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RESEARCH RESULTS DIGEST

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Guidelines for Establishing Executive Management Information Systems for State Departments of Transportation

An NCHRP digest of the essential findings from the final report on NCHRP Project 20-24(2), "Executive Management Information Systems for State Departments of Transportation," prepared by Andersen Consulting, Arthur Andersen & Co., Hartford, Connecticut, and Keystone Management Systems, Inc., State College, Pennsylvania.

THE PROBLEM AND ITS SOLUTION

State departments of transportation face many new challenges in expanding, enhancing, and maintaining the nation's transportation infrastructure. The revitalization of state transportation networks has increased the workloads of DOTs dramatically. Projects have grown in size, complexity, and visibility. Management is also faced with cutbacks in federal support, additional funding rules, and more sources of funds to be managed. The ever-changing environment of today necessitates, more than ever, that timely, accurate and concise information be available and organized in a manner that supports each department's strategies, goals, and objectives. Information meaningfully organized and presented can greatly facilitate the management and decision-making process.

Often, in an attempt to provide executives with information, voluminous paper reports are generated. Yet, such volumes of paper and figures can slow down the decision-making process by making it difficult and time-consuming for an executive to obtain the specific numbers he or she needs. Also, the sheer volume of data can obscure relationships and trends that may be crucial to the decision-making process. Nevertheless, little has been done to assist executives in obtaining the information they require to support effective and efficient decision-making.

Today many of these requirements can be met with information technology. Unfortunately, the executive suite remains largely untouched by both the concepts of Executive Management Information Systems (EMIS) and the use of advanced technology.

Personnel from Andersen Consulting of Arthur Andersen & Company, and Keystone Management Systems, conducted research on NCHRP Project 20-24(2), "Executive Management Information Systems for State Departments of Transportation." The overall objective was to provide the executive accurate, timely, relevant, and accountable information to measure the accomplishments and status of the department. Specific objectives were to (1) develop a prototype to assist DOT executives in understanding

what an Executive Management Information System (EMIS) can do for state DOTs, and (2) outline the step-by-step process that would be needed to design, implement, and support an EMIS.

These objectives were accomplished through the following activities:

- Executive information requirements were determined through interviews and questionnaires.
- An EMIS prototype was developed and revised based on interview comments.
- Information requirements were analyzed, producing a matrix describing the relationship of executive requests and the department's base systems.
- EMIS software and hardware alternatives were identified and evaluated.
- EMIS design and implementation guidelines were drafted.

The prototype incorporates the characteristics of an EMIS and the types of information required by chief administrative officers (CAOs) to manage their departments. The guidelines address the key development issues; the overall iterative design and installation approach; and the step-by-step process to design and install an EMIS. Each segment of the guidelines is described by objectives, tasks, major deliverables, notes, and skills required. Resource needs and ongoing support requirements for the overall system are also provided.

FINDINGS

The interviews and research performed during NCHRP Project 20-24(2) produced the following findings:

- State DOTs have a need and a desire for executive information which is timely, accurate, relevant, and presented in a user-friendly format. In short, the state DOTs would use an EMIS system.
- DOTs with installed EMISs provide accountability and status within the department and to the legislature (Arizona, Connecticut, Washington).
- Most often the transportation executives interviewed thought that they would use the EMIS themselves and found a touchscreen (eliminates the extensive use of a keyboard) and EMIS technology demonstrated in the prototype to be truly user-friendly.
- Information-systems personnel supported the move towards an EMIS while understanding the time and resources required to change base systems. However, some members of middle management expressed concern that top executives would bypass them and rely on information in the EMIS that may not be available to middle management.
- The information requirements most frequently expressed by the executives included the following: (a) project status information by various categories (town, bureau, legislative district, program, etc.); (b) cash flow and forecasting (revenues, expenditures); (c) program funding balances (federal, state, local, other); (d) comparison of actual performance vs. plan; (e) staffing information (position tracking, recruitment, retirement, retainment, future needs projection); (f) department financial status by bureau/division (budget, committed, expended, etc.); and (g) condition and service level of infrastructure.
- Many state DOTs base transaction systems were in varied stages of development, maintenance, and support. Because base transaction systems were principally designed for the daily operations of the department, most systems will require enhancements to capture the information needed to support an EMIS. Data should be extracted from the base system to ensure the entire department is working from the same base of controlled data. Updating these systems will take significant time and other resources.
- Although many state DOTs have similar executive information requirements, the responsibilities and individual management styles of transportation executives usually require customization of an EMIS.
- No one EMIS software alternative was identified to be clearly superior to the others. A number of products were reviewed and compared to provide the states with selection criteria to help them in their EMIS evaluation process. However, the individual states must select the product which best fits into their information systems plan.
- Some DOTs are interested in Decision Support Systems (DSS). After providing executive information in an EMIS, the need to provide

