Articles on the subject of "COTS/EEE Parts in Space"

Components Engineering

Introduction

Dan Friedlander, former Head of MBT/IAI Components Engineering has published an on- going articles series dealing with COTS in general and use of COTS in space applications in particular.

Following are the already published articles:

COTS/EEE parts in space applications: evolution overview, revolution forward view

November 4, 2016

By Dan Friedlander
Retired following 44 years in components engineering

For decades, military/space electrical, electronic, and electromechanical (EEE) parts have proved to be suitable for use in military and space applications. [NASA's Office of Safety & Mission Assurance (OSMA) evaluates newly available and advanced electronic parts for programs and projects under its EEE Parts program.] The traditional MIL-SPEC [U.S. defense standard/military specification] methodology is based on risk avoidance by testing the finished parts. Yet, global developments, like declining availability and budget constraints, have triggered the need to find an alternative solution.
The alternative solution was officialized in 1994 by U.S. Secretary of Defense William Perry's directive imposing the use of commercial off-the-shelf (COTS) parts in military applications, exempting space applications. After decades of successful use of COTS in military applications, the above change has been proved viable.
Many challenging space application requirements can be met only using COTS. The time comes (better sooner than later) for the policymakers to reach a consensus on applying the COTS philosophy to space applications. This policy change is critical for the space industry.

This paper attempts to suggest different issues to be tackled in order to meet technical, quality assurance, and cost requirements using COTS. The term "COTS" in this paper refers to commercial EEE Parts, including plastic encapsulated active ones.

To the full article: http://www.intelligent-aerospace.com/articles/2016/11/cots-eee-parts-in-space-applications-evolution-overview-revolution-forward-view.html

COTS/EEE parts in space applications: resistance to change

January 4, 2017

By Dan Friedlander
Retired following 44 years in components engineering

Electrical, Electronic, and Electromechanical (EEE) parts and the traditional MIL-SPEC methodology, based on risk avoidance by testing the finished parts, have proven to be suitable for use in military and space applications. Global developments like declining availability and budget constraints have triggered the need to find an alternative solution. In 1994, then U.S. Secretary of Defense William Perry issued a directive imposing the use of this alternative: commercial off-the-shelf (COTS) parts in military applications, exempting space applications. (The term "COTS" here refers to commercial EEE Parts, including plastic encapsulated active ones.)
After decades of successful use of COTS in military applications, the above change has been proved viable.
Many challenging space applications requirements can be met only using COTS. The time has come (better sooner than later) for policymakers to reach a consensus on applying the COTS philosophy to space applications. This policy change is critical for the space industry.
The main obstacle to be overcome to change the present policy on the use of selected COTS in space applications is the well-known resistance to change.

To the full article: http://www.intelligent-aerospace.com/articles/2017/01/cots-eee-parts-in-space-applications-resistance-to-change.html

COTS/EEE parts in space: component engineering challenges

January 13, 2017

By Dan Friedlander

Retired following 44 years in component engineering

The use of commercial off-the-shelf (COTS) technologies in space requires a more skillful component engineering approach -- one that includes process control improvements, modern microelectronics packaging technologies, and advanced qualification and testing. Radiation-hardness assurance, counterfeit parts avoidance, and the use of lead-free materials also play key roles.

The parts industry is driven by profit and profit is driven by demand. Technically, profit is driven by more die integration (smaller geometry, 3D transistors) and more die in a wafer (same or larger wafers). For COTS, mainly meant for the commercial market, that means maximum use of die area. This priority has a negative impact on a manufacturer's decision to sacrifice die area for means to combat space-related threats (SEL, SEU etc.).

The rush to higher part complexity implies more focus on die design and manufacturing. Such complex die cannot be manufactured without continuous statistical process control (SPC) improvements.

Developments in die packaging technologies, like stacked silicon interconnect (SSI), pose further challenges to component engineering. Traditional space parts lag generations behind these already available technologies.

