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The "Only Other" Sure Thing in Life

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Today, there are only three certainties in a circuit board market that for the last three years has proven anything but certain: death, taxes, and military business. As the overall North American electronics market has declined and manufacturing continues to shift to lower cost geographies, circuit board manufacturers have been searching for answers. Should North American manufacturers give up and concede defeat or is there a sustainable, growing business model that justifies the attention of U.S. manufacturers? The answer is simple; it's the circuit board market for military products, which over time is taking on an increasingly important role in our industry.

Despite the recent decline in the overall PCB market, the market for military products has continued to grow. From 1997-2002 the overall U.S. PCB rigid market declined at a compound annual rate of 7.8% from $7.8B to 5.1B (Figure 1A). During that same time period, the military PCB market grew at a compound annual rate of 27% and is projected to represent a $1B circuit board market by 2006 (Figure 1B). As a result, by the end of 2002, the military PCB market represented approximately 12% of the total PCB market, suggesting that this market should be materially significant for U.S. PCB manufacturers (IPC-TMRC data 1985- 2002).

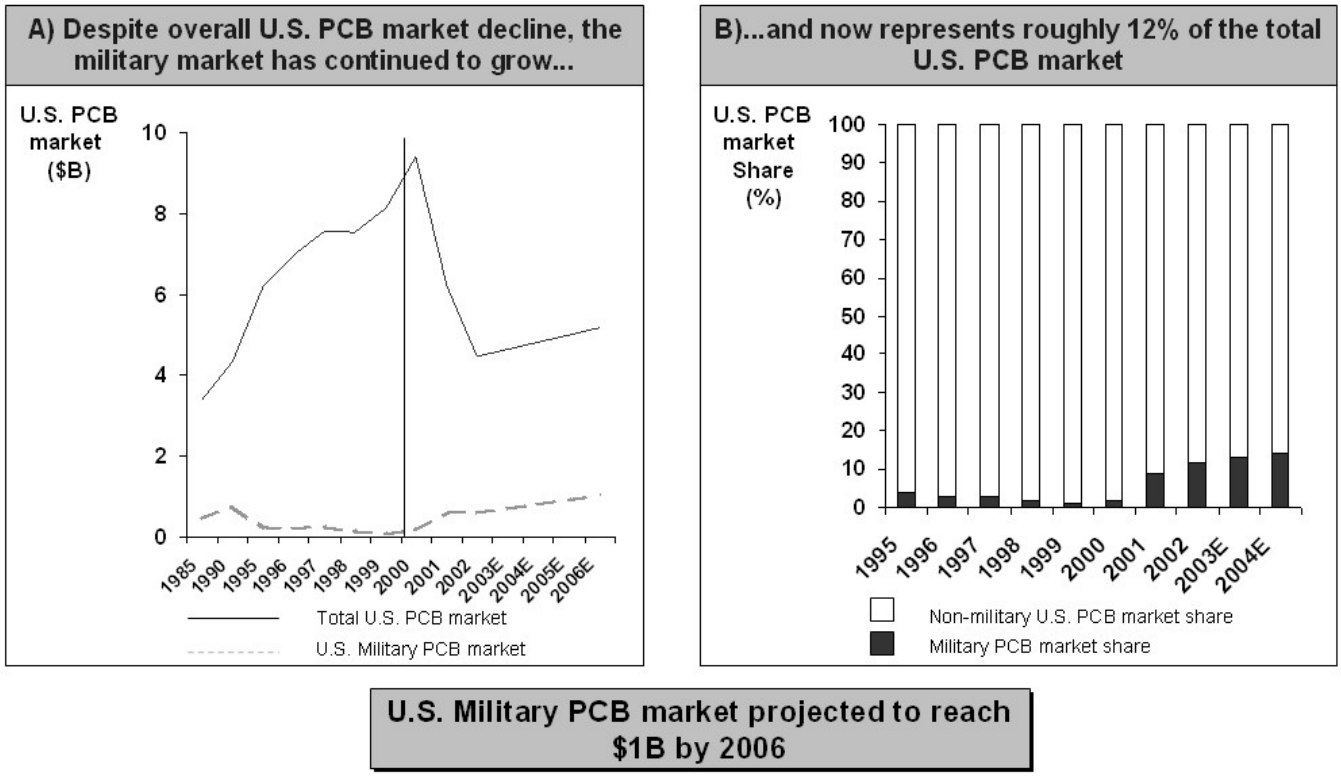


Figure 1 - While Overall PCB market HAS Declined Dramatically the Military Market has Continued to Grow - Military PCB Market Now Represents ~12% of Total U.S. Market

Furthermore, the military market is attractive for North American manufacturers because the security implications associated with military electronics make it unlikely that these products will be sourced overseas in large quantities. In addition, elected officials have a strong incentive to ensure that scarce tax dollars are allocated predominantly in the United States. Presently, there are military certified sources in Canada, Europe, Japan, Israel, and India but the vast majority are located in the US. Notably, there are currently no military certified PCB manufacturers in China or Taiwan, which "last year represented over 32% of the total PCB world market (Figure 2), despite cost advantages of as much as 40-50% relative to U.S. manufacturers (California Circuits Association Figures). Consequently, as the total available US PCB market continues to shrink and the military market continues to climb, securing military certification becomes more and more imperative for U.S. manufacturers because it is one of the only PCB market segments that has a strategic reason to keep its business in the states.

