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AEROSPACE INFORMATION REPORT

SAE AIR4276

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SURVEY RESULTS: COMPUTERIZATION OF RELIABILITY, MAINTAINABILITY & SUPPORTABILITY (RM&S) IN DESIGN

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1. SCOPE:

This Aerospace Information Report (AIR) is the primary vehicle for providing the survey results to industry and government.

The Institute of Defense Analysis (IDA), has performed a study which concludes that computerized techniques must be developed to integrate RM&S into product design in order to permit design influence from inception throughout the product life cycle. This AIR addresses the DoD initiative for developing Computer Aided Acquisition and Logistic Support (CALS) and industry's role in its evolution.

AIR 4276 provides the detailed results of an industry/government survey inquiring into the extent of computerization of RM&S into the design process. Background information describes the evolution of the survey and why it was developed. The results provide demographic information about the respondents, the existence and extent of their CALS policy and plans, the priority placed on each RM&S task, and the extent to which these tasks have been computerized into the design process. Recommendations based on the survey results are included.

2. PURPOSE:

The overall purpose of this report is to heighten industry and government awareness as to the importance of computerizing RM&S into design, providing information on the current status and actions for computerization, and identifying the prioritization of tasks for automation.

3. BACKGROUND:

A DoD/Industry CALS task force and the CALS initiative were established by the Deputy Secretary of Defense in 1985. Management for CALS is provided by a Department of Defense (DoD) steering group, an Office Secretary of Defense (OSD) CALS Policy Office, counterparts in each military department, and the Defense Logistics Agency (DLA). Current DoD CALS initiatives are defined in two phases: Phase I applies current computer technology in existing and emerging DoD/Industry computer systems and deals with interfacing, file transfer standards, and computer system prototyping; Phase II applies advanced computing technologies and emphasizes on-line access capabilities in terms of DoD/Industry data exchange. Advanced technology is being developed involving substantial integration and redesign of current processes, to take advantage of a shared data base environment. An objective is to create an Integrated Weapons System Database (IWSDB) where RM&S is applied early in design.

The SAE Committee G-11, Reliability, Maintainability, and Supportability, recognizing the importance of the CALS initiative, formed a Computerization of RM&S In Design (G-11CR) subcommittee to address specific aspects of the initiative and to heighten industry awareness as to the importance of integration of RM&S into engineering design through utilization of computer resources. This would be accomplished by providing industry with information on current status and action for computerization in addition to identifying and prioritizing tasks that should be automated.

3. (Continued)

To initiate this, a survey of industry and government agencies was circulated to determine the existing status of CALS policies, plans and implementation.

4. DISCUSSION:

A preliminary questionnaire on RM&S computerization was prepared and sent to a limited segment of government and industry. The responses to the questionnaire were used to prepare a final survey which was sent out in March 1988 to 250 organizations. A copy of the survey is included as Appendix A.

The 92 survey responses that were returned represented the following types of organizations:

a.	Aircraft/Aerospace	25
b.	Electronics	35
c.	Propulsion	6
d.	Government	26

The majority of the responses came from companies having over 2000 employees and 500 engineers with 60 to 100% of their sales to the government. Data were forwarded to the Air Force Institute of Technology (AFIT) for data reduction. The (processed) data were analyzed and the results summarized in three sections (Management, Technical, and General) to correspond to the survey partitioning.

4.1 Management: The first five questions of the Management section of the survey addressed company demographics, e.g., product line, number of employees, and military sales. The remaining questions pertained to company CALS policies.

The primary product lines of the respondents were:

a. Electronics
b. Aircraft
c. Missiles

See Fig. 1 for detailed distribution.

It was evident from the demographics that the majority of the responses were from large companies having greater than 2000 employees and more than 500 engineers (Figs. 2 and 3).

Over 50% of the companies have 80% or more of their sales to the military (Fig. 4).

In the area of CALS, 75% of all surveyed companies either have a policy in place, or are in the process of developing a policy. Only 10% have a formal plan (Fig. 5).

