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LOCKHEED MARTIN MISSILES & SPACE:
A BACKGROUND PAPER ON THE WORLD'S TOP MISSILE PEDDLER

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Fulfilling a boyhood dream, Glenn L. Martin in 1909 took to the air near Santa Anna, California in his home-made airplane. Although too late for World War I, the Martin bombers and flying boats played a key role in World War II. Later Martin Company merged to create the Martin Marietta Corporation. In 1993 Martin Marietta purchased General Electric's aerospace business for $3.05 billion, including management of several DOE facilities. (GE had previously swallowed RCA's satellite business.) In 1994 Martin Marietta acquired General Dynamics' Space Systems Division for $208.5 million, and became America's fourth largest military contractor for that year.

Allan Loughead lifted his Model-G hydro-airplane from the surface of San Francisco Bay in 1913. He and his brother, Malcolm, later changed their name and formed Lockheed Aircraft Company. This company was purchased by the Gross brothers, Robert and Courtland, during the 1930s, and furnished fighters and bombers for the Army Air Corps during World War II. Expansion continued after the war and the Missiles and Space Division was established, later to be known as Lockheed Missiles and Space Company of Sunnyvale, California. With the demise of the cold war, Lockheed combined with a Russian company to form Lockheed-Khrunichev-Energia International in 1992, thus allowing Lockheed to sell commercial launch services on Russia's Proton rocket. Lockheed also acquired Sanders Associates, a large military electronics firm in Nashua, New Hampshire. In 1993 Lockheed bought General Dynamics' Fort Worth Division for $1.5 billion, and became builder of F-16 fighter jets. This made Lockheed America's #2 weapons contractor for 1994.

A. LOCKHEED MARTIN CORPORATION.

On 12 March 1995 the merger of Lockheed and Martin Marietta was completed to form the new Lockheed Martin Corporation. The resulting giant represented the ultimate in military-contracting conglomeration -- a huge institution which manufactures and exports death in the most technologically advanced form. This merger made Lockheed Martin not only the top dollar-recipient of prime military contracts in the US, but also the biggest weapons maker in the world. The business included aircraft, missiles, space systems, professional services, defense electronics, armored vehicles, computer services, artillery, engines, communications, ordnance, and maintenance & upgrades -- the whole gamut except ships, helicopters and trucks.

Corporate mergers have a habit of simmering down to fewer jobs. In June 1995, 12,000 layoffs were announced as the first round during the "restructuring" of the company. But while the merger bodes ill for employment, it was extremely profitable for the top executives and stockholders. Newspapers report that the Pentagon supplied $1 billion in federal funds (i.e. taxpayers' money) to subsidize the merger -- some $31 million of that going toward a bonus to top Lockheed Martin executives. Later that year Congressman Bernard Sanders (Vermont) cited Lockheed Martin as the first winner of the "Gilded Lily" award, saying: "This company's top executives [including former Lockheed Martin Chairmen Daniel Tellep and Norman Augustine] began receiving in March (1995) $31 million in taxpayer-financed bonuses from the Pentagon to pay one-third of the $92 million in overall bonuses they have granted themselves as a reward for pulling off the biggest merger of defense contractors in US history."[1]

In a 9 May 1996 joint letter to then Defense Secretary William Perry; Congressman Sanders, Congressman Peter DeFazio (Oregon) and Congresswoman Carolyn Maloney (New York) pointed out that: "During the past eight years, 2.2 million Americans have lost their defense-related jobs. At precisely the same time, the top CEOs among defense contractors have been taking home huge salaries and stock payouts paid in no small part by US taxpayers."[2] Daniel Tellep, then CEO and Chairman of the Board at Lockheed Martin, tops the list with $5.5 million total compensation in 1995.

In late 1996 it was estimated that the merger will save the new company and the Pentagon $4.2 billion between 1995 and 2000, and will cost $724 million overall. Since the Pentagon's share of that potential savings is $2.7 billion, Pentagon officials decided in late November 1996 that it would pay $428 million of the taxpayers' money to help Lockheed Martin restructure.

B. LOCKHEED MARTIN ABSORBS LORAL CORPORATION.

Lockheed's merger with Martin is not the end of business ambitions. Corporate conglomeration continues. On 8 January 1996 Lockheed Martin announced that it had clinched a $9.1-billion deal to absorb all of Loral Corporation except its Space Systems. The acquisition was approved by federal regulators on 18 April 1996. To facilitate this merger Lockheed Martin raised its debt level to $3.5 billion; the largest investment-grade offering of corporate debt ever.

Loral Corporation was headquartered in New York City with Bernard L. Schwartz as Chairman and CEO. Some 5,480 of Loral's 38,000 employees work in the San Francisco Bay Area. This merger boosted Lockheed Martin's 1996 sales by 18 percent over 1995. Combined employment jumped to 190,000. This created a multi-faceted, advanced-technology behemoth receiving 40 percent of the Pentagon's procurement budget.

Space Systems/Loral, which is not part of the merger, is a joint venture with Qualcomm (San Diego, California) in developing the $2-billion, 48-satellite Globalstar worldwide communication system capable of serving 10 million subscribers. Loral's 31% interest in Space Systems/Loral will come under a new and independent "Loral Space and Communications Corporation" with Bernard Schwartz as Chairman and CEO. Lockheed Martin will buy 20-percent equity in this new company

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[1] *Mercury News*, 4 August 1995, p. 3D.

