COMMERCIAL AND STANDARDIZATION EVALUATION (CASE) TOOL

Final Technical Report
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TABLE OF CONTENTS

1.0 INTRODUCTION

For years the Department of Defense (DoD) has maintained its weapon systems with military standard parts. These parts were readily available from commercial contractors who supported the DoD in this effort. In the past few years, the DoD has had great difficulty in obtaining these parts because the DoD is no longer a major customer. To solve this problem, the DoD has embarked on a program to increase the use of commercial parts in military applications if possible.

As the DoD continues to shift to an acquisition policy that demands a larger number of commercial grade components, greater pressures have been applied to the designer and logistician to understand the ramifications of implementing non-military parts into new and existing weapon system designs. One area of utmost concern when shifting from military standard (MIL STD) to commercial-off-the-shelf (COTS) technology is that of microelectronics. Not only has the acquisition reform movement steered DoD in this direction, but the growing problem of obsolescence has made many MIL STD microelectronic parts impossible or cost prohibitive to obtain. Increased demands from the commercial sector for advanced microelectronics have driven many manufacturers away from the defense sector. Estimates of the military share of the microelectronics market now stand at less than one half of one percent. This has translated into an environment where most manufacturers are unwilling to adapt their product lines to meet the rigorous specifications of the military.

This standardization effort sought to develop a structured methodology and software tool to evaluate candidate spare parts for commercialization and standardization potential. Although the DoD has issued the requirement to insert commercial technology into both new and legacy weapon systems, there are no effective tools for the integrated product team (IPT) to use so that maximum efforts can be focused on the most promising COTS solution. The purpose of this research and development effort was to develop a methodology to aid the designer in identifying a replacement COTS part as a substitute for an unavailable MIL STD electronic part. To complete this effort an engineering practice was established to document and standardize the method by which a MIL STD electronic part could be analyzed for potential COTS replacement. To support this practice, the Commercialization and Standardization Evaluation (CASE) software tool was developed

The CASE tool presents a set of structured queries to the IPT in such a manner as to take known information about the design and determine its appropriateness for commercial technology insertion. The methodology and supporting software tool will not only assist the team in selecting candidates for commercial item utilization, but will also provide a mechanism to facilitate standardization of spare parts in the weapon system modernization and sustainment process. By capturing key design parameters in a structured database format, IPT engineers and logisticians can communicate their requirements with industry and other government agencies in a more effective manner.

The CASE tool, which embodies the methodology, supports the user in a logical approach to using commercial parts in military applications. It addresses a number of factors that must be considered to minimize any electronic system degradation that would impact weapon system readiness. Many vendors within the microelectronics industry were contacted and technical literature was studied in order to obtain information used in developing this approach for using commercial parts in military applications.

2.0 OBJECTIVE

It is possible to find some commercial parts that are functionally equivalent to military components; however, the military parts usually have more stringent environment requirements. These include temperature range, radiation, and moisture. It is still possible to make direct substitutions provided the commercial parts are properly screened or the environment requirements are modified to accommodate system needs. However, these direct replacements must be undertaken with knowledge and caution. The system readiness is extremely dependent upon the flawless functioning of its associated electronics. Hence, the overall objective of this effort was to outline for the novice engineer, logistician or procurement specialist the procedures required before a commercial piece part replacement can be made.

The detailed objectives of the CASE program were:

- To investigate the use of commercial piece parts as replacements in legacy Army weapon systems.
- To identify all relative parameters and determine the necessary processes for choosing the right replacement part.
- To develop the CASE software to serve as a decision support tool to aid in the implementation of the process for choosing a replacement commercial part.

3.0 BACKGROUND

3.1 Military Standard Parts

For years the Army could support its weapon systems by readily purchasing parts that met military specifications. This was partly because the DoD was a major customer in the electronics components field. However, during the late 1970's an explosion of electronics goods in the commercial sector attracted many manufacturers away from supporting the military. Also, due to the end of the Cold War, military budgets were reduced significantly, leading to the decision to keep weapon systems in the field longer. As the century came to an end, the military was considered an insignificant customer for the electronics industry.

To illustrate this point, in 1970 the military commanded about 10 percent of the electronics market share. Thirty years later, in the year 2000, it is projected that the military share will be about 0.03 percent. Because of this, electronics manufacturers concentrate their sales on the commercial market. The military IC expenditures in the year 2000 are estimated to be $1.1 billion, relatively insignificant compared to the consumer market of approximately $300 billion.

3.2 Parts Obsolescence and Potential Solutions

One of the most critical logistics problems facing the military is the enormous expense of maintaining electronics-based weapon systems in the face of rapidly advancing technology, with the associated rapid parts obsolescence. For example, the Aegis weapon system was designed in the mid-1960’s and fielded in 1978. At fielding, over half of the products that went into the design no longer existed. That took 15 years. Today, the same effect can take place in 4 years.

In this new century, system sustainment concerns have changed dramatically. The increase in technology growth has been exponential. New technologies are being developed and old ones dropped at a rapid pace. For example, 5-volt technology has peaked, 3-volt is here; 2.5 volts and 1-volt systems are coming. In fact, every manufactured IC will undergo a fabrication move or wafer diameter change or electrical design change or shrink or package materials/process change or some combination within 3 years. Manufacturers only support data sheet and intended market requirements. This will seriously affect future obsolescence problems. This is coupled with a declining military budget and a commercial electronics industry that decides future development directions.

In this new environment the DoD has to find a way to keep its weapon systems supplied with electronic parts for lifetimes of as long as 30 years. This is not a trivial problem. The choices are limited and as follows:

- Find a replacement MIL STD part.
- Establish a means of ensuring the fabrication and supply of the part.
- Buy the part from after-market suppliers.
- Use commercial industrial-grade parts.
- Redesign the board with latest technology.

No single option from the above list will be adequate. In order to maintain readiness a combination of the above solutions will be required to sustain the system.

3.2.1 Replacement Parts

Finding an acceptable MIL STD part replacement is the most cost-effective solution. Searching for a substitute part is the usual path taken. However, this is very time consuming and requires engineering knowledge. There are limited military parts that can be substituted for others. Unfortunately, even when a part is found to be acceptable, there is a good chance that it will have a very limited quantity available before it too becomes non-procurable.

3.2.2 Establish Means of Fabricating Supply of Parts

Although it can be done, establishing the means to have the microelectronic parts continue to be manufactured is very costly and puts the military into a business that takes it away from its real mission. The problem is much more complex than it may at first seem. If the government establishes a means to continue to manufacture the exact device, testing will be required to insure an acceptable product. The newly fabricated parts must be an exact replication of the original device; the manufacturer must not do anything to change the system or the required component parameters might be changed. Even an improvement in either the system's or the component's functionality may be unacceptable.

Another potential problem with this approach is the supply of raw materials that must be maintained. The same grade of silicon must be available; newer and purer materials often are not acceptable. It is also likely that a ready supply of the older packages must remain available. Except in the most critical cases, it is not clear that the added problems and costs justify the continued supply of the obsolete parts.

3.2.3 After-Market Suppliers

When a device is discontinued the manufacturers usually give warning and the government then has a chance to make a lifetime buy. Because of underestimating the future needs and limited budgets, these buys are frequently inadequate to meet the future demands for the part. When this occurs an after-market supplier may be a viable solution. After-market companies fill the void by assuming the manufacture and supply of discontinued parts. They provide a relatively risk-free albeit expensive solution to the obsolete parts problem. However, this process only remains risk free until additional capability is required, i.e., the legacy hardware is out of processing power, out of memory, or simply too old and slow.

3.2.4 Commercial Parts

Since the military parts market is shrinking, it is imperative that the original equipment manufacturer's (OEM's) establish a means to use commercial piece part devices in weapon system design. As long as an acceptable commercial replacement part can be found, it is a satisfactory solution to the growing obsolescence problem. While, in theory, replacing unavailable military parts with commercial spare parts is a good idea, the implementation is quite complex. It is not sufficient to just match the functionality of the part; environmental specifications also must be met.