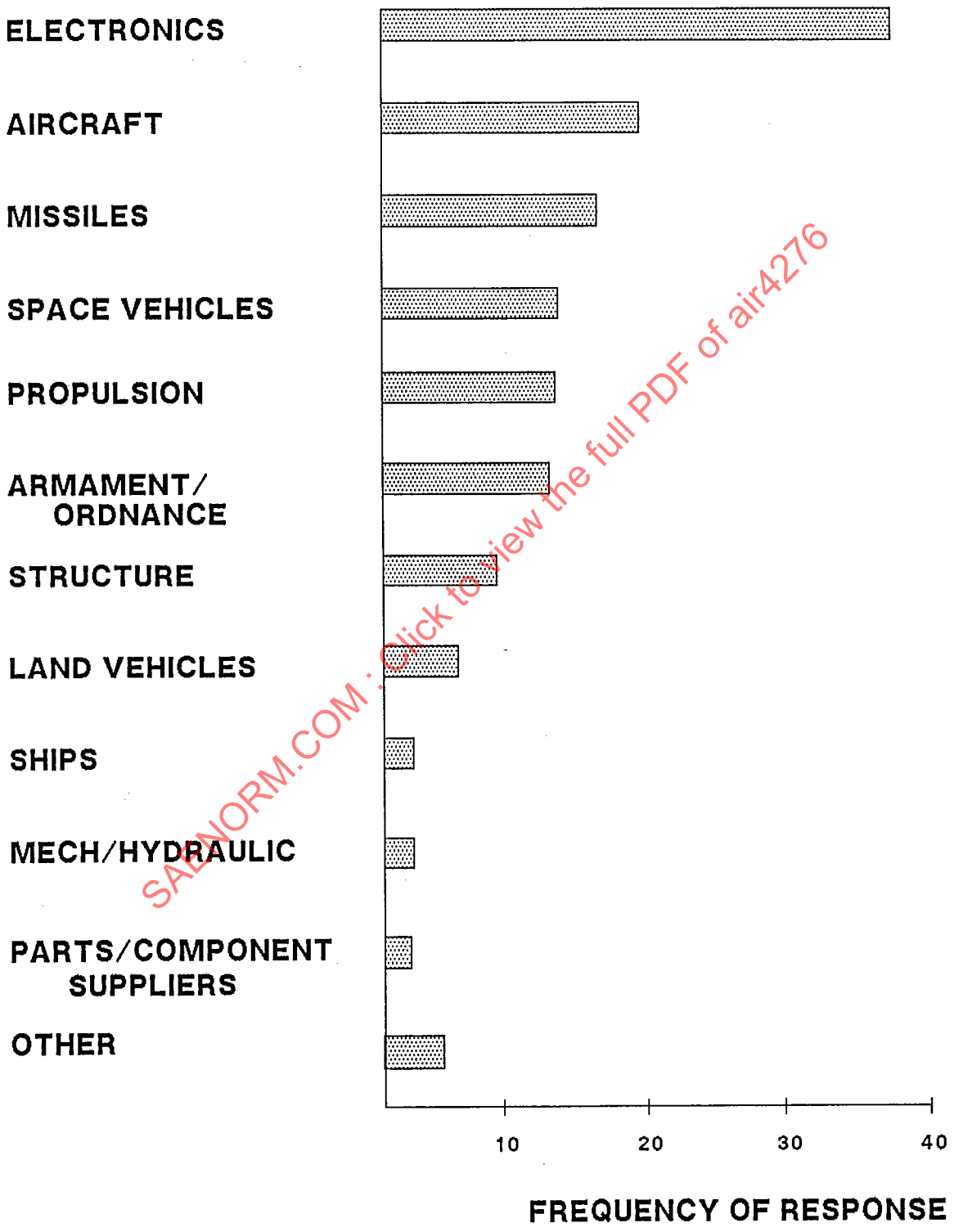

FIGURE 1 - Primary Product Line

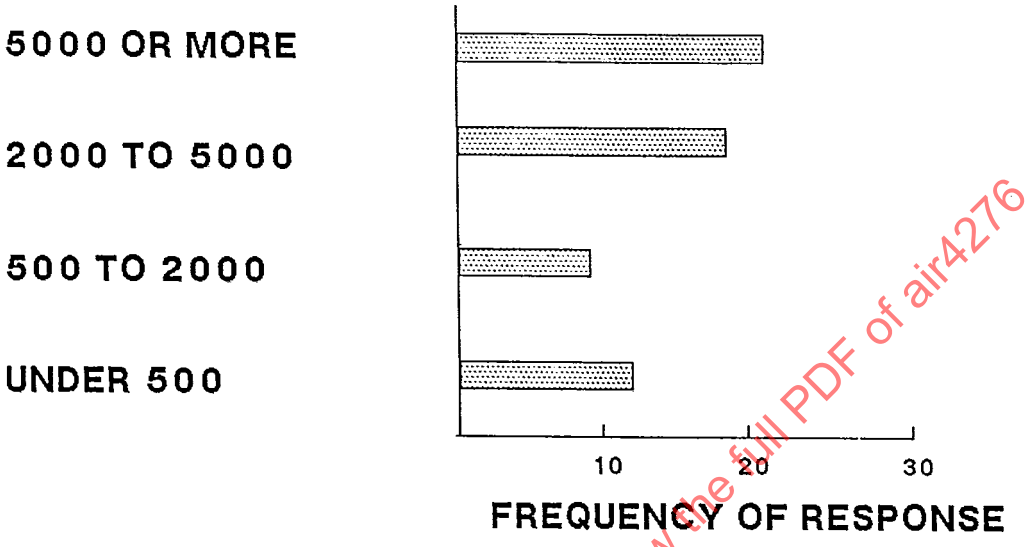

FIGURE 2 – Number of Personnel in Organization

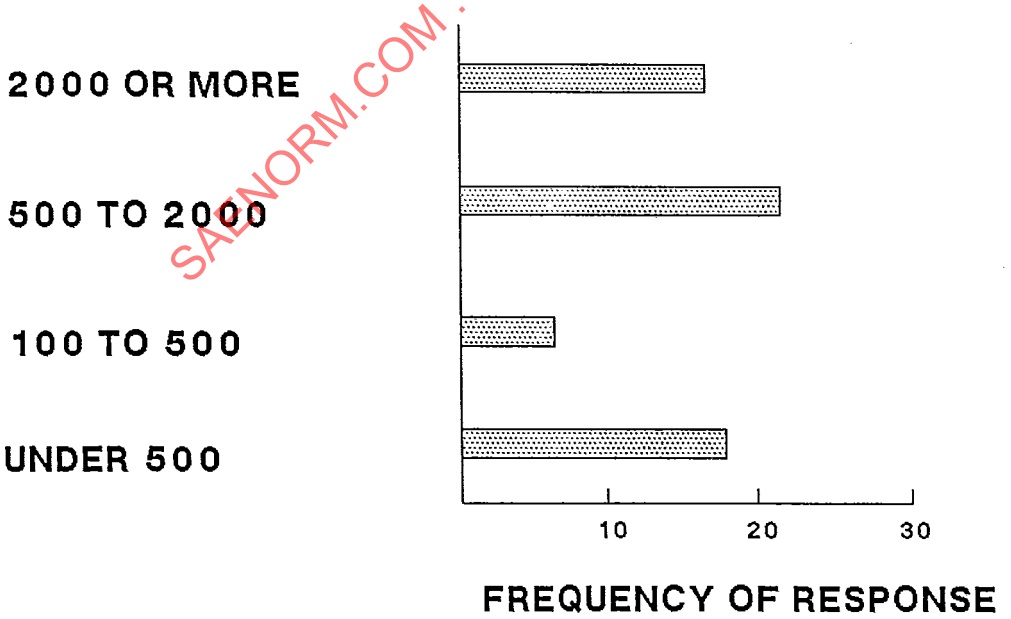

FIGURE 3 – Number of Engineers Employed

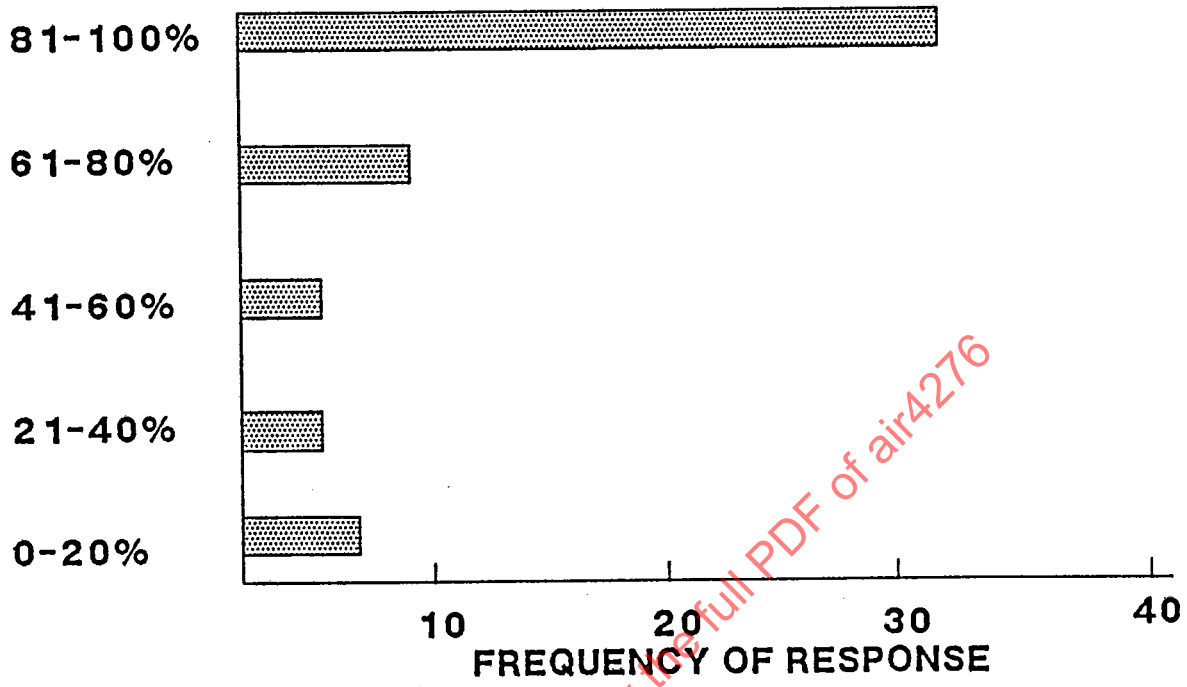

FIGURE 4 - Percent Military Sales

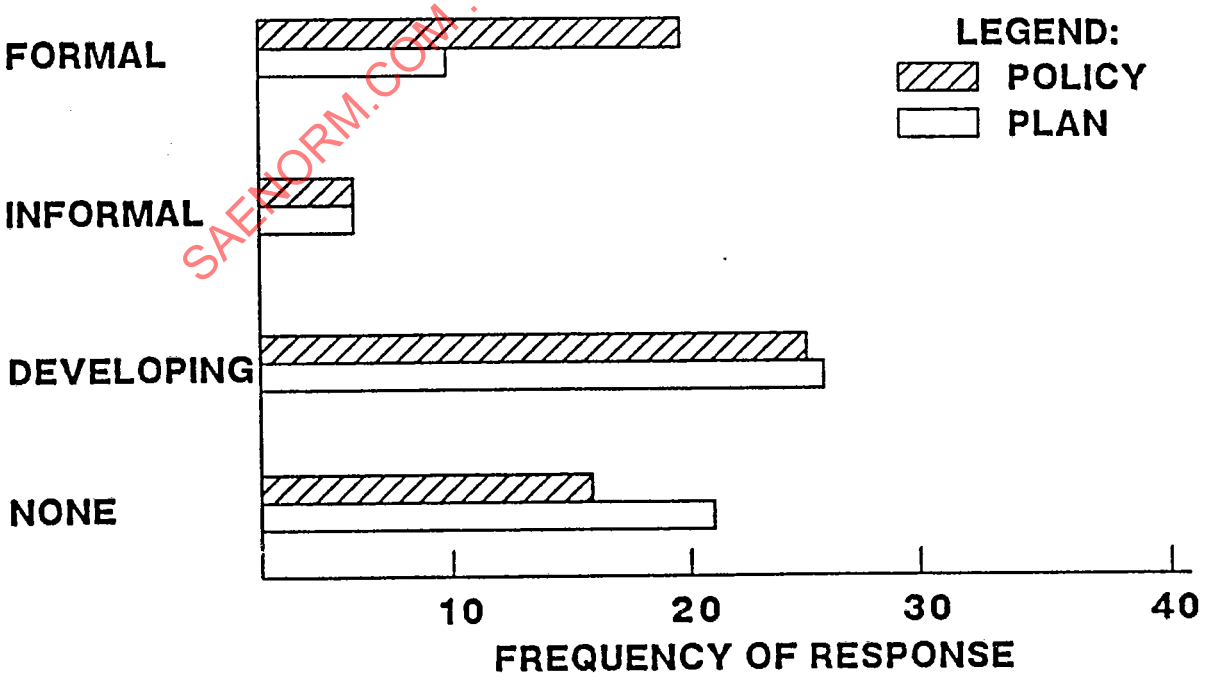

FIGURE 5 - CALS Policy/Implementation Plans

4.1 (Continued)

The survey indicates that the top three functional groups involved with CALS are Product Support/Integrated Logistic Support (ILS), R&M, and Design (Fig. 6) with the primary responsibility for CALS implementation residing in Product Support/ILS (Fig. 7).

Management of CALS programs was overwhelmingly assigned to middle level management (Fig. 8).

The respondents were asked to provide the primary objectives of their CALS program. The most frequently cited objectives were:

a. Common data base for R, M, S, LSA, and Safety
b. Ensure new products are CALS compliant
c. Integrate R, M, and S into design processes
d. Enhance productivity
e. Enhance quality
f. Enhance product support

An attempt was made to determine where the CALS programs were focused. Fig. 9 indicates that CALS has a broad application to many functional areas and is being addressed over these areas.

