Introduction

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This is a story about a project that spans more than 20 years. I wasn't involved in the beginning and I retired before the effort was completed, but I was there for much of the middle parts. This is a history of the development of a Flight Termination Safe and Arm (FTSA) device. Later I’ll explain what those acronyms mean. The use of acronyms is very popular in this industry.

I’ve been thinking about writing this story for several years and I was going to write a lessons learned paper or some sort of case study. So for a while now, I’ve been collecting background information with the thought of one day writing the history of this project.

When the United States military wants to test a new weapon or upgrades, it often performs the tests at a military test range. There are about 15 large test ranges where test and evaluation takes place in controlled arena. The ranges are equipped with radars, telemetry receiving equipment and other instrumentation necessary for these tests. A test article, be it an airplane, missile, bomb or drone is usually instrumented so that the guidance or control functions on the test item can be monitored and the data analyzed. If the test article is a one time usage device like a missile or bomb, the data is transmitted to ground stations during the flight. Sometime it is necessary to have a method of terminating the flight of a missile if things go wrong. A flight termination system is the name given to a collection of equipment that is used to remotely end the flight of a missile or test article that is not operating correctly and posses a threat to life or property.

This story is about the design and development of one of the components of the flight termination system called the Flight Termination Safe and Arm (FTSA) device. The story will also touch on areas such as some of my experiences working as a civil servant for the US Navy for 35 years and the design of a new telemetry system for an air to ground missile called the High Speed Anti-Radiation Missile (HARM).

The FTSA is an interesting component because it is an electronic device that initiates the explosive chain leading to the destruct charge in a flight termination system. As an electrical engineer the development of device to initiate an explosive component was a new area that was very interesting and outside the realm of anything that I had worked on before.

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Notes:

RDT&E Budget Item Justification: PB 2013 Office of Secretary Of Defense

Since its inception in FY 1990, this program element has been used to fund the development of critically needed, high priority Test and Evaluation (T&E) capabilities for

joint/multi-Service requirements.

The Central Test and Evaluation Investment Program (CTEIP) uses a corporate investment approach to combine Service, Defense,

and other government agencies T&E needs, maximize opportunities for joint efforts, and avoid unwarranted duplication of test capabilities. CTEIP focuses investments

on projects that will have high productivity returns on investment. Projects under the CTEIP Program Element (PE) support two basic tasks: investments to improve the

test capabilities base (Joint Improvement and Modernization (JIM) projects) and development of near-term solutions to test capability shortfalls in support of ongoing

operational test programs (Resource Enhancement Project (REP)).

The JIM funds critically needed T&E investments in the major functional areas of: air combat; armament and munitions; Command, Control Communication,

Computer and Intelligence (C4I) and networks; common range instrumentation; electronic combat; land combat; sea combat; space combat; target systems; and test

environments. Examples of project subject matter include: highly accurate time-space-position information, network enhanced telemetry, miniaturized flight safety

systems, realistic urban test environments, ground testing for hypersonic systems and satellites, and end-to-end testing of infrared countermeasure systems. CTEIP

continues as the focal point for fostering common architectures throughout the test and training communities to enhance the sharing of resources and links between

test and training ranges.

CTEIP has provided special focus to institutionalize the use of modeling and simulation (M&S) as a practical test tool; to link ranges through internetting to enhance

inter-range and inter-Service cooperation and resource sharing; and, to ensure development and acquisition of common instrumentation necessary for a more efficient

test infrastructure.

Analyses of alternative solutions are conducted for each investment project to validate T&E requirements, to define integrated support systems, and to determine

overall cost effectiveness of the proposed test investments. The use of Department of Defense (DoD)-wide criteria for requirement validation, prioritization, and risk

assessment ensures an effective test resource investment program.

The REP funds development of near-term solutions for critical ongoing operational tests supporting decisions on major, high priority defense acquisition programs.

These unanticipated operational test (OT) capability requirements arise from several sources such as a new threat system identified during OT planning, acquisition of

foreign military assets that are critical in determining weapon system operational effectiveness, short timelines between system design maturity and scheduled OT, and

emerging technologies and test requirements resulting from operational concept changes mandated by Congress or Director, Operational Test & Evaluation (DOT&E),

MRTFB Ranges

Department of the Army

Aberdeen Test Center

Dugway Proving Ground

High Energy Laser Systems Test Facility

Kwajalein Missile Range

White Sands Missle Range \*

Yuma Proving Ground \*\*

\* + Electronic Proving Ground

\*\* + Cold Regions Test Center

\*\* + Tropic Regions Test Center

Department of the Navy

Atlantic Fleet Weapons Training Facility

Atlantic Undersea Test and Evaluation Center

Naval Air Warfare Center, China Lake

Naval Air Warfare Center, Patuxent River

Naval Air Warfare Center, Point Mugu

Naval Air Warfare Center, Trenton

Pacific Missile Range Facility

Department of the Air Force

30th Space Wing, Vandenberg AFB

45th Space Wing, Patrick AFB

Air Force Development Test Center, Eglin AFB

Air Force Flight Test Center, Edwards AFB

Arnold Engineering Development Center

Nevada Test and Training Range

Utah Test and Training Range

Department of Defense Agencies

Joint Interoperability Test Command

The Major Range and Test Facility Base [MRTFB] is a set of test installations, facilities, and ranges which are regarded as "national assets." These assets are sized, operated, and maintained primarily for DoD test and evaluation missions. However, the MRTFB facilities and ranges are also available to commercial and other users on a reimbursable basis. Oversight of the MRTFB is performed by the Office of the Director for Test, Systems Engineering, and Evaluation, Resources and Ranges.

