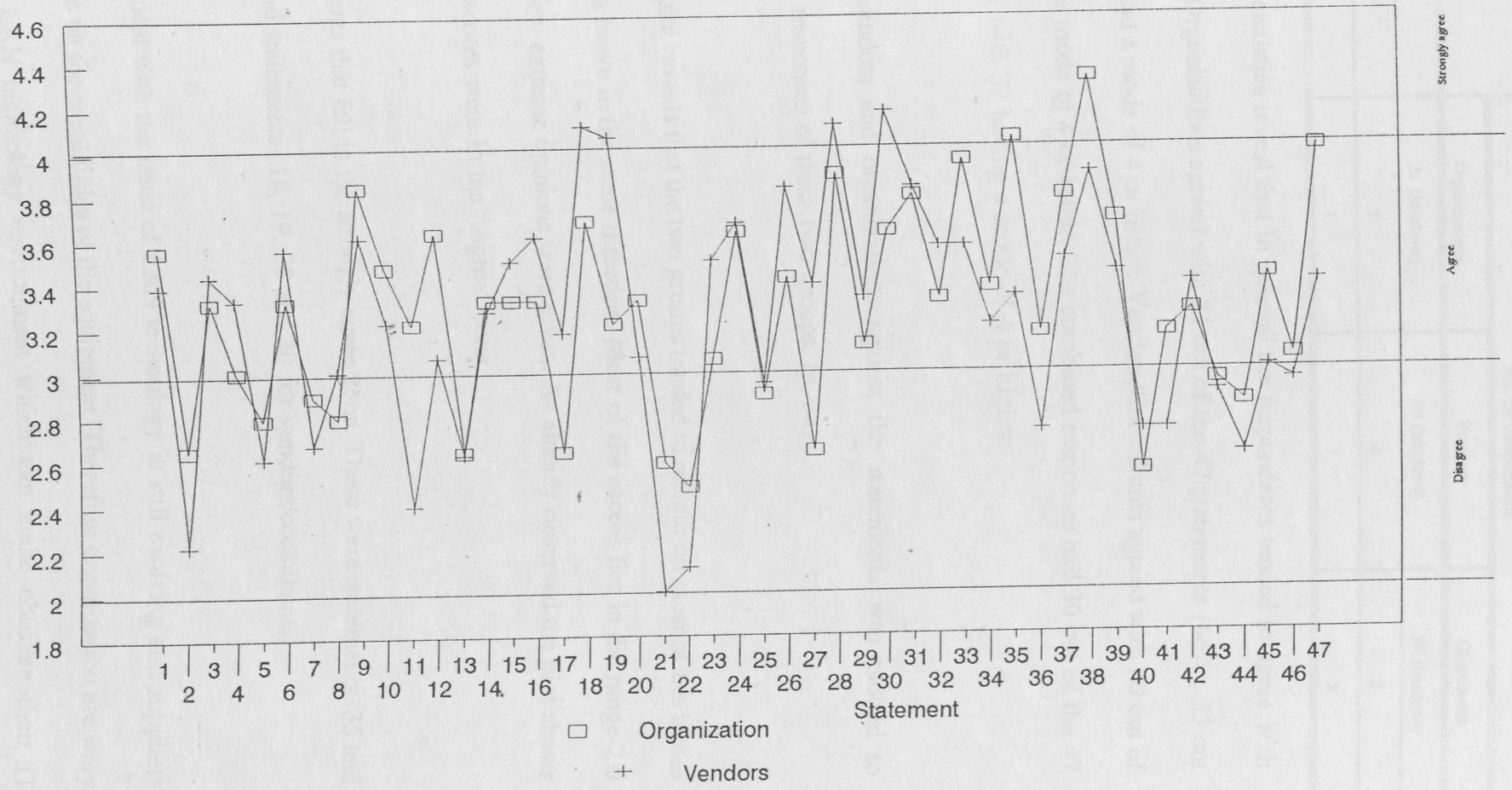

Table 4.15: Responses Comparison

Response	No. Of Respondents		
	Organizations	Vendors	Consultants
Agree	31 (Mode=4)	30 (Mode=4)	30 (Mode=4)
Strongly Agree	2	4	3
Neither Agree or Disagree	1	1	3

A look at the summary statistics reveal that in general the respondents tended to agree with most of the statements. Organizations agreed with 31 out of the 47 statements (66%), 33 out 47 statements (70.2%) had a mode of 4 or better. Vendors/Consultants agreed with 30 out of the 47 with 27 having a mode of 4 or better. The combined responses had 30 out of the 47 statements in agreement with 32 having a mode of 4 or higher.

The mean scores of vendors and organizations against the statements was plotted to investigate the trend of responses of these two groups. (p. 34)

An examination of the plot reveals that the two groups tended to concur on most of the issues raised. The mean scores move in the same direction. Most of the scores lies in the range 2.0 and 4.0 indicating the few extreme opinions were given. As already observed the plot shows that most of the mean scores were in the "Agree" zone.

There were few statements that fell in the strongly agree zone. These were statements 35 and 38 for organizations and statements 18, 19, 28 and 30 for vendors/consultants.

Statements 35 and 38 deal with the issue of LAN technology is still evolving and suppliers are bound to exaggerate on the capabilities of the equipment. Therefore organization are wary of the fast changing LAN technology environment which can make obsolete their IT

investments. They feel that suppliers are not likely to warn of them of this danger and exaggerate the capabilities of their equipment.

Statements 18, 19, 28 and 30 deal with issues of lack of comprehensive security policy, lack of preparation for impact of LANs, utilization of LANs and attitude toward implementation. Lack of comprehensive security policy is of concern to vendors. They feel that security is more than just implementing security features in the LAN which is their responsibility. Management should look at security broadly and give guidelines on this matter. Vendors concern is that they tend to get blamed when security is compromised while they are only responsible for some certain aspects of system security. It is only management through design of a comprehensive security policy who can guarantee security.

Statement 19 reflects vendors concern on lack of preparation for the LAN on part of the management. It is only management that can prepare the organization for the impact of LAN. People need to be educated about LAN technology and what its adoption means to them.

Statement 28 reflects the vendors feeling that LANs are under-utilized. This could stem from the fact that organizations do not make adequate preparation to ensure its adoption by the people as a tool in performance of their tasks. People continue to work as before and may even resist the technology as they do not understand it and they lack the necessary skills. This under-utilization, the vendors feel, is due to lack of preparation for LANs by the organizations.

Statement 30 reflects the concern vendors have on the narrow view by management of the implementation concept as only acquisition and installation of LANs. This again ties with lack

of preparation for LAN impact, the result of a narrow view of the implementation process. Many vendors double up as consultants and would like management to see them as people who sell solutions as opposed to products. They would like to play a greater role in the implementation process from planning to post-implementation.