4.2 Technical: The Technical section of the questionnaire was structured to determine the priority for computerization of RM&S tasks and the extent to which computerization has been accomplished. The questions were formatted in accordance with the tasks contained in the appropriate military standard; Reliability, MIL-STD 785, Maintainability, MIL-STD 470, and Supportability, MIL-STD 1388 (Logistic Support Analysis). The respondents were asked to prioritize each of the tasks in order of importance their organization gives to computerization, that is, what task should be computerized before the other. They were also asked if the task was already computerized. Figs. 10, 11, and 12 show the results. It should be noted that the high priority tasks have been computerized to a greater extent than the low priority tasks. In general the most important items are being automated first. The results also show that Reliability functions have been computerized more than either Maintainability or Supportability.

The respondents were asked to prioritize the importance that their organization places on electronic integration of the RM&S tasks into the design process. This was intended to find out for example, if reliability allocations were provided automatically to design, and whether maintenance task analyses were electronically integrated with technical publications or training. Figs. 13, 14, and 15 show that there is a minimal integration of RM&S tasks into design. The extent of actual electronic integration does not necessarily correlate with the high priority tasks. There is negligible difference in the extent of integration for RM&S since most failed to reach 5%.

The Technical section survey results indicate that in general greater emphasis has been placed on automating high priority RM&S tasks with little emphasis on electronic integration into the design process. Table 1 compares the priorities for task computerization to the priorities for task integration. It shows that there is some correlation in these priorities.