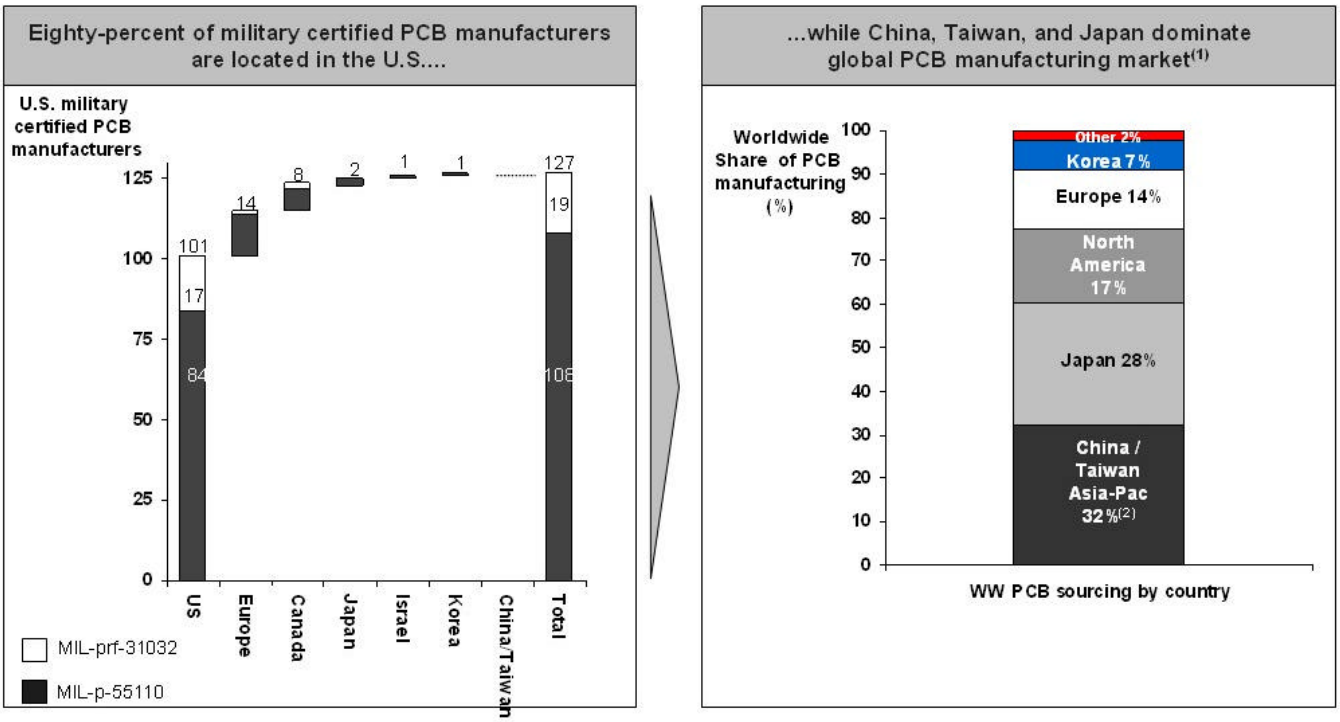


Figure 2 - Vast Majority of U.S. Military Certified PCB Manufacturers are located in the U.S. (III) - Contrasts Sharply with Typical PCB Market Sourcing

Given the strategic significance of the military market, one would expect to see the majority of U.S. PCB manufacturers aggressively targeting this segment. However, the fact of the matter is that only 84 US companies are now certified (Multilayer-Difunctional epoxy) to MIL-P-55110 (QLP-55110-61, 15 Jan 03) (Figure 3). Furthermore, only 17 US companies are certified to the newest Military Standard, MIL-PRF-31032 (QML-31032-14, 13 Jan 2003-multilayer), (Figure 4).

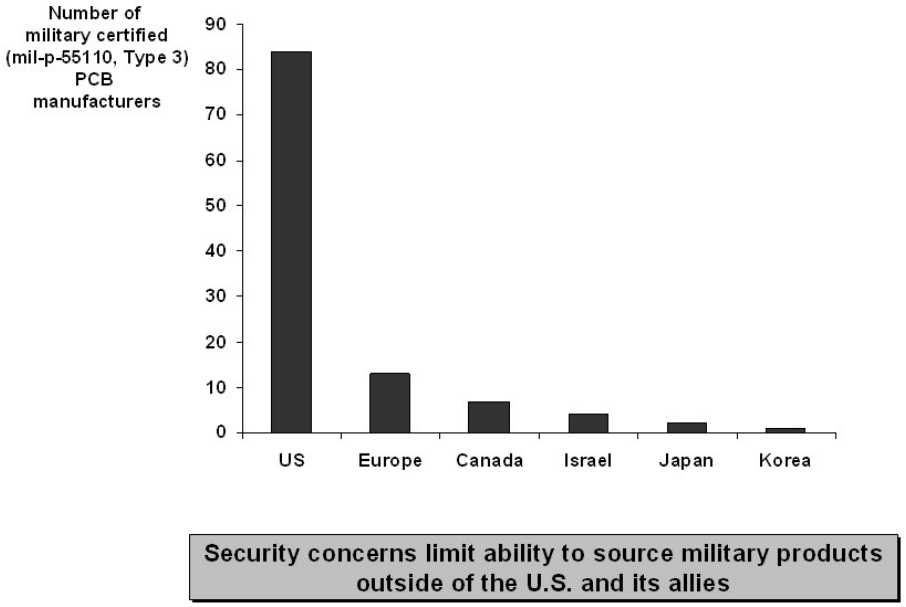


Figure 3 - Vast Majority of U.S. Military Certified PCB Manufacturers are located in the U.S. (I) - Mil – P – 55110, Type 3 Certifications

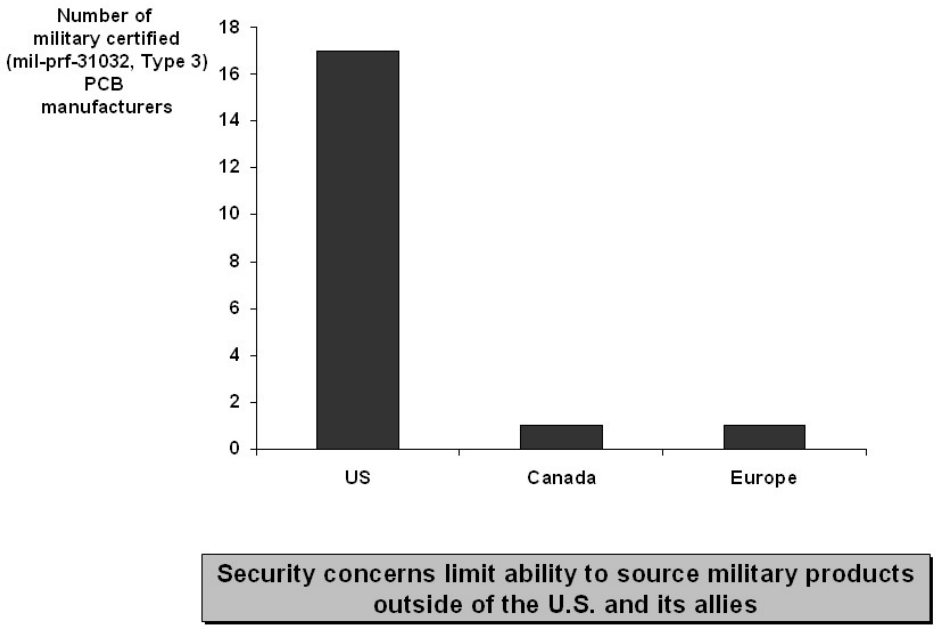


Figure 4 - Vast Majority of U.S. Military Certified PCB Manufacturers are located in the U.S. (II) - Mil – PRF – 31032, Type 3 Certifications

So why is such Low hanging fruit left on the tree? Is it because:

- PCB fabrication facilities no longer have the support resources for the additional requirements (documents/reporting etc.) associated with military business?
- The lack of any military expertise?
- The need to maintain two PCB Military Specifications not just one?