what-if analysis capabilities may follow.

- State DOTs use different terms, measures, and calculations when providing data for reporting purposes. Review and standardization in this area will need to occur to allow the states to communicate and compare themselves one to the other.

APPLICATIONS

The results of this research indicate that, once implemented, an EMIS can be potentially useful in providing executives with the following benefits:

- Ability to answer inquiries without labor intensive research.
- Graphic information and presentations.
- Consistency when a change in management or legislature occurs.
- User-friendly access to information.
- Independent access to timely information for making better decisions.
- Highlighted trouble areas (exception report).
- Improved understanding of the department's goals and objectives.

An EMIS selects, organizes, and integrates key information from different databases, providing management with useful, summarized, and consolidated information. Figure 1 depicts where an EMIS fits in the overall system strategy of developing an integrated systems solution.

INTEGRATED SYSTEMS SOLUTION

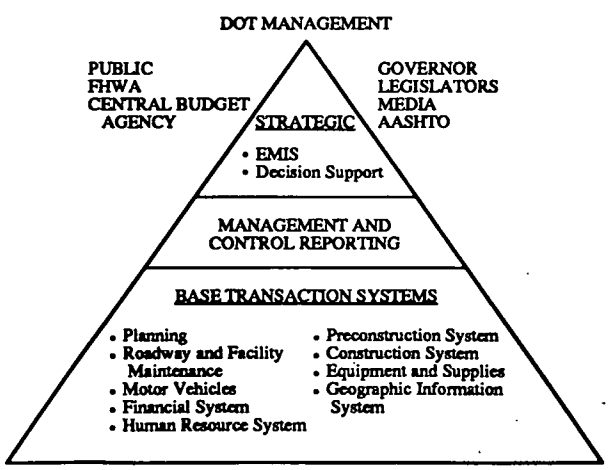

Figure 1

Through automated BASE TRANSACTION SYSTEMS, information is collected daily, weekly, and monthly to support DOT operations on a day-to-day level. These systems provide the foundation upon which the management and control, decision support, and executive management information systems are built.

Each of the base transaction systems contains a MANAGEMENT AND CONTROL REPORTING component. These components serve the needs of middle management in the department. It is also at the level that most departments currently try to meet their executive reporting requirements.

Information from the base transaction and management and control reporting system is extracted, summarized, and integrated for use in STRATEGIC applications. An EMIS presents these summarized data in a user-friendly format, providing executives information to make better decisions.

Listed outside the pyramid are the wide range of organizations that typically request information concerning the operation of the department. The information needs of these organizations can be met by summarizing the information from the underlying systems.

CONCLUSIONS

From the findings noted in the foregoing sections of this Digest, the researchers set forth several conclusions.

- Executive backing and commitment are essential to the successful implementation of an EMIS. In addition, ongoing executive management attention is required to monitor and enforce the defined measures of success.
- The information requirements matrix, guidelines, prototype, and software product evaluations developed in the research should be used as a starting point for an individual state's EMIS. Each of these areas will need to be tailored to a given state's organization, management style, and technical environment.
- Determining the information requirements of the CAO and top transportation executives is worthwhile even if the implementation of an EMIS is not imminent. Knowledge of this information will assist in setting priorities for base system enhancements or replacements, making the implementation of an EMIS easier in the future.
- When reviewing the information for inclusion in the EMIS, old and unused data and reports should be identified and purged from the base

transaction systems.