A closer analysis of the plot reveals three patterns. First the plot shows that for both vendors and organizations an upward movement is almost invariably followed by a down movement. The second pattern in the two groups scores tend to move in the same direction i.e they go up together and down together. The third pattern is that from statement 1 to 13 (14) the mean scores of vendors/consultants tend to be higher than for organizations (8 out of 12 with 2 ties). This trend changes between statements 14 and 32 where the mean score of vendors tend to be higher (15 out of 18 statements). This trend again reverses between statements 32 to statement 47 where the mean score of vendors/consultants tend to be lower (12 out of 15).

Statements 1 to 14 deal with issues of management of the LAN. Organizations tend to respond more positively than the vendors. This could be due to their better appreciation of these issues.

Statements 14 to 32 deal with the issues of organizational impact of LANs and the need for planning and preparation. Vendor/consultants tend to agree more with these statements. This could be due to earlier cited vendors/consultants concern for management's over-reliance on them and organizations narrow view of the implementation concept. Vendors/consultants are more sensitive to these issues.

Statements 33 to 47 deal more with issue of LAN as an immature technology and the difficulty of dealing with a novel and rapidly evolving technology. Vendors tend to be more negative in the responses to these statements than organizations. Vendors are expressing their confidence in dealing with the new technology. They assert that even though the technology is new and evolving they can provide solutions with it. Organizations are on the other hand expressing their reservations. They are unable to use their traditional tools to appraise it. They are thus forced to rely on others, mainly vendors/consultants. But vendors are likely to exaggerate the capabilities of the equipment. Independent advice is difficult to obtain due to lack of experience of consultants.

Though the two plots show remarkable similarities there are a few statements where the responses were in opposite direction i.e they fell on the opposite sides of the Agree/Disagree divide. These are statements 11, 17, 27, 36, 41, and 46. Thus the two groups did not concur on these statements.

While organizations feel that security features of LANs are not as good as those of mainframe or minicomputers vendors feel otherwise (Statement 11). This could tie with earlier expressed feeling by vendors that management look at security issue narrowly. They only look at system features of the technology which is only one aspect of system security. The greater threat or security risk in a LAN environment is due to decentralization. Mainframes tend to be centralized and easy to control. The issue is then management control rather than technology. Organizations are also expressing more confidence in established and more stable mainframe technology as compared to new and evolving LAN technology.

In statement 17 organizations feel that there is defence against a disgruntled worker out to compromise system security. The vendors/consultants feel there is almost none. Again this could be attributed to narrow perspective of management as to what is security threat. Vendors with better understanding of technology might feel that a foolproof system is not possible. Security is more than fraudulent acquisition of information. Data integrity is also an important consideration. Users behaviour in the end is the only guarantee of system security.

On the use of project champion in implementation (statement 27), organizations feel that this is not necessary whereas vendors are more positive about this. The response by the organizations could be due to their narrow view of the implementation process, they fail to see the political aspect of it.

In statement 36, organizations agree that sourcing all products from one vendor is a dangerous strategy whereas vendors disagree. This is to be expected as organizations are wary of becoming dependent on one vendor. Vendors on the other hand feel they can meet all the requirements of organizations. Further "locking in" an organization guarantees them business.

In statement 41 vendors feel that accommodating differing information requirements does not make design of LANs difficult. Vendors feel that they have the necessary expertise to handle LAN design. Organizations feel that visualizing the final design is difficult. This could be true in their case as they lack the necessary manpower and skills.

In statement 46 organizations tend to feel that optimization of a LAN is difficult whereas vendors/consultants tend to feel that it is not. This is because vendors/consultants have more skills than organizations.

In statement 17 organizations feel that there is defence against a disgruntled worker out to compromise system security. The vendors/consultants feel there is almost none. Again this could be attributed to narrow perspective of management as to what is security threat. Vendors with better understanding of technology might feel that a foolproof system is not possible. Security is more than fraudulent acquisition of information. Data integrity is also an important consideration. Users behaviour in the end is the only guarantee of system security.

On the use of project champion in implementation (statement 27), organizations feel that this is not necessary whereas vendors are more positive about this. The response by the organizations could be due to their narrow view of the implementation process, they fail to see the political aspect of it.

In statement 36, organizations agree that sourcing all products from one vendor is a dangerous strategy whereas vendors disagree. This is to be expected as organizations are wary of becoming dependent on one vendor. Vendors on the other hand feel they can meet all the requirements of organizations. Further "locking in" an organization guarantees them business.

In statement 41 vendors feel that accommodating differing information requirements does not make design of LANs difficult. Vendors feel that they have the necessary expertise to handle LAN design. Organizations feel that visualizing the final design is difficult. This could be true in their case as they lack the necessary manpower and skills.

In statement 46 organizations tend to feel that optimization of a LAN is difficult whereas vendors/consultants tend to feel that it is not. This is because vendors/consultants have more skills than organizations.

The statements which fell on the agree/disagree divide i.e neither agree nor disagree were statement 4 for organizations and statements 8 and 45 for vendors/consultants. Organizations are not sure whether vendors have neglected the area of network management or not. Vendor are not sure whether connecting high quality and low quality equipment complicates the LAN and whether fine tuning a LAN is exceedingly taxing.

4.2.1: Factor Analysis

Factor analysis was performed on the two categories of the respondents and also on the combined responses. The statistical computer package that was employed could only take up to 18 variables Some of the statements in the questionnaire were eliminated to fulfil this condition. The criteria of eliminating the statements was standard deviation. The 18 statements with the lowest standard deviation were selected for factor analysis. In the vendor/consultant category the matrix that resulted from this exercise was not invertible. Further elimination and addition of new statements was done using standard deviation criteria and the researcher's personnel judgement to replace some statements with other similar statements in the questionnaire i.e attempt to retain the dimension captured by the previous statements. The final matrix had 17 variables.

The statements selected are shown in Tables 4.16 to 4.18 for organizations, vendors/consultants and combined responses.

Table 4.16: Selected Statements for Organizations

3	There is a general lack of support and development tools for LANs.
5	A LAN is depressingly complex when you have to find what needs fixing when something goes wrong.
9	LAN users have a lot of power on their desks without the security procedures built in traditional mainframe and minicomputer systems.
19	Most organization are never prepared for the impact a LAN has on people within an organization.
20	Introduction of a LAN has a subtle implication on the organization structure with great potential for disruptive change.
23	LAN implementation is unavoidably mixed up with organization politics.
24	A LAN will have persistent long term effect on satisfaction and performance of employees.
28	Many LANs are under utilized.
30	There is a tendency to look at implementation process from a narrow perspective where acquisition and installations aspects are given priority.
31	There is a tendency for management to over rely on IT professionals as far as LAN planning is concerned.
33	Vendors in many cases do not tell about hidden costs of installing LANs.
35	LAN technology is still evolving; what you install today may be obsolete in a few years time.
37	It is difficult to obtain independent advice on LANs due to limited experience of many vendors and Consultants.
38	Suppliers are always bound to exaggerate the capabilities of their equipment.
39	The really difficult issues in networking will continue to be hidden in advertising hyperbole.
42	Traditional financial appraisal techniques e.g NPV, IRR are inadequate in measuring the worth of a LAN.
45	Connecting high quality equipment and low quality equipment complicates the LAN as it is difficult to know how inaccuracies in design are accentuated through the system.
47	Many vendors lack manpower skilled in LAN technology