3.2.5 Board Redesign

Board redesign is very costly and is considered only as the last solution. When a board contains many parts that are unavailable due to obsolescence, the redesign approach may be the only solution for sustainment. If this is the case, new board design should use the latest technology to reproduce the original functionality of the assembly. Given unlimited funds, board redesign may be the best long-term solution to the problem. However, in the short-term, other solutions usually save time and money.

4.0 TECHNICAL APPROACH

The technical approach for this project was to develop a systematic method to address inserting commercial microelectronic devices into military applications. The initial analysis indicated that a decision support tool would be a worthwhile endeavor in addressing this issue. With this premise a high-level logic diagram was generated, thereby allowing the design team to illustrate and verify the logical methodology to be used in the software development. This also gave the developers an opportunity to ensure that all elements were considered in the design process.

To determine the CASE logic, a detailed evaluation of the technical barriers to substituting commercial parts for obsolete or no-longer-available military parts was undertaken. The results of this evaluation were applied to the development of the CASE tool. Since a direct substitution of a COTS component is rarely possible because of operating environment differences, techniques were investigated that could allow the user to make the candidate commercial part conform to the military requirements. While it is possible for the CASE software tool to be used by designers attempting to use commercial parts in place of military parts in a new design, the focus of the software design has been on the substitution of commercial parts into legacy systems.

4.1 Differences Between Commercial Parts and Mil-Std Parts

The DoD has come to the realization that in order to ensure a continuous supply of electronics parts it must start replacing military standard parts with commercial parts wherever possible. These parts are not only readily available because of high consumer demand, but because of the large number being manufactured they are also relatively inexpensive.

The replacement of military parts with commercial parts in legacy systems is possible as long as some important environmental factors are addressed. The operating environment of the military part must be analyzed to ensure that the lower-rated commercial parts can be used. Although the technique is not straightforward, there are techniques that can be used to adapt the commercial part to the military environment. It must also be said that there will be some cases where a substitution is not possible.

Although the DoD has issued the requirement to insert commercial technology into new and legacy systems, there has not been much effort in developing a process to execute this DoD requirement for legacy systems. Before a methodology and support software could be developed, the major differences between commercial and military parts were investigated in detail. The four most compelling factors are as follows:

- The major difference between commercial and military devices is the environmental requirement. The MIL STD devices can operate across a wider temperature range.
- Resistance to radiation is another important difference. Certain technologies have inherent built-in protection while others must be resolved through system design.
- The adverse effect of moisture, particularly in aviation and missile systems, is a major consideration. Since commercial parts make greater use of plastic packages, there is a much greater susceptibility to moisture and hence system degradation.
- The device speed of the original MIL STD part versus the replacement part must be evaluated. While the new devices are faster than the old, the minimum speed of the new devices must be considered.

Aside from these four requirements, the commercial devices usually operate functionally the same as MIL STD devices. The manufacturers of consumer electronic parts are primarily concerned with short-term reliability and low manufacturing costs. Reliability is achieved through advanced processing controls while the costs are kept low because of the large volume demanded by the consumer market. Manufacturers of commercial parts have little concern about operating temperatures outside the 0 – 70^{o} C range, nor are moisture, radiation or temperature cycles issues.

4.1.1 Operating Temperatures

Differences in operating temperature ranges can be addressed by reducing requirements or developing system design modifications, e.g., fans, which maintain an environment that allows commercial devices to be used. Electronic parts fall into three general categories:

- Commercial grade: 0 degrees C to 70 degrees C
- Industrial grade: -40 degrees C to 85 degrees C
- Military grade: -55 degrees C to 125 degrees C

Although the COTS device does not meet the high military design requirement for temperature, there are design techniques that can be implemented that could allow the COTS component to function acceptably within the military environment. These are:

- Heat rails
- Fan and heat rails
- Cold plate
- Forced air chamber
- Heaters and thermostats

For a specific weapon system, the environmental requirements at a particular piece part location may not be as severe as the overall weapon system environmental requirements. The designer should perform a thermal analysis to ensure that the assembly is not over-specified.

4.1.2 Radiation

Although radiation damage to electronic devices is a serious concern, it is not a problem for most military systems. Radiation shielding or hardening will be a requirement for military systems that may be subjected to nuclear explosions or high-energy weapons. Radiation requirements are typically at the system level. This is true for systems such as the Multiple Launch Rocket System (MLRS), which must be capable of surviving a nuclear event.

Electronic devices are more susceptible to radiation damage during a nuclear event while power is applied to the electronic parts. Systems such as the Army's MLRS meet radiation hardening (rad hard) requirements in essentially two ways:

1) Inherent in the design of the piece part.
2) Removing power from the devices through a nuclear detection circuit.

Based upon meeting the requirements stated above, commercial electronic devices are acceptable replacements for meeting the radiation requirements. The design or redesign must be evaluated to determine if the commercial item is a viable alternative.

4.1.3 Moisture

One of the primary differences between commercial electronics and MIL STD electronics is in their method of packaging. Typically MIL STD electronic devices require hermetically sealed ceramic packages while the commercial equivalent often relies on plastic encapsulation. The epoxy material used within the commercial world is susceptible to water vapor intrusion. Although there are R&D efforts ongoing to research methods for coating plastic parts, such as the Army's "Development of Plastic Encapsulated Microcircuit (PEM) Coating Processes for Military Applications" MANTECH project, moisture remains a significant barrier to commercial part usage.

The evaluation of each application must assess the use of plastic instead of ceramic packaging as it relates to the intrusion of moisture. Aside from the immediate effects of moisture on the part, the threat of moisture can have an effect on the long-term storage of the part. If the part is going to be in frequent use, the problem of moisture can be reduced due to the heat generated during system operation, which tends to have a drying effect on moisture.

The viability of using commercial electronics within a weapon system often concentrates on the adverse effects of moisture on the system's performance. The resolution of this issue has stirred significant controversy within DoD and is well beyond the scope of this task. For simplicity reasons, this project categorized weapon systems into three distinct areas: ground support equipment, missiles and aviation systems. The decision of whether commercial electronics are feasible in large part depends upon which type system is being analyzed. Ground support systems are much more likely to be amenable to the use of commercial parts. Since these systems can be operated periodically, moisture is essentially “dried out” of the electronics. Missile systems, with their long-term storage requirements, do not enjoy this same attribute. Aviation systems, although they can also be operated periodically, are also more susceptible to catastrophic failure due to their operating environment. In other words, should the electronics on ground support equipment malfunction there is not an immediate and deadly crash of the system.

During the design of the supporting CASE tool it became obvious that this software could be used to address commercial part usage for any application since the two basic differences were temperature and moisture intrusion. However, the scope of the effort did not include an in-depth analysis of the effects of moisture on aviation or missile systems. The software does include an obvious “hook” whereby this information could be added as it becomes more widely accepted within the DoD community.

4.1.4 Device Speed

When replacing an obsolete military electronic part with a newer commercial item, the logistics technician must compare the speed of the old part with that of the new one. It is not necessarily true that faster is better. Below is an example of the problems that can occur when a new faster part is used to replace an old slower part:

> The original designer has used the slow speed of the original part to ensure that a signal arrives at a subsequent stage at the proper time. Since the replacement part is faster, the signal will now arrive at the subsequent part earlier causing the system to malfunction.

Therefore, before accepting a replacement part that is faster than the original, the technician must perform an analysis to ensure design margins have not been compromised with the faster device.

5.0 RESULTS

5.1 Description of CASE Tool

The CASE tool was developed to provide knowledge and understanding to the engineer or logistics technician when attempting to replace military-grade electronic parts with commercial-grade substitutes. This procedure is not simple nor does it guarantee a solution, but, for the first time, technical personnel experiencing parts replacement problems will have a systematic approach for solving the problem.

The software is a user-friendly, Windows-based application and does not require a user's manual to operate. There is one important point that must be understood, however. Since the database is continuously changing and old parts are becoming unavailable at a fairly rapid pace, the database should be periodically updated.

