The Local Area Network (LAN) Implementation Project Life Cycle Model presented in this paper integrates various checklists of LAN specific implementation considerations with the critical success factors (CSFs) associated with the various stages of the project life cycle. This model addresses the sequence and the timing of various implementation tasks based on the project CSFs over the various implementation life cycle stages. This model provides a superior model for practitioners to implement their local area networks, as it provides focus in addressing the factors critical for success. This model also provides a superior basis for approaching research work in comparison with the current checklists, as it highlights the tasks associated with the CSFs over each phase of the LAN implementation project life cycle.

The implementation of Local Area Networks (LANs) are expected to require the allocation of significant and increasing amounts of U.S. business resources in the next few years. Models for implementing LANs are currently little more than checklists of reminders, and do not properly address the sequence of implementation or the relative importance of the factors critical for implementation success over the implementation life cycle. Many authors (Brandt, 1989; Gallegos, 1987; Fireworker & Stewart, 1988; Mirsa & Belistos, 1987) have been written articles concerning the factors needed to achieve a successful LAN implementation.

This paper organizes the issues highlighted in several of these LAN specific checklists, and combines these issues with existing research-backed theory concerning critical success factors (CSFs) related to project implementation over the various stages of the project life cycle. This work results in the LAN Implementation Project Life Cycle Model. This model is justified because of the size of the expenditures expected for LANs over the next few years, the potential for organizational change associated with LANs, the high probability that personnel in charge of LAN implementation and maintenance may have minimal skill in dealing with the interpersonal and organizational aspects of this emerging technology, and because a consolidated perspective on LAN implementation would provide a stepping stone for further research. No original research will be done, as this paper will rely
upon and consolidate research previously performed relating to this topic.

Local area networks have recently come into wide popularity. As of June of 1989, approximately 6,015,000 (15% of 40.1 million) personal computers in U.S. businesses were connected by some form of network, and by 1992, approximately 28,247,000 (47% of 60.1 million) of the U.S. business personal computers will be included in networks (Brandt, June 5, 1989). “Worldwide sales of network hardware and software jumped 85% in 1988, to $4.8 billion, according to market researcher Dataquest Inc.” (Brandt, June 5, 1989). See Figure 1. The large increase in connectivity will require the expenditure of many billions of dollars in the next few years.

Implementation of a LAN is often the responsibility of the technical personnel responsible for the business’s micro computers. Laudon (1988, p. 615) contends that technical personnel may not have the ability to successfully handle the organizational and interpersonal aspects of the implementation process. The organizational needs of the users must be the driving force behind the LAN project, not the technical aspects of the technology. Thus, communication on a LAN can alter the message routing, summarization, delay, and modification process of the organization’s information system which can have significant changes on the organization’s tasks, structure, people, and culture. The technically-oriented individuals responsible for micro computers and LANs probably do not have the experience or training to deal with all of the sweeping changes which can be created by the implementation of a LAN.

**Local Area Networks**

**LANs in the Telecommunications System**

“A Local Area Network (LAN) offers reliable, high speed communications channels for connecting information processing equipment in a limited graphic area” (Fireworker & Stewart, 1988, p. 36). Jacobsen (1990) indicates that in the near future, a Local Area Network will define a logical work group entity, even if the work group is geographically disbursted. Interoperability through naming and directory services, transparent navigation and devices which work together will facilitate logical work group connections (Jacobsen, 1990). LANs are becoming an integral part of an organization’s overall telecommunications infrastructure. LANs enable the organization to create synergies by allowing lower level employees greater access to information and greater coordination of their activities, as well as increased access to and communication with the six levels of the organization.

**LAN Design Considerations**

When designing the LAN, the organization must consider how the LAN fits into its overall telecommunications network, and how the overall telecommunications network fits into the six (6) main levels of an organization. Starting at the top of the organization, these six levels are:

1. Corporate headquarters;
2. Divisions, regions, or countries;
3. Sites;
4. Departments;
5. Work groups;

Sprague and McNurlin (1986) propose three guidelines for the design of an organization’s telecommunications network:

1. [Telecommunication] Networks should
be developed to serve all six levels of an organization, from the corporate office to individual employees.

2. [Telecommunication] Networks should be integrated so that they can serve a multitude of applications, instead of being dedicated to only one type of application.

