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APPENDIX A

A COMPENDIUM OF REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES

NOTE: Companies listed are representative; the list is not exhaustive. Inclusion or exclusion does not imply future business opportunities with or endorsement by DoD.

REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #1: Combat Support

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
ACS Federal Healthcare	1988	Dallas, TX	40,000	3,063.0	Medical systems integration
ActivMedia Robotics, LLC.	1999	Peterborough, NH	18	2.3	Robotics
Akimeka	1997	Honolulu, HI	27	8.4	Telemedicine and telehealth technologies
Alliance Medical Corp.	2000	Phoenix, AZ	247	16.6	Medical equipment reprocessing
AM General Corp.	1903	South Bend, IN	1,559	549.8	High mobility multipurpose wheeled vehicles
Analex Corp.	1964	Alexandria, VA	378	21.9	Medical and engineering services and microsatellites
AniVision, Inc.	1999	Huntsville, AL	62	5.0	Simulation and training technologies
Anthem Insurance Companies, Inc.	1992	Indianapolis, IN	14,800	10,445.0	Healthcare services
Applied Innovation Inc.	1983	Dublin, OH	251	73.0	Next generation support systems
ATI Medical, Inc.	1994	San Diego, CA	22	0.9	Therapeutic heat and radiation technologies
Avigen, Inc.	1991	Alameda, CA	127	0.1	Gene therapy products
BarControl Systems and Services, Inc.	1987	Greenville, SC	26	2.3	Industrial software services
BioPort Corp.	1998	Lansing, MI	280	16.9	Anthrax vaccine
CNF Inc.	1929	Palo Alto, CA	26,100	4,862.7	Transportation and network management equipment
Coalescent Technologies Corp.	1996	Orlando, FL	72	15.5	Simulation systems and auto identification technology
Curis, Inc.	2000	Cambridge, MA	105	1.1	Bone regeneration therapy
Cyterra Corp.	2000	Waltham, MA	25	2.0	Land mine, chemical, and biological detection
Daubert VCI, Inc.	1997	Burr Ridge, IL	60	7.0	Corrosion inhibitor technologies
Design Continuum, Inc.	1983	Newton, MA	100	15.1	Design and engineering consulting
DigitalThink, Inc.	1996	San Francisco, CA	258	43.4	e-Training
Diversa Corp.	1992	San Diego, CA	276	36.0	Small molecule drugs and monoclonal antibodies
EAI Corp.	1980	Abington, MD	142	24.0	Chemical and biological defense technologies
Electropure, Inc.	1992	Laguna Hills, CA	18	1.3	Laser-based microbial detection systems
EluSys Therapeutics, Inc.	1998	Pine Brook, NJ	30	2.0	Anthrax vaccine
Epicyte	1996	San Diego, CA	23	2.4	Immune system boosters
FieldCentrix Inc.	2001	Irvine, CA	130	2.8	Field service automation systems
FLIR Systems, Inc.	1978	Portland, OR	798	214.0	Infrared imaging and camera systems
Foresight Imaging, LLC.	1999	Lowell, MA	20	4.6	Medical and scientific imaging technologies
Frisby Technologies Inc.	1989	Winston Salem, NC	22	7.8	Thermal management technologies
GEOMET Technologies, Inc.	1986	Germantown, MD	54	6.5	Health and safety products
Great Lakes Dredge and Dock Company	1890	Oak Brook, IL	700	275.6	Dredging
GSE, Inc.	1983	Incline Village, NV	4	1.2	Remote controlled, non-gasoline burning water craft
iRobot	1992	Somerville, MA	98	n.a.	Intelligent robotic systems
MÄK Technologies	1990	Cambridge, MA	32	6.2	Multi-functional display system
Microsensor Systems, Inc.	1998	Bowling Green, KY	19	3.0	Chemical warfare detection systems
Nomadics, Inc.	1993	Stillwater, OK	70	7.0	Landmine detectors and advanced sensors
Oakley, Inc.	1975	Foothill Ranch, CA	1,685	476.9	Military human form accessories
Optra Inc.	1980	Topsfield, MA	21	2.6	Two-color imaging remote thermographers
Paravant Computer Systems	1982	Morristown, NJ	224	51.8	Rugged military electronics
Physical Sciences Inc.	1973	Andover, MA	145	24.7	Multispectral thermal imaging systems
Polaris Industries Inc.	1994	Hamel, MN	3,560	1,512.0	All terrain vehicles
Quantum Dot Corp.	1984	Hayward, CA	41	1.3	Biological labeling with streptavidin conjugate
Sarcon Microsystems, Inc.	1997	Knoxville, TN	9	0.0	Microcantilevered, uncooled infrared sensors
Syagen Technology, Inc.	1996	Tustin, CA	15	1.3	High-throughput molecular analysis
Technical and Management Services Corp.	1982	Calverton, MD	570	98.2	Telecommunications and telemedicine
Triwest Healthcare Alliance	1996	Phoenix, AZ	750	23.4	Health care services
Universal Space Network, Inc.	1999	Newport Beach, CA	44	3.8	Telemetry, tracking, and control services
The Walt Disney Company	1923	Burbank, CA	121,378	25,269.0	Training and simulation software
Xybernaut Corp.	1992	Fairfax, VA	139	9.8	Computer technology, hardware, and related software
Zyvex Corp.	1997	Dallas, TX	31	2.1	Nanoscale technologies