It's probable some or all of the above, but more importantly this segment has likely been ignored because in the last two hectic years companies have not reviewed the strategic significance of the military market.

In this article I will define the trends in the Military Market segment over the last 17 years, explain the newest Department of Defense (DOD) military standard (MIL-PRF-31032) and list the basic steps for certification. This will give the necessary information to help your company decide if military circuit boards should be part of your strategy and a "sure thing" in your business plans.

Military Market and Expected Growth

IPC's Technology Market Research Council (TMRC) defines the products that make up the Government and Military Market as follows: "Radar, guidance and control systems, communication and navigation, electronic warfare, ground support instrumentation, sonar ordinance, missiles and satellite related systems."

Listed below are a few recent articles concerning the rate of growth of the Military sector:

- Electronic Outlook March 2003
- The World Electronic Equipment Revenue trend by market type shows the Government/Military segment growing from 7.9 to 11.2 percent from 1999 thru 2004 (Figure 5). Note: In this 6-year time span, the value of Gov/Military Equipment dollars grows from $90 to $113 Billion.
- March 24, Walt Custer: 2003 IPC Expo:
- " Military Electronics and Security devices are the USA's niche growth markets."

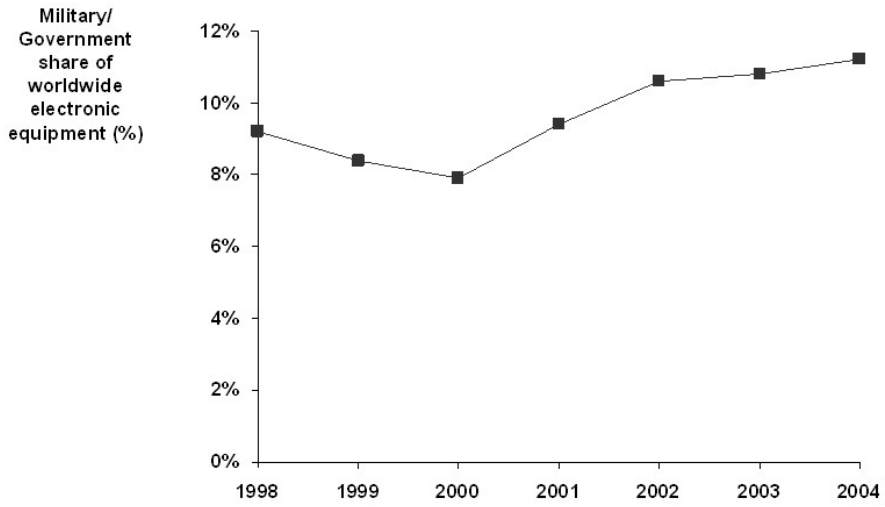


Figure 5 - Military/Government Share OF Worldwide Electronics Business Displays Similar Share Gains

May 30, 2003 Technology Forecasters, Inc.
Technology Forecasters, Inc. (TFI) projects global revenues for aerospace/defense electronics contract manufacturing to grow from $4.0 billion in 2001 to $7.7 billion in 2006, for an average annual growth rate of 14.0%.

July2003 Walt Custer: Circuit Tree
"N. American PCB sales and orders remain lackluster as anemic demand, over-capacity and low prices continue to take their toll on local PCB makers. However, there are some bright spots. Military electronics (primarily made locally) continue to grow."

Walt's July chart (Monthly Military Bookings) shows May orders up approximately 20% just since Dec 2002 and the 12-month average ending in May 2003 is now the same as the rate in 2000! In this PCB market anything with the same level of demand as 2000, is truly a miracle!

Walt also stated: "Search & Navigation (primarily military) electronics orders are up almost 30% (Feb-Apr 2003 vs. Feb-Apr 2002)….. It would appear that domestic PCB makers must continue to "hunker down", focusing on the locally made end-markets such as military, medical, high reliability prototype & quick turn segments. No one said it would be easy."

IDC Worldwide Blackbook data for total US IT Spending and VARBusiness, Sonia R Lelii, Jun 18, 2003:
Total US IT market (Software and Hardware) is projected to decline at a 2.4% annual rate from 2000 to 2004 while Federal Government IT spending for this same five years will grow 18.9% per year (Figure 6).

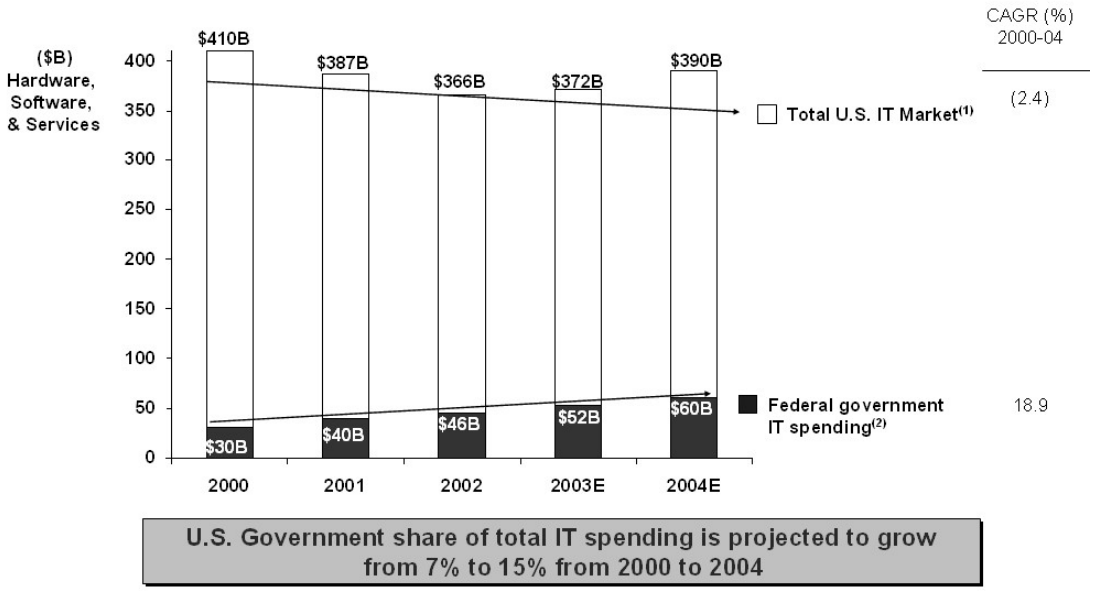


Figure 6 - While Overall U.S. IT Market has declined, Federal Government IT Spending has Consistently Increased

To summarize, unlike the declining total US Rigid Market, the Military growth rate and actual market size is double digit and continuous over the next several years. Ergo, the Military business will not go away any time soon!