3. [Telecommunication] Networks should be open, so that hardware and software from many suppliers can be attached. (p. 139)

Sprague and McNurlin (1986) conclude that “baseband nets and PABX technologies are likely to coexist at most larger organizations; they might even coexist with a broadband trunk network as well” (p. 158). “The best approach may be to continue to develop several of the options and seek ways to integrate them” (Sprague, 1986, p. 157). Stallings (1990) agrees with this approach when he states, “The network or communications manager must develop a strategy that selects the mix of networks that meets internal requirements at the lowest cost and is flexible enough to permit future growth” (p. 418). To emphasize this point, the LAN manager must match the telecommunications requirements which result from the organization’s tasks, structure, people, and culture with the appropriate technologies. LAN technology is an integral part of the overall telecommunications system. Stallings (1990) advises that the LAN should conform to industry standards.

What Can A LAN Do?

Schultheis and Sumner (1989) point out that in the past, reasons to create a LAN included the sharing of expensive peripherals, sharing data files and expensive programs, and electronic mail. Unlike the implementation of a stand-alone personal computer, a LAN can change the organizational structure as well as the nature of the work itself. By the very nature of a LAN, access to more information is granted to more individuals. Contact between individuals increases and can alter the company’s traditional structure and culture. E-mail is an efficient and direct method of contact between top management and all other levels of management.

According to Fireworker and Stewart (1988), he functions of a LAN include:

• Supporting a variety of computers from different manufacturers
• Coordinating the operations of departments on more than one floor or building
• Creating a centralized database with the capacity for bulk data transfer to reduce or eliminate redundancies
• Providing high-speed data communications and transmissions with few errors or failures
• Sharing peripheral resources including printers, message centers and modems
• Establishing each portion of the network as an independent entity so that in the event of a failure, the entire network is not effected
• Using electronic mail to replace a major portion of paper flow. (p. 36)

Considerations for LAN Implementation Success

Several important considerations have been identified in the literature with regard to planning for and controlling micro computers and LAN’s. These factors include top management involvement, a centralized approach, user training, political considerations, control considerations (e.g. sabotage, data entry fraud, and system fraud), data security and data integrity, efficiency of use (cost, reliability, and auditability), an overall corporate policy regarding micro computers, physical controls, backup and recovery, documentation, and control over the information center data (Gallegos, 1987, p. 375-392). The items on this check list of things to remember vary in importance over the various stages of the implementation life cycle, and will be organized into the LAN Implementation Project Life Cycle Model to be discussed later.

Defining a “Successful” LAN Implementation

Before the factors which are most critical to achieving implementation success can be defined,
the concept of what constitutes a successful implementation project (the desired goals) must be defined. An information system failure occurs when “... it [the information system] is not used the way it was intended or is not used at all. Users may have to develop parallel manual systems to obtain the information they need or devise manual procedures to make the system work properly” (Laudon, 1988, p. 604). If information system failure occurs when the system is not used the way it was intended, then information system success could be defined as occurring when the system is used in the way it was intended. But this definition is limited as its vagueness makes it hard to measure.

MIS researchers consider the most important measures of information system success or failure to be:

1) High levels of system use;
2) High user satisfaction;
3) Favorable attitudes of users about information systems and the information systems staff;
4) Achieved objectives (the extent to which the system meets its specified goals, as reflected by the quality of decision making resulting from use of the system); and
5) Financial payoff to the organization, either by reducing costs or by increasing sales or profits. (Laudon, 1988, p. 609)

Critical Success Factors

Literature Review of Critical Success Factor Theory

It should be noted that CSFs are not ends in and of themselves. “Goals represent the end points that an organization hopes to reach. Critical success factors, however, are the areas in which good performance is necessary to ensure attainment of those goals” (Rockart, 1979).

According to Rockart (1979, p. 86), CSFs are variable over time and between organizations, industries, and geographic areas depending on the present environmental situation. Later work by Rockart asserted that CSFs could be used as a general planning tool for guiding information technology (IT) development efforts (Boynton, 1984, p. 17). “Munro and Wheeler suggest that CSFs can be used to direct an organization’s efforts in developing strategic plans. In addition to applying CSFs to fabricate a set of strategies, they can also be used to identify critical issues associated with implementing a plan” (Boynton, 1984, p. 18). Thus, CSFs have evolved from a general organizational planning tool to an implementation tool, and has been accepted also as a tool applicable to MIS: “It is evident that CSFs can be used for both MIS planning and requirements analysis” (Boynton, 1984, p. 19). According to Boynton, the implementation of a LAN would fall under the category of information function planning, and the use of CSFs as a planning tool for LAN implementation is appropriate (Boynton, 1984, p. 19).