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Source: Dun & Bradstreet reports, OneSource reports, Standard & Poor's corporate descriptions, SEC filings, and suppliers

REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #2: Power Projection

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
Accruent, Inc.	2001	Santa Monica, CA	65	8.0	Contract management solutions
Adel Wiggins Group	1993	Los Angeles, CA	176	16.2	Aerospace and refueling systems and components
Advanced Energy Systems, Inc.	1998	Medford, NY	18	3.0	Improved high-current injector technologies
Advanced Power Technology	1984	Bend, OR	197	36.9	Semiconductors and power modules
Amerind, Inc.	1983	Alexandria, VA	190	22.4	Optimization and enterprise learning technologies
Amptek Inc.	1977	Bedford, MA	25	7.0	Nuclear instrumentation
Arvan, Inc.	1998	Gardena, CA	75	7.7	Mechanical and electrical component fabrication
AVX	1990	Myrtle Beach, SC	18,000	2,608.1	Electronic capacitors
BEI Technologies, Inc.	1983	San Francisco, CA	1,118	239.0	Linear and rotary voice coil actuators
Broadax Systems, Inc.	1986	City of Industry, CA	26	7.5	Ruggedized computing technologies
Business Objects SA	1990	San Jose, CA	2,200	415.0	Integrated business intelligence applications
Camber Corp.	1998	Huntsville, AL	740	95.9	Systems engineering and consulting
CH2M Hill Companies, Ltd.	1946	Englewood, CO	11,500	1,940.5	Engineering and infrastructure development consulting
ComCept, Inc.	1999	Rockwell, TX	50	4.9	Systems engineering
Digirad Corp.	1986	San Diego, CA	250	31.9	Solid-state photodetector imaging
Digital Systems Resources, Inc.	1982	Fairfax, VA	450	112.7	Defense software, algorithms, and architectures
Enova Systems	1993	Torrance, CA	41	3.8	Power generation
ESSI	2002	Alexandria, VA	276	17.4	Logistics support
E-team.com, Inc.	1989	Canoga Park, CA	29	2.4	Collaborative logistics solutions
Evidence Based Research, Inc	1985	Vienna, VA	35	3.6	Strategic consulting services
Excalibur Systems	1986	Elmont, NY	30	2.8	Navigation systems
Fair, Isaac & Company, Inc.	1979	San Rafael, CA	2,388	392.4	Intelligence management and decision making tools
FileNet Corp.	1982	Costa Mesa, CA	1,800	332.5	Enterprise content management software
i2 Technologies	1988	Dallas, TX	4,800	986.0	Value chain management software
Intelliseek, Inc.	1996	Cincinnati, OH	65	5.2	Enterprise intelligence solutions
Intergraph Corp.	1969	Huntsville, AL	4,300	532.1	Interactive computer graphics systems software
International Rectifier	1947	El Segundo, CA	5,800	700.0	Power management and semiconductor technologies
International Shipholding Corp.	1978	New Orleans, LA	762	304.4	Shipping services and vessels
Jacobs Engineering Group Inc.	1947	Pasadena, CA	20,600	3,956.0	Operations and maintenance consulting
Keithley Instruments	1946	Cleveland, OH	600	97.0	Data acquisition products
KLA-Tencor Corp.	1975	San Jose, CA	5,778	2,103.8	Yield management and process monitoring systems
Lloyd-Lamont Design, Inc.	1986	Herndon, VA	145	15.1	Engineering services
Materials Electrochemical Research Corp.	1985	Tucson, AZ	50	5.7	Advanced materials and energy conversion systems
Mechanical Technology Inc.	1961	Albany, NY	76	7.2	Fuel cells and power generation technologies
Micromuse Inc.	1995	San Francisco, CA	176	212.5	Service and business assurance software
Midwest Research Institute	1943	Kansas City, MO	900	245.8	Environmental product development
Mission Research Inc.	1970	Santa Barbara, CA	405	86.1	Advanced research and development
NAVMAR Applied Sciences Corp.	1978	Warminster, PA	110	13.9	Engineering services
Noesis	1994	Manassas, VA	124	24.7	Logistics
Pacific Science and Engineering Group	1984	San Diego, CA	29	2.5	Logistics
Parsons Corp.	1944	Pasadena, CA	9,500	1,500.0	Technical and management consulting
PEI Electronics, Inc.	1999	Huntsville, AL	475	27.5	Industrial hardware and software
Platform Computing Inc.	1992	San Jose, CA	30	3.3	Distributed computing software
Polexis, Inc.	1996	San Diego, CA	70	8.5	E-business enterprise infrastructure
PolyPlus Battery Company Inc.	1990	Berkeley, CA	25	2.0	Power generation
PowerTrain, Inc.	1994	Landover, MD	30	3.0	Logistics