Military Specifications (MIL-P-55110 and MIL-PRF-31032): The Old versus the New

MIL-P-55110, now at Rev F, is a board performance specification requiring a Quality system that meets the inspection aspects described in the document. Contrast that with MIL-PRF-31032, which has a lot of the same board performance specifications but now integrates the Quality System requirements of ISO-9000 plus other unique ones. Fortunately, MIL-PRF-31032 offers degrees of flexibility such that many of these unique requirements can be handled with the company's existing quality systems.

The Defense Supply Center Columbus (DSCC) addressed the need for this new specification as follows:

"In the past the Department of Defense (DOD) drove leading edge technology and the commercial industry followed along. Most shops were captive, designed to build specific DOD systems. Today the commercial world has much to offer the DOD in the way of technology and cost savings. The Qualified Manufactures List (QML) for MIL-PRF-31032 attempts to capture these "best practices" and apply them to military product. The key concept in the QML is the development of a working relationship between the manufacturer and the Qualifying Activity, DSCC. This relationship is established during the certification process, and is maintained through status reports and revalidations. Although the certification process may seem quite involved, the development of this relationship will allow the manufacture the freedom to make its own decisions regarding certified product. All boards produced by a certified MIL-PRF-31032 supplier will be marked with the letters "QML"."

Another contrast between the old and the new is the responsibility for data review. In MIL-P-55110, DSCC performs the burden of "management review" (similar to the same function in ISO-9000) of a limited amount of fabrication data sent in by the fabricators. Contrast that to MIL-PRF-31032, where the fabricator is responsible for "management review", of all measured attributes. The "management review" in MIL-PRF-31032 is a periodic formal review by a group designated in the specification as the Technical Review Board (TRB). Think of the TRB as the company's "Quality Steering Committee" for military products.

Why should Fabricators Certify to MIL-PRF-31032?
As new contracts are let and in some cases older ones updated, MIL-PRF-31032 is often specified. Certification to just MIL-P-55110 will not allow fabrication of designs requiring MIL-PRF-31032. However, the converse is true, certification to MIL-PRF-31032 will allow the fabricator to build to either specification provided the board is the same technology listed in QML-31032.

Certification Steps for MIL-PRF-31032
This is a summary of the basic steps to certification. As you read these steps please remember MIL-PRF-31032 does not spell out a "step by step" process. The ones outlined here are considered the most logical and efficient method by the author. The process can be segmented into five distinct subgroups or phases. The time frame for each phase is listed as a range. The range depends on familiarity with MIL-PRF-31032, resources available and ISO-9000 status. Note: The times listed below assume ISO-9000 registration has already been obtained.

Certification Initiation and Training
In this first phase, your company must notify DSCC of its intent to certify. Following that, an implementation team should be formed and trained.

Getting started: The first step is to communicate to DSCC your company's plan for certification. Once the start is acknowledged by DSCC, a through review of the MIL-PRF-31032 documents must be done and communicated with the "implementation team". The "implementation team" will carry the title of Technical Review Board (TRB) per MIL-PRF-31032. The TRB's first assignment should be to get basic MIL-PRF-31032 training. Once this training is complete, the systems documentation work can begin for the Qualified Manufacture (QM) Plan.

The Certification Initiation and Training phase will take 30- 45 days.

Quality Management Plan (QM)
The documentation for certification is contained in the QM Plan, the central heart of the process. A manufacture's QM program is its means of assuring that QML printed boards meet the requirement of MIL-PRF-31032. The QM plan is a controlled document with a separate section for each element of MIL-PRF-31032. When the QM is complete it will have fourteen (14) separate sections documented and implemented

The time required for this step will range from 1-3 months.

Planning, Fabrication and Testing of Qualification Parts
As the QM Plan is completing, the Qualification Test Plan can also be finished. In it, the manufacture defines the plan for qualification fabrication and testing.

When the QM plan, Qualification Test Plan, and training are finished, the TRB must decide when to start the building of the qualification boards. Regardless of when the boards and/or test vehicles are fabricated, they are built using the new QM documentation.

The time required for his step is 20 to 60 days.

Audit Process
The audit phase of MIL-PRF-31032 consists of a self-audit, the Pre-validation Submission and a formal audit by DSCC. The self-audit and formal audit are referred to as the "Self Validation" and "Validation Audit" in MIL-PRF-31032.

Self-Validation is the manufacture's means of determining compliance to MIL-PRF-31032 and the QM program. This Self-Validation process is exactly the same as the self-audits of ISO-9000.

Once the Self-Validation is complete, it's time to prepare the Pre-validation Submission. The Pre-validation package consists of the QM plan, the Self-Validation results, and the Qualification Test Plan. These three items are necessary to obtain a validation audit from DSCC.

The qualifying activity (DSCC) will review the pre-validation submission for compliance to MIL-PRF-31032 and schedule a validation audit once all of the pre-validation information is approved. This audit is a detailed review of each of the fourteen (14) QM sections.

The time required for this phase is a function of internal and DSCC resources and can vary considerably. DSCC's Validation Audit depends on how much time has been allocated to audits and how many companies are ahead of your request. As a result, this phase can take from 2-4 months.

Implementation and Certification

In this final phase, the TRB must respond to all Validation findings and submit the board/test vehicle Qualification data.

Any concerns/audit findings by the DSCC validation team will be communicated in writing to the attention of the TRB. TRB will be responsible for the associated corrective actions and communication of those to DSCC. Corrective action responses must be written.

The board qualification and associated laboratory data needs to be assembled in report format and reviewed by the TRB. Once approved by the TRB, a copy is sent to DSCC.

Once the corrective actions have been submitted and approved by the Qualifying activity and all the Qualification fabrication data is accepted, a MIL-PRF-31032 certification will be issued. The certification letter from DSCC will detail the technologies in the QM plan. If ISO-9000 is part of the validation, an ISO 9000 certification let will also be issued.

This last phase will take 30 to 60 days.

Adding the times of all the five phases, results in a range of 5 to 12 months to complete certification from start to finish.

Summary

Certification to MIL-PRF-31032 although more complex than MIL-P-55110, offers a wider range of the PCB military sector and a far less number of competitors.

In a world where we don't like to discuss the first two sure things in life, it's refreshing to understand the military market is certain to stay primarily in America and be here for many years to come.