[2] *Defense News*, 3 June 1996, p. 14.

for $344 million. Schwartz will also become a Vice Chairman of Lockheed Martin and join its board of directors.

This new Loral Space and Communications Corporation will be based in Sunnyvale, California and consist of 2,300 employees -- 100 working on Globalstar. Globalstar is competitive with Motorola's Iridium system for which LMMS is building the satellites. The merger and Lockheed Martin's share in the spinoff company, along with the dual hats worn by Bernard Schwartz, have caused some raised eyebrows. Some analysts believe that the two systems will also eventually merge into one.

C. LOCKHEED MARTIN SWALLOWS NORTHROP GRUMMAN.

On 3 July 1997 Lockheed Martin announced that it is buying Northrup Grumman Corp. for $11.6 billion. This creates a 235,000 employee company with estimated 1997 revenues of $37 billion. It brings under Lockheed Martin the B-2 stealth bomber and the MX strategic missile. This new company would represent the consolidation of five large defense contractors who were independent just three years ago: Lockheed, Martin Marietta, Loral, Northrup, and Grumman. This deal would put under the title of Lockheed Martin what used to be 22 separate companies who competed to make free enterprise work in America. What mergers are doing is bringing this country under the control of monopolistic capitalism where free enterprise just doesn't work because small companies can't compete. This was apparently recognized by the US Justice Department in March 1998 as it has filed suit to block the merger.

D. LOCKHEED MARTIN SUBSIDIARIES AND JOINT VENTURES.

Lockheed Martin UK is a subsidiary of Lockheed Martin (Bethesda, MD) based in Portsmouth, England. It is a registered British company.

Lockheed Martin Australia Pty. Ltd. is an Australian company involved with radar which is lies at the heart of Australia's long-term defense strategy.

Lockheed Martin and Rafael (Haifa, Israel) each own 50% interest in Precision Guided Systems US (PGSUS) located at Orlando, Florida. Purpose of this renewable five-year joint venture is to globally market the Popeye family of standoff strike missiles. Manufacturing will take place at Orlando and Oscala (both in Florida), Pike County (Alabama), and several Rafael sites in Israel.

Lockheed Martin and Elbit Systems Ltd. (Haifa, Israel) were in January 1998 making plans to do joint business. This is part of Lockheed Martin’s strategy to win Israel’s $2.5 billion fighter contract with the F-16.

During the latter half of 1995 Lockheed Martin and Israeli weapons contractor TAAS Israel Industries Ltd. (Ramay Hasharon, Israel) started negotiations on a semi-merger. Formal talks began in April 1996 when Lockheed Martin offered to buy 40 percent of TAAS's heavy munitions division. The Israeli Ministry of Defense is not enthused about the deal and is holding up negotiations.

Lockheed Martin's Aeronautical Sector has formed a long-term alliance with IBM (Armonk, NY) and Dassault Systemes (Suresnes, France) to design virtual development systems -- next-generation computer-based aircraft development tools and processes. This will allow engineers to simulate the spectrum of airplane design, support and manufacture before actually creating parts, tools and processes.

Lockheed Martin Missiles & Space has formed a joint venture with Russia's Intersputnil communications network to strengthen its competitive position in marketing communications satellites globally. Intersputnil owns 15 prime-high altitude slots for satellite deployment. The first product will be Lockheed Martin's A2100 satellite bus (described below).

Talks started in January 1997 between Lockheed Martin and Aerospatiale (France) on possibly means of trans-Atlantic cooperation on military aircraft and communications satellites.

Lockheed Martin also has an office in Geneva, Switzerland called Lockheed martin International S.A. This office is the spearhead to grab as much as possible of the potential $5-billion to $10-billion new market in East Europe. Lockheed Martin already in April 1996 sold Romania five long-range radar systems. Bids have been submitted to do the same in Slovakia, Hungary and the Czech Republic with Croatia and Macedonia waiting in the wings. In addition to these radars and F-16 fighter jets, Lockheed Martin is seeking East European markets for its dual use (military and commercial) technology in electronics, energy, and environmental management.

E. LOCKHEED MARTIN ORGANIZATIONAL STRUCTURE.

Vance Coffman is Chief Executive Officer (CEO) and Chairman of the Board. Peter Teets is President and Chief Operating Officer of Lockheed Martin Corporation.

The organizational structure of Lockheed Martin Corporation is, in hierarchical order,: Sectors, Business Units, and Groups. Starting with the highest, Lockheed Martin has six business sectors reporting directly to CEO Vance Coffman They are: (1) Aeronautics, (2) Electronics. (3) Energy, (4) Information & Services, (5) Space and Strategic Missiles, and (6) Joint Ventures. Under these six business sectors are tens of separate operating companies. This paper will now narrow its focus to the Space and Strategic Missiles Sector.

More information and future changes at the corporate level is available at Lockheed Martin's home page on the Internet: http://www.lmco.com/

F. LOCKHEED MARTIN SPACE AND STRATEGIC MISSILES SECTOR.

The Space and Strategic Missiles business sector, headed by Mel Brashears, originally absorbed four main facilities: Lockheed Missiles and Space Company (LMSC -- Sunnyvale, California), Martin Marietta Astronautics (Denver, Colorado), Martin Marietta Astro Space (East Windsor, New Jersey), and Martin Marietta Astro Space (Valley Forge, Pennsylvania).