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REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #2: Power Projection (cont'd)

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
Power Spectra, Inc.	1979	Portola Valley, CA	18	0.7	Power semiconductor systems
Reticular Systems, Inc.	1989	San Diego, CA	15	1.0	Logistics
Sanmina-SCI Corp.	1989	San Jose, CA	50,000	8,714.0	Engineering and design services
Satcon Technology Corp.	1985	Cambridge, MA	364	41.7	Shipboard power conversion technologies
Savi Technology	1999	Santa Clara, CA	190	31.6	Radio computer tags with embedded microcomputers
Serena Software, Inc.	1980	San Mateo, CA	320	98.6	Enterprise change management products
Silicon Graphics, Inc.	1981	Mountain View, CA	4,756	1,854.0	Information processing technologies
Simula	1975	Phoenix, AZ	600	107.0	Energy management systems and safety systems
Semtech Corp.	1960	Camarillo, CA	777	102.8	Single, configurable power management chipsets
Southwest WindPower, Inc.	1993	Flagstaff, AZ	52	4.9	Power generation
Spectrum Astro Inc.	1988	Gilbert, AZ	336	160.2	GIS Systems and imaging and communications systems
Spectrum Control Inc.	1968	Fairview, PA	763	89.3	Power control, interconnect, and microwave products
Sytex, Inc.	1998	Doylestown, PA	800	77.2	Logistics and systems engineering
Tacit Knowledge Systems, Inc.	1997	Palo Alto, CA	65	7.0	Logistics
United States Marine Repair	1998	Norfolk, VA	2,200	390.7	Ship repair and overhaul
URS Corp.	1996	San Francisco, CA	1,600	2,319.4	Engineering, construction, and architecture
US Nanocorp	1996	Willington, CT	13	1.0	Power generation
Valero Energy Corp.	1980	San Antonio, TX	22,452	14,988.0	Oil and energy products and services
Verity, Inc.	1988	Sunnyvale, CA	295	93.8	Three-tier infrastructure software
Wellspring Solutions, Inc.	1996	Santa Ana, CA	30	1.7	Logistics software
White Electronic Designs, Corp.	1951	Phoenix, AZ	309	96.8	Ruggedized display products and interface assemblies
Zinc Matrix Power, Inc.	1996	Santa Barbara, CA	23	3.1	High-energy, rechargeable, silver-polymer batteries

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REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #3: Precision Engagement