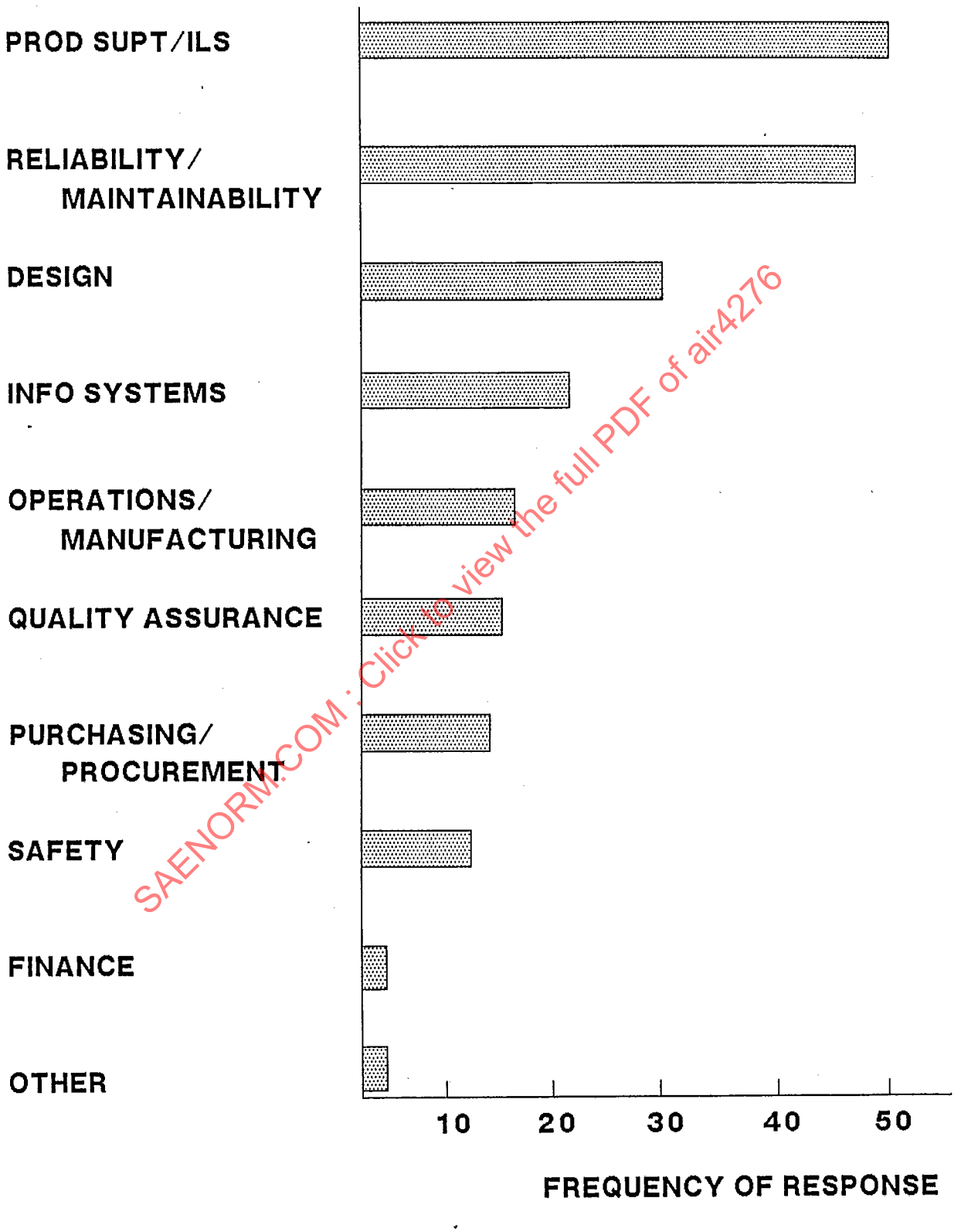

FIGURE 6 - Functional Groups Involved with CALS

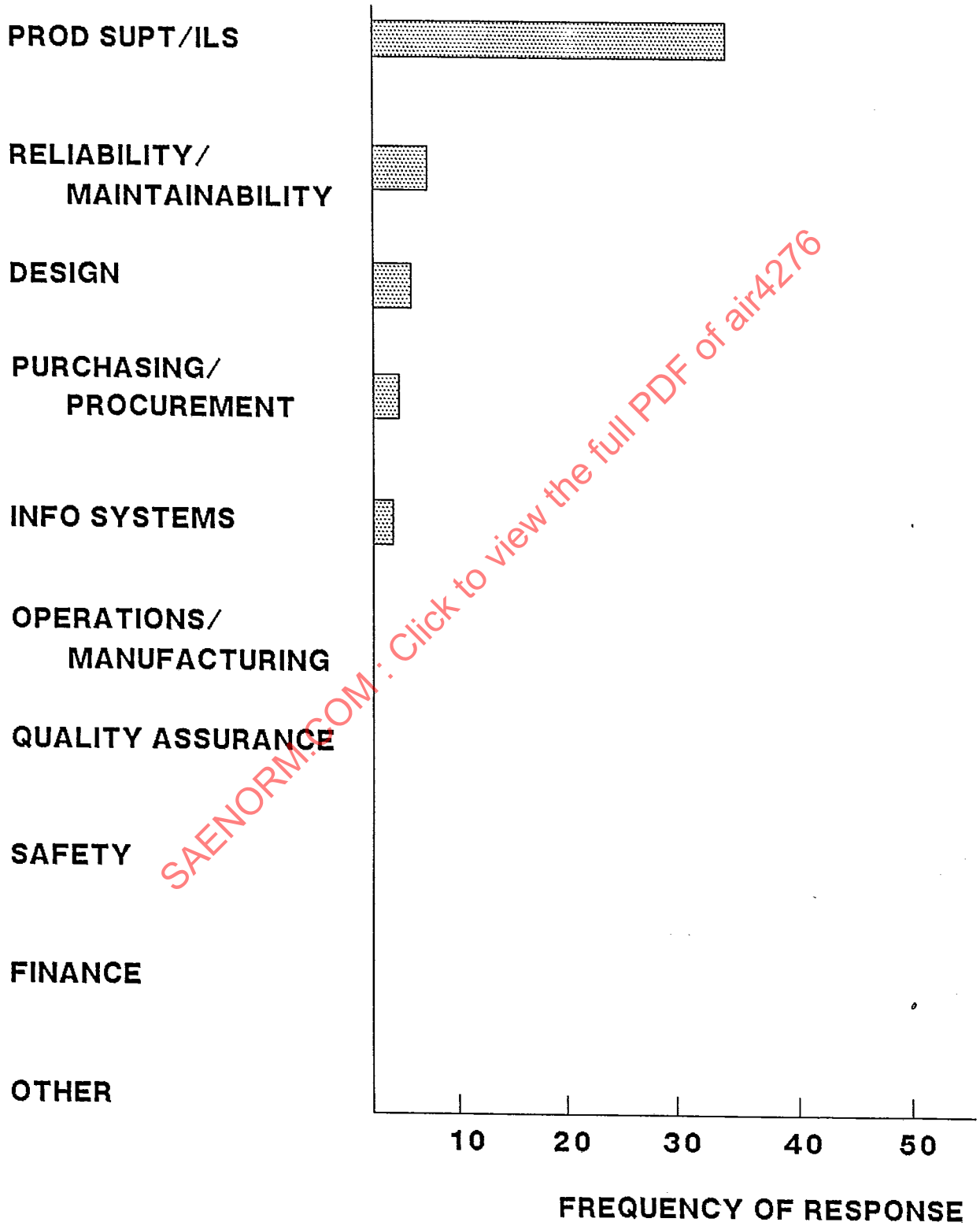

FIGURE 7 - Responsibility for CALS Implementation

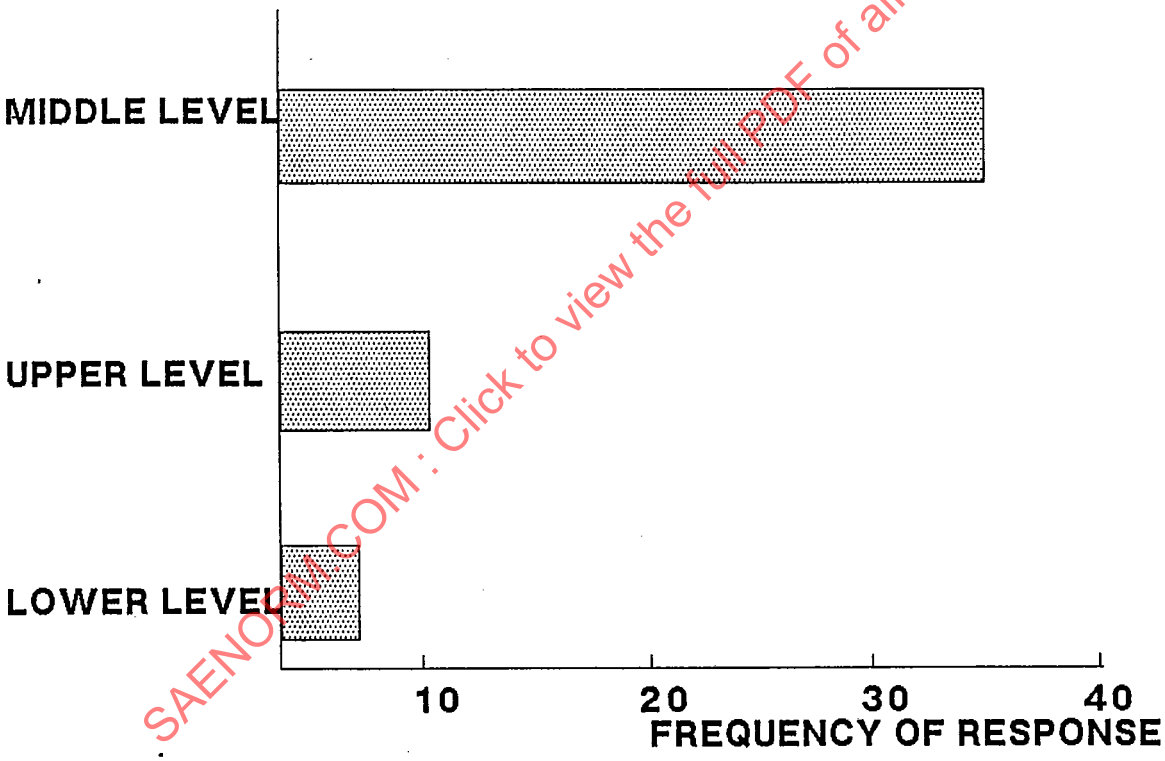

FIGURE 8 – Management Level Responsible for CALS

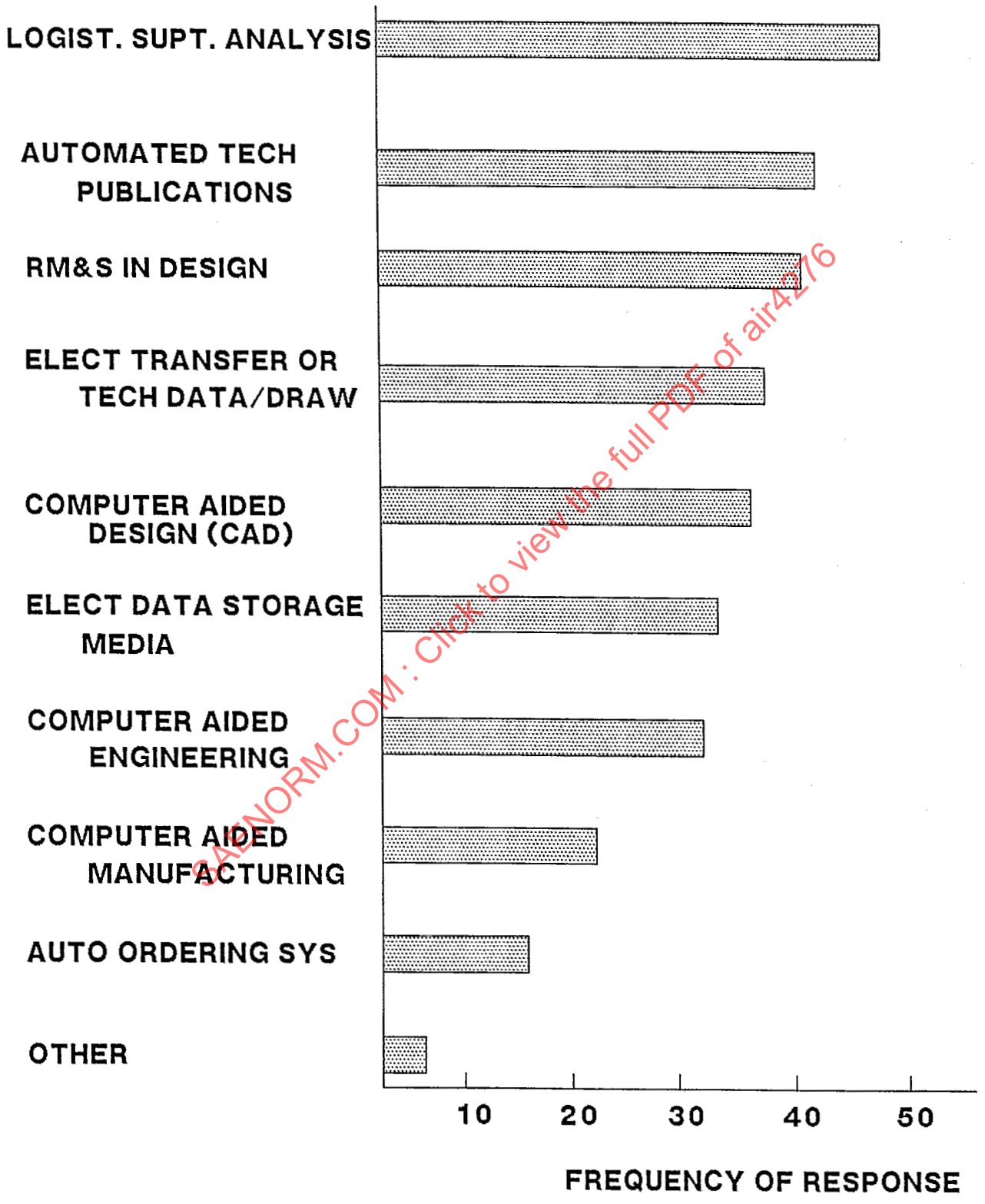