To the full article: http://www.intelligent-aerospace.com/articles/2017/01/cots-eee-parts-in-space-component-engineering-challenges.html

Standardization of COTS components in space

July 18, 2017

By Dan Friedlander
Retired following 44 years in components engineering

The term "standardization" is well known and practiced for military and space components. It does not mean, however, that everyone is happy with compliance requirement policies, especially as they endeavor to use standard components to the maximum possible extent. The main resistance to adopting standards is rooted in the individual designer’s will not to have factors restrict his or her creativity.
The use of more and more commercial off-the-shelf (COTS) components is and will continue to be the way to go for space applications. The large variety of COTS components in the commercial market emphasizes the need for standardization of the use of "space COTS." Standardization is the way to survive the transition to the use of COTS in space applications. For some faithful followers of the exclusive use of space and military components in space, the COTS market is a jungle to be avoided, and not a chance to survive.

To the full article: http://www.intelligent-aerospace.com/articles/2017/07/standardization-of-cots-components-in-space.html

The use of COTS components in space: debunking 10 myths

July 5, 2017

By Dan Friedlander
Retired following 44 years in component engineering

The use of selected Electrical, Electronic, and Electromechanical (EEE) commercial off-the-shelf (COTS) components in space applications is slowly expanding – too slowly – and not free of myths. It is imperative to be aware of the pitfalls posed by these myths to reach a decision whether to use COTS parts in a specific space mission.

To the full article: http://www.intelligent-aerospace.com/articles/2017/07/the-use-of-cots-components-in-space-debunking-10-myths.html

COTS components in space: overcoming the fear of risk

August 15, 2017

By Dan Friedlander
Retired following 44 years in components engineering

Traditional space and military specification (MIL-SPEC) components have long proven to meet the requirements of various aerospace and defense applications; nevertheless, these successes do not come free of failures.

“99 percent of success is built on failure.” — Charles Kettering

The failures helped, among other things, the Electrical, Electronic, and Electromechanical (EEE) component policymakers to prepare entire specification/standards/handbook systems to mitigate the risk of failures. Whoever believes in the myth of "avoid failures" must revisit this term.

Risk is everywhere and the use of any EEE component in any application is not an exception. The greatest risk is really to take no risk at all.

At the timing of the space/MIL/QPL (Qualified Products List) concept establishment, the EEE components global market share (in $) of the space/MIL EEE components was 60 percent. I have difficulties believing the risk of losing availability of components was then on the agenda of the policymakers. They were focused on mitigating technical failures.
Global developments, based on manufacturers' business decisions, changed completely the space/MIL EEE components market share (in $) to less than 0.1 percent.

This development was the main driver for the courageous William Perry, former U.S. Secretary of Defense, to take the risk and change the policy to use of commercial off-the-shelf (COTS) components in military applications. During his post-decision period, it was field proven that the not-free-of-risk decision was the right one. Unfortunately, the reform did not include space applications. Space applications were exempted, ignoring the issue of insecure components availability.

Although 23 years have passed since the above reform, the path for COTS in space has not yet been officially and fully cleared. Of course, local initiatives are always popping up here and there. The imminent change has not yet been dealt properly. The policy makers are still plagued by myths.
"The risk of a wrong decision is preferable to the terror of indecision." — Maimonides

To the full article: http://www.intelligent-aerospace.com/articles/2017/08/cots-components-in-space-overcoming-fear-of-risk.html

COTS components in space: the storage barrier

September 6, 2017

By **Dan Friedlander**
Retired following 44 years in component engineering

The transition to using commercial off-the-shelf (COTS) components in space applications is a complex process. Many technical, psychological and emotional, and even political barriers have to be broken down to enable culture change.
One of those barriers is the well-rooted belief that COTS components are unable to meet their specifications (spec) after a relatively long storage period, largely because COTS components are meant for the commercial world. This world is associated with mass production, consuming the components shortly after their production, resulting in a very short shelf life, without negative impacts on the components.
The above is true for mass production. However, is worth mentioning that smaller-volume commercial production lines are also producing COTS components with reasonable success.
The space industry does not live (not yet) in a similar environment of mass production. Consequently, even the most organized space entities (military as well) cannot enjoy short shelf life. The relative long shelf life of components becomes a barrier to be dealt with on the way to using COTS parts in space applications.