The initial action of the CASE tool is to perform a search of the U.S. Army Aviation and Missile Command (AMCOM) master database to determine if potential commercial replacement parts have been previously identified for the user-provided MIL STD part. The user is led through the process until a replacement part is found or the user is informed that none exists. The user is also advised on methods to modify the operating environment or screen commercial parts in order to arrive at an acceptable substitute for the military-grade part.

5.2 Ground Rules

In the completion of this project there were ground rules and assumptions established that served as the foundation for the software development. These were needed so that the limitations of the software would be understood and the tool would not be misused. Some of the more important rules are as follows:

- Any part replacement identified by the tool has essentially the same functional characteristics as the original part, except for the environmental characteristics.
- The silicon chip processing for the replacement part is essentially the same as that for the original part.
- Any replacement device inserted into a weapon system must be tested at various levels to insure no system degradation.
- Documentation changes must be done to maintain configuration control.

Although the DoD allows the use of COTS parts where applicable, their use in a legacy system immediately violates that system's requirements document. Because of this the replacement part must not only provide the required functionality, but it must not cause any significant degradation in the operational performance of the weapon system.

One of the important findings of this study has been the fact that the only apparent difference between military and commercial parts is the range of temperatures over which the part operates. The military parts operate over a greater range. Therefore, as a first cut, the search begins by finding commercial parts that meet the functionality requirements of the military part, even though the specified temperature range may not be acceptable. Before taking action to adjust for the temperature range difference, the environment of the part to be substituted should be realistically evaluated. It may be that the particular location of the board does not experience high temperature. Also, the particular system may always be in a temperature-controlled room. In this case, it is important not to over specify the replacement part. This will allow a broader range of commercial devices to be considered for insertion.

Since integrated circuit design at the silicon level (die/wafer) is essentially the same for all families of silicon devices, the major specification differences between the commercial grade part, industrial grade part and the military grade part are the environmental temperature limits. As previously stated, the temperature range of the various categories of microcircuit are classified as follows:

- Commercial grade: 0 degrees C to 70 degrees C
- Industrial grade: -40 degrees C to 85 degrees C
- Military grade: -55 degrees C to 125 degrees C

Although each of these parts is guaranteed by the manufacturer to operate in the stated temperature range, some of the parts can actually exceed the temperature range. When the I/C manufacturer specifies a narrow temperature requirement for commercial parts, i.e., 0 to 70 degrees C, the manufacturer's yield increases, thereby lowering the associated unit cost. Given this premise, commercial parts can be applied to specific military application functions if proper temperature screening and design considerations are applied. The designer must assess system degradation, if any, to ensure system readiness is not compromised.

Because the commercial world makes great use of plastic encapsulated module (PEM) packaging, care must be used when substituting these parts for those having ceramic packaging. There are two problems that can occur:

- PEM package chips can have trapped moisture from fabrication or can develop moisture over time. If the intended environment is warm and dry, e.g., the board is operational for long periods of time, it may be possible to minimize the problem.
- Proper soldering techniques must be followed when installing the PEM chip on the board. The heat from the soldering process could damage the device.
- If the replacement device is going to be put into long-term storage, there may be a problem with long-term reliability.
- Another potential problem is the differential expansion of the part and the board. Because of mounting techniques and different coefficients of expansion of plastic versus ceramic, a plastic part could be damaged with cycling temperatures.

5.3 CASE Tool Operation

When first entering the CASE tool, the user is presented with a choice of reading a Project Summary, reading a Program Summary, starting the program, or viewing the project final report. The format of this screen is shown in Figure 1.

Figure 1 – CASE Tool Opening Screen

5.3.1 Project Summary

Selection of the **Project Summary** option will display an information screen that will explain the details of the project that led to the development of the CASE software.

5.3.2 Program Summary

Upon selection of the **Program Summary** option, an information screen, Figure 2, will explain the use of the CASE program and provide details for the efficient utilization of the tool. The user will have the option of selecting an appropriate help topic from a menu, and will be provided with tips and hints on how to optimize the use of the software. From this screen, the user may choose to return to the main (option) menu, proceed to the search menu, or exit the program.

Figure 2 – Program Summary Screen

5.3.3 Search for Replacement Part

When the user chooses the **Program Start** button, an interactive screen, Figure 3, is presented that begins the search process. The user must enter the original manufacturer's part number of the military part to be replaced along with the maximum and minimum operating temperatures (if known). When the **Search** button is selected, the tool will search the database and select zero to five candidate commercial replacement parts.

If the user does not know the entire part number of the military part, a wild card entry can be used. This is accomplished by entering the first part of the number followed by an asterisk (*) to indicate the entry as a wild card. For example, the part number 5962* might be entered if only the first four numbers are known. The tool will then search for all listed parts that begin with the requested number. The results of this search will appear as shown in Figure 4. By selecting the arrow next to the part number, a pull down menu will list possible parts that meet the requirements of the input.