In the "restructuring" announced 26 June 1995, the East Windsor and Valley Forge facilities will be phased out over a three-year period, accounting for 5,000 of the 12,000 jobs lost. The Austin, Texas division of the former LMSC has been closed, although the Courtland Plant near Huntsville, Alabama (which officially opened in July 1994) will remain open.

Lockheed Martin's Space and Strategic Missiles business sector now consists of four companies:

- **Lockheed Martin Missiles and Space Company (LMMS)** (Sunnyvale, California).
- **Lockheed Martin Astronautics Company** (Littleton, Colorado).
- **Lockheed Martin Michoud Space Systems** (New Orleans, Louisiana).

- **Lockheed Martin Special programs.**
- **Lockheed Martin Telecommunications** (Sunnyvale, California).

This paper will now narrow down further to focus on Lockheed Martin Missiles and Space Unit, which has several subdivisions.

G. LOCKHEED MARTIN MISSILES AND SPACE.

Lockheed Martin Missiles and Space (LMMS) is the largest of the corporations 82 operating companies. In June 1995 it had 10,400 employees in the San Francisco Bay Area, and 13,688 nationwide. Six months later the San Francisco Bay Area employment had dipped slightly to 10,120 and total employment to about 13,100. LMMS reported sales in excess of $4.5 billion for 1995 and 1996, and expects to reach $5 billion by 1999.

The main LMMS plant is in Sunnyvale, California. Research and Development offices are in Palo Alto, California. Detonation cords for separating missile stages are fabricated at a plant in the Santa Cruz Mountains of California. The Courtland plant near Huntsville Alabama, named after Lockheed pioneer Courtland Gross, was officially opened in July 1994 to develop and produce the THAAD anti-tactical missile.

The "Office of the President" runs LMMS. It is headed by President K. Michael Henshaw. Executive Vice President L.L. (Vic) Victorino oversees missile programs. Another Executive Vice President may be appointed to run space programs. Under the Office of the President are 14 business units headed by LMMS vice presidents. Additional vice presidents and directors will head sub-organizations. See Appendix-A for the LMMS organizational chart. More information and future changes can be found at the LMMS website on the Internet: http://lmms.external.lmco.com/

H. LMMS BUSINESS ACTIVITY.

For all of 1995 LMMS won 39 contracts and was underbid on another 20 -- a two-thirds success rate in numbers of contracts. In those 39 contracts LMMS garnered a third of the contract dollars available.

1. Specialty Product Centers.

Besides becoming a "world-class spacecraft production facility," LMMS has also been named in the corporate-wide consolidation plan as a "Center of Excellence" for certain products. There are seven divisions within LMMS which build systems and parts for all other Lockheed Martin companies as well as rival aerospace companies. Some of these are:

- **Solar Array Center**. This center is being consolidated into Building 153 in Sunnyvale. It has a backlog of some 14,000 square feet of solar arrays annually through 1999. Some projects for which solar arrays are being fabricated are MILSTAR, Iridium, the first International Space Station, and the NASA Space

Station. LMMS solar arrays were added to the Russian Space Station MIR-1 while it was in orbit.

- **Electronics Product Center**. This center will report to the Sunnyvale office of LMMS. It occupies almost four acres of floor space in Building 102 in Sunnyvale, and is the electronics center for the Space and Strategic Missiles Sector. The summer 1996 work force of 275 is expected to reach 600 in a couple of years.

- **Communications And Power Center** opened 30 July 1997 in Newton, Pennsylvania. Most of the 1,40 employees will be transferred from LMMS in East Windsor, NJ and Valley Forge, PA, as part of the consolidation effort announced in 1995.This specialty center will build communications payloads and power components for final spacecraft integration at the LMMS Commercial Satellite Center in Sunnyvale, CA. The four teams are Antenna Products, Communications Processing Products, Power Products and RF Products.

- **Commercial Satellite Production Center**. This $65-million facility occupying 158,000 square feet is a Factory of the Future with a goal of having eight spacecraft in this venture by 1998, and will be ultimately build 16 satellites a year. Located in Building 159 in Sunnyvale, this new production center opened on 19 November 1996 to build spacecraft for Lockheed Martin Telecommunications, including EchoStar satellites and other A2100 bus operations.

- **Software Product Center.** This center is being created at LMMS per President Mike Henshaw in The Star (1 November 1996, p. 4; 14 February 1997, p. 6)

- **State-of-the-Art Satellite High Bay** in Bldg. 152 to house two meteorological satellite programs -- the Air Force's Defense Meteorological Satellite Program (DSMP) and NASA's Television Infrared Observation Satellite (TIROS).

- **World Class Propulsion Manufacturing Facility** in Building 103 accommodates all unclassified propulsion module and testing. It was first opened to accommodate the A2100 propulsion bus operations.