Table 4.17: Selected Statements for Vendors/Consultants

4	Vendors have generally neglected the area of network management.
6	Connectivity brings with it problems of management and resource control which are frequently considered only after the network is installed.
9	Even after a LAN is installed and running (Working) considerable amount of bug-finding, tuning and enhancement will need to be undertaken as time goes.
15	LAN users tend to think of their privacy rather than corporate security.
16	LAN users tend to use simple passwords that are easy to crack.
18	Few companies have a comprehensive security policy.
19	Most organization are never prepared for the impact a LAN has on people within an organization.
23	LAN implementation is unavoidably mixed up with organization politics.
24	A LAN will have persistent long term effect on satisfaction and performance of employees.
26	Implementing a LAN is a part selling, part technical operation.
28	Many LANs are under utilized.
30	There is a tendency to look at implementation process from a narrow perspective where acquisition and installations aspects are given priority.
31	There is a tendency for management to over rely on IT professionals as far as LAN planning is concerned.
32	LAN planning in many cases has failed to estimate what can be achieved, the time required and the costs involved.
33	Vendors in many cases do not tell about hidden costs of installing LANs.
38	Suppliers are always bound to exaggerate the capabilities of their equipment.
47	Many vendors lack manpower skilled in LAN technology

Table 4.18: Selected Statements for Combined Analysis

5	A LAN is depressingly complex when you have to find what needs fixing when something goes wrong.
9	Even after a LAN is installed and running (Working) considerable amount of bug-finding, tuning and enhancement will need to be undertaken as time goes.
10	The overly concern with computer fraud makes managers overlook other serious threats from more mundane sources.
15	LAN users tend to think of their privacy rather than corporate security.
18	Few companies have a comprehensive security policy.
19	Most organizations are never prepared for the impact a LAN has on people within an organization.
20	Introduction of a LAN has a subtle implication on the organization structure with great potential for disruptive change.
22	LANs can reduce the quality of working life of people through deskilling.
24	A LAN will have persistent long term effect on satisfaction and performance of employees.
26	Implementing a LAN is a part selling, part technical operation.
28	Many LANs are under utilized.
30	There is a tendency to look at implementation process from a narrow perspective where acquisition and installation aspects are given priority.
37	It is difficult to obtain independent advice on LANs due to limited experience of many vendors and Consultants.
38	Suppliers are always bound to exaggerate the capabilities of their equipment.
39	The really difficult issues in networking will continue to be hidden in advertising hyperbole.
45	Connecting high quality equipment and low quality equipment complicates the LAN as its difficult to know how inaccuracies in design are accentuated through the system.
46	Optimization of a LAN is difficult and even an optimal solution may not last for long.
47	Many vendors lack manpower skilled in LAN technology

4.2.1.1: Factor Analysis Results For Organizations

The Eigen values for this Analysis are shown in Table 4.19

Table 4.19: Analysis For Organizations: Eigen Values

Factor	Eigen Values	Percentage Variance	Cumulative Percentage
1	4.503	25.0	25.0
2	3.283	18.2	43.3
3	2.435	13.5	56.8
4	1.735	9.6	66.4
5	1.299	7.2	73.6
6	1.050	5.8	79.5
7	0.920	5.1	84.5
8	0.731	4.1	88.6
9	0.624	3.5	92.1
10	0.420	2.3	94.4
11	0.396	2.2	96.6
12	0.225	1.3	97.9
13	0.144	0.8	98.7
14	0.906	0.5	99.2
15	0.075	0.4	99.6
16	0.045	0.2	99.9
17	0.022	0.1	100.0
18	0.0003	0.0	100.0

The Eigen values shows how much variance is extracted by each factor. Each factor accounts for a decreasing proportion of variance subject to the condition that it is uncorrelated to all previous factors. Thus factor 1 accounts for 25.0% of the total observed variation. The Eigen values form the basis on which the number of factors to be extracted is determined. It is the sum of square of variable loadings on the factor. Since the variables are standardized each has a variance of 1. Therefore for a factor to account for at least one variable it should have a variance (eigen value) of at least 1. This then serves as a cut off point that determines the number of variables to be extracted. The table 4.19 indicates that if 100% of the variance was

to be accounted for, 17 factors need to be extracted. Using the criteria mentioned above 6 factors were extracted. The 6 factors accounted for 79.5% of the total observed variation.

The achieved communalities after the six factor solution are shown in Table 4.20.

Table 4.20: Analysis for Organizations: Achieved communalities

Variable No.	Statement No.	Communality
1	3	0.777
2	5	0.848
3	11	0.790
4	19	0.768
5	20	0.848
6	23	0.695
7	24	0.830
8	28	0.678
9	30	0.891
10	31	0.834
11	33	0.835
12	35	0.802
13	37	0.640
14	38	0.846
15	39	0.652
16	42	0.929
17	45	0.792
18	47	0.792

Communality expresses the proportion of variance of a variable that is accounted or extracted by the factors. It is the sum of square of factor loadings on a variable. Therefore the six factor solution accounted for 78% of the variance observed in variable 1 (statement 3). Similarly 79% of variance observed in variable 17 (statement 45) is explained by the factors.

An analysis of the communality table reveals that most of the variation in the variables was captured by the factors. The lowest variation was for variable 13 (statement 37) where 64%

of the variation was captured. Variations in variable 9 (statement 30), variable 10 (statement 31) and variable 16 (statement 42) were almost fully captured by the factors. Thus the factors do explain most of the variation.

Varimax rotation was done on the initial factor matrix. The final rotated matrix is shown in Table 14.21

Table 14.21: Analysis for Organizations: Rotated Factor Matrix

Statement No.	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
3	0.191	-0.264	-0.587	0.501	0.135	0.238
5	0.223	0.078	0.867	0.092	0.121	-0.129
11	-0.618	0.276	-0.189	0.266	0.461	0.114
19	0.032	0.446	0.645	0.174	-0.197	0.287
20	-0.230	-0.027	-0.086	0.875	-0.061	0.133
23	0.251	0.139	0.244	0.739	-0.073	0.039
24	0.532	0.422	0.201	0.305	-0.258	-0.404
28	0.244	-0.025	0.131	0.085	-0.130	0.759
30	-0.433	0.723	0.357	0.196	0.110	0.051
31	0.037	0.929	0.016	0.078	-0.094	-0.108
33	0.100	0.147	-0.330	0.060	-0.809	0.189
35	0.612	-0.153	0.348	0.441	0.198	0.221
37	0.659	-0.033	0.244	0.157	0.058	0.342
38	0.820	0.173	-0.046	0.119	-0.355	6.5E-3
39	-0.119	0.707	0.111	-0.224	0.170	-0.216
42	-0.210	0.237	-0.394	-0.076	0.810	0.107
45	-0.844	0.217	0.015	0.085	0.137	-0.079
47	-6.9E-3	-0.205	-0.236	0.147	0.052	0.819

Varimax is an orthogonal type of rotation. Rotation, varimax or otherwise, is done in an attempt to make loading either close to 1 or 0. Such loadings show more clearly what variables go together and are thus more interpretable (Churchill 1987). Orthogonal rotations preserve the right angles that exist among factor axes. They are more mathematically simple

to handle. The final rotated matrix stands for both a pattern and a structure matrix. The coefficient in the table represent both regression weights and correlation coefficients.