FIGURE 9 - CALS Program Focus

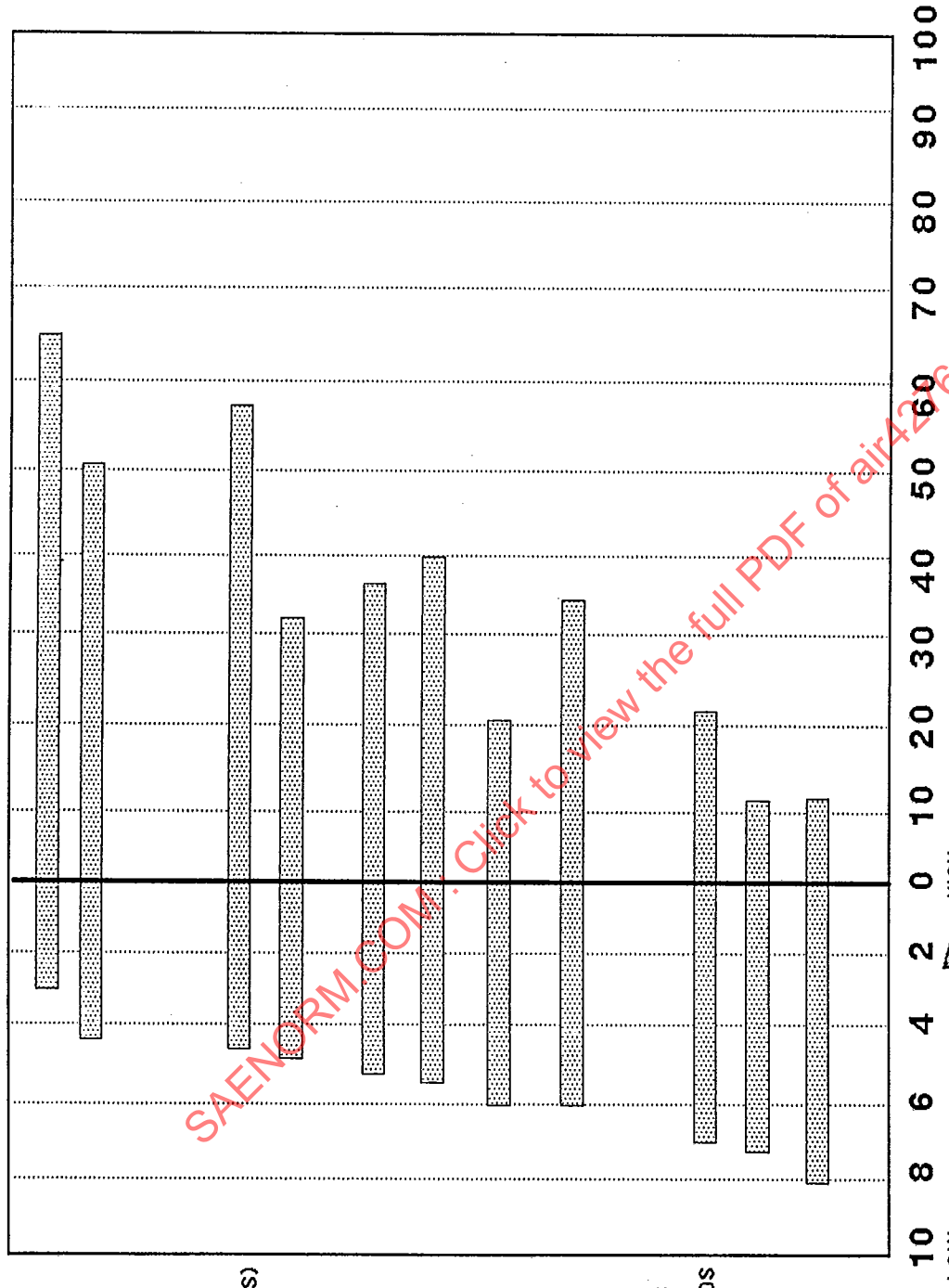

FIGURE 10 - Reliability Tasks Computerized

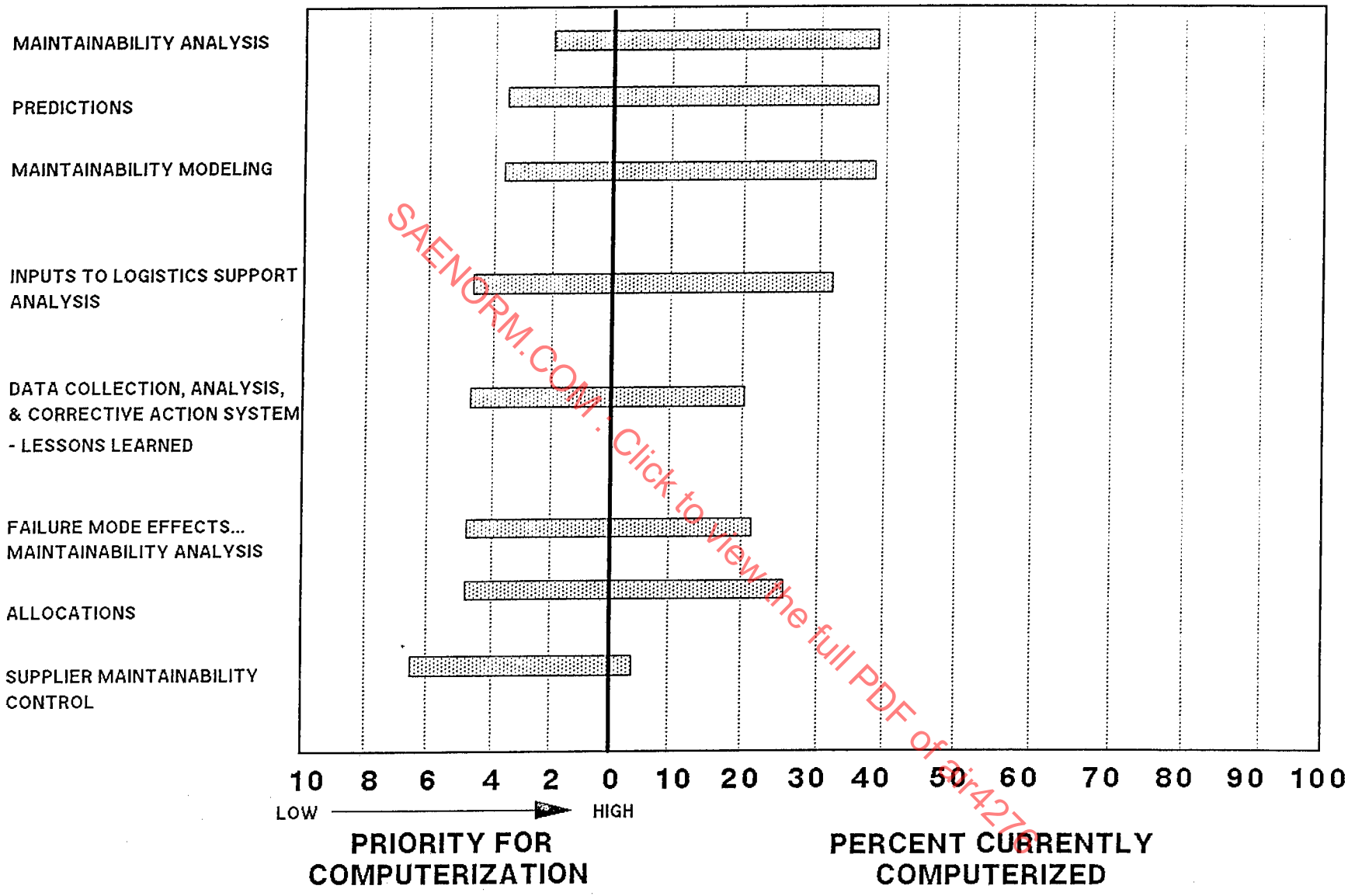

FIGURE 11 – Maintainability Tasks Computerized

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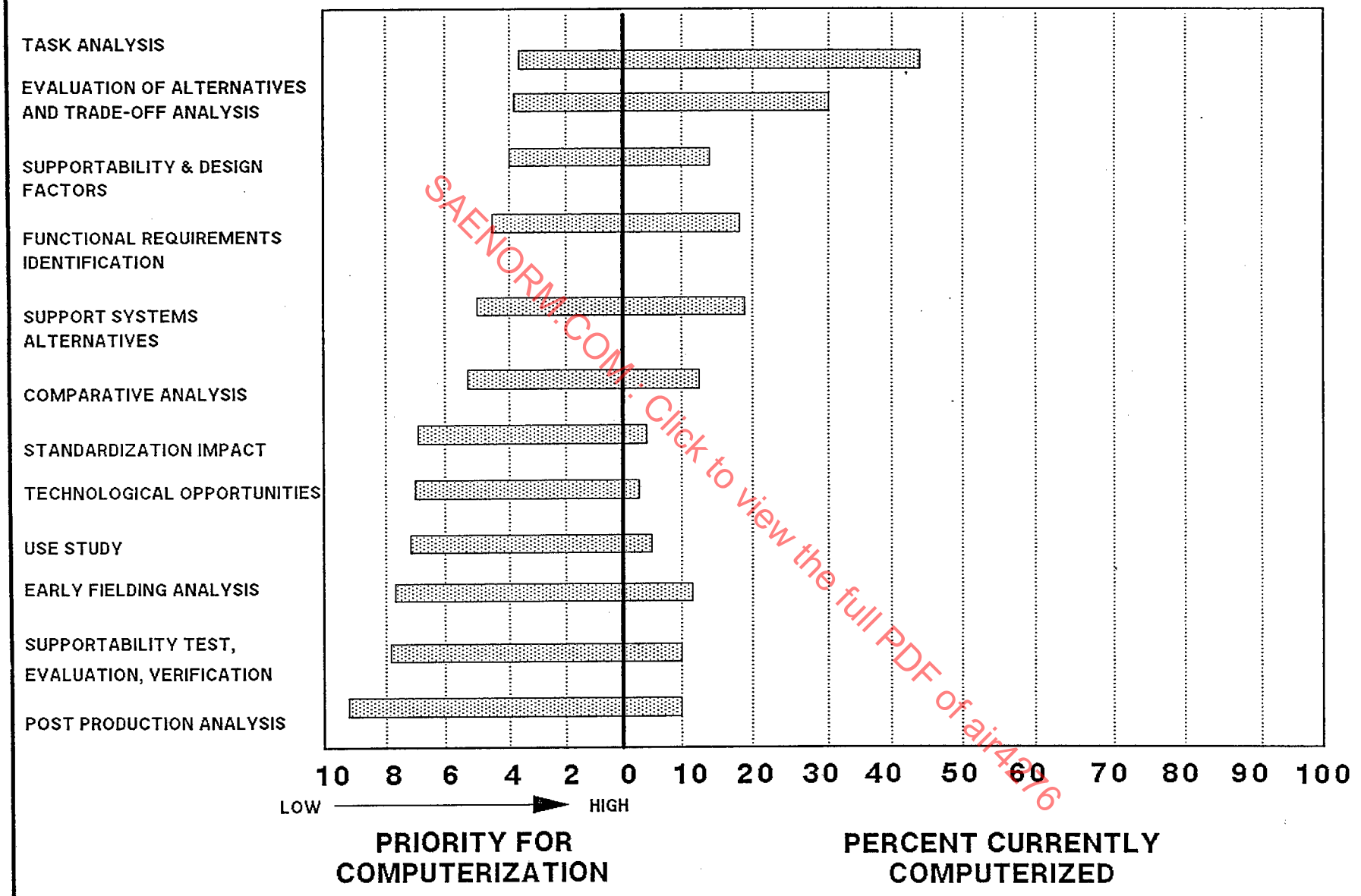