“Three levels of planning arise within both the information resource and information function contexts: operational planning, strategic planning, and policy planning” (Boynton, 1984, p. 19). The operational planning level is appropriate for the LAN implementation project, as it is a specific computer-based information system. The strategic and policy planning should be integrated with the operational planning to provide a cohesive information system which is based upon meeting the organization’s strategic interests and is compatible with the tasks, structure, people, and culture of the organization.

“Because rather concrete thought processes are required to arrive at a detailed specification of information requirements, the CSF method might not, by itself, be an effective requirements analysis tool” (Boynton, 1984, p. 21). To overcome this problem, the project life cycle approach to CSFs will be integrated with a summary of the various LAN checklists to create an integrated implementation model.

The Project Life Cycle Approach to CSFs

There are various stages in a project’s life cycle. Research by Pinto and Prescott (1984) dealing with variations in critical success factors for projects over the various stages in the project life
cycle appears to be valid for the implementation of LAN’s. See Figure 2. Note that the number of critical success factors for any given life cycle stage is between two (2) and five (5), which is reasonable. Each stage of the life cycle presents unique priority problems, and thus the CSFs will vary over the various stages.

In addition to these factors, Monitoring and feedback and Communication are also considered by Pinto and Prescott to be keys to project success and are ingredients in many of the CSFs listed in Figure 2. Monitoring and feedback and Communication were found to have a high degree of multicollinearity with other factors, and thus were not given specific places in the life cycle stages. Technical competence with the technology by the project team members is a given (Pinto, 1988), which may not be a reasonable assumption with regard to managing the impact of the LAN implementation on the tasks, structure, people, and culture of the organization by technically-oriented personnel. The Pinto and Prescott model (Figure 2) will be used as the basis of the LAN implementation model.

Each LAN implementation life cycle stage is composed of several critical success factors, and each critical success factor is composed of various detailed tasks whose completion is necessary for the completion of the critical success factor. Completion of the several critical success factors is necessary for the successful completion of the implementation life cycle stage. See Figure 3 for a graphical depiction of the LAN Implementation Model. Failure to successfully complete any detailed task threatens the successful completion of the CSF, depending on the relative importance of each detailed task to the critical success factor.

See Figure 4 for a summary of the checklists for LAN implementation success from Fireworker and Stewart (1988), Gallegos (1987), and Mirsa and Belistos (1987).

### LAN Implementation Project Life Cycle Model

#### Conceptualization Phase

Pinto and Prescott (1988) identify the project mission and client consultation as being the critical success factors applicable during the conceptualization phase. The project mission is a critical success factor across all phases of the project’s life cycle. Pinto and Prescott (1988) define project mission as the “initial clarity of goals and general directions” (p. 7).

A LAN project mission statement should be created which outlines the objectives of the LAN and denotes that success will be measured by high levels of LAN use, high user satisfaction with the LAN, favorable attitudes of users about the LAN and the LAN project implementation staff, achievement of the objectives outlined and the extent to which the quality of decision making improves as a result of using the LAN, and the financial payoff to...
the organization (Laudon, 1988, p. 609). The mission statement should be constructed within the context of the overall organizational policy and corporate strategy.

“The main risk of increased access to information resources ... is that information access will be extended first and control added as an afterthought, if at all” (Gallegos, 1987. p. 371). Thus, it is critical that the LAN mission statement include control considerations (sabotage, data entry fraud, and system fraud), data security and data integrity, efficiency of use (cost, reliability, and auditability), physical controls, backup and recovery, documentation, and control over the information center data as being general prerequisite parameters which must be fully satisfied.

Pinto and Prescott (1988) define client consultation as “communication, consultation, and action listening to all impacted parties” (p. 7). The LAN project staff must recognize political considerations and sensitivities of the organization’s tasks, structure, people, and culture to the changes that a LAN could bring about.

“[User] Involvement is consistently defined as a subjective psychological state, reflecting the importance and personal relevance of an object or event” (Barki, 1989, p. 61). The LAN implementation team should strive to create an information system and an organizational change that is important and personally relevant to the intended users in a positive, synergistic way. Baronas and Louis (1988) provide several suggestions for increasing user involvement thus increasing user acceptance:

System developers and implementors should make an effort to (1) give users a complete and accurate picture in advance of their likely experiences during and after implementation - make it predictable; (2) find areas in which users can make meaningful decisions throughout the process - provide choice; (3) get users to “sign up,” to be accountable for results on tasks necessary to the implementation effort - engender a sense of responsibility. Together, success in facilitating users’ experiences of predictability, choice, and responsibility during CBIS [computer-based information systems] implementation should be associated with a heightened sense of personal control, which is naturally threatened during system implementation. (p. 121)

**Planning Phase**

The LAN project mission, top management support, and client acceptance are the critical success factors for the planning phase. The project
## Conceptualization Stage

- **Organizational Policy**
  - Centralized corporate microcomputer policy (budgets, users, and overall direction of goals).