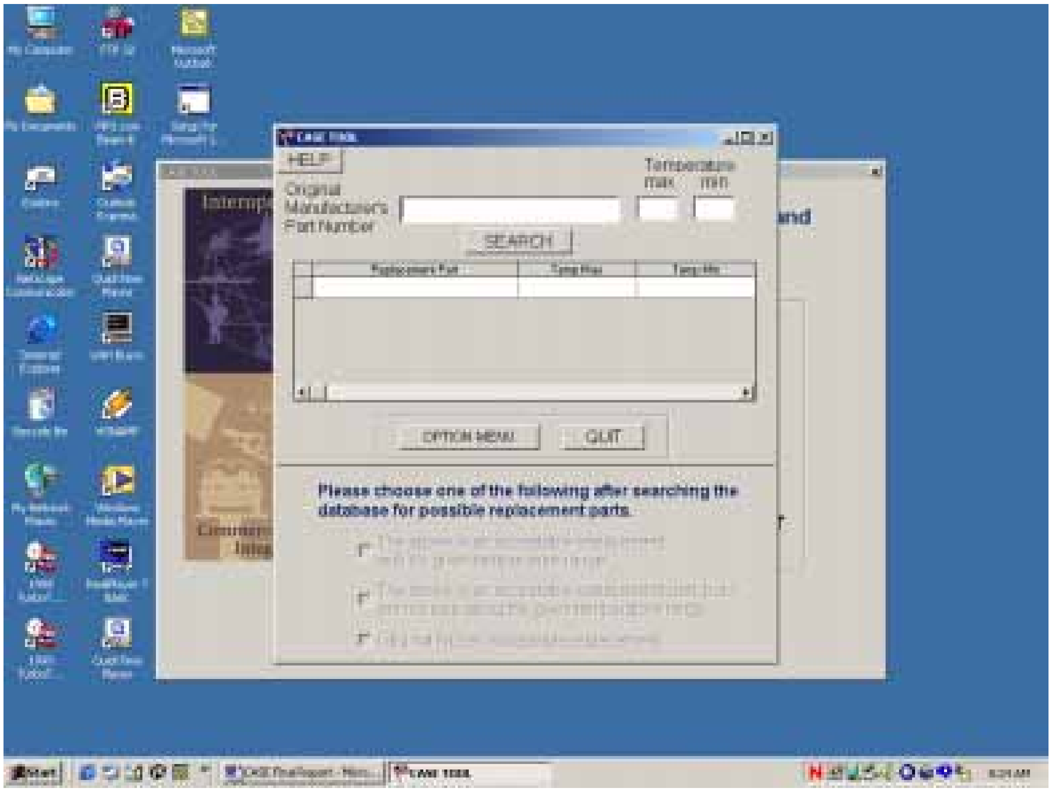

Figure 3 – Program Start Screen

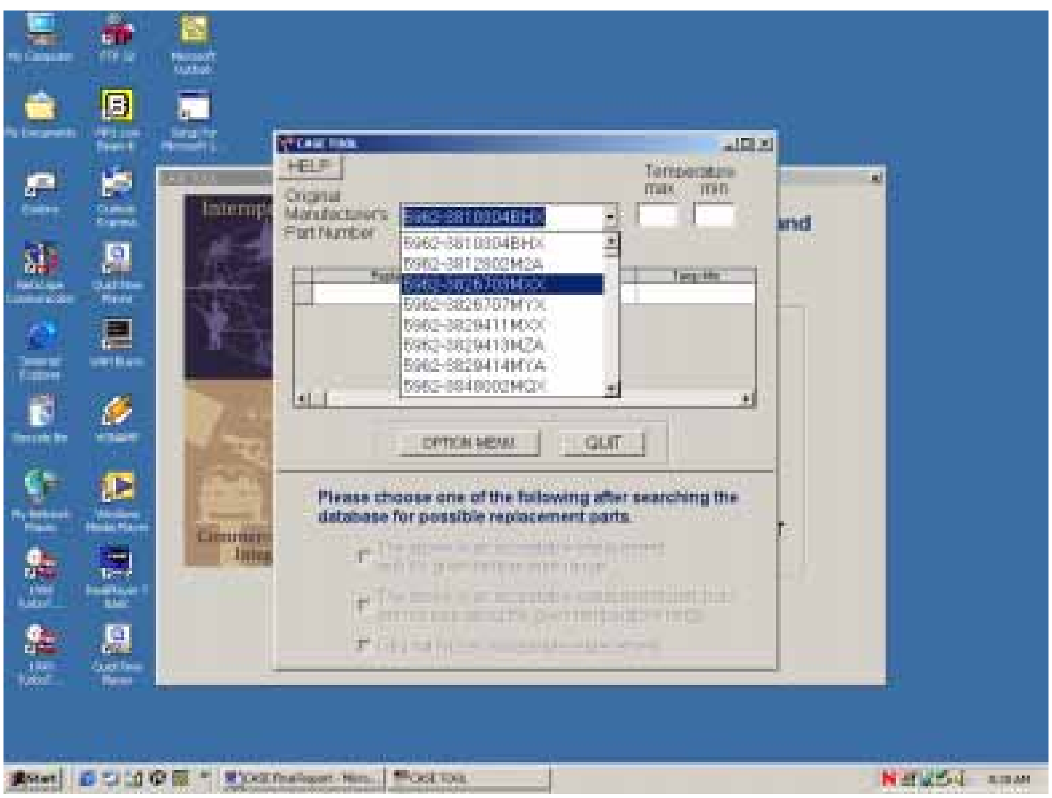

Figure 4 – Part Identification Screen

To illustrate this example, assume that the user decides that the part in question is the second part listed, 5962-3812802M2A. When this part is selected, the tool will search for candidate commercial parts to be considered. The results of that search are shown in Figure 5.

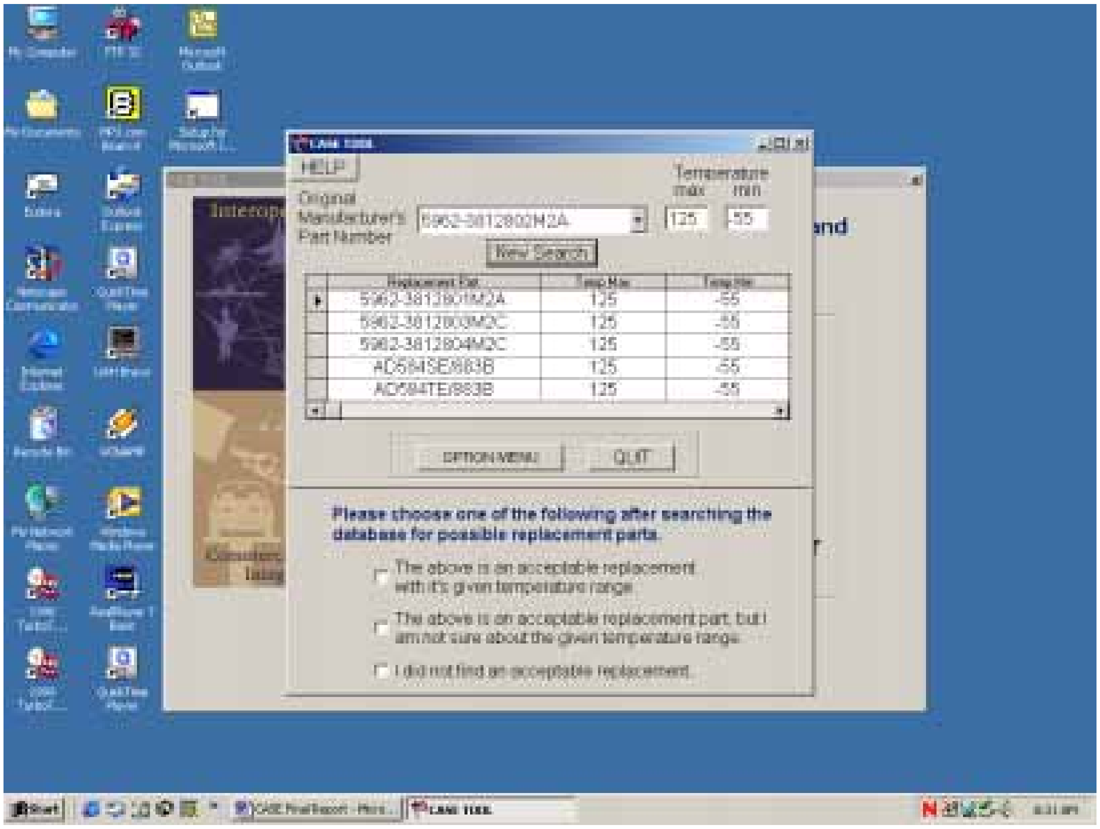

Figure 5 – Selected Candidate Screen

The tool now presents the user with five possible choices for substitution for the original part. Note that all the presented candidates meet the required temperature range requirements and, therefore, any one of them could be acceptable.

The lower section of the screen provides the user with various options. Selecting one of these options will continue to move the user through the selection process. The user can decide:

- At least one candidate part is acceptable.
- At least one candidate part is acceptable with reservations about temperature range.
- An acceptable part was not found.

In the example case, a number of potentially acceptable parts were found so the first option was selected. The software then proceeds to the Radiation Screen (Figure 6) so that the candidate part can be further examined.