MIL-PRF-31032 Certification

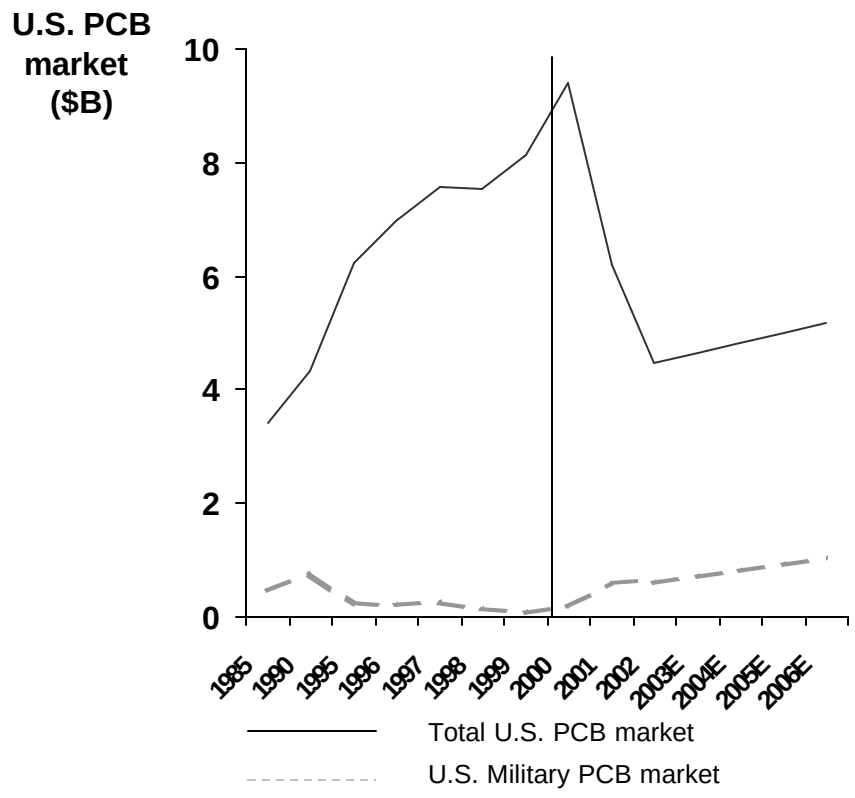
Chart 1,2,3,4,5,6

Update 8/18/03

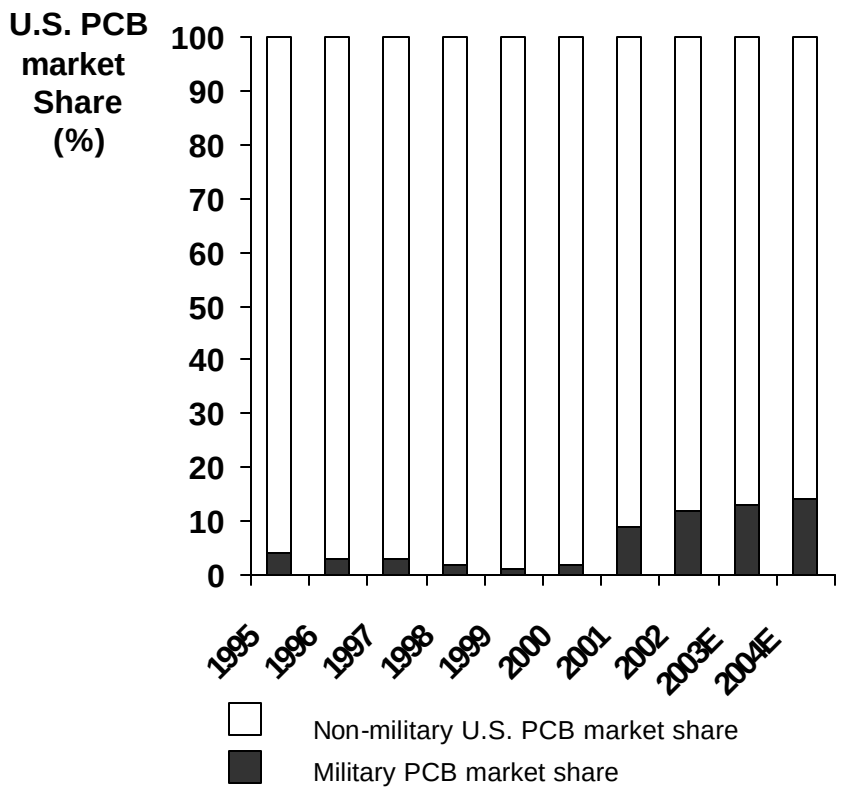
Chart 1 (A&B). WHILE OVERALL PCB MARKET HAS DECLINED DRAMATICALLY THE MILITARY MARKET HAS CONTINUED TO GROW

Military PCB Market Now Represents ~12% of Total U.S. Market

A) Despite overall U.S. PCB market decline, the military market has continued to grow...



B)...and now represents roughly 12% of the total U.S. PCB market



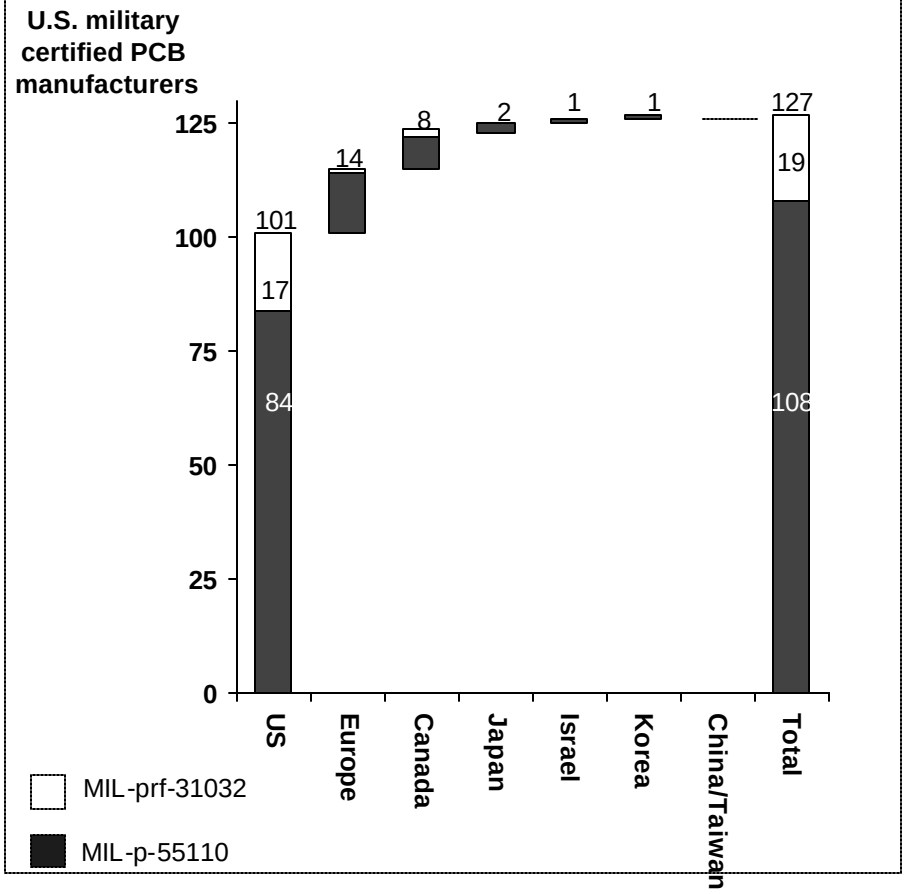
U.S. Military PCB market projected to reach $1B by 2006