- **Project Mission**
  - Security and control of the LAN (e.g. access controls to prevent sabotage, fraud, and unauthorized use).
  - Security, integrity, and reliability of data.
  - Control over data.
  - Physical controls.
  - Backup and recovery.
  - Efficiency of use (cost, reliability, auditability, and system maintenance).
  - Documentation.

- **Client Consultation**
  - Political Considerations.

### Planning Stage

- **Project Mission**
  - (See Above)

- **Top Management Support**
  - Top management involvement and commitment to the project.

### Execution Stage

- **Project Mission**
  - (See Above)

- **Trouble Shooting**
  - (Not Specifically Mentioned)

- **Schedule/Plan**
  - (Not Specifically Mentioned)

- **Technical Tasks**
  - Determine the current and future network software and hardware requirements (e.g. quantity and type of personal computers, printers, storage media, modems, and gateways) to support the desired applications (e.g. electronic mail, file sharing, etc.)
  - Current and future transmission types and throughput levels.
  - Current and future geographic distribution (number of sites and distances).
  - Evaluate any special data requirements.
  - Design systems for network administration, control, and security.
  - Estimate node and total costs.
  - Prepare specifications for vendor quotation.
  - Evaluate vendor support (hardware, software, maintenance, and training).
  - Verify performance claims/track record.
  - Evaluate vendor responses, negotiate, and place an order.
  - Outline, purchase and install cable runs.
  - Design and program the network server.
  - Install the network.
  - Client Consultation (Not Specifically Mentioned)

### Termination Stage

- **Technical Tasks**
  - (See Above)

- **Project Mission**
  - (See Above)

- **Client Consultation**
  - (See Above)

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**Figure 4: Summary of Local Area Network Checklists for Success**
mission should be revised to reflect an updated version of the goals and general direction. The goals may change as the project proceeds. Careful consideration and top management approval should be given to any changes to the mission statement.

Pinto and Prescott (1988) define top management support as the “willingness of top management to provide the necessary resources and authority/power for project success” (p. 7). The implementation team must “… gather support from the key players in the organization, particularly those who will be affected by the change. Start with those people who would be most supportive and who have the most influence; they can be used to persuade others. Present the plan, discuss it, and alter it to fit the needs of the key players” (Johnson, 1986, p. 48).

Client (user) acceptance is defined as “the act of ‘selling’ the final project to its ultimate intended users” (Pinto, 1988, p. 7). This can be accomplished best if the implementation team can define the needs of the users and key decision makers and how the LAN will affect those needs. The LAN must fulfill the user’s perception of their needs for the system to be successful.

Execution

The LAN project mission, trouble shooting, project schedule/plan, technical tasks, and client consultation are identified as the critical success factors for the execution phase. The project mission will need to be reviewed and clarified to ensure that the project’s team members continue to have relevant goals to shoot for.

Trouble shooting is defined as the “ability to handle unexpected crises and deviations from plan” (Pinto, 1988, p. 7). Considerable thought should be put into analyzing what could go wrong. Contingency plans should be developed for the most likely and riskiest deviations. Monitoring and feedback of the project progress and communication are important factors in effective trouble shooting.

The project schedule/plan is defined as “a detailed specification of the individual action steps required for project implementation” (Pinto, 1988, p. 7). Formal planning tools such as PERT and CPM are used to define the tasks and develop the project schedule/plan, and formal control tools such as variance analysis will enable the implementation team to identify their progress and spot deviations from the plan (Laudon, 1988, p. 614-623).

Technical tasks are defined as the “availability of the required technology and expertise to accomplish the specific technical action steps” (Pinto, 1988, p. 7). Per Misra and Belitsos (1987), some common LAN requirements include:

1) What kinds of applications (i.e. electronic mail, file sharing, and so on) will be needed?
2) What types of transmission and what level of effective throughput are required now and in the future?
3) How many sites must the LAN support? Over what distances must devices be interconnected in the LAN?
4) Are there any special data requirements, such as bursty traffic or the need for deterministic transmission times?
5) What are the number and types of computing devices, printers, storage devices, modems, and interconnection schemes (gateways) existing or needed now? In the future?
6) What types of network administration, control, and security do the users and managers need?
7) What is the cost per connection, or total cost, that the LAN can be? (p. 153)

According to Mirsa and Belitsos (1987), the most important vendor qualities to consider are:

1) Quality of user training and documentation.
2) Quality of software, hardware, and maintenance support.
3) Verification of performance claim/track record. (p. 153-154)

A network administrator needs to be trained to handle the ongoing maintenance and supervision
of the LAN. The users need to be trained in the use of the LAN. The training process would appear to fit in well toward the end of the execution phase or the beginning of the termination phase. Note, however that client (user) consultation involves much more than just training the users. If the organization lacks the personnel to adequately handle the technical tasks, then it would be wise to hire a consultant who is experienced in LAN implementations to perform the work.