FIGURE 12 – Supportability Tasks Electronically Computerized

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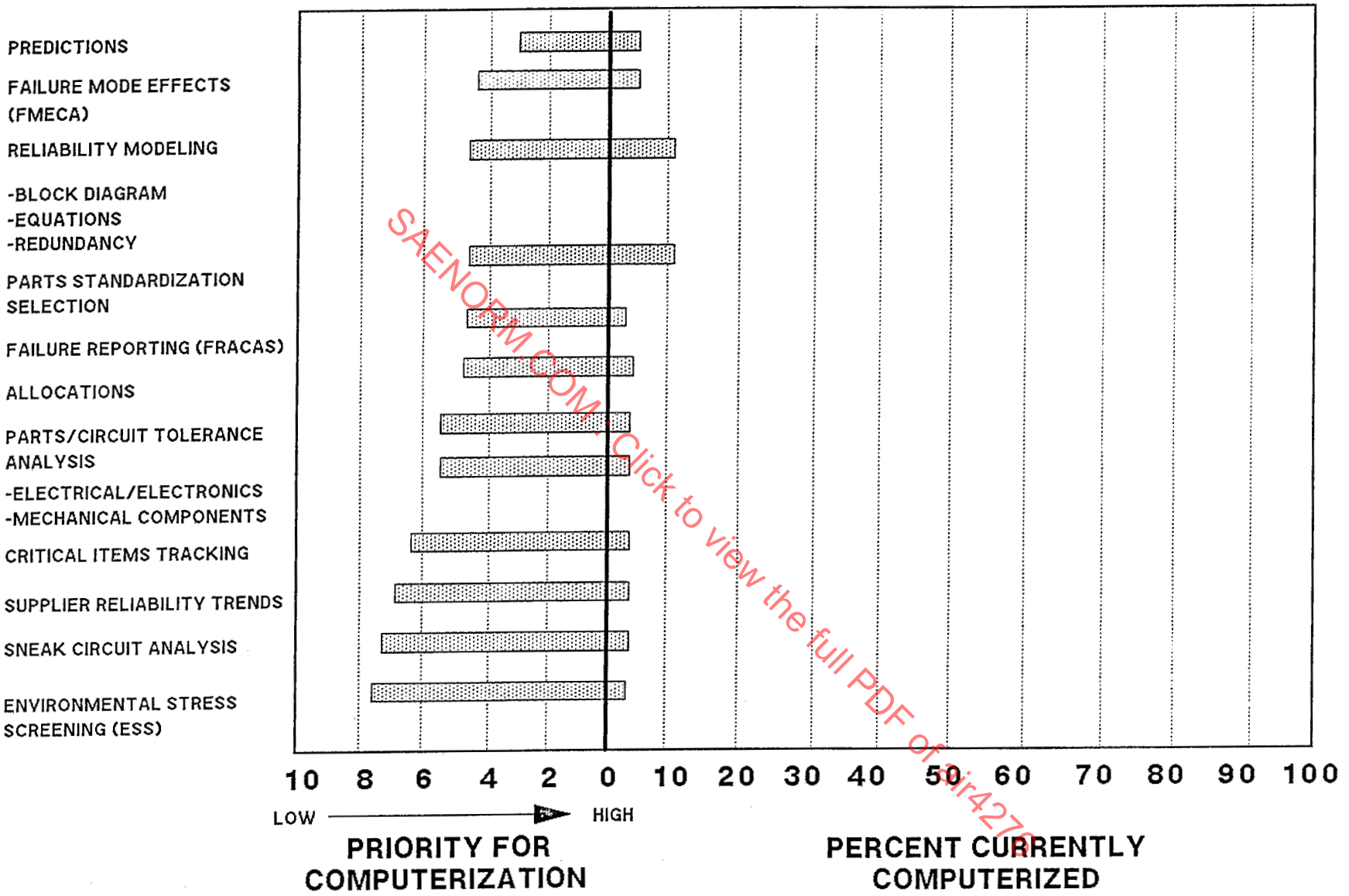

FIGURE 13 – Reliability Tasks Electronically Integrated

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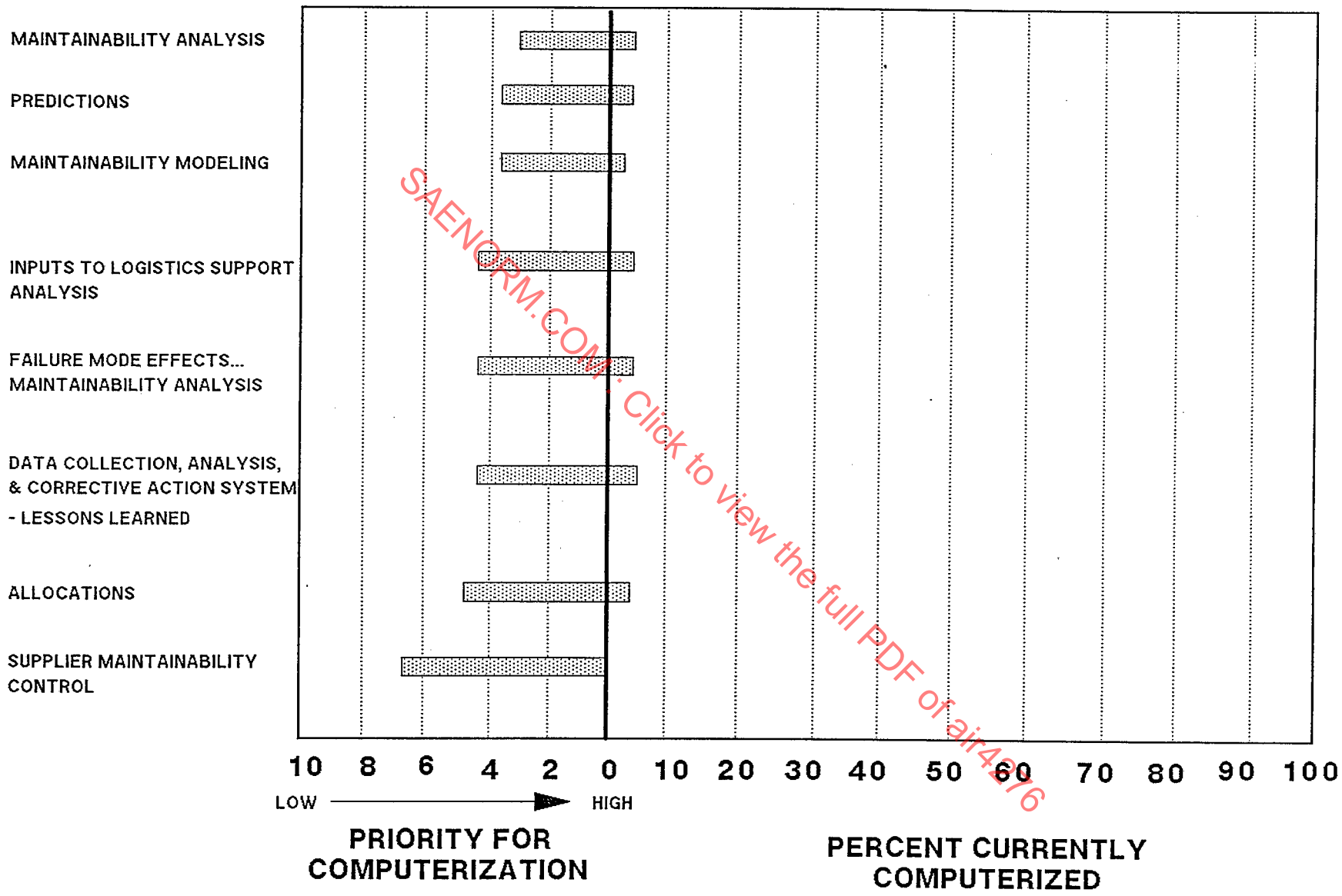