In 1971, DoD recognized that large military test facilities represented national assets and were required to support development and deployment of U.S. warfighting capabilities. DoD established the MRTFB management concept to provide coordination among the major facilities, promote multi-Service use, reduce unnecessary duplication of assets and establish budgetary priorities at the Department level. Each of the above MRTFB members were selected because of unique test and evaluation (T&E) assets needed to ensure proper T&E support for U.S. Military weapon systems developers.

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Usage: In an essay, article, or book, an introduction (also known as a prolegomenon) is a beginning section which states the purpose and goals of the following writing. This is generally followed by the body and conclusion. The introduction typically describes the scope of the document and gives the brief explanation or summary of the document. It may also explain certain elements that are important to the essay if explanations are not part of the main text. The readers can have an idea about the following text before they actually start reading it. ln technical writing, the introduction typically includes one or more standard subsections: abstract or summary, preface, acknowledgments, and foreword. Alternatively, the section labeled introduction itself may be a brief section found side-by-side with abstract, foreword, etc. (rather than containing them). In this case the set of sections that come before the body of the book are known as the front matter. When the book is divided into numbered chapters, by convention the introduction and any other front-matter sections are unnumbered and precede chapter 1.

Sample: In 2010, French mathematician Cédric Villani received the Fields Medal, the most coveted prize in mathematics, in recognition of a proof which he devised with his close collaborator Clément Mouhot to explain one of the most surprising theories in classical physics. Birth of a Theorem is Villani's own account of the years leading up to the award. It invites readers inside the mind of a great mathematician as he wrestles with the most important work of his career.

But you don't have to understand nonlinear Landau damping to love Birth of a Theorem. It doesn't simplify or over explain; rather, it invites readers into collaboration. Villani's diaries, emails, and musings enmesh you in the process of discovery. You join him in unproductive lulls and late-night breakthroughs. You're privy to the dining-hall conversations at the world's greatest research institutions. Villani shares his favorite songs, his love of manga, and the imaginative stories he tells his children. In mathematics, as in any creative work, it is the thinker's whole life that propels discovery—and with Birth of a Theorem, Cédric Villani welcomes you into his.

Sample: Computers have changed since 1981, when The Soul of a New Machine first examined the culture of the computer revolution. What has not changed is the feverish pace of the high-tech industry, the go-for-broke approach to business that has caused so many computer companies to win big (or go belly up), and the cult of pursuing mind-bending technological innovations. The Soul of a New Machine is an essential chapter in the history of the machine that revolutionized the world in the twentieth century.

Sample; Barely fifty years ago a computer was a gargantuan, vastly expensive thing that only a

handful of scientists had ever seen. The world’s brightest engineers were stymied in their quest to make these machines small and affordable until the solution finally came from two ingenious young Americans. Jack Kilby and Robert Noyce hit upon the stunning discovery that would make possible the silicon microchip, a work that would ultimately earn Kilby the Nobel Prize for physics in 2000. In this completely revised and updated edition of The Chip, T.R. Reid tells the gripping adventure story of their invention and of its growth into a global information industry. This is the story of how the digital age began.

Sample: The dramatic and enthralling story of the building of the Brooklyn Bridge, the world’s longest suspension bridge at the time, a tale of greed, corruption, and obstruction but also of optimism, heroism, and determination, told by master historian David McCullough. In the years around 1870, when the project was first undertaken, the concept of building an unprecedented bridge to span the East River between the great cities of Manhattan and Brooklyn required a vision and determination comparable to that which went into the building of the great cathedrals. Throughout the fourteen years of its construction, the odds against the successful completion of the bridge seemed staggering. Bodies were crushed and broken, lives lost, political empires fell, and surges of public emotion constantly threatened the project. But this is not merely the saga of an engineering miracle; it is a sweeping narrative of the social climate of the time and of the heroes and rascals who had a hand in either constructing or exploiting the surpassing enterprise.

Sample: How Music Got Free is a riveting story of obsession, music, crime, and money, featuring visionaries and criminals, moguls and tech-savvy teenagers. It’s about the greatest pirate in history, the most powerful executive in the music business, a revolutionary invention and an illegal website four times the size of the iTunes Music Store. Journalist Stephen Witt traces the secret history of digital music piracy, from the German audio engineers who invented the mp3, to a North Carolina compact-disc manufacturing plant where factory worker Dell Glover leaked nearly two thousand albums over the course of a decade, to the high-rises of midtown Manhattan where music executive Doug Morris cornered the global market on rap, and, finally, into the darkest recesses of the Internet. Through these interwoven narratives, Witt has written a thrilling book that depicts the moment in history when ordinary life became forever entwined with the world online—when, suddenly, all the music ever recorded was available for free. In the page-turning tradition of writers like Michael Lewis and Lawrence Wright, Witt’s deeply reported first book introduces the unforgettable characters—inventors, executives, factory workers, and smugglers—who revolutionized an entire artform, and reveals for the first time the secret underworld of media pirates that transformed our digital lives. An irresistible never-before-told story of greed, cunning, genius, and deceit, How Music Got Free isn’t just a story of the music industry—it’s a must-read history of the Internet itself.