Interpretation of the factors is now presented.

Factor 1 is heavily loaded by statements shown in Table 4.22.

Table 4.22: Factor 1 Loadings for Organizations

Statement No.	Statement	Mean score
11(0.62)	LANs users have a lot of power on their desks without security features on mainframes or minis	3.21
24(0.50)	A LAN will have persistent long term effect on satisfaction and performance.	3.79
37(0.61)	It is difficult to obtain independent on LANs due to limited experience of vendors.	4.05
38(0.82)	Suppliers are always bound to exaggerate the capabilities of their equipment.	4.32
45(0.84)	Connecting high quality equipment and low quality equipment complicates LANs.	3.42
35(0.61)	LAN technology is still evolving what you install today may be obsolete in a few years time.	4.05

This Factor can be named: LAN is a novel and fast changing technology. It expresses organizations' general attitude towards LANs. It shows that organizations are wary of this relatively recent technology. Given that the technology is still evolving, the danger of obsolescence is real. Further evolving technology will require different generation of equipment to be supported by the LAN which they feel complicates it. The situation is exacerbated by the feeling that independent advice is difficult to come by due to the limited experience of consultants and the likelihood of suppliers exaggeration of the capabilities of their equipment. They are expressing greater confidence in older and more stable mainframe and minicomputer technology. They feel it to be more dependable, at least as far as security is concerned. This situation will require organizations to take keener interest on this technology as dependence on others (vendors/consultants) will be undesirable. Organizations have to build their own internal capacity to fully exploit this technology. The implication is

that employees will need to be more involved in adoption and exploitation of this technology, they will be required to take a more proactive approach when dealing with it. This demand on them will undoubtedly have an impact on their performance and satisfaction.

Statements loading heavily on factor 2 are shown in Table 4.23

Table 4.23: Factor 2 Loadings for Organizations

Statement No.	Statement	Mean score
30(0.73)	There is a tendency to look at implementation process narrowly as acquisition and installation	3.63
31(0.93)	There is a tendency for management to over-rely on IT professionals on LAN planning.	3.79
39(0.71)	The really difficult issues in networking will continue to be hidden in advertisements.	3.68

This factor can be named: Information for planning for a LAN is not widely or easily available, even when available it is not always reliable. The organizations are admitting they do not get involved in planning and delegate this matter to IT professionals. This is due to the fact that they lack the expertise in the technology and the information is lacking as the difficult issues are hidden from them. Thus the only option for them acquire a LAN and delegate the other aspects of implementation to professionals.

Statements that load heavily on factor 3 are shown in Table 4.24.

Table 4.24: Factor 3 Loadings for Organizations

Statement No.	Statement	Mean score
3(0.59)	There is a general lack of support and development tools for LAN	3.32
5(0.87)	A LAN is depressingly complex when you have to find what needs fixing.	2.79
19(0.65)	Most organizations are never prepared for the impact of LAN.	3.21

This is a post-implementation factor, it can be named: Post implementation maintenance of LANs is challenging. The general lack of support and development tools makes it difficult for organizations to maintain their systems. They also lack preparation for the impact of LAN.

But their lack of preparation and lack of tools has not quite handicapped them in utilizing LANs.

Statements loading heavily on factor 4 are shown in Table 4.25.

Table 4.25: Factor 4 Loadings for Organizations

Statement No.	Statement	Mean score
20(0.87)	Introduction of a LAN has subtle implication on organization structure with great potential for disruptive change	3.32(4)
23(0.74)	LAN implementation is unavoidably mixed with organization politics	3.05(2)

This factor can be named: Organizational politics impact on LAN implementation process. It expresses the political dimension of the implementation process. A LAN effects power structure in organizations as it changes the way information flows, as information gives power and influence to those who have access to it. Organizations tend to feel that politics are not entirely unavoidable, they do concede that they have great potential for disruptive change.

Statements loading heavily on factor 5 are shown on table 4.26

Table 4.26: Factor 5 Loadings for Organizations

Statement No.	Statement	Mean score
33(0.81)	Vendors in many cases do not tell about hidden costs of installing LANs.	3.95
42(0.82)	Traditional financial techniques NPV, IRR are inadequate in LAN appraisal	3.26

This factor can be named: Difficulty in appraising cost elements in a LAN. Organizations are handicapped when it comes to appraising LANs as their traditional techniques are inadequate. This is made more acute by the fact that the vendors will not tell about the hidden costs. Therefore organizations are at a loss when it comes to making investment decisions on LANs.

The statements that load heavily on factor 6 are in Table 4.27.

Table 4.27: Factor 6 Loadings for Organizations

Statement No.	Statements	Mean score
28(0.76)	Many LANs are under-utilized .	3.89
47(0.82)	Many vendors lack the manpower skilled in LAN technology	4.0

This factor can be named: Tendency to under utilize a LAN system. The organizations feel that their investment are not fully utilized. They attribute this to vendors lack of experience and lack of skilled manpower in LAN technology. They may thus play safe and over-design their systems at the expenses of the organizations. Vendors (as expressed in factor 3) may not be providing the necessary management and support tools to make full use of the investment.

4.2.1.2: Factor Analysis Results for vendors/Consultants

The Eigen values for this analysis are presented in Table 4.28

Table 4.28: Vendors/Consultants Analysis: Eigen Values

Factor	Eigen Value	Percentage variance	Cumulative Percentage
1	6.030	35.5	35.5
2	2.824	16.6	52.1
3	2.007	11.8	63.9
4	1.494	8.8	72.7
5	1.375	8.1	80.8
6	0.795	4.7	85.5
7	0.652	3.8	89.3
8	0.593	3.5	92.8
9	0.410	2.4	95.2
10	0.270	1.6	96.8
11	0.240	1.4	98.2
12	0.151	0.9	99.1
13	0.076	0.4	99.5
14	0.053	0.3	99.8
15	0.019	0.1	99.9
16	0.011	0.1	100.0
17	0.00	0.0	100.0

From the eigen values 5 factors were extracted. This captured 80.8% of the observed variation which is relatively high.

The achieved communalities of this 5 factor solution are presented in Table 4.29

Table 4.29: Vendors/Consultants Analysis: Achieved Communalities

Variable No.	Statement No.	Communality
1	4	0.761
2	6	0.886
3	9	0.832
4	15	0.678
5	16	0.696
6	18	0.701
7	19	0.934
8	23	0.729
9	24	0.830
10	26	0.912
11	28	0.834
12	30	0.807
13	31	0.740
14	32	0.863
15	33	0.924
16	38	0.833
17	47	0.769

The achieved communalities were relatively high. Only variables 4 and 5 had values of less than 70 percent.