FIGURE 14 – Maintainability Tasks Electronically Integrated

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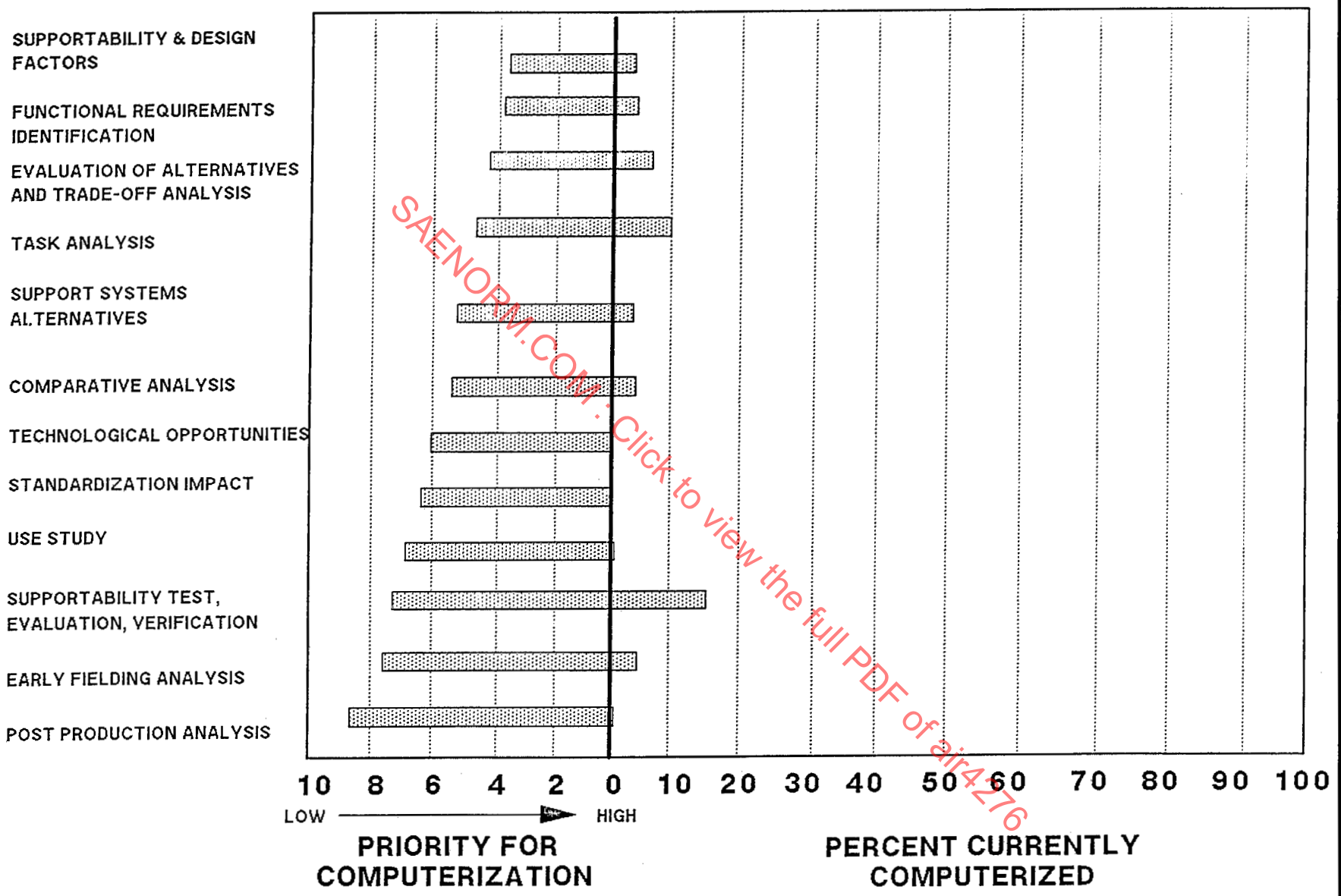

FIGURE 15 - Supportability Tasks Electronically Integrated

TABLE 1

PRIORITY FOR COMPUTERIZATION	PRIORITY FOR INTEGRATION
RELIABILITY	
PREDICTIONS	PREDICTIONS
RELIABILITY MODELING	FAILURE MODE EFFECTS & CRITICALITY ANALYSIS (FMECA)
FAILURE REPORTING (FRACAS)	RELIABILITY MODELING
FAILURE MODE EFFECTS & CRITICALITY ANALYSIS (FMECA)	PARTS STANDARDIZATION
ALLOCATIONS	FAILURE REPORTING (FRACAS)
PARTS STANDARDIZATION	ALLOCATIONS
CRITICAL ITEMS TRACKING	PARTS/CIRCUIT TOLERANCE
PARTS/CIRCUIT TOLERANCE	CRITICAL ITEMS TRACKING
SUPPLIER RELIABILITY TRENDS	SUPPLIER RELIABILITY TRENDS
ENVIR. STRESS SCREENING (ESS)	SNEAK CIRCUIT ANALYSIS
SNEAK CIRCUIT ANALYSIS	ENVIR. STRESS SCREENING (ESS)
MAINTAINABILITY	
MAINTAINABILITY ANALYSIS	MAINTAINABILITY ANALYSIS
PREDICTIONS	PREDICTIONS
MAINTAINABILITY MODELING	MAINTAINABILITY MODELING
INPUTS TO LSA	INPUTS TO LSA
DATA COLLECTIONS, ETC.	FAILURE MODE EFFECTS & CRITICALITY ANALYSIS
FAILURE MODE EFFECTS & CRITICALITY ANALYSIS	DATA COLLECTIONS, ETC.
ALLOCATIONS	ALLOCATIONS
SUPPLIER MAINTAINABILITY CNTL	SUPPLIER MAINTAINABILITY CNTL
SUPPORTABILITY	
TASK ANALYSIS	SUPPORTABILITY/DES. FACTORS
EVAL. OF ALTERNATIVES	FUNC REQMTS IDENTIFICATION
SUPPORTABILITY/DES. FACTORS	EVAL OF ALTERNATIVES
FUNC REQMTS IDENTIFICATION	TASK ANALYSIS
SUPPORT SYSTEMS ALTERNATIVES COMPARATIVE ANALYSIS	SUPPORT SYSTEMS ALTERNATIVES COMPARATIVE ANALYSIS
STANDARDIZATION IMPACT	TECH OPPORTUNITIES
TECH OPPORTUNITIES	STANDARDIZATION IMPACT
USE STUDY	USE STUDY
EARLY FIELDING ANALYSIS	SUPPORTABILITY TEST, EVAL, VERIFICATION
SUPPORTABILITY TEST, EVAL, VERIFICATION	EARLY FIELDING ANALYSIS
POST PRODUCTION ANALYSIS	POST PRODUCTION ANALYSIS

4.3 General: The General section of the survey was structured to determine the areas of the greatest perceived improvement from the automation of RM&S into the design process. The survey asked respondents to indicate whether they believed automation of RM&S into the design process would provide benefits in a wide range of product elements, e.g., productivity, readiness, etc. They were asked to consider these elements from their organization's and customer's perception. General opinion on subcontractor activity was also solicited.

The responses to this survey section indicated that industry is, in general, more optimistic than government about the breadth and degree of design process improvement that RM&S automation would yield. Fig. 16 shows the seven primary elements within the industry environment that could improve. It can be seen that approximately 80% of the industry respondents thought that, overall, all elements would be improved in contrast to roughly 60% of government respondents. Fig. 17 shows the four primary elements within the operational environment that could improve. Approximately 82% of the industry respondents in comparison to 66% of the government said that these key elements would improve. These figures indicate that there is general agreement that benefits will result from automation. When asked about the role of subcontractors in automation the respondents (90%) strongly indicated that they should also automate RM&S in design but, stated that only 20% or less of their subcontractors are currently integrated (Fig. 18).

In summary, most respondents saw greatest industry improvement in the area of productivity, end product RM&S, and in-process work. They also saw operational improvements in RM&S, readiness, and operations and support costs.

5. CONCLUSIONS:

Upon review of the survey results the following conclusions were reached:

a. CALS policies and plans are emerging at large organizations dealing in military sales. Their policies and plans are bringing about the development of common company data bases for RM&S and design data.

b. Computerization of RM&S tasks is being accomplished; however, there is currently a limited amount of electronic integration of these tasks.

c. The respondents generally agreed definite improvements in the industry and operational environment would result from CALS implementation. Industry was noted, however, to be more optimistic on the degree of improvement than government.

d. It is also apparent from the survey results the respondents perceive that their subcontractors have done little, if any, automation of RM&S into design. They feel there is a need for subcontractors to automate their process.