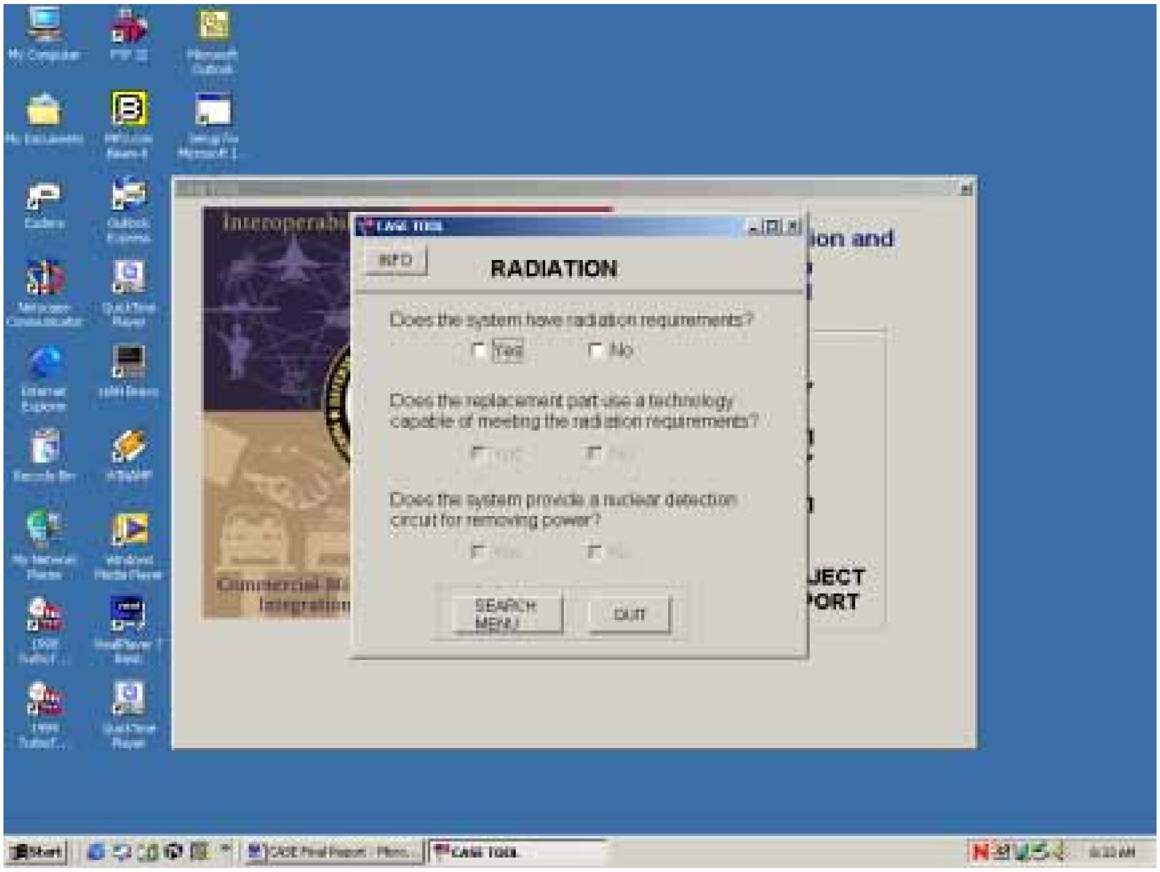

Figure 6 – Radiation Screen

5.3.4 Replacement Not Exact

For a case where the user knows the part number of the part to be replaced, the process is much easier. As a further illustration, assume the original manufacturer's part number is LTC6901S8. It has a temperature range of 125 degrees C maximum and –55 degrees C minimum. After entering the part number, the tool selects four possible replacement candidates (Figure 7).

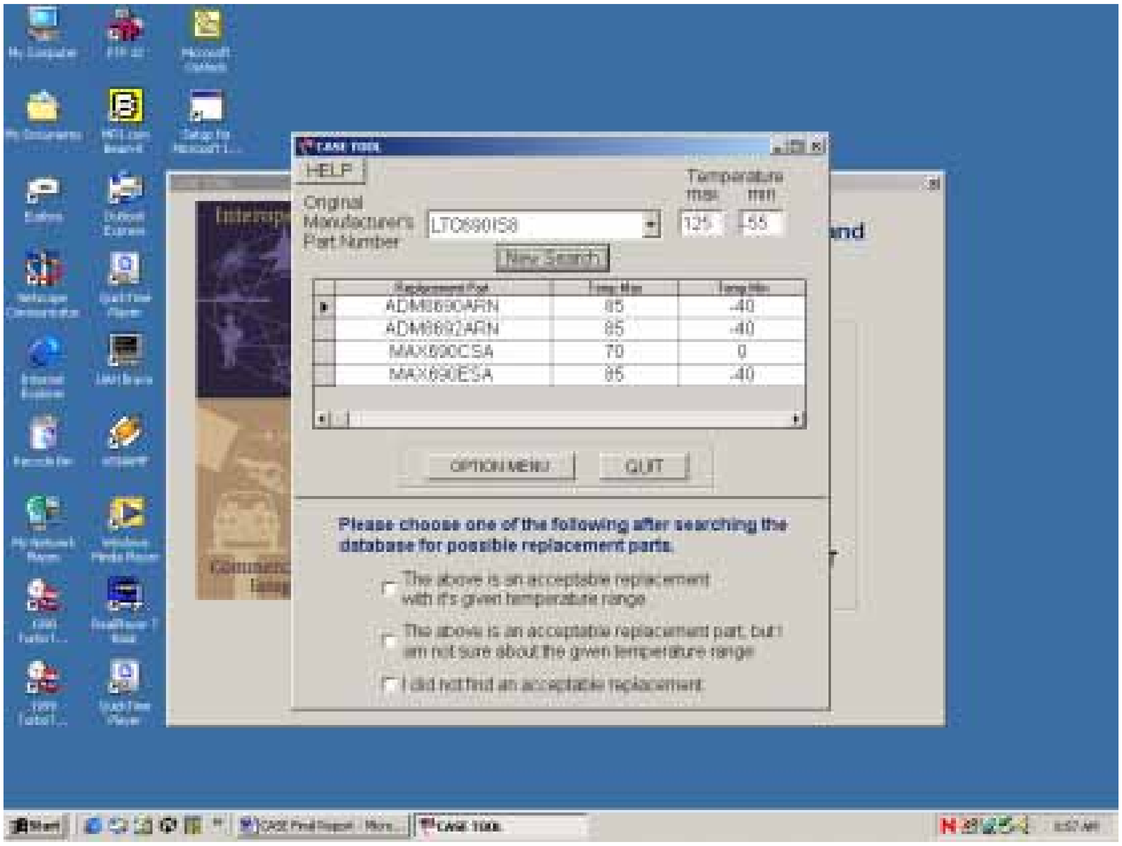

Figure 7 – Candidate Replacements Screen

The screen reveals that all the candidates fail to meet the required temperature requirements. In fact, one of them, MAX690CSA, only has a temperature range of 70 to 0 degrees C. At this point the user would select the second option, which states that the parts are acceptable except for temperature range. If the user assumes that the first replacement candidate on the list is acceptable and chooses it, he is then sent to a screen for guidance in temperature assessment (Figure 8).

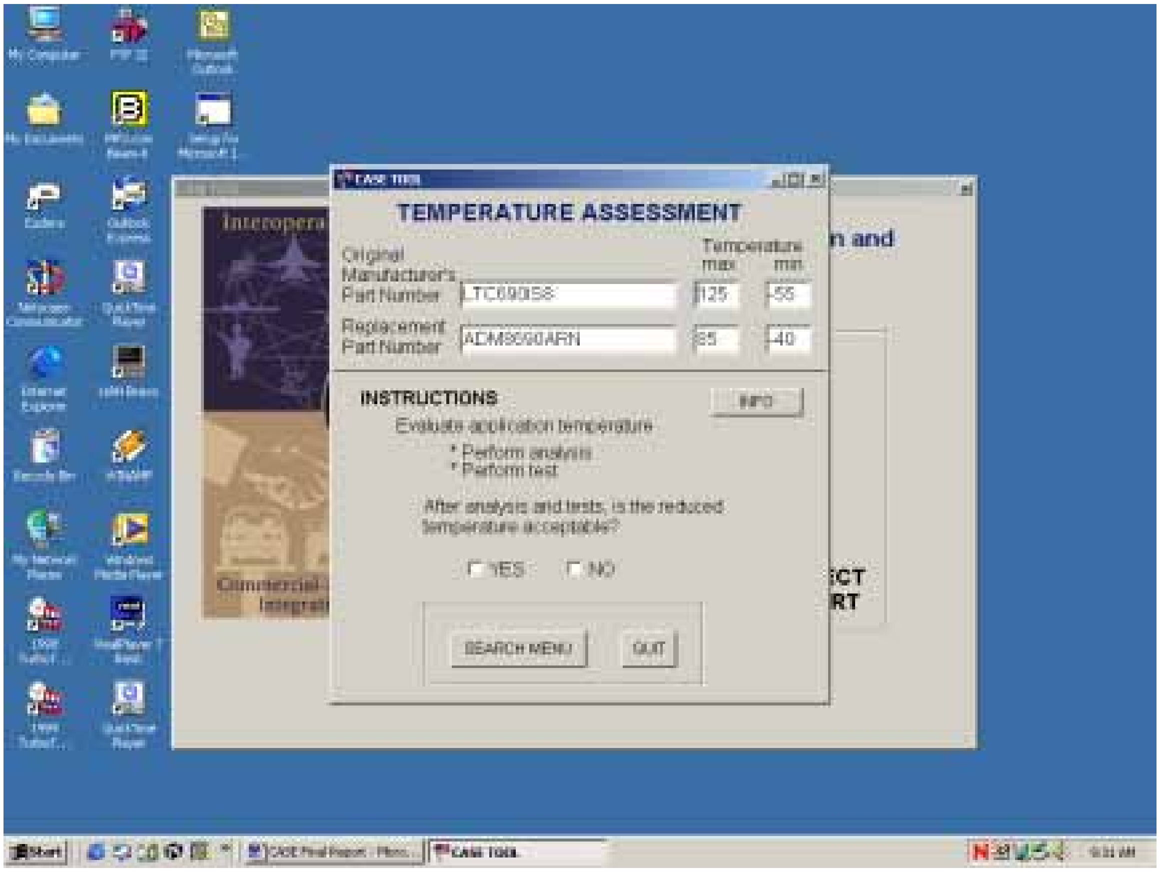

Figure 8 – Temperature Assessment Screen

5.3.5 Temperature Assessment

The displayed screen indicates that the replacement part ADM8690ARN has been selected as a possible commercial replacement. The user is instructed to insert the replacement part into the circuit board and test the board at the normal range of operating temperatures. This is not necessarily the military specification temperature range. The data is then analyzed and the user must determine whether the part is acceptable for use in this particular board in its normal environment.