The final rotated matrix is presented in Table 4.30

Table 4.30: Vendors Consultants Analysis; Final Rotated Factor Matrix

Statement No.	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5
4	0.862	0.073	0.107	-0.027	-0.030
6	0.895	-0.234	2.8E-3	-0.164	0.057
9	0.031	0.652	0.167	0.354	0.504
15	0.161	0.212	-0.255	-0.626	0.389
16	0.115	0.127	-0.014	0.774	-0.258
18	-0.166	0.056	0.061	0.145	-0.804
19	0.437	0.340	0.564	0.285	-0.478
23	0.721	0.358	-0.228	-1.0E-3	0.168
24	0.419	0.776	-0.148	0.162	0.063
26	-0.049	0.926	0.105	-0.165	-0.117
28	0.248	-0.043	0.867	0.126	0.033
30	-0.110	0.172	0.867	0.088	-0.072
31	0.270	0.691	0.420	0.106	-0.044
32	0.745	0.427	0.278	0.193	-0.105
33	0.607	0.234	0.522	0.165	0.449
38	0.788	0.246	0.249	0.142	0.265
47	4.5E-3	0.094	0.190	0.801	0.286

Interpretation of the factors is now presented

Statements that load heavily on factor 1 are shown in Table 4.31

Table 4.31: Factor 1 Loadings for Vendors/Consultants

Statement No. (Loading)	Statement	Mean Score
4 (0.86)	Vendors have generally neglected the area of network management.	3.33
6 (0.90)	Connectivity brings with it problems of management and resource control which are frequently considered only after the network is installed.	3.56
23 (0.72)	LAN implementation is unavoidably mixed up with organization politics.	3.50
32 (0.75)	LAN planning in many cases has failed to estimate what can be achieved, the time required and the costs involved.	3.56
33 (0.61)	Vendors in many cases do not tell about hidden costs of installing LANs.	3.56
38 (0.79)	Suppliers are always bound to exaggerate the capabilities of their equipment.	3.89

This factor can be named: Information for planning for a LAN is not widely or easily available, even when available it is not always reliable. It shows that planning has failed in three respects. It has failed to estimate costs as vendors will not tell about hidden costs. It has failed to estimate what can be achieved as suppliers will exaggerate the capabilities of the equipment and vendors have neglected after sales service. Planning has failed to estimate the time for implementation as politics come into play in implementation process and also the fact that other problems come with connectivity that in many cases were not anticipated. This factor also shows that vendors are first and foremost business people out to make a profit even at the expense of clients.

Statements that load heavily on factor 2 are shown in Table 4.32

Table 4.32: Factor 2 Loading for Vendors/Consultants

Statement No. (Loading)	Statement	Mean Score (mode)
9 (0.65)	Even after a LAN is installed and running (Working) considerable amount of bug-finding, tuning and enhancement will need to be undertaken as time goes.	3.61
24 (0.78)	A LAN will have persistent long term effect on satisfaction and performance of employees.	3.67
26 (0.93)	Implementing a LAN is a part selling, part technical operation.	3.83
31 (0.69)	There is a tendency for management to over rely on IT professionals as far as LAN planning is concerned.	3.83

This factor can be named: Implementing a LAN is a part selling, part technical operation for vendors. It expresses the vendors/consultants perception of their role in the implementation process. The tendency of management to over rely on them has broadened their scope in the process. Their operation is now two faceted, selling the LAN idea (ideally a management task) and technical operations (vendor/consultant) task. The vendors now have to "sell" the idea of LAN to employees as well as handle technical aspects. The long term impact of LAN on satisfaction and performance of employees underscores the importance of selling the LAN.

The continuous fine-tuning, bug finding and enhancement underscores the aspect of technical operation.

Statements that heavily load on factor 3 are shown in Table 4.33

Table 4.33: Factor 3 Loadings for Vendors/Consultants

Statement No. (Loading)	Statement	Mean Score (mode)
19 (0.56)	Most organization are never prepared for the impact a LAN has on people within an organization.	4.06
28 (0.87)	Many LANs are under utilized.	4.11
30 (0.87)	There is a tendency to look at implementation process from a narrow perspective where acquisition and installation aspects are given priority.	4.17

This factor can be named: Tendency to under utilize a LAN system. The vendors are of the feeling that LANs are under utilized. They attribute this to management's narrow view of the implementation process as only acquisition and installation of LAN. They therefore do not make adequate preparation, educate and train users to facilitate adoption of this technology.

Statements that load heavily on factor 4 are shown in table 4.34.

Table 4.34: Factor 4 Loadings (Vendors/Consultants)

Statement No. (Loading)	Statement	Mean Score (mode)
15 (0.63)	LAN users tend to think of their privacy rather than corporate security.	3.5
16 (0.77)	LAN users tend to use simple passwords that are easy to crack.	3.61
47 (0.80)	Many vendors lack manpower skilled in LAN technology	3.39

This factor can be named: LAN is a novel and fast changing technology. Users have not realized that they have migrated from their "personal" stand alone PCs. Their behaviour reflects this. They fail to appreciate or conceptualize the network concept, that they can no longer think only of their own data and privacy. They need to appreciate the power they have on their desks. The fact that vendors are conceding they lack manpower skilled in this area underscores the novelty of the technology.

Statements loading heavily on factor 5 are shown in Table 4.35.

Table 4.35: Factor 5 Loadings for Vendors/Consultants

Statement No. (Loading)	Statement	Mean Score (mode)
9 (0.5)	Even after a LAN is installed and running (Working) considerable amount of bug-finding, tuning and enhancement will need to be undertaken as time goes.	3.61
18 (0.80)	Few companies have a comprehensive security policy.	4.11

This factor can be named: Need for a comprehensive security policy in a LAN environment; over dependence on built in LAN security features should be avoided. It expresses the lack of comprehensive security policy in many organizations. It also stresses that system security is an ongoing process, new features need to be added constantly thus the need for continuous enhancement and bug finding.

4.2.1.3: Factor Analysis Results for combined Responses

The Eigen values for this analysis are presented in Table 4.36

Table 4.36: Combined Responses Analysis: Eigen Values

Factor	Eigen Value	Percentage variance	Cumulative Percentage
1	3.837	21.3	21.3
2	2.527	14.0	35.4
3	2.277	12.6	48.0
4	1.578	8.8	56.8
5	1.375	7.6	64.4
6	1.291	7.2	71.6
7	0.939	5.2	76.8
8	0.763	4.2	81.0
9	0.652	3.6	84.7
10	0.571	3.2	87.8
11	0.497	2.8	90.6
12	0.421	2.3	92.9
13	0.348	1.9	94.9
14	0.278	1.5	96.4
15	0.246	1.4	97.8
16	0.202	1.1	98.9
17	0.126	0.7	99.6
18	0.074	0.4	100.0

The eigen values suggested a 6 factor solution. The six factors extracted accounted for 71.6% the total variation.