Pragmatism in conjunction with risk management is the way to turn down the COTS storage barrier in the space industry.
"In meetings philosophy might work, on the field practicality works." **—** Amit Kalantri

To the full article: http://www.intelligent-aerospace.com/articles/2017/09/cots-components-in-space-the-storage-barrier.html

COTS in space: overcoming the counterfeit barrier

September 20, 2017

By Dan Friedlander
Retired following 44 years in components engineering

Aerospace organizations have to traverse a road full of barriers on their journey to use commercial off-the-shelf (COTS) components in space systems. Although they're not always in full control, the responsibility for the outcome lies with them. Consequently, they have to be aware of each barrier to find an educated way to overcome it and benefit from the use of COTS. It does not matter who is actually raising the specific barrier and what arguments are used, space organizations have to follow the uncontrollable road, in a controlled way, to survive. They have to realize that adaptation, rather than resistance to change is the way to go.
"The art of life is a constant readjustment to our surroundings." — Kakuzo Okakaura
The transition to the use of COTS in space is not free of risks. However, the biggest risk is non-availability of electrical, electronic, and electromechanical (EEE) components needed to build systems. Risk is manageable, if you are aware of it.

"Risk comes from not knowing what you're doing." — Warren Buffett
Each barrier is associated with its own risks. One of the more tricky barriers is EEE components counterfeiting. The lucrative counterfeit industry cannot be defeated, among other things, because:

a. Big money is involved.
Worldwide counterfeiting of electrical products is estimated to range anywhere between US$11 billion to $20 billion annually (ref: *The Holography Times*, Vol. 8, Issue 24).

b. Those that fight it, in parallel, help them.

To the full article: http://www.intelligent-aerospace.com/articles/2017/09/cots-in-space-overcoming-the-counterfeit-barrier.html

COTS components in space: the lead-free barrier

October 4, 2017

By Dan Friedlander
Retired following 44 years in components engineering

Technological advancement, especially in electronics, has changed mankind's culture. Obsession with technology, mainly in developed countries, is dictating the rapid increase of electronic waste (e-waste).

The extent of the e-waste issue can be seen through The World Counts (http://www.theworldcounts.com/) World Waste Figures (2014):
- A culture of use and throw away generates around 40 million tons of e-waste every year, worldwide.
- E-waste comprises 70 percent of overall toxic waste.
- E-waste contains hundreds of substances, of which many are toxic. This includes mercury, lead, arsenic, cadmium, selenium, chromium, and flame retardants.
- Only 12.5 percent of E-Waste is recycled.
- Eighty (80) percent of E-Waste in the U.S. and most of other countries are transported to Asia or Africa. E-Wastes are buried or incinerated in landfills where their toxins pollute our land, air, and water.

The above dramatic figures point to a serious threat to environment and health. Indeed, the huge consumer/commercial quantity of thrown-away electronic products are difficult to be managed.

Nevertheless, the conclusion to ban use of lead (Pb) in electrical, electronic, and electromechanical (EEE) components is controversial. Same goes for the Pb impact on health and environment. The balance between the achieved benefits and the associated detriments is also controversial.
According to Wikipedia, "less than 4 percent of lead in landfills is due to electronic components or circuit boards, while approximately 36 percent is due to leaded glass in cathode ray tube monitors and televisions, which can contain up to 2 kilograms per screen."
The very same issue is presented differently by Andrew D. Kostic, Ph. D. of The Aerospace Corporation in his presentation "Lead-free Electronics Reliability - An Update," August 2011. It is interesting to see the below presented facts versus the dramatic steps taken through banning the use of lead in the electronics.

To the full article: http://www.intelligent-aerospace.com/articles/2017/10/cots-components-in-space-the-lead-free-barrier.html

Electrical, electronic, and electromechanical COTS components in space: penalizing policy

October 20, 2017

By Dan Friedlander
Retired following 44 years in components engineering

Following global developments in the electrical, electronic, and electromechanical (EEE) market, space- and military-grade components availability has decreased substantially. Military authorities recognized the need to find an alternative to the well-established and proved existing policy. The diminished space/military-grade components market is in a decline stage.
Looking at the relevant official policies of the space agencies (ESA, NASA, etc.), it seems that the policymakers are confident that EEE components availability is not something to be worried about, but history proves EEE components availability is driven by component manufacturers' business decisions and not by wishful thinking.