After system testing, if the user finds that the replacement part(s) is unacceptable, the user will indicate this by responding **NO**. This will send the user to instructions for temperature screening components (Figure 9). If the user finds the part acceptable and enters **YES**, the tool proceeds to the Radiation Screen (Figure 6).

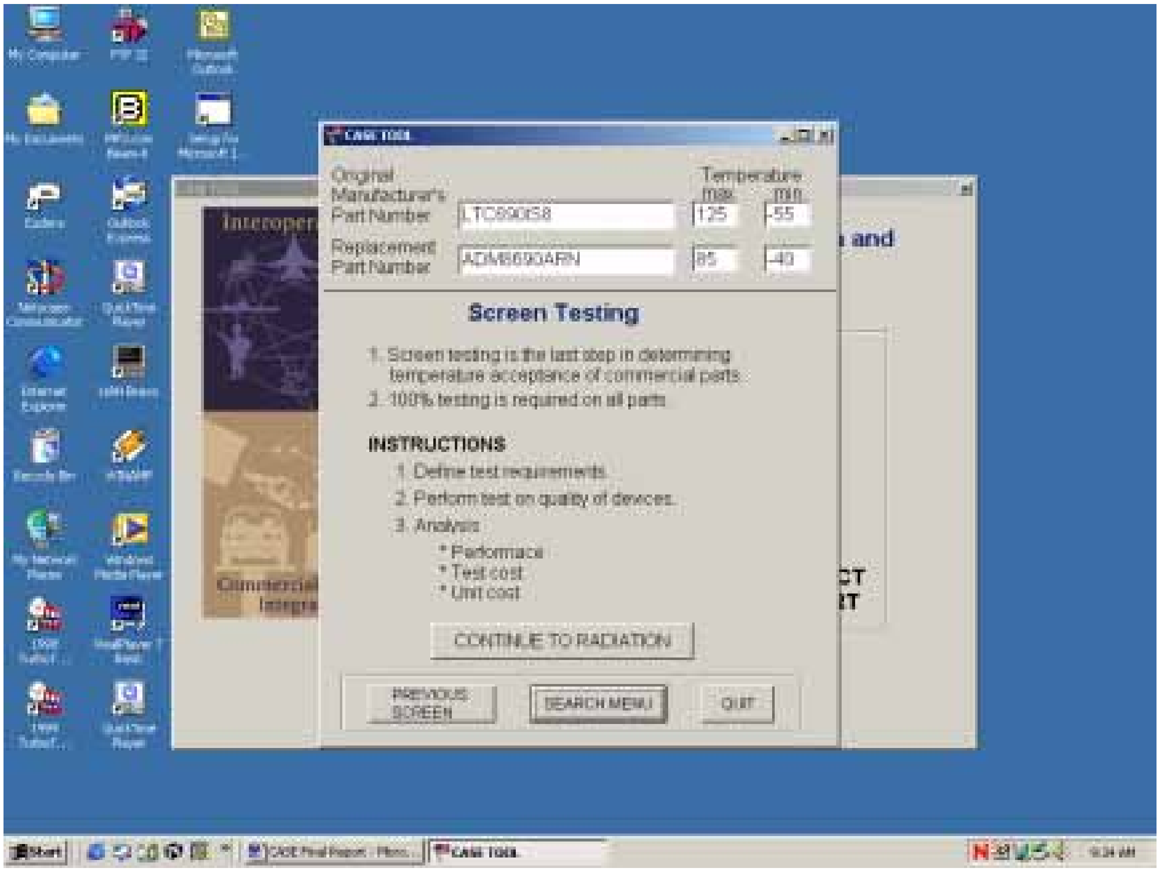

Figure 9 – Screen Testing Screen

5.3.6 Temperature Screening

The assumption is made that even though the selected part does not meet the temperature requirements, if a large number of the parts are tested, there will be a small number that will meet the required temperature requirements. If none meet the requirements then the search is ended. However, if the screening of parts results in some items meeting the requirements, then the user is advised to go on with a radiation assessment (Figure 6).

5.3.7 Radiation Assessment

The assessment for radiation consists of three basic questions. First, does the system have radiation requirements? If it does, then two subsequent questions are asked related to the inherent design of the replacement part or the system's nuclear detection circuitry. Depending upon the analyst's responses to these questions, the process either proceeds to the moisture assessment (Figure 10) or terminates with an appropriate response.

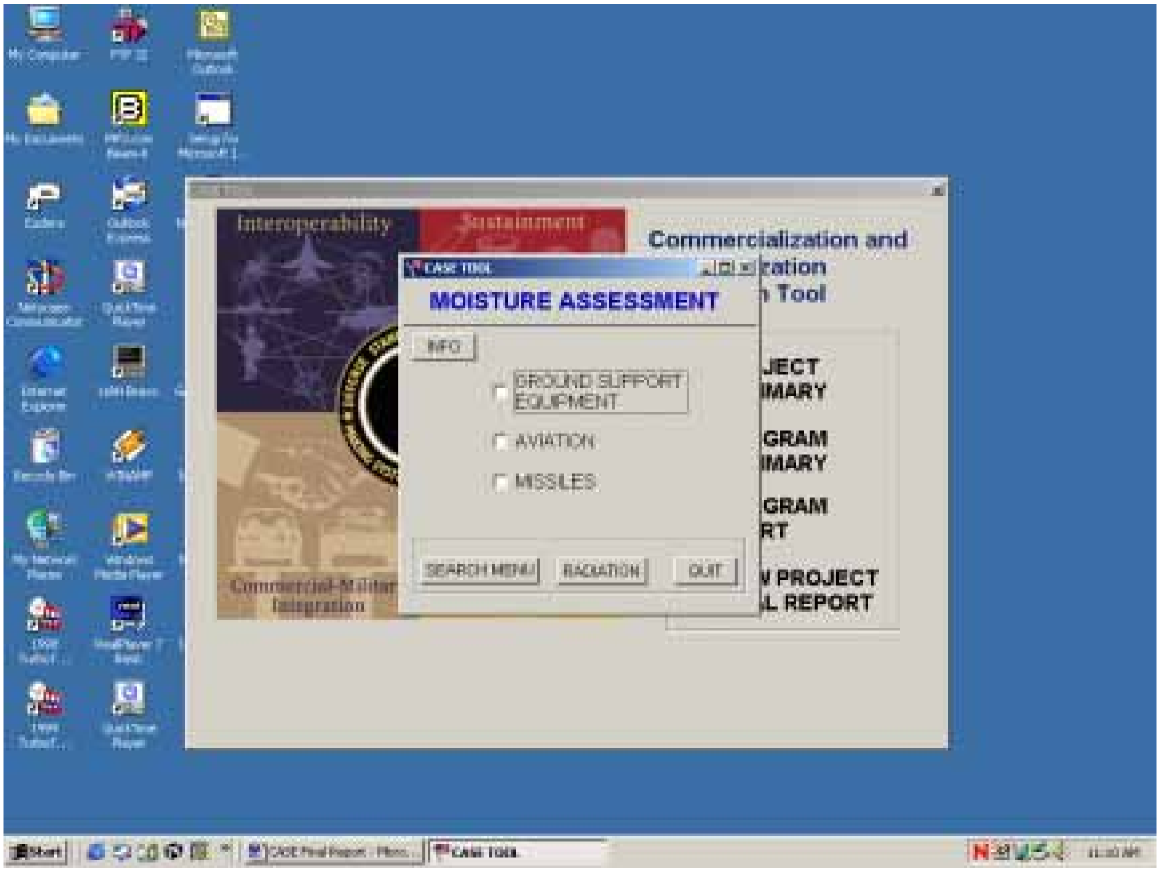

Figure 10 – Moisture Assessment Screen

5.3.8 Moisture Assessment

In order to proceed with a moisture assessment, the user must indicate in which general weapon system category the part will be used. The choices are: ground support equipment, aviation or missiles. For the initial development of the CASE software tool, only parts required by the Army's Aviation and Missile Command (AMCOM) were considered. The systems for which AMCOM has responsibility include these three categories; however, the database can be expanded or changed to reflect any other DoD organizations.