The achieved communalities with these factor solution are presented in table 4.37.

Table 4.37: Combined Analysis; Achieved Communalities

Variable No.	Statement No.	Communality
1	5	0.814
2	9	0.671
3	10	0.789
4	15	0.650
5	18	0.573
6	19	0.850
7	20	0.515
8	22	0.772
9	24	0.761
10	26	0.719
11	28	0.696
12	30	0.751
13	37	0.797
14	38	0.672
15	39	0.676
16	45	0.780
17	46	0.683
18	47	0.715

Variable 7 (statement 30) achieved relatively low communality. The other communalities are somewhat high ranging from 65 percent to 85 percent.

The final rotated matrix is presented in table 4.38.

Table 4.38: Combined Analysis; Final Rotated Factor Matrix

Statement No.	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
5	0.095	-0.041	0.128	-0.165	0.097	0.866
9	0.275	0.216	-0.024	0.360	0.092	0.640
10	0.489	0.210	0.026	-0.037	0.599	-0.381
15	0.226	-0.054	0.086	0.496	-0.586	0.019
18	-0.268	0.357	-0.152	0.146	-0.560	-0.129
19	0.106	0.882	-0.163	-4.6E-3	-2.2E-3	0.184
20	0.491	0.254	0.245	0.346	-0.117	0.126
22	-0.204	-0.139	0.113	0.213	0.758	0.279
24	0.544	0.345	0.509	-0.268	-0.067	0.101
26	0.099	0.609	0.357	-0.259	-0.371	0.076
28	0.105	0.413	-0.221	0.676	0.094	0.026
30	-7.3E-3	0.826	0.201	0.080	-0.052	-0.141
37	0.656	0.046	-0.419	0.256	-0.072	0.344
38	0.709	-0.111	-0.066	0.315	0.052	0.224
39	0.767	0.044	0.290	-0.026	-6.9E-3	-0.033
45	2.4E-3	-0.097	0.876	0.043	2.8E-3	0.044
46	0.272	0.299	0.662	0.094	0.257	0.079
47	0.105	-0.193	0.119	0.806	-0.050	-0.020

Interpretation of the factors is now presented.

Statements load heavily on factor 1 are presented in table 4.39.

Table 4.39: Factor 1 Loadings for Combined Responses

Statement No.	Statement	Mean score
20(0.49)	Introduction of LAN has subtle implication on organization structure with great potential for disruptive change.	3.19
24(0.54)	A LAN will have persistent long term effect on satisfaction and performance of employees	3.65
37(0.66)	It is difficult to obtain independent advice on LANs due to limited experience of vendors and consultants	3.65
38(0.71)	Suppliers are always bound to exaggerate the capabilities of their equipment	4.11
39(0.77)	The really difficult issues will continue to be hidden in advertising hyperbole	3.57

This factor can be named: Information for planning a LAN is not widely or easily available; even when available it is not always reliable. The fact is that a LAN has a subtle implication on organization structure implying a persistent long term effect on employee satisfaction and performance. This calls for meticulous planning to avoid potential disruptive aspects. But the necessary information is lacking due to lack of expertise, suppliers exaggerating and advertisements misleading. This lack of information for planning is an important factor in implementation.

Statements that load heavily on factor 2 are shown in table 4.40.

Table 4.40: Factor 2 loadings for combined Responses

Statement No.	Statement	Mean score
19(0.88)	Most organizations are never prepared for the impact on people	3.62
26(0.61)	Implementing a LAN is part selling part technical operation	3.62
31(0.83)	There is tendency to look at implementation process narrowly as acquisition and installation	3.81

This factor can be named: Implementing a LAN is a part "selling", part technical operation. It shows that there is need for a broad perspective when looking at the implementation process. But there is a tendency to view it narrowly as acquisition and installation of a LAN, a situation that leads to most organization never being prepared for the full impact of the LAN.

Statements that load heavily on factor 3 are shown in table 4.41.

Table 4.41: Factor 3 Loadings for Combined Responses

Statement No.	Statement	Mean score (mode)
45(0.86)	Connecting high quality equipment with low quality equipment complicates the LAN.	3.22 (4)
46(0.66)	Optimization of LANs is difficult and even an optimal solution will not last	3.00 (4)

This factor can be named: Optimizing components of disparate qualities in a LAN is challenging. It is an operational aspect of a LAN. Connecting a medley of equipment complicates the LAN. But this may at times make optimization difficult. But this is not necessarily the case always.

Statements that load heavily on factor 4 are shown in table 4.42.

Table 4.42: Factor 4 Loadings for Combined Responses

Statement No.	Statement	Mean score
28(0.68)	Many LANs under-utilized	4.0
47(0.81)	Vendors lack manpower skilled in LAN technology	3.7

This factor can be named: Tendency to under utilize LAN systems. The fact that many LANs are under-utilized is due to vendors lacking skilled manpower. They thus play safe and over-design their system. They are not confident enough to design optimal systems. This is therefore a vendor recommendation factor.

Statements that load heavily on factor 5 are shown in table 4.43.

Table 4.43: Factor 5 Loadings for Combined Responses

Statement No.	Statement	Mean score
10(0.60)	The overly concern with fraud makes managers overlook other equally serious threats	3.35
15(0.59)	LAN users tend to think of their privacy rather than corporate security	3.41
18(0.56)	Few companies have comprehensive security policy	3.89
22(0.76)	LAN can reduce the quality of work life through deskilling	2.30

This factor can be named: Need for a comprehensive organization security policy regarding a LAN; over dependence on built in LAN security features should be avoided. The lack of a comprehensive security policy is due to narrow view of management on what LAN security is. To them security is prevention of fraud. Due to lack of policy or guidelines users only consider their own security. Manual controls are still seen as more reliable.

Statements that constitute factor 6 are presented in table 4.44.

Table 4.44: Factor 6 loadings for Combined Responses

Statement No.	Statement	Mean score
5(0.87)	LANs are depressingly complex when you have to find what needs fixing	2.7
9(0.64)	LAN needs Continuous bug finding tuning and enhancement	3.73

This factor can be named: LAN maintenance is a continuous ongoing process. It underscores the need for continuous maintenance of LAN but this is not a drawback as problems can be fixed when they occur.

SECTION 5

SUMMARY AND CONCLUSION

The objective of the study was to explore factors considered important in implementation of microcomputer based Local Area Networks (PC-LANs). The aim was to get a Kenyan perspective to supplement what has already been documented in literature.

The findings indicated a major shift towards LAN technology in the last 3 years. The LANs in existence were also relatively small in size and the level of integration was not yet 100 percent as would be ideally expected. But this can be attributed to the novelty of the LAN technology. It further shows that organizations have become more sophisticated and they are more selective in their choice of LAN products. They realize the dangers of proprietary systems and single sourcing of technology.

The organizations are also more self reliant in utilization of LAN technology. The traditional view of computers as support tools and a property of one department has also changed. Users of LANs have moved towards decentralization. They also tend to appreciate the strategic value of the LANs.