Official commercial EEE components usage policies are rather addenda to the traditional space methodology than a much-needed culture change. The official methodology of selecting and using EEE COTS components for space applications continues to be based on intensive testing/screening, rather than on the widely accepted methodology of statistical process control (SPC).
The traditional methodology of dealing with space/military grade EEE components has been extended (with some tailoring) to commercial EEE components. Beside locking new designs in usage of questionable EEE components availability, such an extended policy penalizes the use of EEE COTS components. Such policy not only imposes on the user a "last resort" selection path and a higher COTS ownership cost path, but also moves a heavy burden of unjustified (considering the COTS process control methodology) testing/screening from the components manufacturer to the user. It is widely accepted and widely proven that reliability of EEE components is built into them by design and by manufacturing process and not by testing/screening.
In spite of the questionable declining availability issue of space/military EEE components, the space authorities are reluctant to officially and timely recognize the EEE COTS components flight worthiness, under a new reality compliant methodology. Allowing use of EEE COTS components as last resort flight-worthy components within the traditional methodology, under a COTS penalization regime, is not a solution to secure designs and meet the foreseen global trends.
This article attempts to emphasize the rightness an applicable Albert Einstein quote: "We cannot solve our problems with the same thinking we used when we created them." In other words, methodology change invokes change of thinking.
To the full article: http://www.intelligent-aerospace.com/articles/2017/10/electrical-electronic-and-electromechanical-cots-components-in-space-penalizing-policy.html

COTS in space: the 100 percent testing risk

November 13, 2017

By Dan Friedlander
Retired following 44 years in component engineering

The current European Space Agency (ESA) and National Aeronautics and Spac¢e Administration (NASA) approach to the use of Electrical, Electronic, and Electromechanical (EEE) commercial off-the-shelf (COTS) components in space applications continues to rely on heavy testing requirements. The official methodology looks more as an addendum to the traditional approach, rather than a new approach based on COTS. The value of Statistical Process Control (SPC) is more or less disregarded. One hundred percent post-procurement testing is moved from the component manufacturer to the user, regardless of involved difficulties caused by higher complexity, integration, speed, and number of package terminations and lower package geometries of COTS. These parameters make the testing more and more difficult and less efficient, affecting the component electrical and/or mechanical integrity. Testing becomes more and more risky to the components, outweighing the benefit.
I question the rationale behind the benefit of post-procurement 100 percent testing and screening in the different world of SPC. New thinking is required.

<u>**To the full article:**</u> http://www.intelligent-aerospace.com/articles/2017/11/cots-in-space-the-100-percent-testing-risk.html

COTS in space: hasty generalizations

November 30, 2017

By Dan Friedlander
Retired following 44 years in component engineering

Multiple articles I have authored on commercial off-the-shelf components in space applications have been met with more and more indications of fallacious, unpersuasive arguments. Some of the arguments are rooted in multi-year convictions, others are rooted in misunderstanding and/or misinterpretation of ambiguous, confusing, on-going official mixed MIL/COTS space policy. In this article, I go back to the basics to clarify some points to be considered in reasoning. The issue is a complex one, involving a lot of hidden (not accessible) information needed to understand the whole issue fully. Saying that, I do not exclude myself from those confused by the ambiguous and/or unrealistic rules to be followed. That may lead me to misunderstandings. In such cases, I welcome adequate feedback.

To the full article: http://www.intelligent-aerospace.com/articles/2017/11/cots-in-space-hasty-generalizations.html

EEE COTS components in space: cost

December 8, 2017

By Dan Friedlander
Retired following 44 years in component engineering

Dealing with electrical, electronic, and electromechanical (EEE) components for any application is a complex, multi-disciplinary task. Those who are specialized in engineering should be aware of their creativity cost aspects. Design-to-cost (DTC) is a cost management technique to be applied from the earliest concept decisions. Wrong cost estimation decisions in the field may later become a financial disaster. As suggested by the term design-to-cost, symbiosis between engineering and economy designs the costs "into the product."

Cost savings is an important goal, but not at any cost. If not approached with technical reasoning, cost savings is a dangerous pitfall. Commercial competitiveness to reduce cost and improve performance relative to commercial applications can jeopardize reliability, security, or system longevity. Unbiased cost savings assessment shall be performed in order to ensure proper decision making. Of course, the penalty for the cost savings (e.g., risk, etc.) shall be assessed as well.