Source: IPC TMRC 1985-2002 data

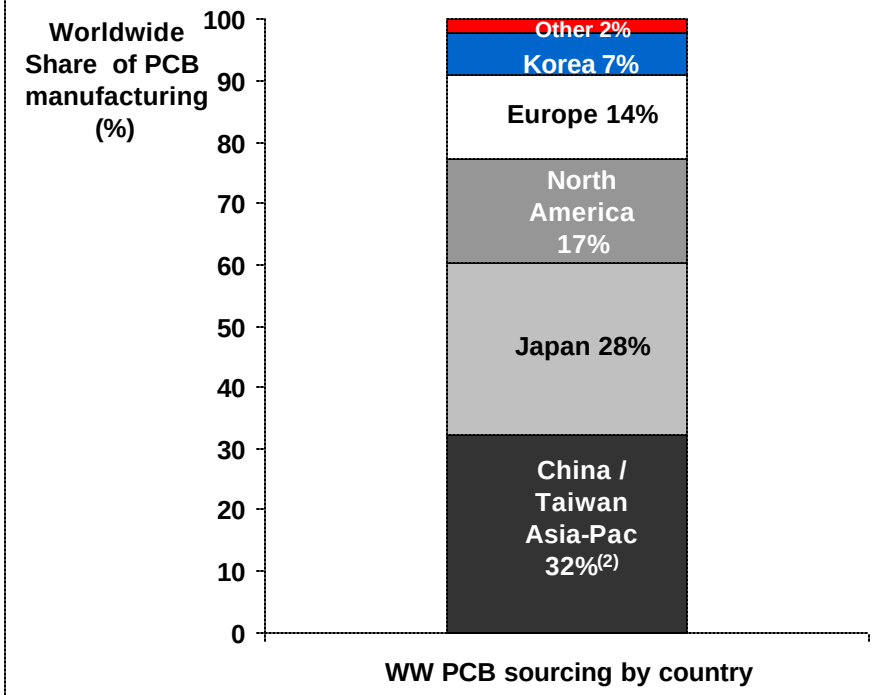
Chart 2. VAST MAJORITY OF U.S. MILITARY CERTIFIED PCB MANUFACTURERS ARE LOCATED IN THE U.S. (III)

Contrasts Sharply with with Typical PCB Market Sourcing

Eighty-percent of military certified PCB manufacturers are located in the U.S....



...while China, Taiwan, and Japan dominate global PCB manufacturing market(1)



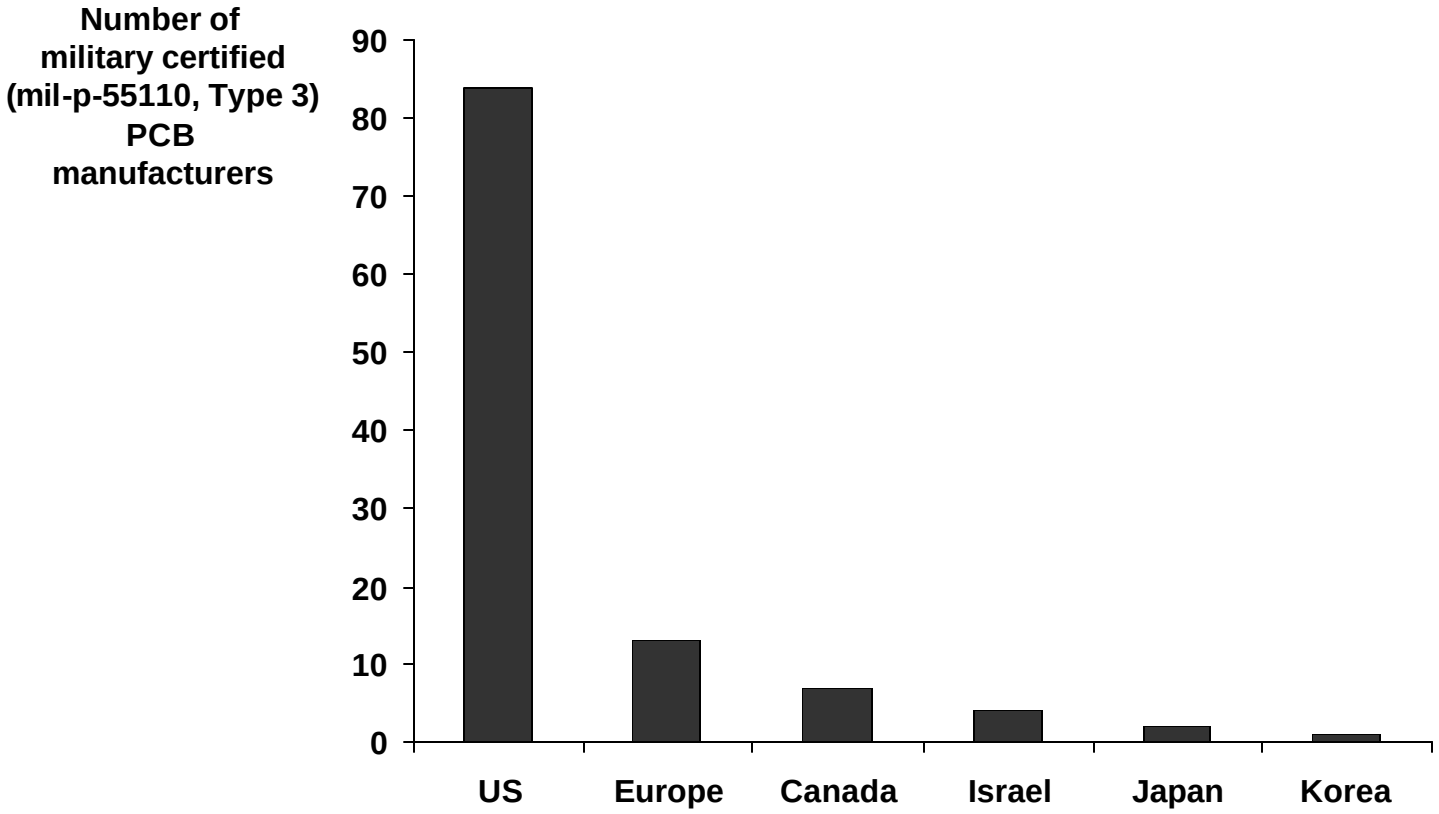
(1) Henderson Venture Data for 2002

(2) Includes China 13.8%, Taiwan 11.9%, and rest of Asia-Pacific excluding Japan and Korea