As was previously stated in this report, the scope of this project did not include a conclusive analysis of the use of non-military parts in aviation and missile systems. The user of this system is advised to perform extensive engineering analysis when the replacement electronics are based on either of these platforms. However, the user is guided through appropriate screens that could be enhanced as more consensus is reached throughout DoD on this topic.

Figures 11, 12 and 13 illustrate the moisture assessment interface for the three categories of systems.

Figure 11 – Ground Support Equipment Moisture Screen

Figure 12 – Aviation Moisture Screen

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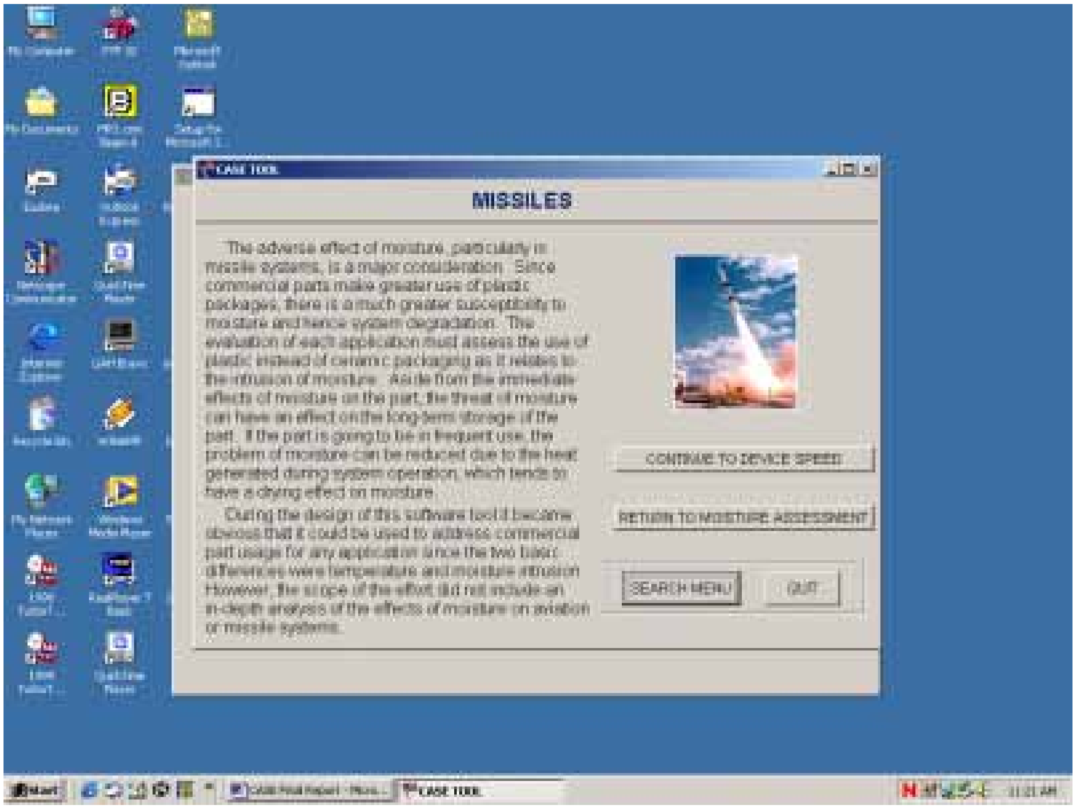

Figure 13 – Missiles Moisture Screen

Upon completion of the moisture assessment, the user is requested to provide details on the device speed of the replacement part. This screen is depicted in Figure 14. Depending on the response, the user is provided a warning message concerning device speed or is given the tool's final recommendation.

Once the candidate part is determined to be acceptable, the user is requested to perform prototyping and testing, as shown in Figure 15. If the user finds that, after testing, the replacement part is acceptable, the software displays instructions for entering the replacement part into the inventory. The user is advised that the TDP must be changed to reflect that the new part is an acceptable substitute. The board must now be placed into the subsystem and the entire weapon system must be tested to ensure that there are no adverse effects in using the substitute commercial part.