Summary statistics revealed a high degree of agreement by organizations and vendors/consultants with most statements. The statements had been extracted from literature documenting problems that have been experienced with LANs by users in developed world. Therefore most of the problems that have been experienced in the developed world have also

been experienced here. There was striking similarity in general trend of responses from the two categories. Only the degree of agreement or disagreement was different.

Organizations showed great concern of the fact that LAN technology is still evolving making the danger of obsolescence real. They also felt strongly that suppliers are likely to exaggerate the capability of their equipment, a fact that compounds the danger of obsolescence.

The vendors felt strongly that organizations have a narrow view of the LAN technology. They tend to view implementation narrowly as just acquisition and installation, failing to appreciate other equally important aspects of LAN planning. They strongly felt that most organization are unprepared the impact of LAN technology. This leads to low utilization of LANS. This lack of preparation also results in lack of comprehensive security policy.

The summary of the factors that came out of the factor analyses is presented in tables 5.1, 5.2, and 5.3 for Organizations, Vendors/consultants and Combined responses.

Table 5.1: Factors Considered Important by Organizations

1. LAN is a novel and fast changing technology.
2. Information for planning a LAN is not widely available, even when available it is not always reliable.
3. Post implementation maintenance of LANs is challenging.
4. Organizational politics impact on LAN implementation process.
5. Difficulty of appraising cost elements in a LAN.
6. Tendency to under-utilize LAN systems.

Table 5.2: Factors Considered Important by Consultants/Vendors

1. Information for planning a LAN is not widely available, even when available it is not always reliable.
2. Implementing a LAN is part "selling" part technical operation.
3. Tendency to under-utilize LAN systems.
4. LAN is a novel and fast changing technology.
5. Need for a comprehensive security policy in a LAN environment, over dependence on built in LAN security features should be avoided.

Table 5.3: Factors Considered Important from Combined responses

1. Information for planning a LAN is not widely available, even when available it is not always reliable.
2. Implementing a LAN is part "selling" part technical operation.
3. Optimizing components of disparate qualities in a LAN is challenging.
4. Tendency to under-utilize LAN systems.
5. Need for a comprehensive security policy regarding a LAN, over dependence on built in LAN security features should be avoided.
6. LAN maintenance is a continuous ongoing process.

Most of the factors were similar across the three categories. A summary of the final factors is presented in table 5.4 together with the stage they fall in the System Development Life Cycle (SDLC).

Table 5.4: Summary of Factors Considered Important in LAN Implementation

FACTOR	Stage in SDLC
LAN is a novel and fast changing technology.	Systems Analysis
Information for planning a LAN is not widely available, even when available it is not always reliable.	System Design
Post implementation maintenance is challenging.	Evaluation
Organizational politics impact on LAN implementation.	Implementation
Difficulty of appraising cost elements in a LAN.	System Design
Tendency to under-utilize LAN systems.	Evaluation
Implementing a LAN is part "selling" part technical operation.	Implementation
Need for a comprehensive security policy regarding a LAN, over dependence on built in LAN security features should be avoided.	Statement of Objectives
Optimizing components of disparate qualities in a LAN is challenging.	Evaluation
LAN maintenance is a continuous ongoing process.	Evaluation

The major limitation of the study was that the sample elements were not randomly selected. Therefore care should be taken in generalising the findings of the study.

Another limitation was the computer package used for data analysis. Its limitation of 18 variables meant that 29 variables had to be eliminated. It is difficult to estimate what the effect this had on the findings.

The study can be in the future extended to cover a more representative sample. The original 47 statements can be further reduced without loss of content.

APPENDIX 1

UNIVERSITY OF NAIROBI
FACULTY OF COMMERCE
DEPARTMENT OF MANAGEMENT SCIENCE

Telephone: 732160 Ext. 205
Telegrams: "Varsity" Nairobi

P.O. Box 30197
Nairobi, Kenya

Dear Sir/Madam

RE: RESEARCH ON FACTORS IMPORTANT IN LANs IMPLEMENTATION

I am a post-graduate student at the faculty of commerce, University of Nairobi. As part of my MBA course requirements I am undertaking a research project that seeks to establish factors considered important when implementing microcomputer based Local Area Networks (PC-LANs).

To satisfy the information requirements for this research I am administering a questionnaire to people in the industry involved in the implementation of PC-LANs. These are Computer (LAN) Managers, LAN Vendors and IT Consultants.

I would like your assistance in completing the attached questionnaire. I would be most grateful if you can spare sometime to answer these questions to the best of your Knowledge and ability. The questions could be enjoyable and can provide you with a new insight into this relatively new and exciting technology.

The information provided will be treated in strict confidence and will not be used for any other purposes other than for my research.

Your assistance will be greatly appreciated.

Yours Sincerely

Julius Gatune

MBA II Student

Supervisor:
Danny Fernandes, Lecturer
Department of Management Science
University Of Nairobi.

QUESTIONNAIRE ON LAN USER CHARACTERISTICS

Please fill in as appropriate.

1. In which industrial sector (or business) would you classify your organization ?

_____

2. When did your organization first install computers ?

Less than 5 years ago	( )
Less than 10 but more than 5	( )
More than 10 years	( )

3. How many years ago was the LAN implemented ?

Less than 1 year	( )
Less than 3 but more than 1	( )
Less than 5 but more than 3	( )
More than 5 years	( )

4. How big is your LAN ?

Less than 5 nodes	( )
Less than 20 but more than 5	( )
Less than 50 but more than 20	( )
More than 50	( )

5.(a) Is your LAN system proprietary or Non proprietary ? (Proprietary is a system that can support equipment from only one manufacturer)

Proprietary	( )
Non-Proprietary	( )

(b) If the system is non proprietary, how many different vendors equipment does it support?

No._____

6.(a) Do you have the position of a network manager or administrator ?

Yes	( )
No	( )

(b) If Yes, who does the LAN manager report to ?

_____

(c) If No, please explain who is responsible for managing the LAN and to whom he reports?

_____

_____

7. How many departments are connected to the LAN system as fraction of the total No. of departments ?

No._____ out of_____

8. Does the organization have an acquisition policy for hardware and software ?

Yes ( )

No ( )

9. Does your company retain consultancy services to get advice on use of LAN ?

Yes ( )

No. ( )

10. Has the LAN caused any change in organization structure ?

Yes ( )

Explain_____

No ( )

11. (a) Did you take any steps to ensure smooth installation and acceptance of the LAN by your staff ?

Yes ( )

No ( )

(b) If Yes, please list the steps taken below.

_____ _____

_____ _____

_____ _____

QUESTIONNAIRE ON LAN IMPLEMENTATION FACTORS

For each of the following statements tick as appropriate.