Source: Data as of January 2003

Chart 3. VAST MAJORITY OF U.S. MILITARY CERTIFIED PCB MANUFACTURERS ARE LOCATED IN THE U.S. (I)

Mil – P – 55110, Type 3 Certifications

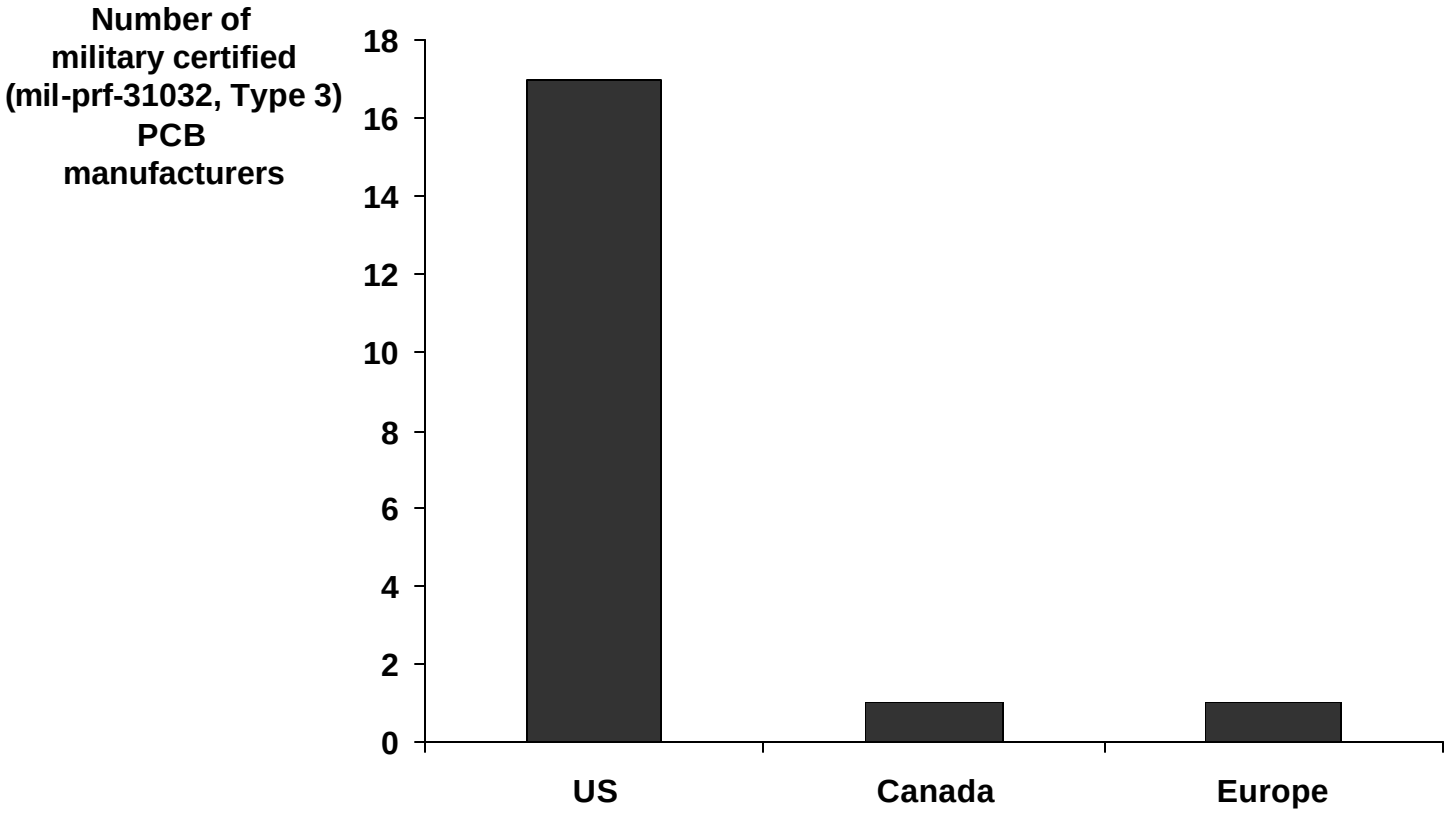


Security concerns limit ability to source military products outside of the U.S. and its allies

Source: Data as of January 2003

Chart 4. VAST MAJORITY OF U.S. MILITARY CERTIFIED PCB MANUFACTURERS ARE LOCATED IN THE U.S. (II)

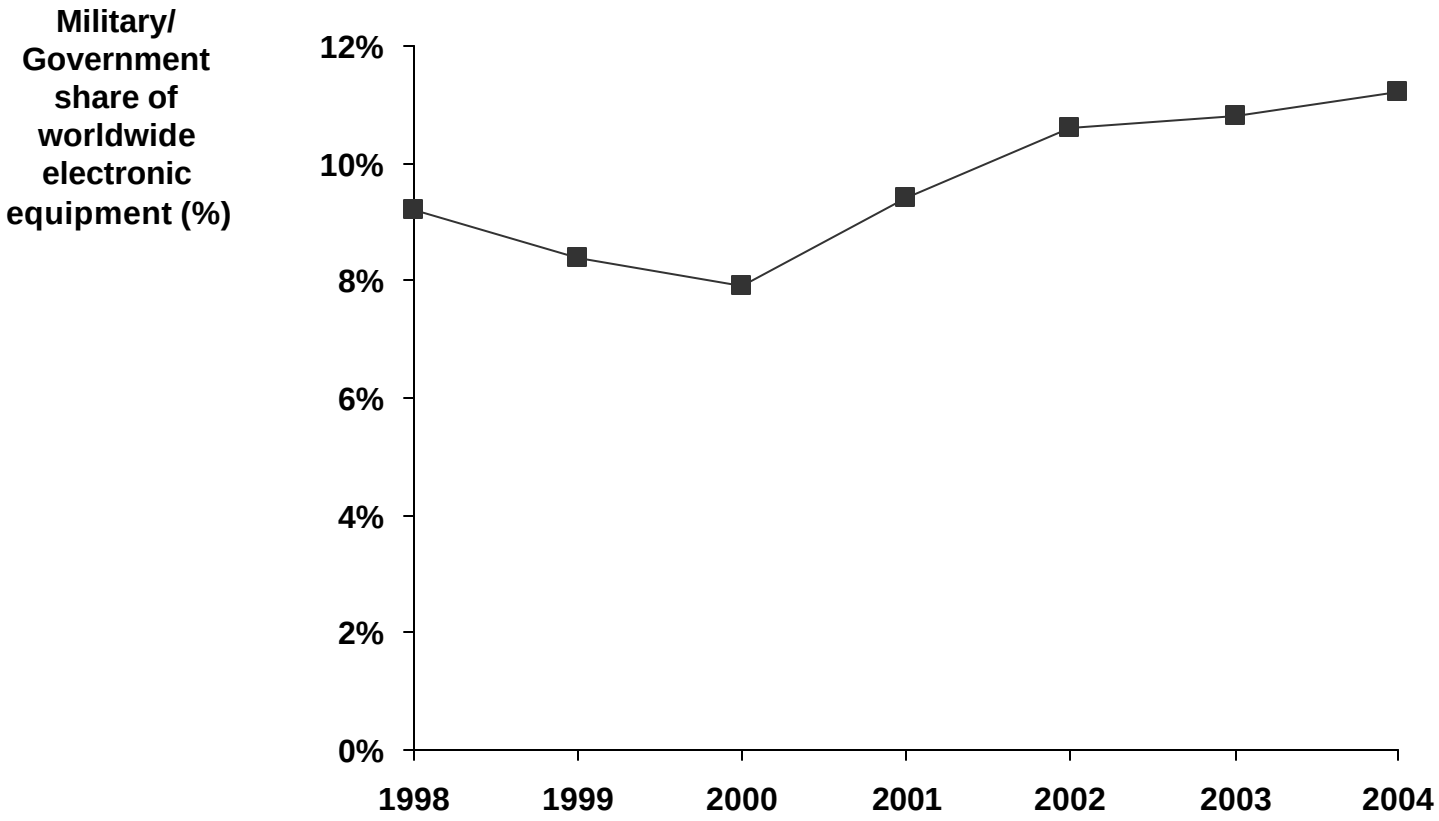
Mil – PRF – 31032, Type 3 Certifications