2. US Military Sales.

Most of LMMS business is conducted with the Pentagon. LMMS core programs are prime military contracts for Trident, MILSTAR, and THAAD plus the classified (black) programs of which the public in not informed. Known military contracts, after restructuring, are (military and LMMS organizations follow in parentheses):

- **Trident-2 (D-5) submarine-launched ballistic missile**. (Navy)(FBM Programs)

- **THAAD anti-tactical missile** (Courtland plant). About 1,000 people work on THAAD. (Army)(Defensive Missile Systems) The 7th test flight took place on 6 March 1997 at White Sands Missile Range, New Mexico. It was the fourth unsuccessful attempt to intercept a target missile. Three more THAAD flights are scheduled for 1997, the next one in June.

- **Patriot anti-tactical missile** subcontractor. (Army) (Defensive Missile Systems)

- **Extended-Range Interceptor** (ERINT). Loral Vought has the contract for this but, with the merger complete, ERINT should now come under LMMS. (Army)(Defensive Missile Systems)

- **Army Tactical Missile System** (ATACMS). Lockheed Martin Vought Systems (Dallas, TX) has the contract for ATACMS. It is not clear whether Vought Systems has or will come under LMMS. (Army)

- **Airborne Laser** (ABL). LMMS is part of a Boeing team, which also includes TRW, that was awarded a $1.1-billion Air Force contract on 12 November 1996 to build a prototype airborne laser on a 747-400F freighter aircraft. LMMS will supply the optics for the ABL -- the beam control/fire control system which will point and fire the ABL. (Air Force)(Defensive Missile Systems)

- **Atmospheric Interceptor Technology** (AIT). Also called the Advanced Interceptor Technology Phase-III project, LMMS was recently awarded a contract to continue development, fabrication and flight testing of a new kinetic kill vehicle which destroys its target by impact. This could evolve into a $111-million contract. The vehicle, which attacks its target in the earth's atmosphere, could be used as a warhead on all the concepts being developed for lower and upper tier theater missile defense. (Army)(Defensive Missile Systems)

- **Medium Extended Air Defense System** (MEADS). Lockheed Martin Integrated Systems Inc. is the US partner of one of the two industry teams preparing design requirements for MEADS. Fifty percent of the cost and business will involve a European consortium made up of French, German, and Italian companies. If Lockheed Martin wins the contract for development, test and production, it will probably be awarded to LMMS in Sunnyvale. (Army)(Defensive Missile Systems)

- **MILSTAR** Block-2 communications satellite. LMMS is the prime contractor and TRW provides the low-data-rate communications payload and key antennas and processing systems for the medium-data-rate payload. Hughes Aircraft Company supplies the medium-data-rate payload. Four MILSTAR Block-2 satellites are scheduled for launch from 1999 through 2002. (Air Force) (Military Space Programs)

- **Advanced EHF MILSATCOM**. The Defense Department's follow-on to MILSTAR. LMMS and TRW have teamed to bid for this contract. LMMS will be the prime contractor and provide the satellite bus and overall systems integration. TRW Space & Electronics Group will be responsible for the EHF payload and processing systems. The contract is expected to be awarded in 2000 with the first launch in about 2005.

- **Dark Star unmanned aerial vehicle** (UAV) for ballistic missile defense boost-phase intercepts. Being designed by Lockheed Martin Skunk Works (Palmdale, CA) with Boeing's Military Airplanes Division (Seattle, WA) and LMMS as co-contractors. (DARPA)

- **A next generation spy satellite**. Lockheed has designed and built all previous spy satellites. (Air Force)(Military Space Programs)

- **All the US military low-orbit and polar-orbit satellites**.

- **Low Orbit Space-Based Infra-Red System** (SBIRS-Low). Formerly called the Space and Missile Tracking System, and before that "Brilliant Eyes," this is a network of 18 to 32 small satellites with ground stations. It is the low-orbit portion of the Air Force's integrated Space-Based Infrared System (SBIRS). This $179-million contract will build the LM700 satellite bus (also used for the commercial "Iridium"), integrating the experimental passive sensor, orbiting the spacecraft with a Lockheed Martin rocket, providing operations control while in orbit and ground support. The spacecraft is to be launched in 1999. LMMS is bidding on a production contract to be awarded in 2001, with deployment of the system in 2004. (Air Force and Boeing)(Military Space Programs)

- **High Orbit Space-Based Infra-Red System** (SBIRS-High). After ten years of competition, a team led by LMMS on 8 November 1996 received a ten-year, $1.8-billion Air Force contract to build five geosynchronous-orbit satellites for SBIRS-High, which is a global missile-warning system of geosynchronous and polar orbit satellites combined with the SBIRS-Low above. The first satellite of this initial contract is to be launched in 2002. LMMS will provide the commercial A2100 satellite bus, integrate the system, furnish the launch vehicle, and provide operations control while in orbit and ground support. Contracts for other polar-orbit satellites can continue the program until 2020. (Air Force) (Military Space Programs)

- **National Missile Defense** (NMD) Lockheed Martin, specifically LMMS, is equal owner with Raytheon Co. (Lexington, MA), and TRW Inc. (Cleveland, Ohio) of the United Missile Defense Company. Bill Loomis, Vice President of LMMS for Defensive Missile Systems, is president of United Missile Defense Company, which is one of two teams contracted to compete in the definition of a NMD concept. (BMDO)(Defensive Missile Systems)

- **Laser research**.

