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APPROACHING DEVELOPMENT IN LOGISTIC INFORMATION SYSTEMS

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SYNOPSIS

The introduction of technology into modern defence necessitates integrated computerized information systems to render effective and efficient logistic support. Traditional information system development does not ensure attainment of use and time scale requirements in the continuously developing environment of logistics. This paper describes current approaches to the development of logistic information systems.

1. INTRODUCTION

The objective with this paper is to describe current approaches being applied in the development of logistic information systems.

Logistics is seen as the collection of activities required for the acquisition provisioning, distribution and maintenance of materiel, facilities and services and the movement of materiel and personnel in support of actions by military forces. Although principles contained in this paper are equally applicable in commercial and industrial ventures, above definition delineates the subject scope of this paper.

The introduction of technology as a cardinal element in modern defence necessitates integrated computerized information systems to render effective and efficient logistic support. The approaches described in this paper stems from the experience that traditional information system development approaches does not ensure attainment of use and time scale requirements. These approaches are currently being applied in a major logistics information systems development program.

The paper assumes a working knowledge of logistics and is structured to cover the following :

- o Overview description of the logistics environment and the "logistic information system"
- o Approaches to design and development.
- o Approaches to management of the design and development process.

2. LOGISTIC ENVIRONMENT

This section contains an overview description of the "logistics environment" as a reference to the reader.

2.1 OBJECT DEFINITION

Objects are defined as the actual weapon and operational support systems. Logistics ensure continued availability and/or readiness of these systems. Typical examples are Aircraft Systems, Ground Weapon Systems, Airspace Control Systems, Air Defence Systems and Communication Systems.

2.2 LIFE CYCLE SCENARIO

Weapon systems defined as "objects", typically "exists" through the total life cycle pattern :

- o Need identification and evaluation of options.
- o Requirement definition and development of the weapon system to satisfy the need.
- o Production, introduction into service and fielding of the object system.
- o Operation and in-service upgrades.
- o Phase-out.

It is obvious that the objectives of activities and organizations involved change considerably as the object progresses from phase to phase. Figure 1 illustrates this for the "User" and "Developer" organizations.

Figure 1 : Objectives and Activities During Object Life Cycle

Life Cycle Phase	User Activities/Objectives	Developer Activities/Objectives
1. Need Identification and options evaluation	Identify/Define/Optimize Need and User Implications	Identify/Define Options
2. Requirement Definition and Development	Define requirement and prepare user/use interface	Develop
3. Production Introduction and Fielding	Introduce into Service and Field	Produce
4. Operation	Use and Support	Upgrades and Product Support
5. Phase-out	Phase-out	Phase-out

2.3 LOGISTIC PROCESSES AND FUNCTIONS

The prime objective of logistics as a function in modern warfare, is to ensure weapon system availability and/or readiness, suited to the threat at any point in time. To attain this objective, logistics comprise the continuous execution of the following major processes and/or functions:

a. **Logistic Management**, providing the required strategy, policies and objectives.

b. **Logistic Operations Control** to manage the supply of logistic support in the operations of the organization and supply of logistic support during operations.

c. **Acquisition and Phase-out** of new weapon systems.

d. **Maintenance** of weapon systems.

e. **Materiel Requirements Planning and Procurement** to ensure purchasing/procurement of materiel requirements.

f. **Inventory Control and Distribution** to ensure materiel availability when and where required.

g. **Weapon System Improvement** to ensure continued correction/enhancement of weapon system performance and support.

h. **Logistic Services** to ensure supply of "general" logistic services such as fire-fighting and facility construction.

2.4 ORGANIZATIONAL STRUCTURE

The "total" logistic organizational structure contains three inherently different types of organizational entities:

- **Operational Entities** such as Area Commands and Operational Bases.
- **Logistic Support Entities** such as Repair and Stores Depots as well as Industrial Maintenance Facilities and Vendors.
- **Acquisition Entities** such as System Houses, Main Contractors, Sub-contractors and Vendors.

3. LOGISTIC INFORMATION SYSTEMS

This part contains an overview description of the major logistic information systems (application systems) required to support execution of the logistic activities.