The military/space EEE components methodology has been developed in the '60s, when there were no availability problems. In the '90s, the global military/space EEE components market was massively left by the components manufacturers, following business decisions, based on low demand.

The main reason to go for EEE commercial off-the-shelf (COTS) components for military and space is market non-availability of traditional level components due to diminishing sources. In addition, the military budgets reductions had further pushed the U.S. Department of Defense (DoD) in 1994 to transit to an alternative, technically advanced, cost-effective methodology of use of EEE COTS components in military applications.

Military applications can benefit from cost saving, providing that the EEE COTS components are used "as is" (as purchased). After two-plus decades of use of EEE COTS components in military applications the transit decision has been proved as a right one.

The space applications differ from the military ones. EEE COTS components cannot be used in space applications as is. The space applications are not maintainable (not yet). They have to function in exclusive environmental stresses (radiation, etc.) to be dealt with. Consequently, the risk of failure or even total loss is higher. Some extra, expensive testing is necessary.

Usually, the cost of a satellite and its launch is high. Cost savings is an important factor in making the space application more affordable within the allocated budgets. The quality and the reliability of the used EEE components (regardless of using the traditional methodology or the COTS one) shall be optimized for the specific mission. The cost of quality shall be managed properly. Saying that, once again, it has to be stressed that components availability is the leading factor also in the case of space applications.

To the full article: http://www.intelligent-aerospace.com/articles/2017/12/eee-cots-components-in-space-cost.html

COTS in space: Infusing MIL EEE components with COTS practices, part I and II

December 28, 2017

By **Dan Friedlander**
Retired following 44 years in component engineering

The 1994 Perry Memo triggered a policy of transition from MIL, including military standard (MIL-STD) and military specification (MIL-Spec) which typically were purpose-built, custom, and proprietary, components to commercial-off-the-shelf (COTS) products. Unfortunately, space applications were exempted. It is understood that the U.S. Department of Defense (DoD) is a space user and not the space policy maker. Although the same drivers apply, history shows that even after 23 years, the space authorities need more time to realize that COTS is not just a "last resort" selection option.

It seems that the MIL-SPEC to MIL-PRF (military performance specification) conversion is considered a satisfactory solution, in spite of these components' insecure availability.

Technically, if MIL components availability is foreseen as secure and the space users can confine to the relatively (referenced to COTS) less advanced technologies, less sophistication, less integration, no SWaP (size, weight, and power) issues, they can live with the present policy of MIL components supremacy.

Budget-wise, the DoD reformers' target to save money in military applications by using COTS **as is** and MIL as last resort. The present space policy piggybacks on the now liberalized traditional **costly** methodology of heavy 100% testing/screening even for COTS. Keeping the status of COTS components as "last resort" and applying to them the above costly methodology is counterproductive. Space users are pushed in the wrong direction.

The MIL-SPEC to MIL-PRF is a change in the right direction, but is not a full lasting solution in view of the ongoing global trends. In fact, it is a new *infusion* of vitality to the outdated MIL system, using basic elements of COTS.

It has to be mentioned that electrical, electronic, and electromechanical (EEE) components-related issues are only a subset of the huge defense acquisition reform. Defense acquisition reform has been debated for the past five decades in an environment of strong resistance to change.

This article is about the MIL side of the MIL/COTS multi-decade debate.

To the full article:

http://www.intelligent-aerospace.com/articles/2017/12/cots-in-space-infusing-mil-eee-components-with-cots-practices-part-i.html

http://www.intelligent-aerospace.com/articles/2017/12/cots-in-space-infusing-mil-eee-components-with-cots-practices-part-ii.html

COTS in space: Addressing obsolescence, part I and II

January 19, 2018

By **Dan Friedlander**
Retired following 44 years in component engineering

A component becomes obsolete when the original component manufacturer stops marketing it. Electrical, electronic, and electromechanical (EEE) components obsolescence hits the military, space, and commercial market. In the military, massive EEE components obsolescence occurred due in part to manufacturers’ decisions to leave or reduce activities in this market. For reasons not immediately understood, the military often uses phrase "diminishing manufacturing sources" rather than the term "obsolescence".