- The EMIS should be developed iteratively. Prototyping and using a pilot approach will offer the executive a quick and useful means to accommodate the changing environment of the department. **The EMIS, thus, is never in "steady-state."**

FINAL REPORT

The project final report will not be published in the regular NCHRP report series. However, copies of the agency's report, entitled "Guidelines for Establishing Executive Management Information Systems for State Departments of Transportation," have been distributed by the American Association of State Highway and Transportation Officials to all member departments. Copies of this 159-page agency report, which includes 38 color pictures of sample computer screens, are available on loan or may be purchased at a cost of $40 by request to the NCHRP, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418.

The "Contents" page from the agency report is reproduced in Figure 2. Subsequent pages of this Digest also depict a typical hardware configuration as viewed from the executive's perspective and four supporting alternative architectures (mainframe or minicomputer host; dedicated minicomputer; microcomputer, individual workstation; and microcomputer, local area network) that are explained in greater detail in the agency report.

NCHRP PROJECT 20-24(2)

GUIDELINES FOR ESTABLISHING EMIS FOR STATE DOTs

FINAL REPORT

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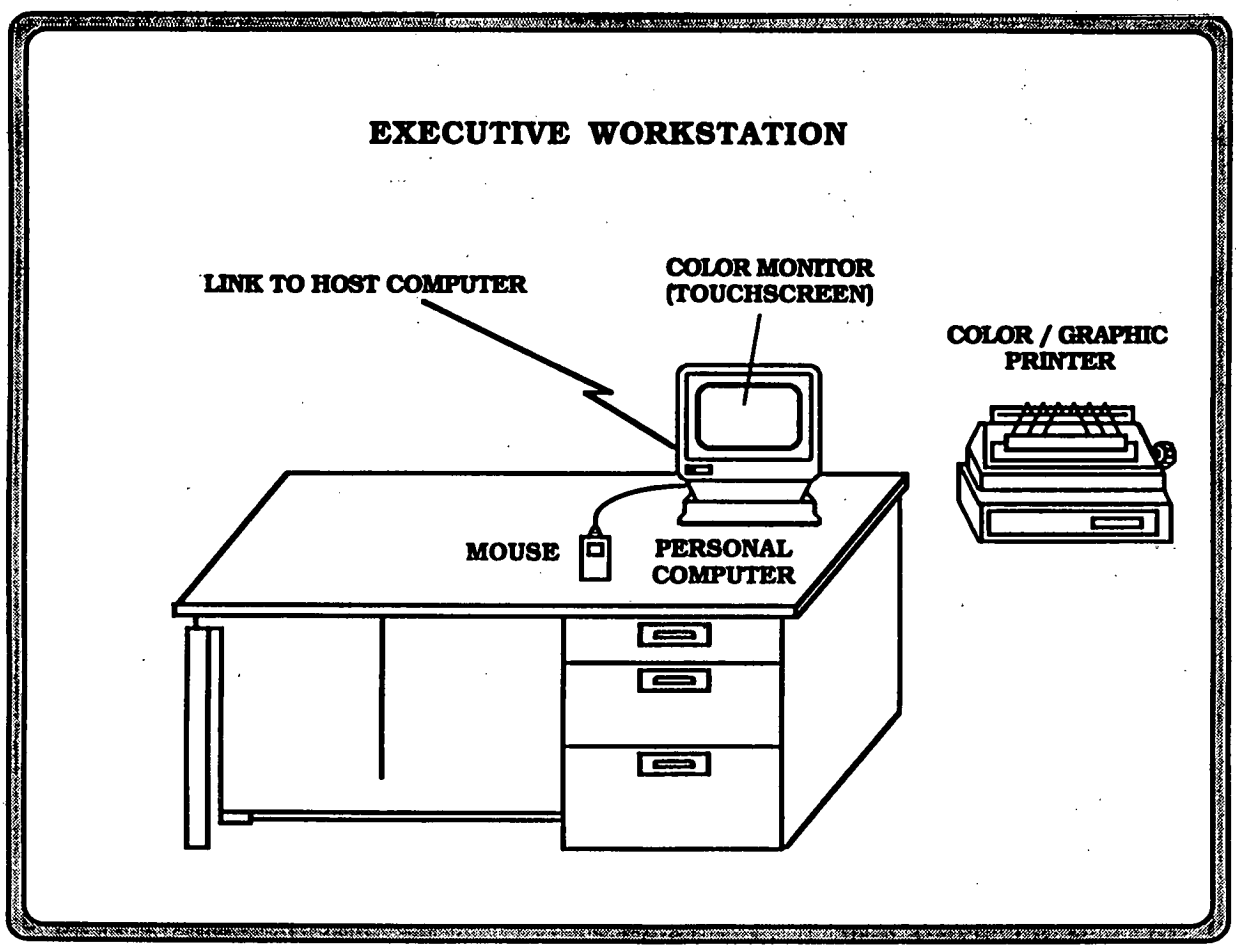
EXECUTIVE WORKSTATION
LINK TO HOST COMPUTER
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(TOUCHSCREEN)
COLOR / GRAPHIC
PRINTER