3.1 SYSTEMS IDENTIFICATION

Systems are identified in the following major categories:

a. **Acquisition Systems** to support management and execution activities during acquisition of new weapon systems.

b. **Management Systems** to support strategic and management level planning and control activities.

c. **Maintenance Systems** to support weapon system maintenance activities.

d. **Materiel Systems** to support procurement, control and distribution of materiel.

e. **Engineering Systems** to support in-service engineering activities.

f. **Logistic Service Systems** to support logistic service activities.

g. **Operations Support Systems** to support activities ensuring support during operations.

3.2 OPERATING CONCEPT

Figure 2 contains a simplified illustration of the functional operation of the system groups identified above. The primary operating cycles illustrated, are the following:

a. **Planning Cycle.** Interpretation of corporate goals and strategy with reference to actual performance, expenditure and new weapon systems requirements into logistic guidelines, goals and budgets.

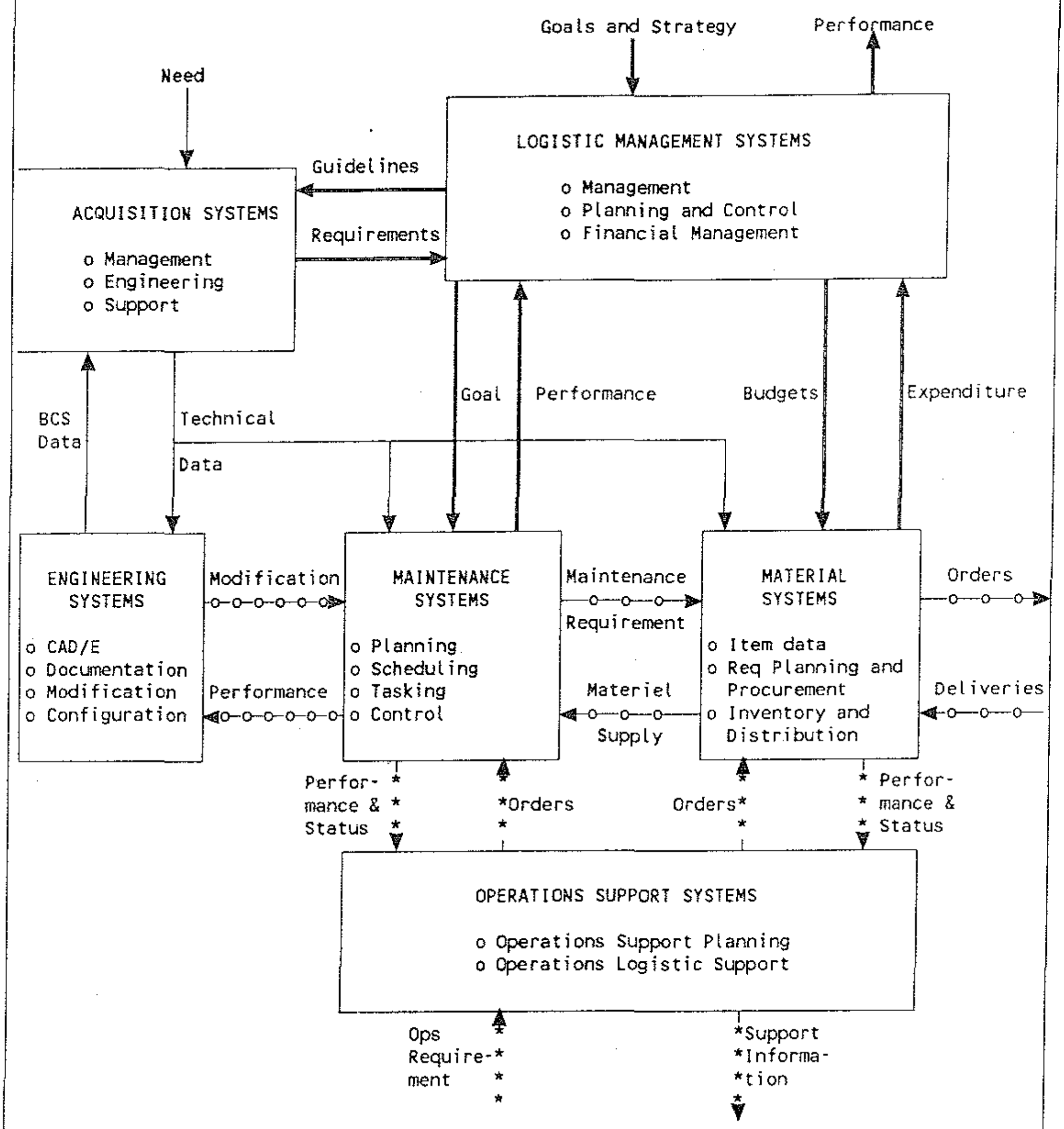
b. **Acquisition and Phase-out Cycle.** Develop and supply of new weapon systems to satisfy the stated need with cognisance of baseline comparative systems data. The information systems will supply cardinal technical data to the use phase information systems. At the phase-out stage, data will be removed in parallel to system removal.