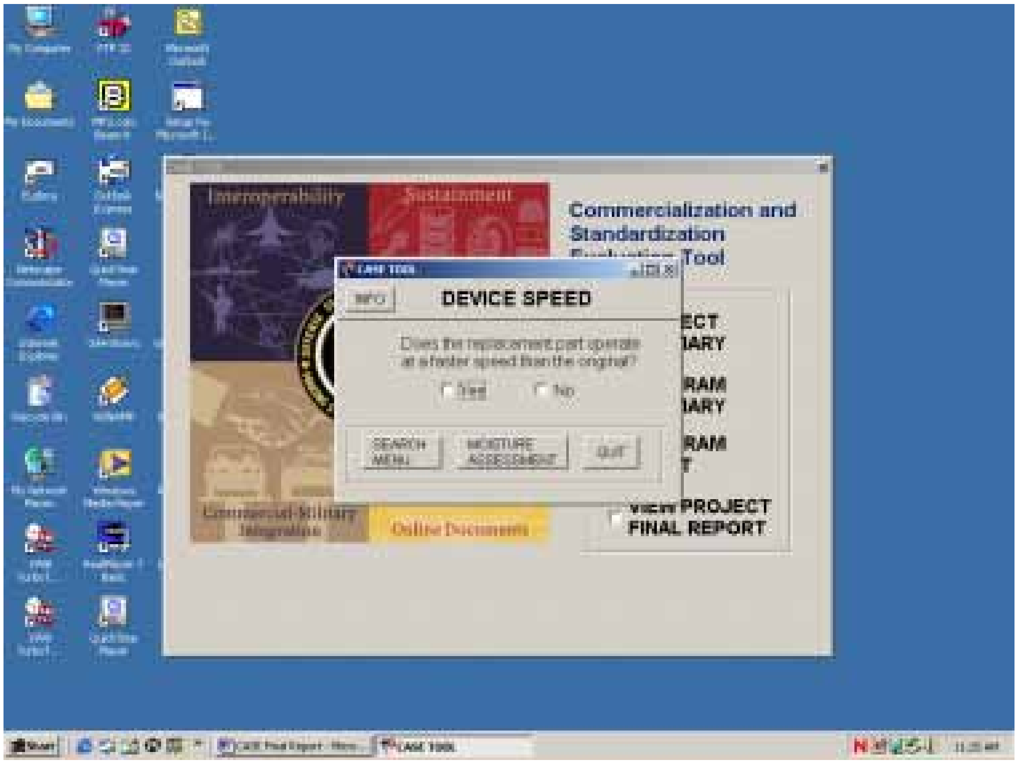

Figure 14 – Device Speed Screen

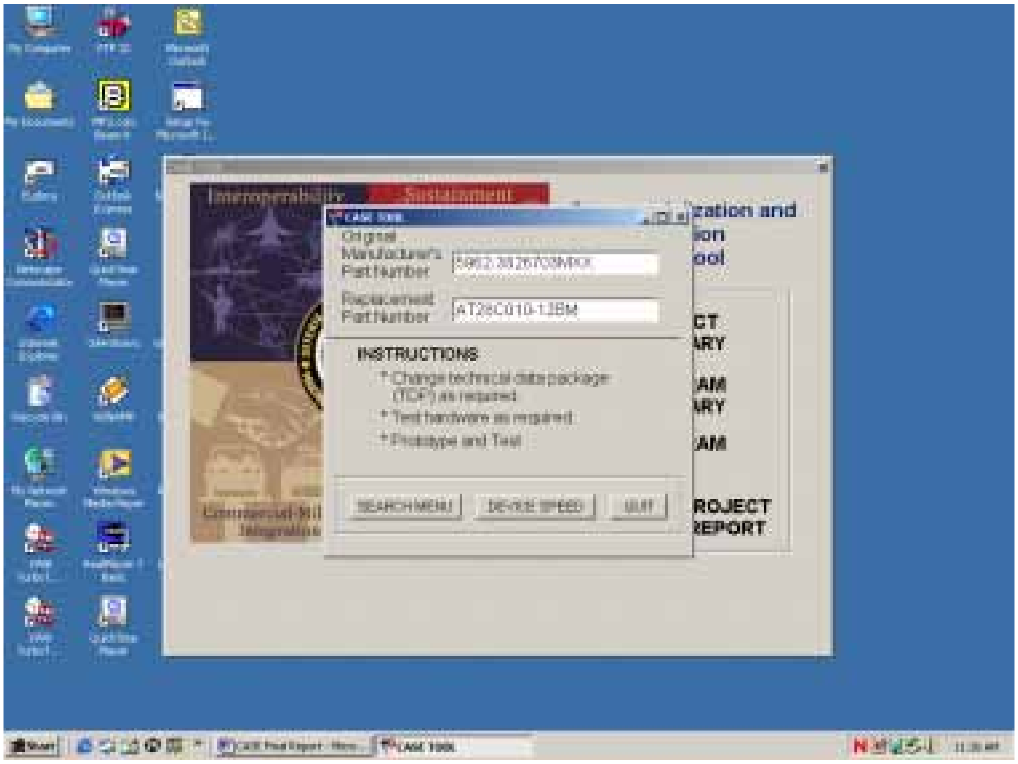

Figure 15 – Final Recommendation Screen

5.3.9 No Replacement Part Found

In the event that the initial search did not find any candidates for use as replacement parts (for any environment), the screen illustrated in Figure 4 allows the user to indicate that no acceptable substitute was found. The user is then asked whether there may be some other part that the user believes could be a substitute (Figure 16).

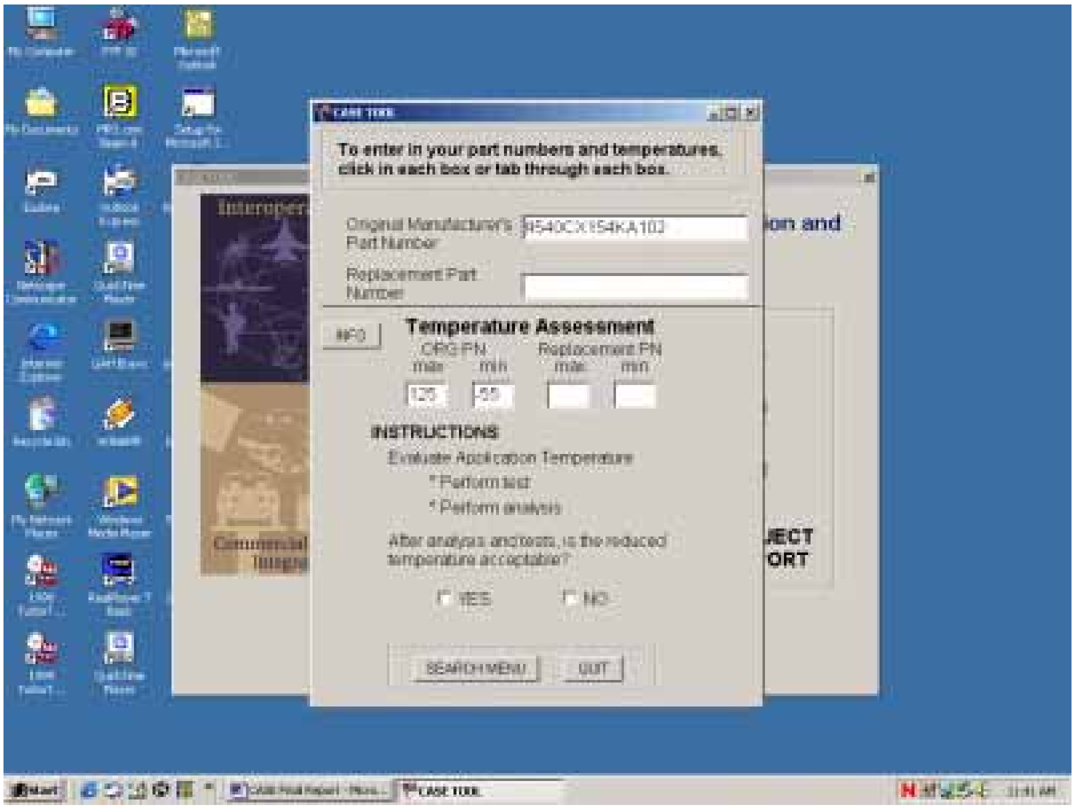

Figure 16 – No Substitute Part Found Screen

The screen depicted in Figure 16 allows the user to manually input a part number when the CASE tool cannot identify a potential solution in the database. The user must make an assessment regarding the use of the potential substitute. An analysis should be made at the subsystem level to ensure the maximum/minimum temperature requirement for this specific part for the required application. Testing should be done to measure the temperature of the device and air temperature of the box to better understand the exact requirements for the part. If this device is shown after analysis to be a potential candidate, the user can continue using the tool to assess the part.

If the original part number entered into the CASE Tool by the user is not included in the database, the user is allowed to use a version of the screen shown in Figure 16. The original part number and the temperature ranges of the part to be replaced are filled in for the presented form. The user must enter the part number and temperature ranges of the possible replacement part. The user must then assess the temperature range differences, if any. If the differences do not appear to be great, the user is advised to continue with temperature screening or the radiation assessment, as appropriate. The CASE tool will then proceed on the path that was previously described.

6.0 CONCLUSIONS/RECOMMENDATIONS

After studying the problem of replacing military electronic components with commercial equivalents, it was concluded that the problems are difficult. However, when military replacement parts are no longer available, there is little choice but to substitute COTS parts. As long as a careful standardized selection methodology is followed, it will be possible to keep some electronic systems long after their military components are unavailable. This study and accompanying software was a first attempt to standardize the selection process and to lay the groundwork for more sophisticated approaches in the future.

The CASE tool should provide the logistics technician or engineer with a standardized methodology that could reduce the time required to identify replacement COTS parts and limit the number of part numbers in the inventory. If records are kept of screening techniques and testing, the selection process will become even more efficient and rapid.

It is recommended that the CASE tool and database be made available throughout the DoD. This can be done through various means; however, use of the Internet would present the most appropriate option. The use of the Internet with the required level of security can allow access to the database without the problems of obsolete hardcopy, i.e., CD-ROM. By linking into the database, updates, enhancements and modifications can be made at the server level, thus serving the user community in the most efficient and cost-effective manner.

It is recommended that the database of parts be refreshed on a periodic (at least annual) basis. The dynamic environment of microelectronics requires constant monitoring. In order to ensure that COTS items that are recommended for replacement are not themselves obsolete, the database must be updated.

The database of the CASE tool was initially populated with only AMCOM-managed component items. However, as a DoD tool it should be populated with as many components from the Services as possible. The CASE tool was developed to provide a proof of concept and a limited capability with its initial database of component item numbers. To reap the full benefits of the tool, it should continue to grow. Regular maintenance and enhancements are encouraged.