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
Adroit Systems, Inc.	1983	Alexandria, VA	275	30.0	Engineering & technical services
Advanced Technologies Inc.	1988	Newport News, VA	66	7.4	Aerospace research and development
AMI Semiconductors	1966	Pocatello, ID	2,400	327.0	Microelectronics
Anaren, Inc.	1967	East Syracuse, NY	550	73.5	High power resistive components
ANSYS Inc.	1994	Canonsburg, PA	450	84.8	Engineering simulation software
Applied Materials, Inc.	1967	San Jose, CA	16,000	7,343.2	Semiconductor manufacturing equipment
ARINC Inc.	1929	Annapolis, MD	3,000	557.7	Avionics and aviation communications technologies
Brush Wellman	2000	Cleveland, OH	2,257	314.0	Beryllium materials and high performance alloys
Cadence Design Systems, Inc.	1982	San Jose, CA	5,600	1,430.4	Electronic design automation products
Candescent Technologies Corp.	1990	San Jose, CA	366	27.4	High performance flat panel displays
Canesta, Inc.	1999	San Jose, CA	15	1.5	Robotics
Carbon-Carbon Advanced Technologies, Inc.	1988	Fort Worth, TX	10	2.0	Heat shields and gas turbine components
Composite Engineering	1988	Sacramento, CA	115	10.4	Advanced composite parts
Composite Optics, Inc.	1975	San Diego, CA	393	57.9	Advanced aerospace composite products
Cree, Inc.	1987	Durham, NC	970	177.2	Silicon carbide devices
Custom Manufacturing and Engineering, Inc.	1996	St. Petersburg, FL	45	5.0	Electronic fabrication and assembly
Device Technologies, Inc.	1984	Marlborough, MA	21	4.0	Grommet edging and specialty fasteners
Diodes, Inc.	1959	Westlake Village, CA	748	95.2	Discrete semiconductors
DYNALLOY, Inc.	1989	Costa Mesa, CA	20	3.8	Shape memory alloys
Engineering Services Inc.	1971	Springdale, AZ	35	1.6	Robotics
Foam Matrix, Inc.	1995	Inglewood, CA	12	4.0	Net molded structures
Forrester Research, Inc.	1983	Cambridge, MA	367	159.1	Technology research and consulting
Foster-Miller, Inc.	1951	Waltham, MA	300	55.5	Robotic, electronic, and equipment engineering
Honeybee Robotics, Ltd.	1983	New York, NY	20	3.0	Custom robotic and automation systems
Hybrid Plastics	1998	Fountain Valley, CA	10	1.0	Nanocomposites
INFICON Inc.	2000	East Syracuse, NY	263	144.1	Vacuum instrumentation and sensor technologies
Invision Technologies, Inc.	1990	Newark, CA	276	74.3	Sensing technologies
Irving Burton Associates, Inc.	1979	Falls Church, VA	225	27.2	Program support services
Jabil Circuit, Inc.	1966	Saint Petersburg, FL	8,097	4,330.7	Printed circuit board development
Microchip Technology Inc.	1989	Chandler, AZ	3,049	571.2	Semiconductors for embedded control applications
Miller Electric	1995	Appleton, WI	1,500	135.4	Advanced welding and plasma technologies
Ophir Corp.	1980	Littleton, CO	17	2.3	Infrared absorption hygrometers
Perceptron	1981	Plymouth, MI	330	50.7	Robotics
Planar Systems, Inc.	1983	Beaverton, OR	807	208.0	Electro luminescent, LCD, AMLCD, and plasma displays
Rofin-Sinar, Inc.	1996	Plymouth, MI	1,151	220.6	Diffusion-cooled slab lasers
Sentel Corp.	1987	Alexandria, VA	300	35.0	Systems integration
SI Diamond Technology	1993	Austin, TX	54	3.5	Carbon films and field emission applications
SRI International	1957	Menlo Park, CA	1,400	164.0	Client-supported research and development
Synetics Corp.	1991	Marietta, GA	32	1.9	Airflow management technologies
Taylor Devices, Inc.	1955	Niagara, NY	99	15.4	Shock absorption, control, and energy storage devices
United Industrial Corp.	1958	New York, NY	1,500	238.5	Electronics and aerospace systems
Videojet Technologies Inc.	2002	Wooddale, IL	1,500	139.5	Laser coding systems and high speed imaging
Xinetics, Inc.	1994	Aver, MA	44	8.1	Precision motion control products

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REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #4: Homeland and Base Protection