c. **Operating Cycle.** During weapon system operation, maintenance will supply planned requirements to the materiel systems to procure and distribute materiel according to requirements.

d. **Improvement Cycle.** During operation, performance will continuously be evaluated and modifications to the weapon system will be implemented.

e. **Operations Cycle.** In preparation for and during actual operations, actual requirements will be satisfied through priority orders within performance and status envelopes.

Figure 2 : Logistic Systems Functional Operation



Key to operating cycles:

- Planning cycle
- Acquisition cycle
- Operating cycle
- Improvement cycle
- Operations cycle

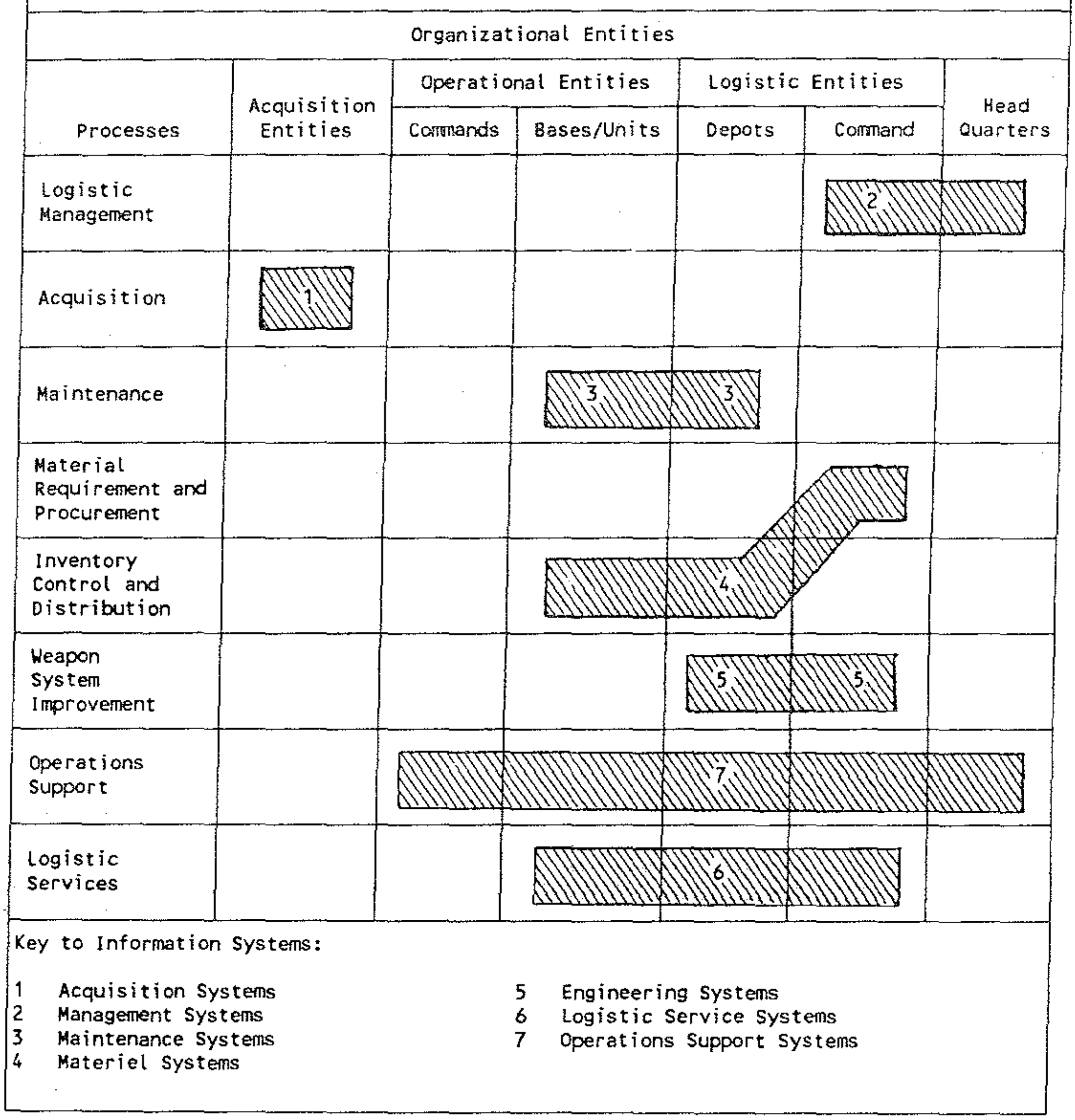
Key to abbreviations:

BCS = Baseline Comparative Systems
Ops = Operations
CAD/E = Computer Aided Design/Engineering
Req = Requirements

3.3 SYSTEMS IMPLEMENTATION

The implementation of logistic information systems into the "logistic organization" is primarily dependent on the role of each of the organizational entities in the execution of the logistic processes. Figure 3 contains a summarized system implementation matrix.

Figure 3 : Information Systems Implementation



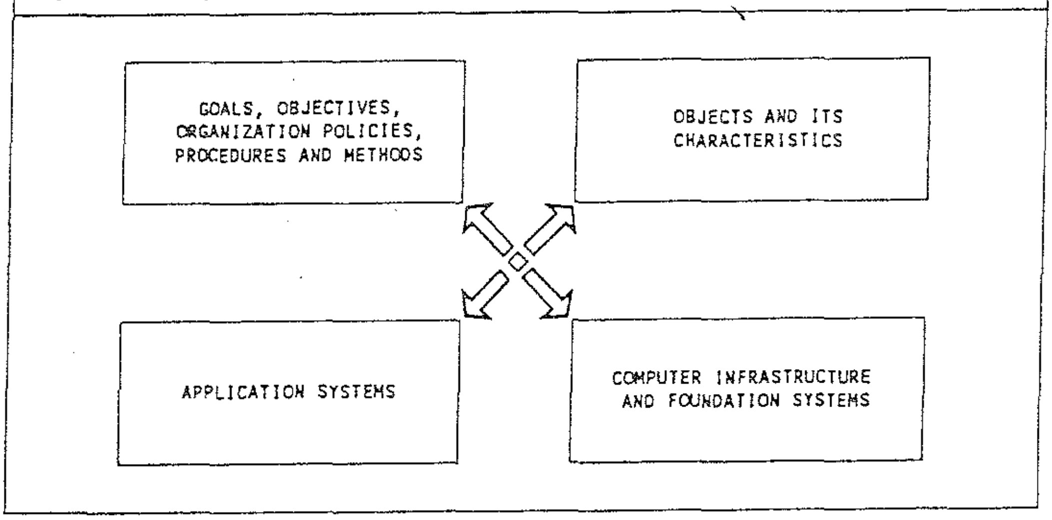
4. DESIGN APPROACHES

This part defines the major current approaches applied in the design of the logistic information systems. The description covers the principles of integrated function allocation and multi-dimentionality, the overall design process as well as specific problems in the process.

4.1 DESIGN VARIABLES

In the design of logistic information systems, it is fundamentally important to properly consider all design variables. True optimization can only be approached if "environmental" elements like organization, technology and functionality can be changed or re-designed at the same time. Figure 4 depicts a summary total system view. An example of this is new computer technologies such as graphics or distributed processing that will require changed application systems and can only effectively be utilized if use and user changes can also be effected.