It must be mentioned that the components already in space orbit do not need obsolescence-related attention for maintenance or repair purposes (at least for the one shot launched, not maintainable systems). Nevertheless, attention shall be paid to follow-up designs.

In the commercial market, due to the high dynamics in technological development and due to consumer demand, the availability period of commercial off-the-shelf (COTS) components is often shortened.

As the space and military technology community insert more open architectures and COTS technology, the challenge of managing the obsolescence that comes with COTS will only become more difficult.

Candidate COTS components for space applications constitute only one subset of the COTS population, used mainly in consumer electronics. Consequently, the potential user of COTS for space should carefully assess the mechanism of obsolescence in context with space applications. Obsolescence, by no means, should be considered a "showstopper" of any application; it is an obstacle to be overcome.

This article addresses the need for obsolescence issue understanding as an obstacle in a series of obstacles to be overcome to go for the inevitable use of selected COTS in space applications.

To the full article:

http://www.intelligent-aerospace.com/articles/2018/01/cots-in-space-addressing-obsolescence-part-i.html

http://www.intelligent-aerospace.com/articles/2018/01/cots-in-space-addressing-obsolescence-part-ii.html

COTS in space: procurement strategy

February 1, 2018

By Dan Friedlander
Retired following 44 years in component engineering

The procurement of electrical, electronic, and electromechanical (EEE) components phase is common for all applications (commercial, automotive, military, space, etc.). Nevertheless, every application type has its own characteristics.
For the majority of cases, the term "procurement" is associated with a mainly logistics process, including phases of negotiations, ordering, order status monitoring, supply chain assurance, delivery of components to be used as is. Often, the procurement staff efficiency is measured in terms of money. Such a mindset of money prioritization may result in quality and reliability compromises.
The procurement of EEE components for space applications is a more complex process than the above-mentioned one. In addition to more complex logistics (activities performed in different locations), the process includes component engineering, test engineering, electrical/environmental testing, radiation testing, and specification writing.
The moneywise issues' importance is still an important factor, together with quality/reliability assurance.
In fact, the procurement process is an extended three-tier process: pre-procurement, procurement, and post-procurement. This extended process outputs the ready-to-be-flown EEE components.
There are different practiced procurement strategies and methods, tailored to the EEE components buyers' needs.
The main parameters for selecting the applicable strategy are and not limited to:

- outsourcing decisions
- components buyer status: prime contractor, subcontractor
- contractual requirements
- parts control plan requirements
- cost effectiveness
- applicable in-house infrastructure extent
- experience accumulation

This article is mainly based on my component engineering experience in the domain of military and space applications. The experience is not confined to the use of MIL/space EEE components, but also to extensive and successful use of commercial off-the-shelf (COTS) components.
To the full article:

http://www.intelligent-aerospace.com/articles/2018/02/cots-in-space-procurement-strategy.html

COTS in space: realist navigators wanted, part I and II

February 21, 2018

By Dan Friedlander
Retired following 44 years in component engineering

MIL-SPEC, military specifications, started some 50 years ago, for well-justified reasons. At that time, the use of integrated circuits (ICs) was in the infancy stage, the personal computer had not yet been built, the Internet had not yet been born. The system proved itself successful, although the relations between the government and industry have not always been harmonized. After decades of “faithfully" following MIL-SPEC system rules, a series of EEE component manufacturers have left the above regime due to global developments. Business decisions led them to a more profitable market: the commercial one.
The relevant EEE component manufacturers proved that business decisions are stronger than politics.
The military has always emphasized quality over price. It was not until the massive budget cutbacks and the shrinking military EEE components availability that the U.S. Department of Defense (DOD) was forced to change its policy.
The 1994 MIL-SPEC reform turned down numerous barriers between industry and government. The policy makers realized that striving to overcome the global developments is a lost case. The DOD has realized its goal of increased access to commercial technology.
The general reform idea was: Don’t tell a person how you want them to do something, but rather tell them what you want.