- **Army precision tracker**. (Army)

- **Defense Satellite Communications Systems Phase III** (DSCS-III). Also called Defense Surveillance and Communications Satellite. A DSCS-III was launched on 24 October 1997. (Air Force)(Military Space Programs)

- **NAVSTAR Global Positioning System** (GPS) satellites. Twenty-one NAVSTAR Block-2R (replenishment) satellites are being built, under a $800-million contract awarded in 1989, by Lockheed Martin's Valley Forge Astro Space facility. The Block-2R is less dependent on ground controls for corrections and is claimed to have an accuracy of one meter. The first launch attempt on 17 January 1997 failed when the Delta-2 rocket blew up in mid-flight, destroying the $40-million satellite. The first Block-2R NAVSTAR GPS was put in orbit on 22 July 1997. Production of GPS satellites is being transitioned to Building 104 in Sunnyvale, plus a new mechanical

building being erected along the D Street side of Building 104, which will be ready on 1 October 1996. (Air Force)(Military Space Programs)

- **Tactical Exploitation of National Capabilities** (TENCAP) Systems Engineering, Demonstration and Integration (SEDI) contract. A $36-million, 2-year contract awarded 12 September 1995 to examine how space systems can be used to improve tactical commanders' abilities to wage regional wars. A prototype system will be built and tested. Two options may be exercised to extend the work for five years and increase the contract value to $197 million. Space assets to be studied include NAVSTAR, MILSTAR, DSCS, DMSP and commercial communications satellites. (Air Force)(Military Space Programs)

- **Smart Hemispherical Antenna**. A 36-inch diameter, 90-pound autonomous shipboard antenna which can track two missile test flights simultaneously and collect high-fidelity telemetry data. (Navy)

- **Payload for Darkstar** (Tier III minus) high-altitude, long-endurance unmanned aerial vehicle -- Side Aperture Radar (SAR) and Electro-Optical (EO) sensors. (DARPA)

- **Autonomous Control Logic for the Unmanned Underwater Vehicle** being developed by the Charles Stark Draper Laboratories. (Navy)(Electronics Sector's Marine Systems in Sunnyvale and the Artificial Intelligence Center in Palo Alto).

In addition to the above, many of the so-called civilian contracts have military applications, as indicated below.

3. US Government Civil Space Sales.

LMMS conducts a smaller portion of its government business with NASA and other US agencies. Much of it has military usage. (Mostly LMMS Civil Space Programs).

- **Defense Meteorological Satellite Program (DMSP).** The military weather satellites. The last Block5D-2 spacecraft, with a 4-year service life, was launched in April 1997. Six more remain to be delivered but they will be Block 5D-3 satellites with more sensors, a larger power supply, a bigger computer, and a 5-year service life. (Air Force & NOAA)(Civil Space Programs)

- **NASA Space Shuttle.** Heavy military usage. In early August 1995 Lockheed Martin and Rockwell International (now Boeing), the two main contractors on the space shuttle program, announced that they will team-up to compete for taking over operations from NASA. It is not clear whether LMMS or Lockheed Martin Astronautics (Denver) will perform the Lockheed Martin share.

- **NASA/International 17-nation Space Station.** LMMS has had contracts for laboratory equipment, extravehicular activity tools and rotating joints, and solar arrays to support a NASA space station. Four space shuttle flights commencing in September 1998 and continuing through 2001 will deliver the eight solar array wings to the space station. 600 Lockheed Martin employees work on the project.

- **NASA Hubble Space Telescope** was launched in April 1990. LMMS does all of the servicing missions and training of the astronauts. The second servicing mission from the space shuttle Discovery took place during mid-February 1997.

- **NASA's new Discovery series** first spacecraft to continue solar system exploration. A joint project with NASA's Ames Research Center.

- **NASA's Transitional Region And Coronal Explorer (TRACE) spacecraft**, part of NASA's Medium Explorer program, will be put in low earth orbit by a Pegasus XL rocket in late 1997. TRACE is built by LMMS's Palo Alto Research Laboratory.

- **NASA's Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite**, which is one of the first two science missions of the NASA Medium-class Explorer (MIDEX) program. LMMS's Palo Alto research laboratory will build the spacecraft for Southwest Research Institute. LMMS's Palo Alto facility is also involved with development of the scientific instruments. Launch is planned for 2000.

- **NASA's Space Infrared Telescope Facility.** LMMS is working with Ball Aerospace to build, integrate and test this cryogenically-cooled space observatory which will perform infrared astronomy for 2.5 years beginning in 2001.

- **NASA's Stratospheric Observatory for Infrared Astronomy.** LMMS heads a team competing for a contract to modify a Boeing 747-SP aircraft with an infrared telescope, and then operate the aircraft for up to 160 flights a year over the next 20 years.

- **Lunar Prospector spacecraft.** This small 660 pound spacecraft, 4.5 feet high and 4 feet diameter with three 8-foot masts, is being designed by LMMS and NASA Ames to map the surface composition, gravity pull, and magnetic fields of the moon, and look for ice at its poles as well as gas release events from its surface. It was launched into earth orbit on 6 January 1998 atop a Lockheed Martin Athena-2 from Cape Canaveral. It will then use its own booster to get to the moon and then jettison it as it goes into polar lunar orbit for one year. Through design, fabrication, launch, mission operations, and final data analysis, NASA is expected to pay a total of $63.5 million.