Figure 4 : Design Variables in a Total System Approach



4.2 MULTI-DIMENTIONALITY

Expansion of the "total" design fundamental, outlined above, leads to the principle to approach the design with cognisance of the multi-dimentionality of the logistic system. Typical major dimensions are the following:

a. **Goal and objectives structures** as well as the functions to attain the goals and objectives.

b. **Processes** that can be decomposed into tasks or functions, necessary to attain the goals.

c. **Objects** "moved" through its life cycles by the actions inherent in the tasks or functions.

d. **Functional concepts** such as technology centralization or dispersion.

e. **Logistic Functionality** as Logistics is actually a concept or approach that co-ordinate a variety of

4.4 DESIGN PROBLEMS

The most difficult problem is probably to design with cognisance of existing information systems and the changeover or growth path to get to the "ideal" system.

Determination of "real" requirements is made very difficult by the fact that the "science" of logistics is only maturing at this stage and is being influenced by changes in computer and software technology. The "concurrent" growth design logic is probably the cardinal approach to this problem.

Design change management in a "concurrent" approach demands much more from available design "tools". Careful choice of design "tools" is cardinal if the expected development in this area is taken into consideration.

Utilization of new approaches and technologies such as on-line computerized procedures and regulations, help functions and training, implies vast changes to current thinking and organizational roles and normally cause an equivalent resistance.

5. DEVELOPMENT APPROACHES

This part defines the major current approaches applied in the logistic information systems development process. The description covers the fundamentals of parallel development, prototyping, technology interfacing, development strategy and test and integration.

5.1 PARALLEL DEVELOPMENT

The parallel development approach is inherently linked to the concurrent design principle. As the realization cycle of traditional serial development processes exceeds the change cycles in requirements and technology, it is essential to implement and maintain a development approach that shortens the development cycle drastically. In the extreme, this can imply that requirement, definition, design, development and implementation work can be executed within the same time frame to allow an incremental but rapid results profile as illustrated in Figure 6. Due to the control risk inherent in this approach, the following strategies are proposed :

- o Close integration of requirement definition and design and development functions.

inherently different disciplines.

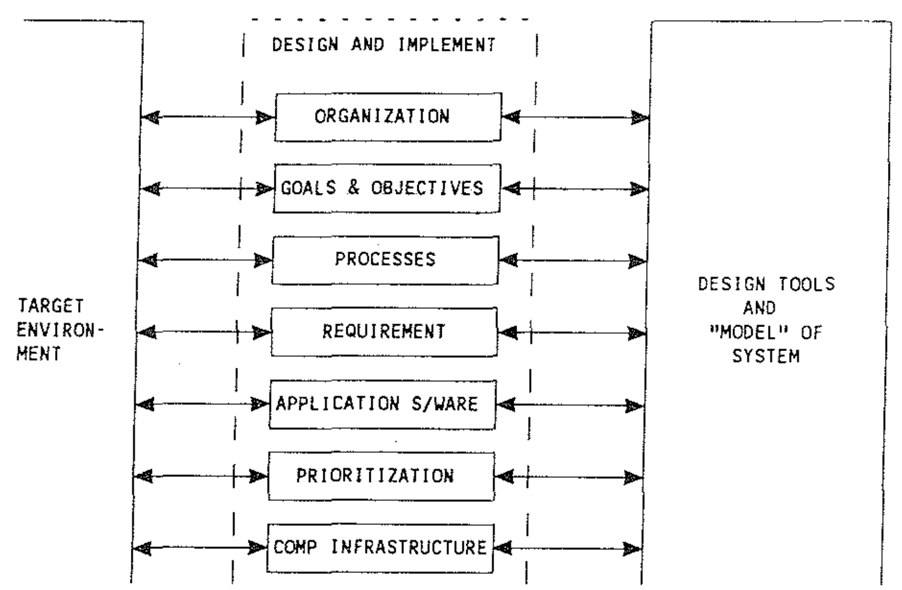
f. **Technological (computer) Characteristics** especially in terms of its interfaces with its application environment.

g. **Application System (software)** characteristics and the functionality thereof.