The space industry has been exempted from the above reform. However, the same factors, leading to the above reform, apply also to the space industry and the relevant policy makers. Unfortunately, grosso modo, 50 years after creation, more than 20 years after the 1994 reform, the traditional MIL-SPEC testing/screening concept still dominates the official space EEE components policy.
Space/military EEE components are preferred over the commercial off-the-shelf (COTS) alternative. Nobody argues about the space/military EEE components suitability for space applications, providing their availability is secured.
Today, the most certain thing about the military/space EEE components availability is its uncertainty.
It has been proved in the past that the power of EEE components manufacturers is the one shaping the future of the relevant market.
“Study the past if you would define the future.” — Confucius
It is a mystery what could be the basis for the space policy makers (governmental NASA, intergovernmental ESA) to predict the space/military EEE components future availability?!
"The only way to predict the future is to have power to shape the future." — Eric Hoffer
The present space EEE components policy is based on first priority selection of space/military grade and last resort selection of COTS with postprocurement testing/screening requirements. The policy makers overestimate their capability to secure or forecast the future

availability of the space/military-grade EEE components and underestimate the potential of using EEE COTS components in space applications.
At this point we urgently need realist navigators, who can look at things as they are and deal with it in a practical manner. This article attempts to outline the uncertain situation the users are dealing with it, looking for guidance.

To the full article:

http://www.intelligent-aerospace.com/articles/2018/02/cots-in-space-realist-navigators-wanted-part-i.html

http://www.intelligent-aerospace.com/articles/2018/02/cots-in-space-realist-navigators-wanted-part-ii.html

COTS in space: automotive EEE components, part I, II and III

April 3, 2018

By Dan Friedlander
Retired following 44 years in component engineering

Automotive-grade electrical, electronic, and electromechanical (EEE) components are a subset of the commercial off-the-shelf (COTS) EEE components population. The prime intended applications for the above subset are the automotive ones. Not all the automotive EEE components are COTS. The custom automotive components are not COTS. Only standard automotive-grade components which come from the manufacturer commercial data book are COTS.
With the increasing sophistication of future vehicles, new and more advanced semiconductor technologies will be used and vehicles will become technology centers. The above trend leads to increasing interest of EEE components manufacturers in the business opportunities offered by the fast-growing automotive market.

The space industry, within the use of COTS in space dilemma, is also looking at automotive EEE components. That is OK, pending the subject is fully understood. In other words, it has to be understood what "automotive-grade" really means in terms of quality and reliability. The reference for the discussion is industrial-grade regular, catalog EEE COTS components.

To the full article:

http://www.intelligent-aerospace.com/articles/2018/04/cots-in-space-automotive-eee-components-part-i.html

http://www.intelligent-aerospace.com/articles/2018/04/cots-in-space-automotive-eee-components-part-ii.html

http://www.intelligent-aerospace.com/articles/2018/04/cots-in-space-automotive-eee-components-part-iii.html

COTS in space: products vs. components for space applications

April 25, 2018

By Dan Friedlander
Retired following 44 years in component engineering

The term "COTS" – which stands for commercial off-the-shelf – encompasses components as well as products, often called non-developmental items (NDI). The COTS NDI selection process for space applications is even more challenging than the selection of COTS components. One of the main reason for encountering difficulties is the NDI content of multiple components, technologies, and processes.

Often the content information – which includes components identity, materials identity, processes identity – is proprietary. The content for a developmental item is within the user influence sphere, that not being the case for NDI.

It seems that space applications are hungry for more and more high-capacity, high-speed, compact mass nonvolatile memories. Looking with envy at the consumer world, space engineers and end users are aware of the rapid progress of solid-state drives (SSD), based on 3D NAND (Not AND) Flash.

The example of a Samsung commercial SSD (850 PRO) product helps outline the difficulties of selecting a COTS product for use in space applications. This example may be extrapolated to other Samsung SSDs and perhaps to other "not addressed" sources, as well.