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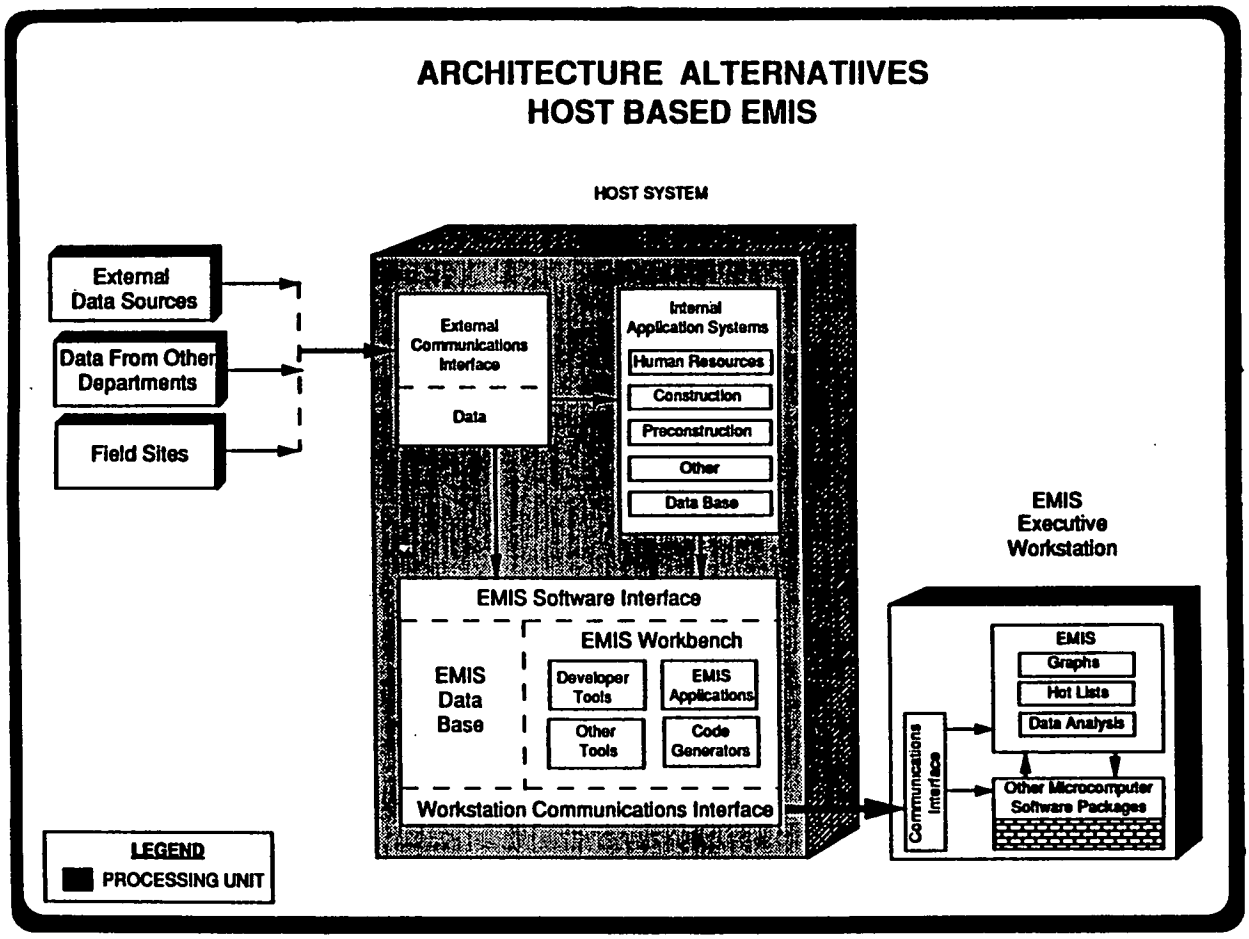
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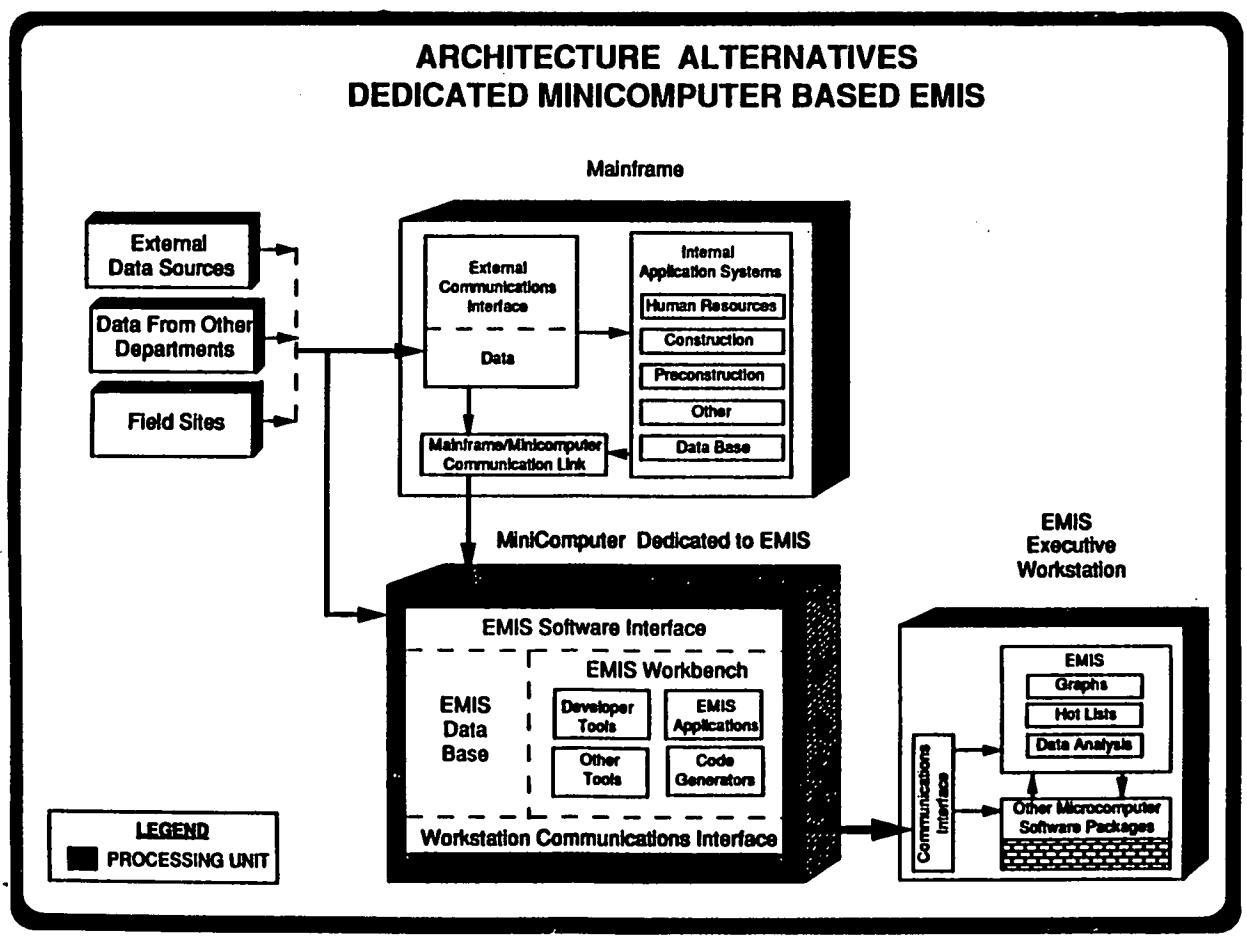
ARCHITECTURE ALTERNATIVES
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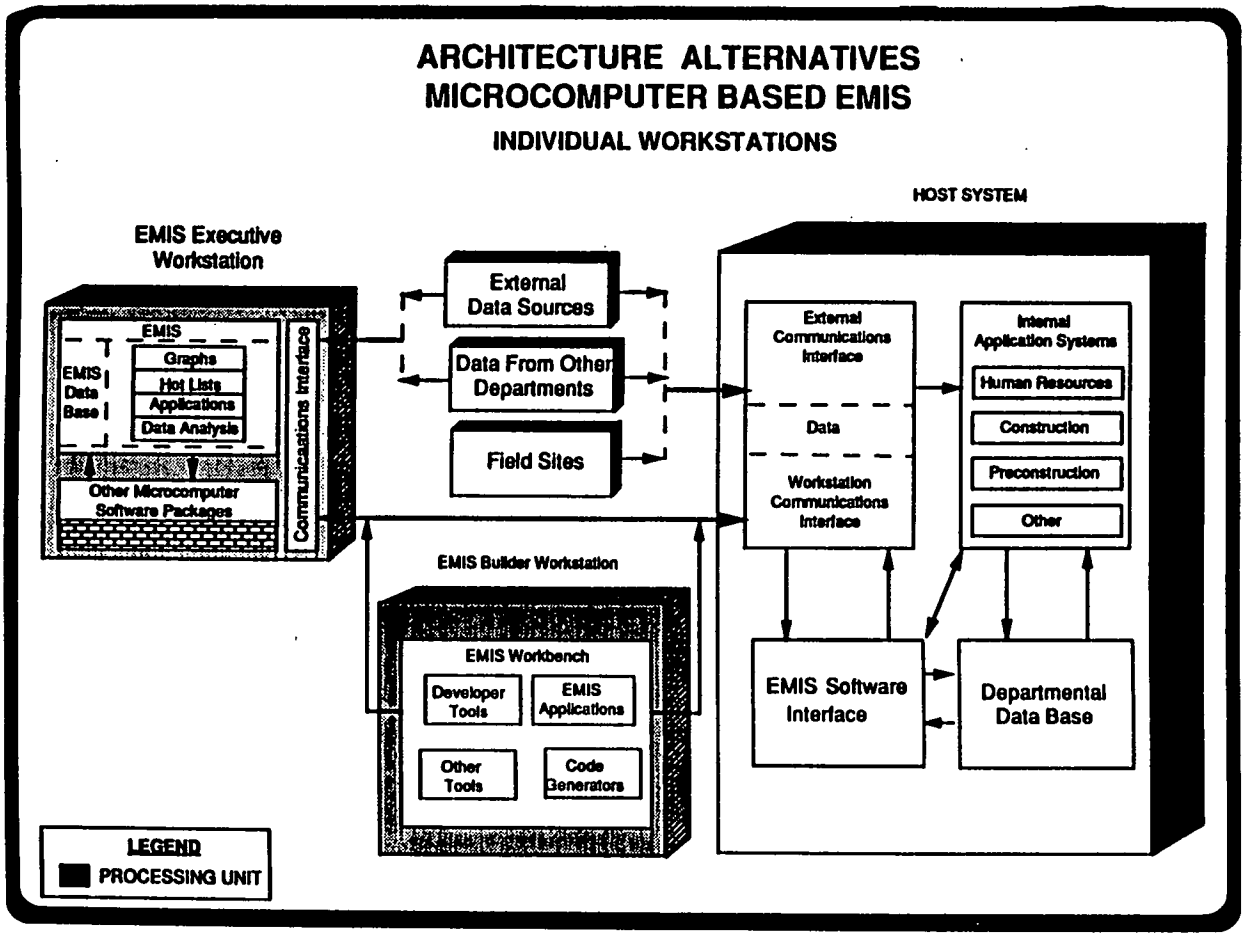
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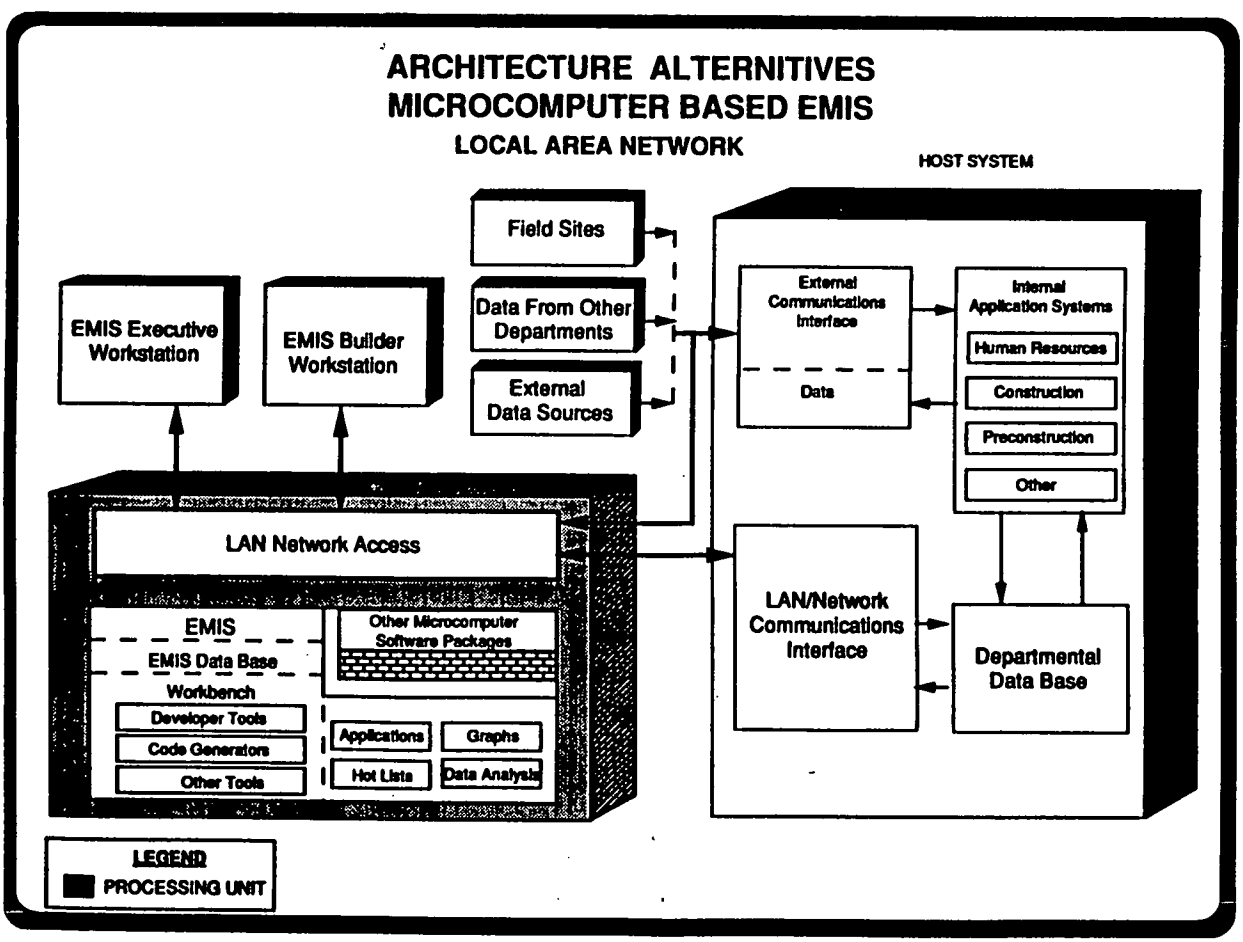
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