4.3 DESIGN LOGIC

It is fundamental to break away from the serial concept of design. The traditional concept of design as a serial logic should be replaced by a "concurrent" concept. A simplified example of this concept is a situation where packaged software is bought in and modified over time to suit requirements as opposed to a full requirement definition, functional analysis, design, etc. approach. It is obvious that this design approach relies heavily on design "tools", implementation software and design support functions such as quality assurance and configuration management. Figure 5 illustrates the "concurrent" design logic by summarizing the design process elements into a few major sub-processes.

Figure 5 : Concurrent Design Logic

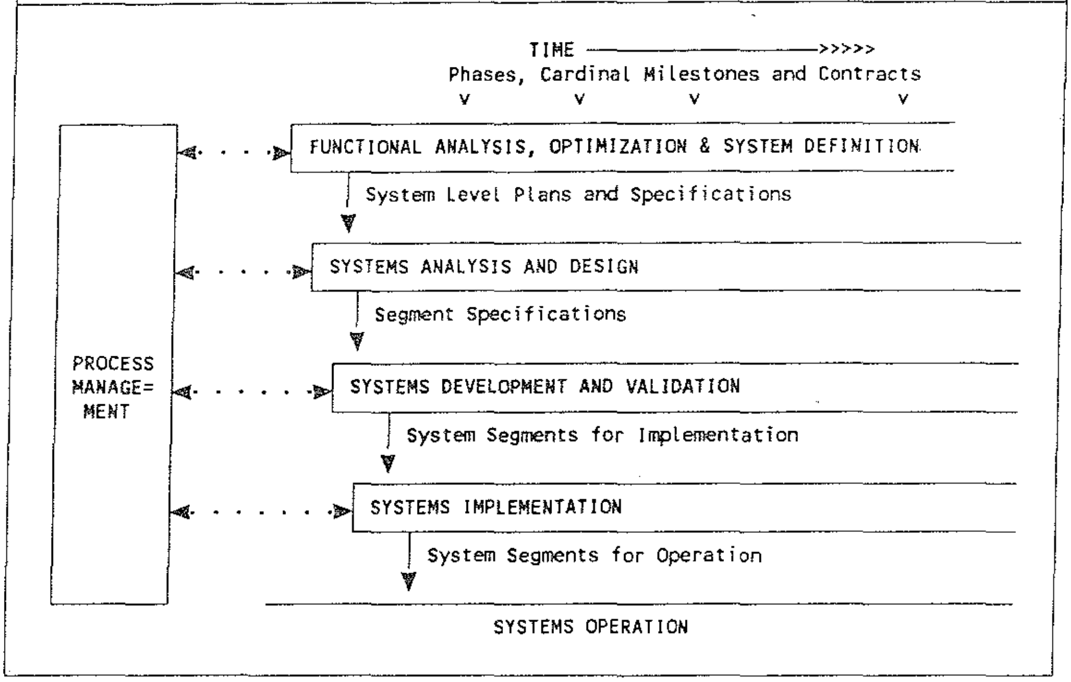


Key:

COMP = Computer
S/WARE = Software

- o Rapid prototyping and early test site introduction, concurrent to design and development.
- o Modular design with stringent interface control.

Figure 6 : Parallel Development Approach



5.2 **METHODOLOGY AND STANDARDIZATION**

Due to typical time scale requirements and complexity of the logistic function, work formalization should be based on a trade-off between the requirement for standardized, rigorous and structured analysis and synthesis methodology and the requirement for different methods to successfully establish a series of inherently diverse functions, processes and systems.

This tends to imply the implementation of an overall methodology template, allowing freedom to use different detail methods, as required.

5.3 **PROTOTYPING**

The advent of new generation tools allows rapid prototyping at minimal cost. Experience has shown that in most cases the contribution of prototypes to

requirement development exceeds the value of prototypes to prove concepts.