To the full article:

http://www.intelligent-aerospace.com/articles/2018/04/cots-in-space-products-vs-components-for-space-applications.html

COTS in space: the radiation barrier

May 16, 2018

By Dan Friedlander
Retired following 44 years in component engineering

The road from the use of space/military electrical, electronic, and electromechanical (EEE) components in space applications to the use of commercial off-the-shelf (COTS) components in space applications is not smooth. Several barriers must be overcome, including: fear of risk, resistance to change, storage, obsolescence, counterfeits, and lead-free barriers.
These manmade barriers were challenges also encountered by military users during the successful transition to the use of COTS components in military applications. The main natural space environmental barrier to be overcome is the radiation threat to the active electronic components. Among many other threats to be addressed, the critical radiation issues have been addressed successfully from the start of the space activities. The figure below summarizes the major space environment hazards, including those relevant to electronic components.

The Radiation Hardness Assurance (RHA) plan is aimed at ensuring that "the radiation withstanding of a given component is higher than the actual expected radiation level in space." To ensure the above, components radiation tests are performed. The testing activities are expensive and make up a significant part of the component ownership cost.
The transition to usage of COTS components in space applications makes the life more difficult, because of a lack of existing relevant radiation database. The radiation barrier is not impassable.

To the full article:

http://www.intelligent-aerospace.com/articles/2018/05/cots-in-space-the-radiation-barrier.html

COTS in space: decisions making

June 5, 2018

By Dan Friedlander
Retired following 44 years in component engineering

Decisions are the hardest thing to make, especially if it is a choice between where you should be and where you want to be. You should be in a position to secure your designs by securing electrical, electronic, and electromechanical (EEE) components availability. You tend to resist changes to secure your present position.

EEE components availability is driven by business decisions, not by wishful thinking of EEE components users and policy makers. Don't entrust your future on others' hands.

Technically, nobody contests the viability of the proven methodology of using space/military-grade components in space and military applications. However, this methodology is not immune to global developments, which impose a new methodology of using selected commercial off-the-shelf (COTS) in space applications. To implement the COTS methodology across the board, timely decision making is requested.

"The hardest decisions in life are not between good and bad or right and wrong, but between two goods or two rights." -- Joe Andrew

Delaying inevitable decision making may prove to be critical.

"Shelving hard decisions is the least ethical course." -- Adrian Cadbury

This article points to needed decision making, based on the already gained heritage of using COTS in space and military applications.

To the full article:

https://www.intelligent-aerospace.com/articles/2018/06/cots-in-space-decisions-making.html

COTS in space - the future

November 28, 2018

By Dan Friedlander
Retired following 44 years in component engineering

In the last 50 years, the electronic components domain has gone through a tremendous series of technological developments, mainly driven by the users' appetite for performance and by components manufacturers' appetite for profit.
The military components official policy (led by US DoD) did not succeed to keep pace with the technology (led by commercial demand). The space components official policy (led by NASA, ESA), piggybacking on the military methodology, has been plagued by the same problems.
Unfortunately, it is hard for engineering judgment to prevail over business decisions. The history proves that even governments are not capable to control business decisions of components manufacturers. Nobody is capable to change components manufacturers business decisions to discontinue products, to merge, to outsource to foreigners, to sell companies to foreigners etc.
The business decisions are driven by demand. The military and space demand is a very small one compared to the commercial one. The military/space components availability security is far from being secure.
The dynamic patterns of changes in the component industry, have an imminent effect on the availability of the components. The space demand size has a critical mass in dollars. The critical mass is determined by the relevant components manufacturers, per their market share. The users should be aware about their lack of power to control business decisions, that their effect may vary from individual components obsolescence to partial or entire markets.
Regarding the use of COTS in space, change in policy should mean adaptation to changing circumstances. It seems that the lessons have not yet been learned by the space components policy makers. Nobody claims that a change in policy is a simple, risk free process. There is no risk free EEE components methodology (in the past, in the present or in the future).
"We learn from history that we do not learn from history".
A proverb states: "History repeats itself".
There should be a time limit to decide what is the optimal timing to fully recognize (not as last resort) the use of selected COTS in space applications. In addition, the even more painful issue of the space designs dependency on the uncertain availability of military, space, hermetically sealed EEE components, shall be dealt with on time.
"Sometimes painful things can teach us lessons that we didn't think we needed to know".
This article attempts to extrapolate the past into the future, namely forecasting and not predicting the future. The future developments in the space/military EEE components domain are not fatalistic in nature.

To the full article:
https://www.intelligent-aerospace.com/articles/2018/11/dan-friedlander-cots-the-future.html