- **Televised Infrared Observation Satellite (TIROS) civilian satellite program**, which is being transitioned to Sunnyvale from East Windsor. TIROS provides 24-hour global meteorological and environmental data for more than 140 nations. As of November 1996, five satellites remain to be delivered to NASA.

- **NOAA-K weather spacecraft.** Part of the TIROS program. (May be the same as previous entry but NOAA indicates other than NASA.)

- **Environmental Observatory Satellite (EOS).**

- **LANDSAT-7 Satellite** -- the most recent in a series of remote sensing satellites which have been in space since 1972. Launch from Vandenberg AFB is scheduled for 7 July 1998.

- **National Polar-Orbiting Operational Environmental Satellite System (NPOESS)**, (NOAA, DOD, NASA).
- **Global Geospace Science Polar spacecraft (GGS)** scheduled for launch from Vandenberg AFB in February 1996 to study solar-induced phenomena in the earth's magnetosphere.
- **Three sensors** -- the Polar Ionospheric X-ray Imaging Experiment (PIXIE), the Source/Loss Cone Energetic- Particle Spectrometer (SEPS), and the Toroidal Imaging Mass Angle Spectrometer (TIMAS) -- for the GGS spacecraft above. (Advanced Technology Center, Palo Alto)
- **NASA'S Gravity Probe-B Spacecraft**. To be launched in 2000 and circle the earth in a 400-mile-high polar orbit. Will carry four superconducting gyroscopes and a reference telescope. (LMMS Advanced Technology Center.)
- **Solar Pointing Attitude Rocket Control System (SPARCS).** A program commenced in 1966 which has made 151 flights on NASA sounding rockets.
- **Soft X-ray Telescope.** Launched 30 August 1991 on Japanese Yohkoh satellite. Joint Experiment between Japan's National Astronomical Observatory and NASA. (Advanced Technology Center, Palo Alto)
- **Venture Star.** In early July 1996 Lockheed Martin's Skunk Works in Palmdale California won a $900-million NASA contract to build a half-scale model of the X-33 space vehicle. Called Venture Star, this single-stage-to-orbit, reusable launch vehicle is scheduled to fly in March 1999. LMMS participates in this contract.
- **Advanced Communications Technology Satellite (ACTS).** This is probably a sustaining effort on a spacecraft now in orbit. It is a precursor to Iridium and other modern communications satellites. A NASA contract.
- **Solar X-Ray Imagers**. A $54 million contract was announced on 18 June 1997 for LMMS to build three of these instruments to take pictures of the sun. They will be mounted on future Geostationary Operational Environmental Satellites. (NASA and NOAA) (Advanced Technology Center, Palo Alto)

4. Domestic Commercial Space Sales.

LMMS business with commercial companies (LMMS Commercial Space Programs).

- **Motorola Iridium Telecommunication Satellites.** LMMS has a contract awarded in 1993 to build up to 125 LM700 satellite buses for this $3.45-billion global personal communications system. A constellation of 66 operational satellites positioned in six orbital planes is planned. There will also be one spare in each plane, bringing the total in orbit to 72. Each satellite weighs 1,500 pounds. LMMS will also furnish satellite subsystems (attitude control, propulsion, power supply, solar arrays, deployment mechanisms, etc.), as well as associated support engineering for these systems space vehicle assembly, integration and test support. Thirteen flights are scheduled to put

the constellation of 66 in orbit by late 1998, when the system is scheduled to begin operating. Launches so far are as follows:

a. Five satellites launched 5 May 1997 on a Delta-2 rocket from Vandenberg AFB.

b. Seven satellites Launched 18 June 1997 on a Proton rocket from Baikonur Cosmodrome in Kazakhstan.

c. Five satellites launched 9 July 1997 on a Delta-2 rocket from Vandenberg AFB.

d. Five satellites launched 20 August 1997 on a Delta-2 rocket from Vandenberg AFB.

e. Seven satellites Launched 13 September 1997 on a Proton rocket from Baikonur Cosmodrome in Kazakhstan.

f. Five satellites launched 26 September 1997 from Vandenberg AFB.

g. Five satellites launched 8 November 1997 on a Delta-2 rocket from Vandenberg AFB.

! **New Media.** MSI-Oracle Team. Media Systems Integration (MSI), a LMMS subsidiary group, has teamed with Oracle Corporation to market and deliver interactive multimedia solutions. This team combines Oracle's "New Media" software suite and MSI's broadband systems integration services.

! **Interactive TV Integration.** Southwestern Bell Television. MSI also has a contract with Southwestern Bell to integrate the systems on interactive television.

! **Commercial Remote Sensing Satellite (CRSS).** This space system provides photographs with a resolution of 1 meter for civilian uses. It is also considered a candidate for international sales. The first satellite's launch is scheduled for 1 December 1997. Sales are being handled through Space Imaging Incorporated (Thornton, Colorado), a LMMS subsidiary group.

! **A2100 bus** -- new-generation Commercial Communications Satellite platform which is a modular, building-block designed as a standard spacecraft bus. Used in several applications mentioned elsewhere as well as being produced in a joint venture with Russia's Intersputnik communications network.

! **GE satellites** manufactured for GE Americom to provide service to cable and broadcast television stations across the continental US and Alaska. GE-1, the first spacecraft using the A2100 bus, was launched on 8 September 1996. GE-2 was launched 30 January 1997 on an Ariane-4 rocket at Kourou in French Guiana. GE-3 was launched on 4 September 1997 aboard an Atlas IIAS rocket from Cape Canaveral.