In addition to this, expanded prototypes that actually function, can have major advantages in addressing and even temporarily satisfying critical user requirements.

5.4 FUNCTIONAL DEVELOPMENT

The most common cause for information systems development failure is probably the lack of "intelligent" requirement analysis and/or functional development in parallel to systems development. It is essential to fund and staff a development activity focusing on development of the functional elements of the total system, primarily implementing through organizational change to suit the systems change at fielding.

5.5 DEVELOPMENT STRATEGY

With reference to the complexity and inherent differences between logistic areas, it is essential that a cascade of development strategies be established. The strategies will form the cornerstone of development flow in each of the target areas. Development strategies should be embodied in formal development plans and should be the result of careful analysis and synthesis of the primary drivers and requirements in each area. It is essential that this activity leads mechanistic planning by a margin that exceeds reaction cycles by the maximum possible margin.

5.6 TEST AND INTEGRATION

Due to the hidden costs in fielding "flawed" systems, it is essential to implement a rigorous test and integration philosophy. Major cost savings in both operation and development can be realized if formal test and integration facilities are established, operated and managed. A typical facility concept can be:

- Alpha test and integration facility that is isolated from the use environment.
- Beta test and integration facility that is identified in the use environment.

Typical functions to be allocated to these facilities will be the following:

- Testing of alternative technologies.
- Modelling (and testing) of eventual system workload.

- o Testing and integration of applications systems before fielding.

6. MANAGEMENT APPROACHES

This part describes the cardinal approaches currently being applied in the management of a information systems development program. The description covers the principle of single design authority, approaches to ensure use and development of technology and expertise, management of existing systems and projects, master planning philosophy, work breakdown structure, phasing and organization.

6.1 DESIGN AUTHORITY

The previous parts outlined the approach to view a total system with functionality, object characteristics, application systems and computer infrastructure as design variables. It is important that this philosophy be effected by rigorous application of the "single design authority" concept and ensuring of continuity of effort throughout the total system life cycle.

"Single design authority" basically implies that information system segmentation drives allocation of total responsibilities with clear interface definitions as the management structure deployes to enable actual program execution. This approach should normally result in a clear and line oriented program organization structure.

6.2 TECHNOLOGY AND EXPERTISE

The inevitable continued change and growth in logistics over the medium to long term necessitates that expertise and technology should be approached to ensure medium to long term survival. The most feasible current strategy is to ensure continued long term local support by actively establishing required resources through maximum utilization and development of existing local capabilities.

6.3 EXISTING SYSTEMS AND PROJECTS

The parallel development approach can not be realized in practice if the management system does not encompass existing systems and projects. It is essential that existing systems supply the lessons learned and that on-going projects be restructured to fit into the overall development strategy and plan.

6.4 WORK STRUCTURING

Seperation of functional development and system engineering into two work areas is essential as the priorities are normally conflicting. Computer Infrastructure and Integrated Support Development need to be separately formed and managed to ensure success in both areas. In addition to system engineering, application systems require further delineation, primarily due to the difference in life cycle status of the individual areas. Figure 7 illustrates this approach.