Client (user) consultation, defined as “communication, consultation and action listening to all impacted parties,” (Pinto, 1988, p. 7) is another critical success factor in the execution phase. Adjustments to the ever-changing user perceptions concerning what they believe they need from the LAN is vital for a successful implementation. Continuous consultation with the users throughout the project is critical to ensuring that the user’s needs will be met, that no big surprises occur, and that the user becomes highly involved in the change process.

**Project Termination Phase**

Technical tasks, project mission, and client consultation are critical success factors during the termination phase. Johnson and Fredian (1986) refer to this phase as the consolidation phase, and suggest the following methods for terminating the project:

- Hold a celebration or kick-off dinner.
- Mete out plenty of rewards and recognition to those who assisted or cooperated in the change.
- Let the transition team become an implementation team.
- Make a formal evaluation of the change. Did it accomplish what it was supposed to accomplish? What couldn’t be accomplished and why? You might write a brief evaluation report, distributed to the key people.
- Hold a debriefing session with the transition team.
- The team should end the project with a celebration of its own. (p. 49)

Once control over the system has been transferred to the user transition team, the new team should continuously monitor and maintain the LAN (Fireworker & Stewart, 1988).

Note that the project mission is a critical success factor over all phases of the project, and client consultation also spans most of the project life cycles. These two critical success factors appear to be somewhat interrelated, as the project mission cannot be accurately developed until the users are consulted as to what they really need.

**Benefits of the LAN Implementation Project Life Cycle Model**

The LAN implementation project life cycle model organizes the check list of items to consider in a LAN implementation by the stages in the life cycle in which they are most critical for success of the project. It draws upon project life cycle theory supported by previous research, and combines this with the particular details necessary for a successful LAN implementation. By dividing the tasks by life cycle stage, it enables the practitioner to identify and focus upon the critical tasks to be performed at each point during the implementation project. It is important to note that technical tasks (which have been the primary emphasis of authors in the past) are important, but are only one of many critical success factors. The project mission and client (user) consultation are critical throughout the entire project, and have typically been glanced over by previous writers.

**Final Comments and Conclusions**

**Areas requiring further research and study**

Research is needed to determine the extent to which users and LAN implementation teams are able to interface and work together. This model assumes that the implementation team is able to fully explain the capabilities and limitations of the LAN system to the clients (users), that the users are able to fully understand and explain their information connectivity needs to the implementation team, and that the implementation team can transform the task and business approach of the users.
into the proper technical specifications and organizational structural changes.

A significant question is whether the traditional difference in orientation between the users and the implementation staff can be overcome by both parties to create a positive organizational change. This question relates to the topic of user involvement and user resistance to the change process.

Conclusion

Local Area Networks will continue to consume significant and increasing amounts of U.S. business resources. Billions of dollars will be spent by U.S. businesses on connecting their microcomputers via Local Area Networks in the next few years. Many of these implementations will fail because the implementation teams neglect to focus their energies on the factors critical for success over the various stages of the LAN implementation project. Models for implementing LANs are currently little more than checklists of reminders, and do not properly address the sequence or the relative importance of the critical success factors. The LAN Implementation Project Life Cycle Model presented in this paper integrates the checklists of LAN specific considerations with the critical success factors associated with the various stages of the project life cycle. This model provides a superior model for practitioners to implement their local area networks, as it addresses the project factors critical for success while at the same time providing the detail necessary to facilitate the execution of the critical tasks.

This model has the potential to save organizations vast sums of money over the next few years. This savings will come in the form of more efficient implementations by the project team and greater usage and synergies obtained by the users resulting from the proper focus on the critical success factors in the model.

This model also provides a superior basis for research work, as it highlights the critical success factors over each phase of the project implementation life cycle. Additional research work on the subject can focus on the particular LAN implementation life cycle stage and the critical success factors of interest. Empirical testing of this model with the purpose of scrutinizing the model to determine the extent of its validity is a suggested area for future research.

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