! **Immarsat-3 series of five spacecraft** which will provide global mobile voice and data communications with some navigation and emergency/disaster operation capabilities.

LMMS is prime contractor to the International Mobile Satellite Organization. Matra Marconi provides the mobile communications payload. Flight-1 was launched in April 1996, Flight-2 on 6 September 1996, Flight 3 on ___, Flight 4 on 3 June 1997. Immarsat satellites are Series 4000 spacecraft.

- **Satphone spacecraft.**
- **EOSAT** (Lanham, Maryland) is a company that gathers and sells satellite imagery and is jointly owned by LMMS and Hughes Aircraft Company. LMMS announced on 7 June 1996 that it plans to buy out Hughes' share.
- **Two "Whitetail" satellites.** (Whitetail refers to a satellite for which there is no customer yet.)
- **EchoStar (Series 7000 high-powered broadcast satellites)**. EchoStar-1 was launched in late 1995, EchoStar-2 on 10 September 1996 and EchoStar-3 on 5 October 1997. The latter will be the first EchoStar to use the A2100 bus and is situated at 61 degrees west longitude in geosynchronous orbit. EchoStar-4 is also in work in the Commercial Satellite Center in Building 159. (EchoStar satellites are built for the EchoStar Satellite Corp., Englewood, CO)
- **Payload Launch vehicle (PLV)** which carries a Boeing payload aloft to view incoming ballistic missiles. PLV-1 was launched 16 January 1997 from Kwajalein Missile Range in the Marshall Islands. PLV 1FT-1A flight test vehicle was launched from Kwajalein on 23 June 1997 to observe an incoming Minuteman-2 missile launched from Vandenberg AFB. Another PLV was launched 15 January 1998 from Kwajalein to observe a modified Minuteman-2 missile launched from Vandenberg.
- **DBSC-1** will be launched in 1997 for the Direct Broadcasting Company.

5. International Sales.

International sales represent about 5 percent of the LMMS business. That percentage has historically been mostly military but LMMS hopes to move some NASA programs into the international arena (LMMS organization follows in parentheses).

- **Trident Submarine-Launched Ballistic Missile.** LMMS has US Navy contracts to provide fleet ballistic missiles and support to Britain's. (FBM Programs)
- **THAAD Anti-Tactical Missile.** There have been indications that THAAD will provide significant overseas business. (Defensive Missile Systems)
- **Medium Extended Air Defense System**. MEADS, being a joint venture with foreign countries, is by nature an international program. (Defensive Missile Systems)
- **Co-contractor with Mitsubishi's Information Systems & Services Group** to study a missile defense system for Japan. (Defensive Missile Systems)

- **Alpha International Space Station.** LMMS has a contract to provide laboratory equipment, extravehicular activity tools and rotating joints, and solar arrays to support the Alpha international space station.

- **Numerous commercial satellites** such as KoreaSat-2 and KoreaSat-3 (the latter to be launched in mid-1999), ChinaSat, AsiaSat-2. ChinaStar is scheduled for launch in 1997. (Commercial Space Programs)

- **Intelsat.** Intelsat-VIII-801 was launched 21 February 1997 on an Ariane rocket from Kourou in French Guiana. Intelsat-VIII-802 was launched from the same location on 25 June 1997, and Intelsat-VIII-803 on 23 September 1997. Four Intelsat-VIIIs are scheduled for launch during 1997 and will be in orbit over the Pacific, Atlantic and Indian Oceans. Two Intelsat-VIIIAs, to provide land mass coverage, will be launched aboard Atlas IIA rockets from Cape Canaveral during 1998. They are being built for the International Telecommunications Satellite Organization (Intelsat) to provide intercontinental communications of video, voice and data.

# # # # #

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Star, The (Lockheed Martin Missiles and Space) various issues. Also its predecessor, The LMSC Star.

GLOSSARY.

ABL	Airborne Laser.
AFB	Air Force Base.
AIT	Atmospheric Interceptor Technology. Also called Advanced Interceptor Technology.
ATACMS	Army TACtical Missile System.
ATM	Anti-Tactical Missile.
CEO	Chief Executive Officer.
CRSS	Commercial Remote Sensing System.
D-5	US Navy Designation for the Trident-2 SLBM.
DARPA	Defense Advanced Research Projects Agency.
DMSP	Defense Meteorological Satellite Program.
DOD	Department of Defense.
DOE	Department of Energy.