Figure 7 : Work Structuring

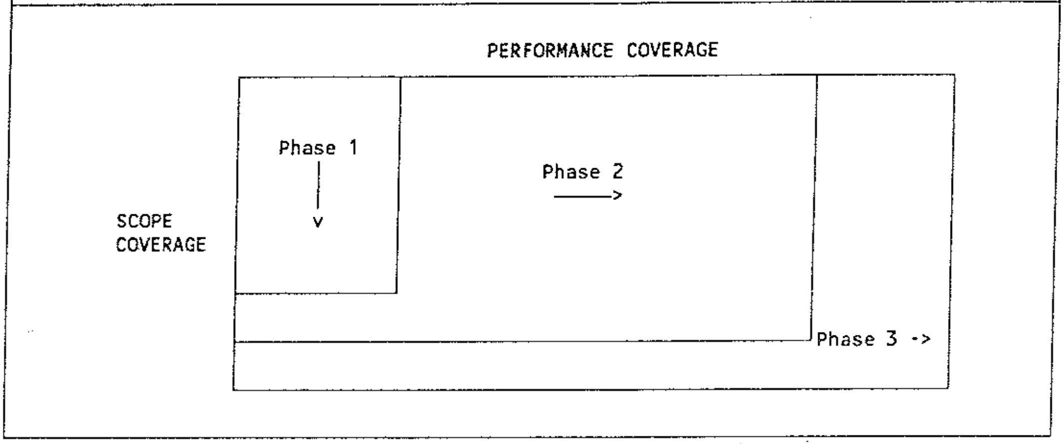
STRUCTURE	DELIVERABLES
MANAGEMENT	o Management Documentation
FUNCTIONAL ENGINEERING	o Functional Change
SYSTEM ENGINEERING	o Integrated Design
ACQUISITION SYSTEMS	o Acquisition Application Systems
MAINTENANCE SYSTEMS	o Maintenance Application Systems
MATERIEL SYSTEMS	o Materiel Application Systems
OTHER SYSTEMS	o Other Application Systems
COMPUTER INFRASTPUCTURE	o Computer Infrastructure
INTEGRATED LOGISTIC SUPPORT	o Supportability and Support

Phasing of work needs careful consideration and should reflect the overall development goals and strategy. In most of the current situations, the following basic strategy/value system, as illustrated in Figure 8 should receive consideration:

- o Initial priority to establish maximum coverage of total scope to ensure integrated operation.
- o Intermediate priority to improvement of performance to meet user requirements.

o Eventual expansion to attain full requirement coverage.

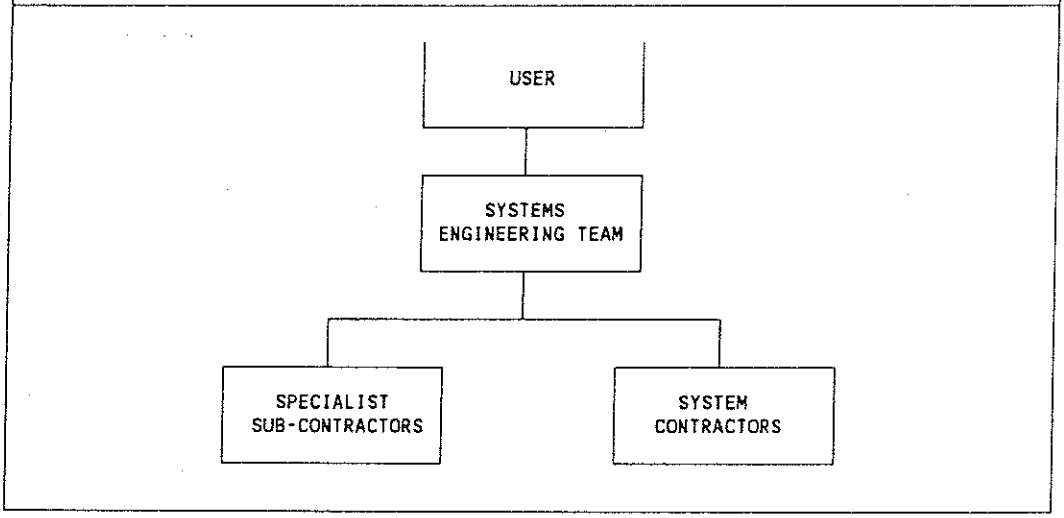
Figure 8 : Phasing Strategy



6.5 ORGANIZATION

Based on the necessity of integration for success, the implementation of a single purpose systems engineering team is recommended. To suit requirements regarding establishment and maintenance of local expertise, as defined earlier, actual systems establishment should be realized on a sub-contracting basis. This is illustrated in Figure 9.

Figure 9 : Basic Organizational Approach



7. CONCLUSION

This paper summarized cardinal approaches that are currently being applied in the development of logistic information systems. Although all these principles have not been fully evaluated, initial results supports continued adherence to the principles.

This paper indicates three areas for future research:

- o Evaluation of alternative approaches against success rates to validate recommendations.
- o Formalization of design/development methodology.
- o Completion of the design of a "standard" logistic system framework.

LIST OF FIGURES