Security concerns limit ability to source military products outside of the U.S. and its allies

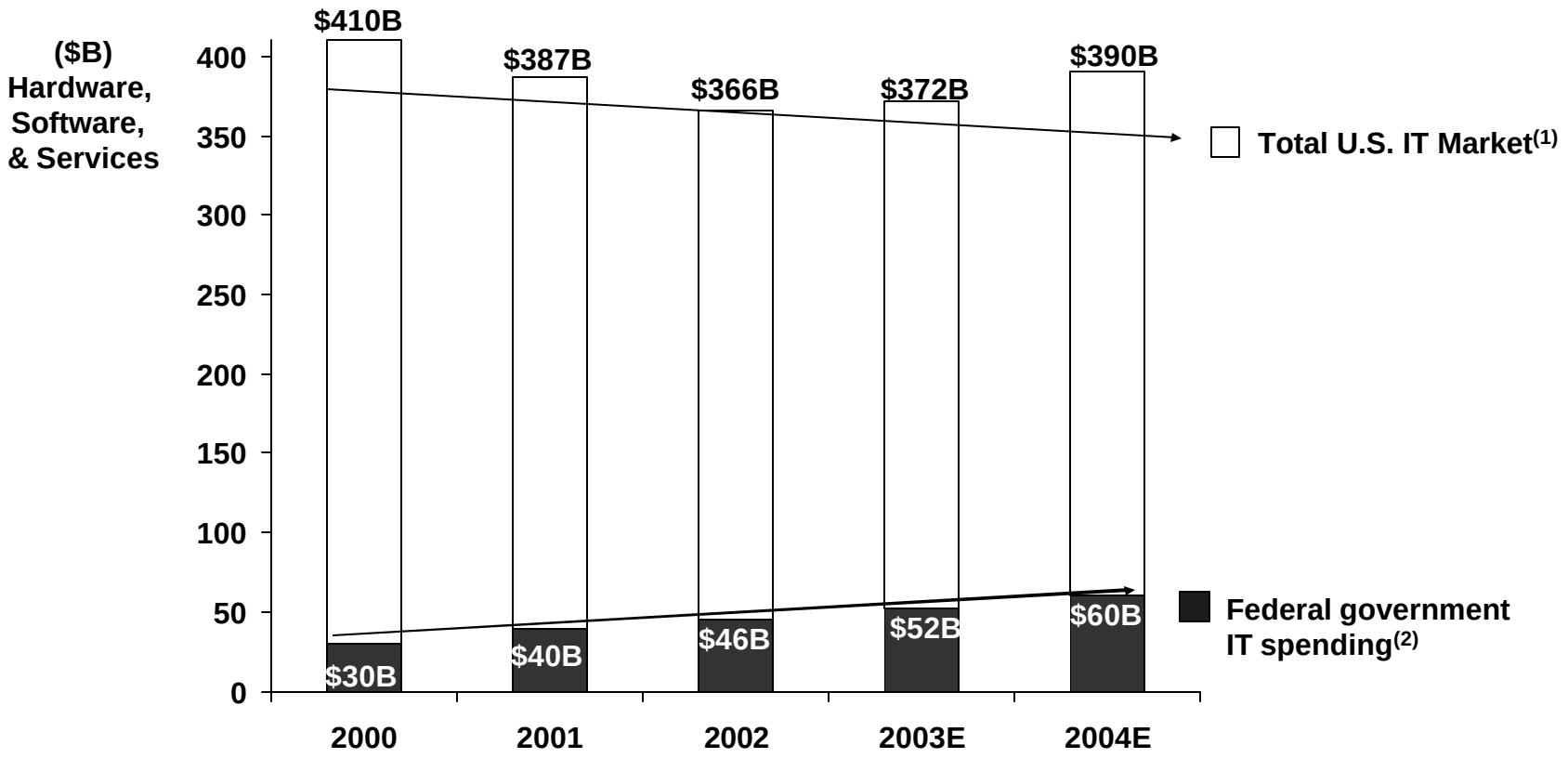
Source: Data as of January 2003

Chart 5. MILITARY/GOVERNMENT SHARE OF WORLDWIDE ELECTRONICS BUSINESS DISPLAYS SIMILAR SHARE GAINS



Source: Electronic Outlook 3/2003

Chart 6. WHILE OVERALL U.S. IT MARKET HAS DECLINED, FEDERAL GOVERNMENT IT SPENDING HAS CONSISTENTLY INCREASED



U.S. Government share of total IT spending is projected to grow from 7% to 15% from 2000 to 2004

(1) IDC Worldwide Blackbook data for Total U.S. IT spending, includes HW, SW, and Services
(2) VARBusiness, Sonia R Lelii, June 18, 2003, Vertical Venues, www.varbusiness.com for Government vertical data