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE OR DISAGREE	AGREE	STRONG AGREE
1.The high level skills required to manage a LAN are scarce.	( )	( )	( )	( )	( )
2. Most LAN Operating Systems do not provide the really important networking features.	( )	( )	( )	( )	( )
3.There is a general lack of support and development tools for LANs.	( )	( )	( )	( )	( )
4. Vendors have generally neglected the area of network management.	( )	( )	( )	( )	( )
5. A LAN is depressingly complex when you have to find what needs fixing when something goes wrong.	( )	( )	( )	( )	( )
6. Connectivity brings with it problems of management and resource control which are frequently considered only after the network is installed.	( )	( )	( )	( )	( )
7. Having a mixture of vendor equipment in a LAN means that control is difficult and its behaviour is unpredictable.	( )	( )	( )	( )	( )
8. Fine tuning of a LAN so that it operates in a most efficient way is exceedingly taxing.	( )	( )	( )	( )	( )
9. Even after a LAN is installed and running (Working) considerable amount of bug-finding, tuning and enhancement will need to be undertaken as time goes.	( )	( )	( )	( )	( )
10. The overly concern with computer fraud makes managers overlook other serious threats from more mundane sources.	( )	( )	( )	( )	( )
11. LAN users have a lot of power on their desks without the security procedures built in traditional mainframe and minicomputer systems.	( )	( )	( )	( )	( )
12.Given time a ''hacker'' will disable any security feature and access any file or data.	( )	( )	( )	( )	( )
13. LAN users are a security threat as they are mostly inexperienced.	( )	( )	( )	( )	( )
14. It is futile to rely only on anti-virus programs to prevent virus contagion.	( )	( )	( )	( )	( )

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE OR DISAGREE	AGREE	STRONGLY AGREE
15. LAN users tend to think of their privacy rather than corporate security.	( )	( )	( )	( )	( )
16. LAN users tend to use simple passwords that are easy to ''crack''.	( )	( )	( )	( )	( )
17. There is no defence against a disgruntled worker out to compromise system security.	( )	( )	( )	( )	( )
18. Few companies have a comprehensive security policy.	( )	( )	( )	( )	( )
19. Most organization are never prepared for the impact a LAN has on people within an organization.	( )	( )	( )	( )	( )
20. Introduction of a LAN has a subtle implication on the organization structure with great potential for disruptive change.	( )	( )	( )	( )	( )
21. LANs can perform most of the coordinating and control job performed by middle managers,leading to removal of a whole tier of middle management.	( )	( )	( )	( )	( )
22. LANs can reduce the quality of working life of people through deskilling.	( )	( )	( )	( )	( )
23. LAN implementation is unavoidably mixed up with organization politics.	( )	( )	( )	( )	( )
24. A LAN will have persistent long term effect on satisfaction and performance of employees.	( )	( )	( )	( )	( )
25. In general increased control as a result of a LAN will be resisted.	( )	( )	( )	( )	( )
26. Implementing a LAN is a part selling, part technical operation.	( )	( )	( )	( )	( )
27. Use of a project champion (a visionary leader and politician) in implementing a LAN is required if the effort is to be successful.	( )	( )	( )	( )	( )
28. Many LANs are under utilized.	( )	( )	( )	( )	( )
29. LANs in many cases are over-designed, a much simpler					

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE OR DISAGREE	AGREE	STRONGLY AGREE
(and cheaper) solution would have sufficed.	( )	( )	( )	( )	( )
30. There is a tendency to look at implementation process from a narrow perspective where acquisition and installations aspects are given priority.	( )	( )	( )	( )	( )
31. There is a tendency for management to over rely on IT professionals as far as LAN planning is concerned.	( )	( )	( )	( )	( )
32. LAN planning in many cases has failed to estimate what can be achieved, the time required and the costs involved.	( )	( )	( )	( )	( )
33. Vendors in many cases do not tell about hidden costs of installing LANs.	( )	( )	( )	( )	( )
34. There is a general lack of communication between top Management and IT professionals.	( )	( )	( )	( )	( )
35. LAN technology is still evolving; what you install today may be obsolete in a few years time.	( )	( )	( )	( )	( )
36. A policy of sourcing all your LAN products from one vendor is a poor and even dangerous strategy.	( )	( )	( )	( )	( )
37. It is difficult to obtain independent advice on LANs due to limited experience of many vendors and Consultants.	( )	( )	( )	( )	( )
38. Suppliers are always bound to exaggerate the capabilities of their equipment.	( )	( )	( )	( )	( )
39. The really difficult issues is networking will continue to be hidden in advertising hyperbole.	( )	( )	( )	( )	( )
40. Immaturity and unreliability of the LAN environment makes adoption of LANs difficult.	( )	( )	( )	( )	( )
41. Visualizing the final design of a LAN is difficult given the many differing needs it has to serve.	( )	( )	( )	( )	( )
42. Traditional financial appraisal techniques e.g NPV, IRR are inadequate in measuring the worth of a LAN.	( )	( )	( )	( )	( )
43. Incompatibility of computer systems is the biggest obstacle to implementing corporate wide communication.	( )	( )	( )	( )	( )

	STRONGLY DISAGREE	DISAGREE	NEITHER AGREE OR DISAGREE	AGREE	STRONGL AGREE
44. The LAN world is rife with inconsistent technology.	( )	( )	( )	( )	( )
45. Connecting high quality equipment and low quality equipment complicates the LAN as its difficult to know how inaccuracies in design are accentuated through the system.	( )	( )	( )	( )	( )
46. Optimization of a LAN is difficult and even an optimal solution may not last for long.	( )	( )	( )	( )	( )
47. Many vendors lack manpower skilled in LAN technology	( )	( )	( )	( )	( )

Any additional comments .....

APPENDIX 2

UNIVERSITY OF NAIROBI
FACULTY OF COMMERCE
DEPARTMENT OF MANAGEMENT SCIENCE

elephone: 732160 Ext. 205
elegrams: "Varsity" Nairobi

P.O. Box 30197
Nairobi, Kenya

Dear Sir/Madam,

RE: Survey of LAN Characteristics in Nairobi

I am a post graduate student at the Faculty of commerce, University of Nairobi. I am currently conducting a background survey for my project. The project will aim to investigate challenges Management face when implementing Microcomputer based Local Area Networks (PC-LANs).

I will first establish the location and basic characteristics of LANs in Nairobi. This will help in justifying my research and also in selecting a subsequent sampling procedure for the research.

As a vendor (or consultant) and having implemented LANs, I would be most grateful if you can spare some time to provide me with details regarding these (see attached form).

The information provided will be treated in strict confidence and will not be used for any purposes other than for my research.

Your assistance is greatly appreciated.

Yours sincerely

GATUNE, JULIUS
MBA II

VENDOR:_____

KEY: D-Dedicated; N- Nondedicated; P/svr- Print server
P-Proprietary ; NP- Nonproprietary ; Y-Yes ; N-No

SITE	TOPOLOGY	TRANSMISSION CHARACTERISTICS				NODES		SERVER		TYPE (P/N) IF P NAME	Stds. (IEEE)
		Media	System	Speed bps	Dist. (Max)	No.	PCs No.	D/N	P/Svr Y/N		

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