DSCS	Defense Satellite Communications System. Also called Defense Surveillance and Communications Satellite.
EOS	Environmental Observatory Satellite.
F-16	US Air Force single-engine fighter jet.
FBM	Fleet Ballistic Missile.
GE	General Electric. Also the designation of GE Americom's commercial satellites.
GGS	Global Geospace Science polar spacecraft.
GPS	Global Positioning System.
Javelin	A US Army anti-tank missile.
LMMS	Lockheed Martin Missiles and Space.
LMSC	Lockheed Missiles and Space Company -- now LMMS.
MEADS	Medium Extended Air Defense System.
MILSATCOM	MILitary SATellite COMmunications.
MILSTAR	MILitary Strategic And TActical Relay satellite, the Pentagon's newest communications satellite.
MSI	Media Systems Integration.
NASA	National Aeronautics and Space Administration.
NAVSTAR	NAVigation System Timing And Ranging
NMD	National Missile Defense.
NOAA	National Oceanic and Atmospheric Administration.
NPOESS	National Polar-Orbiting Operational Environmental Satellite System.
Patriot	US Army anti-tactical missile.
PIXIE	Polar Ionospheric X-ray Imaging Experiment.
Proton	A Russian rocket now sold by International Launch Services.
RCA	Radio Corporation of America.
RF	Radio Frequency.
SBIRS	Space-Based Infra-Red System.
SEDI	Systems Engineering, Demonstration and Integration.
SEPS	Source/Loss Cone Energetic Particle Spectrometer.
SLBM	Submarine-Launched Ballistic Missile.
SPARCS	Solar Pointing Attitude Rocket Control System.
TENCAP	Tactical Exploitation of National Capabilities.
THAAD	Theater High Altitude Area Defense -- a US Army anti-tactical missile..
TIMAS	Toroidal Imaging Mass Angle Spectrograph.
TIROS	Televised Infrared Observation Satellite.
TRACE	Transitional Region And Coronal Explorer, a NASA spacecraft.

Trident-2	US Navy SLBM. Also called the D-5.
UAV	Unmanned Aerial Vehicle.
US	United States.

APPENDIX-A

LMMS ORGANIZATION

OFFICE OF THE PRESIDENT

K. Michael Henshaw, President

|

|---- SPECIAL PROGRAMS, K.W. Peters, V.P.

|

|---- MILITARY SPACE PROGRAMS, Ed Morgan, V.P.

|

|---- COMMERCIAL SPACE PROGRAMS, Dave L. Klinger, V.P.

|

|---- CIVIL SPACE PROGRAMS, Michael L. Coats, V.P.

|

|---- Missiles & SPACE PRODUCT CENTER, Len Kwiatkowski, V.P.

|

|---- FBM PROGRAMS, Tom M. Morton, V.P.

|

|---- DEFENSIVE MISSILE SYSTEMS, W.C. Loomis, V.P.

|

|---- CHIEF ENGINEERING ORGANIZATION,
| Tom Morton, V.P. & Chief Engineer.

|

|---- FINANCE & BUSINESS OPERATIONS,
| Myles D. Crandall, V.P. & Chief Financial Officer

|

|---- BUSINESS DEVELOPMENT, ADVANCED PROGRAMS &
| TECHNOLOGY, Aram M. Mika, V.P.

|

|---- GROUND SYSTEMS,

|

|---- HUMAN RESOURCES, E.S. (Ed) Taft, V.P.

|

|---- CHIEF COUNSEL, L.W. Schlefelbein, Jr., V.P.

|

|---- OPERATIONS SUPPORT, J.C. Suty, V.P.

|

|---- MISSION SUCCESS & PRODUCT ASSURANCE, Charles J. Leontis, V.P.

See next two pages for major subdivisions of above organizations.

MILITARY SPACE PROGRAMS

Ed Morgan, V.P.

|

|---- MILSATCOM PROGRAMS, Ed Morgan, V.P.

|

|---- MILITARY SPACE PROGRAMS, _____, V.P.

COMMERCIAL SPACE PROGRAMS

Dave L. Klinger, V.P.

|

|---- COMMUNICATIONS PAYLOAD CENTER,
| B. Mitchell, V.P.

|

|---- EAST WINDSOR OPERATIONS, K. Johnson, V.P.

|

|---- GEO COMMERCIAL SATELLITE PROGRAMS,
| _____, V.P.

|

|---- LEO COMMERCIAL SATELLITE PROGRAMS,
T.N. Tadano, V.P.

FBM PROGRAMS

Steve Parsons, V.P.

|

|---- ADVANCED FBM PROGRAMS, J. Richter, V.P.

|

|---- FBM PROGRAM REQUIREMENTS, E. Moore, V.P.

|

|---- FBM PROGRAM, S. Parsons, V.P.

|

|---- FBM OPERATIONS, P. Vollmer, V.P.

|

|---- ADV FBM BUS DEV, _____

|

|---- FBM BUSINESS OPERATIONS, A. Buderus, Deputy

FINANCE & BUSINESS OPERATIONS,
Myles D. Crandall, V.P. & Chief Finance Officer

|
|---- BUSINESS PLANNING, G.B. Cline, V.P.
| Includes: CONSOLIDATION under
| H.W. Palmer, Director
|
|---- COMPLIANCE & SYSTEMS OPERATIONS,
| J. Brommer, Jr., Director
|
|---- BUSINESS OPERATIONS SPACE,
| W.L. Krieger, Director
|
|---- BUSINESS OPERATIONS MISSILES,
| E.M. Kyger, Director
|
|---- CENTRAL FINANCE,
J.H. Schultz, Chief Accountant

BUSINESS DEVELOPMENT, ADVANCED PROGRAMS & TECHNOLOGY
Aram Mica, V.P.

|
|---- ADVANCED TECHNOLOGY CENTER
| Ronald Andrews, V.P.
|
|---- NEW BUSINESS PLANNING
|
|---- PRODUCT PLANNING AND DEVELOPMENT
|
|---- ACQUISITION MANAGEMENT
|
|---- STRATEGIC PLANNING AND MARKETING