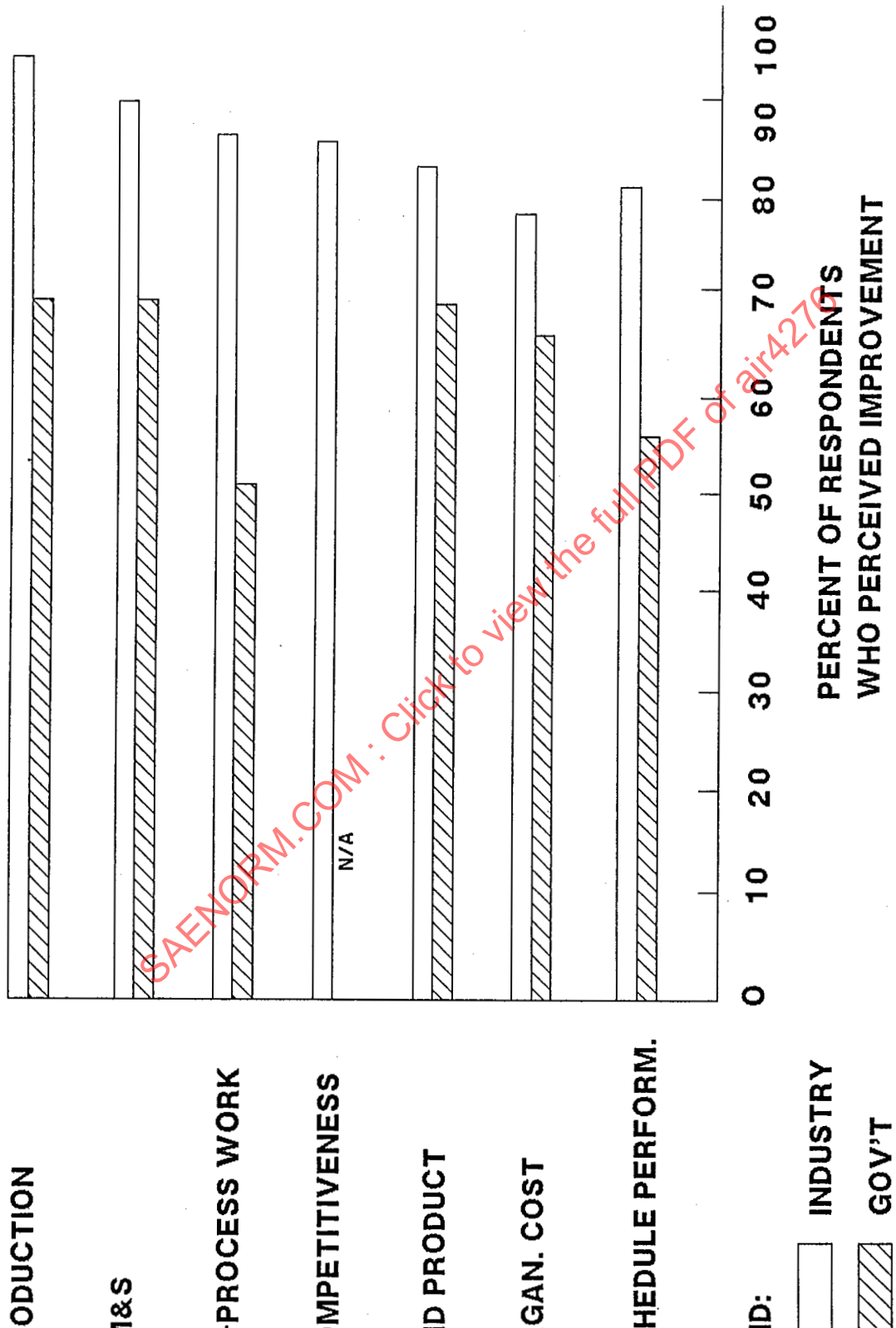

FIGURE 16 - Perceived Areas of Greatest Improvement Through Automation of RM&S in Design

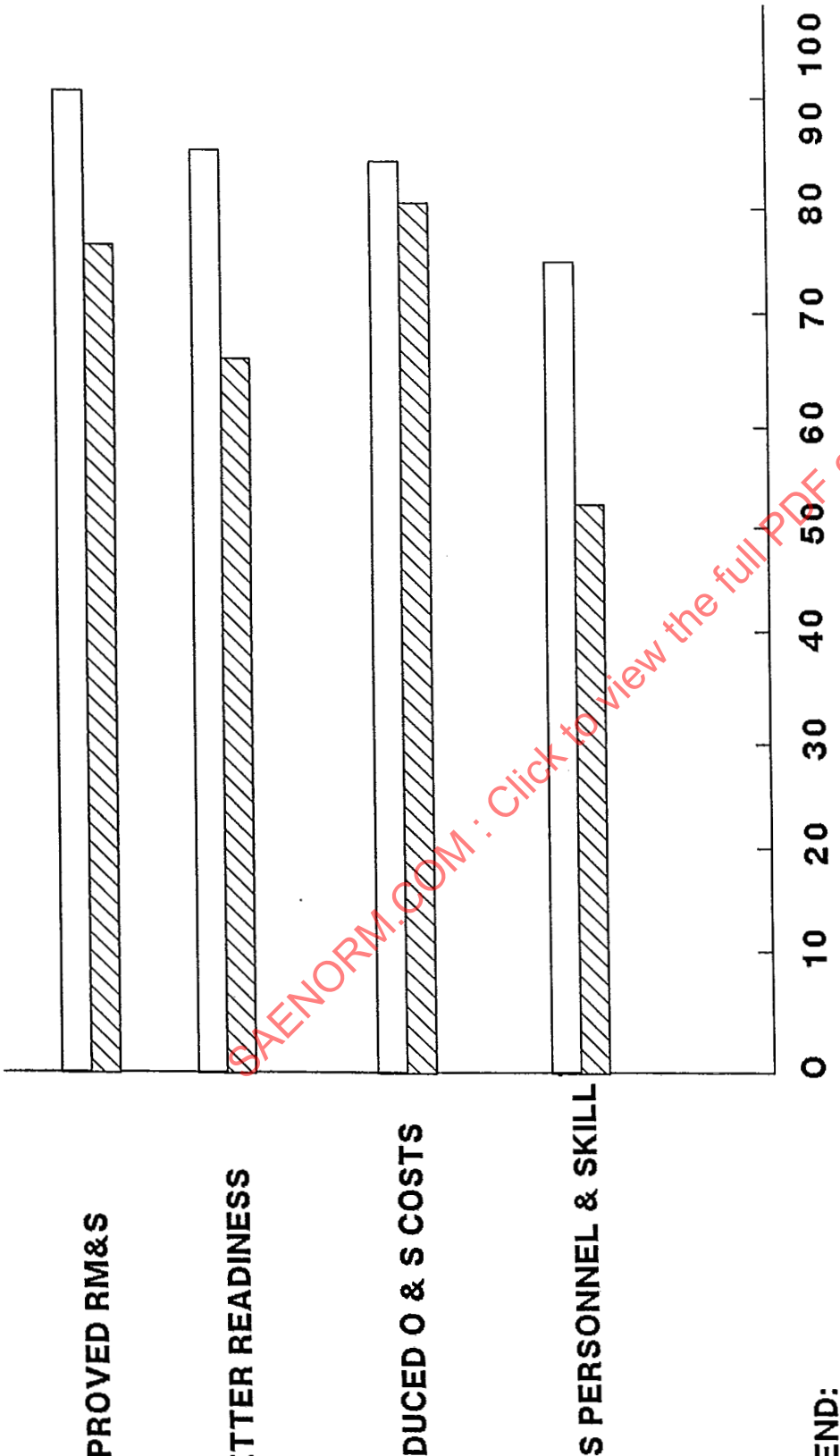

FIGURE 17 - Perceived Government Viewpoint of Automating RM&S in Design

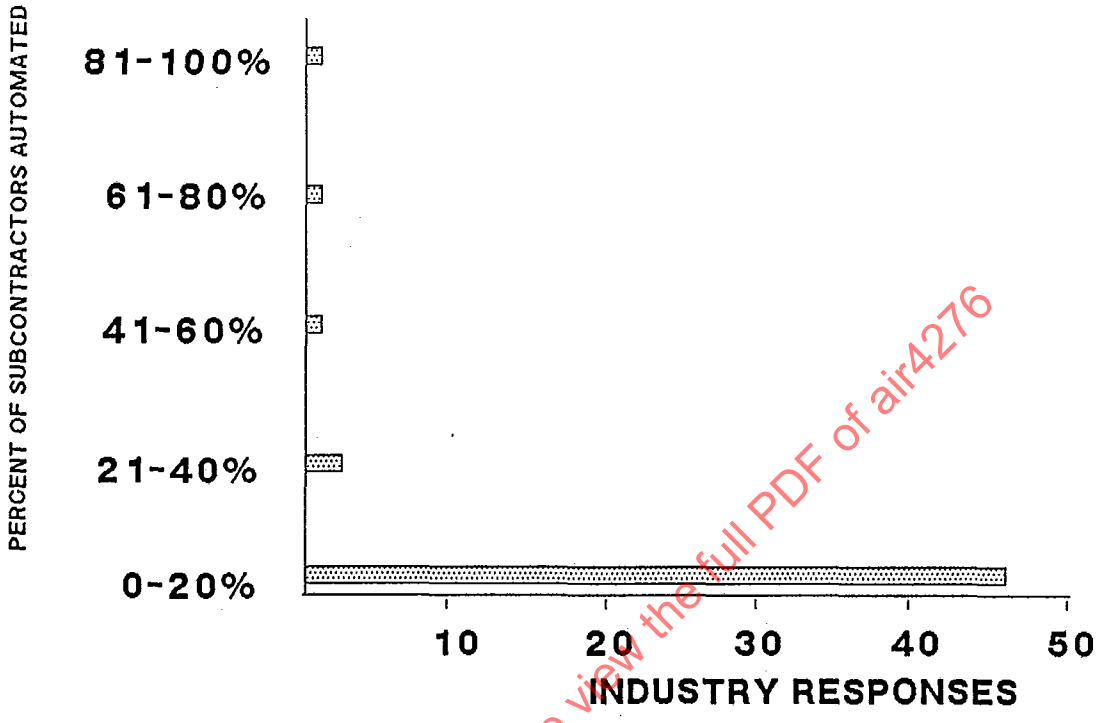

FIGURE 18 - Subcontractor RM&S Automation

6. RECOMMENDATIONS:

Based on the assessment of the results of the "Computerization of RM&S in Design" survey the following recommendations are provided:

a. Accelerate development of a formalized company CALS policy to provide a positive direction for satisfying this initiative. It is further recommended that CALS become part of an organization's operational procedures and structure.

b. Expedite implementation of CALS to improve competitive position and product supportability.

c. Use the priorities for task computerization and task integration as identified in the survey (TABLE 1) as guidelines for CALS implementation.

d. Encourage automation of subcontractor RM&S process in design.

e. Place greater emphasis on electronic integration of RM&S tasks.

APPENDIX A

SAMPLE SURVEY TO DETERMINE

THE

COMPUTERIZATION OF

RELIABILITY, MAINTAINABILITY, & SUPPORTABILITY

IN DESIGN