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
Affiliated Computer Services Inc.	1988	Dallas, TX	28,350	2,063.6	Microfilm processing retrieval and storage
American Heuristics Corp.	1989	Triadelphia, WV	15	1.0	Data-mining and pattern recognition software
Analytic Services, Inc.	1958	Arlington, VA	435	58.8	Biometric identification systems
Applied Technologies, Inc.	1988	Fairfax, VA	25	1.3	Security technologies for portable devices
Arc Second Inc.	1990	Dulles, VA	15	2,245.2	Laser-based position measurement instruments
ATMI	1986	Danbury, CT	1,203	213.5	Thin film circuits
Attensity Corp.	2000	Salt Lake City, UT	30	0.3	Automated extraction and analysis software
Authentica, Inc.	1997	Waltham, MA	55	1.0	Content security software
Blue Coat Systems, Inc.	1996	Sunnyvale, CA	238	55.6	Internet Security
Check Point Software Technologies Ltd.	1993	Redwood City, CA	1,201	527.6	Wireless and enterprise network security solutions
Coherent Technologies, Inc.	1984	Lafayette, CO	150	19.2	Laser radar technologies
CombiMatrix Corp.	1995	Mukilteo, WA	90	10.6	Toxin-detecting biochips
Computer Associates International, Inc.	1996	Islandia, NY	16,600	2,964.0	Internet security solutions
Counterpane Internet Security, Inc.	1999	Cupertino, CA	109	3.2	Internet security products and services
Cylink Corp.	1984	San Jose, CA	213	37.0	WAN encryption and VPN security solutions
Cyrano Sciences Inc.	1997	Pasadena, CA	45	0.4	Polymer composite sensors
Defense Group Inc.	1987	Falls Church, VA	80	11.3	Homeland security solutions
digiMine, Inc.	2000	Bellevue, WA	100	2.5	Data-mining software
Directed Electronics, Inc.	1986	Vista, CA	370	120.0	Security systems
FGM Inc.	1987	Dulles, VA	160	22.0	Software development and systems integration
Finjan Software	1996	Wall, NJ	40	5.0	Active content network security products
Front Porch, Inc.	1998	Sonora, CA	30	0.5	Intelligent network security
Graviton Inc.	1998	La Jolla, CA	55	5.3	Secure wireless networks
Identix Inc.	1982	San Jose, CA	618	76.0	Biometric identification systems
Imaging Automation	1991	Bedford, NH	65	21.0	Biometric identification systems
Imagis Technologies Inc.	1998	Washington, DC	27	1.3	Biometric identification systems
Infrastructure Defense Inc.	1998	Fairfax, VA	35	2.6	Advanced security threat analysis
IEM, Inc.	1985	Baton Rouge, LA	109	8.6	Risk analysis and security management software
Internet Security Systems, Inc.	1997	Atlanta, GA	1,487	223.0	Internet security
M Cubed Technologies, Inc.	1995	Bridgeport, CT	150	27.0	Physical security technologies
Microvision, Inc.	1993	Bothell, WA	171	10.8	Precision optical scanning systems
Mine Safety Appliances Company	1914	Pittsburgh, PA	4,100	575.0	Biological warfare protection
Napco Security Systems, Inc.	1969	Amityville, NY	800	54.8	Security systems
Network Security Technologies	1998	Herndon, VA	60	3.0	Managed security services
Nomadix	1995	Westlake Village, CA	28	2.8	Internet security
Nuance Communications, Inc.	1994	Menlo Park, CA	417	44.1	Voice recognition software
Qualys, Inc.	2000	Redwood Shores, CA	79	1.4	Network security service
Rainbow Technologies	1984	Irvine, Ca	660	137.2	Internet security and software protection
RedSiren Technologies, Inc.	1987	Pittsburgh, PA	125	5.1	Managed security services
Rexon Components, Inc.	1983	Willoughby, OH	20	1.0	Scintillators
Riptech, Inc.	1998	Alexandria, VA	170	45.0	Managed security services
RSA Security Inc.	1986	Bedford, MA	1,218	282.7	Network security products and services
Safenet, Inc.	1983	Baltimore, MD	139	18.0	Internet security
SafeWeb	2000	Emeryville, CA	25	0.4	Internet security
SecureInfo Corp.	1992	San Antonio, TX	56	4.4	Internet Security
SSP Solutions, Inc.	2001	Reston, VA	134	10.2	Encryption software
Symantec Corp.	1982	Cupertino, CA	3,900	1,070.0	Anti-virus software and other security products
Systems Research and Development	1984	Las Vegas, NV	28	7.5	Fraud prevention software
ValiCert, Inc.	1996	Mountain View, CA	195	24.2	Internet security
Verisign, Inc.	1995	Mountain View, CA	3,270	1,180.0	Internet security
WL Gore & Associates, Inc.	1958	Newark, DE	6,000	1.4	Fluoropolymer products
Zone Labs, Inc.	1997	San Francisco, CA	160	14.6	Internet security

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REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #5: Integrated Battlespace

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
AAI Corp.	1959	Hunt Valley, MD	1,500	208.0	Unmanned aerial vehicles
Able Engineering Company, Inc.	1975	Goleta, CA	75	15.0	Space mechanisms and systems
Accelight Networks	2000	Bridgeville, PA	54	26.0	Photonic service switches
Accurate Automation Corp.	1985	Chattanooga, TN	35	2.8	Aeronautical systems and neural networks
Actuality Systems	1997	Burlington, MA	9	1.0	3D spatial imaging technology
Actuate Corp.	1993	San Francisco, CA	609	125.0	Enterprise information management software
Advanced Fibre Communications, Inc.	1992	Petaluma, CA	959	333.0	Fiber optic communications technologies
Advanced Power Technologies	1998	Washington, DC	110	27.0	Hyperspectral imaging technologies
Aegis Semiconductor, Inc.	2000	Woburn, MA	21	0.0	Optical light management solutions
Aero Astro Inc.	1988	Herndon, VA	22	3.8	Nanosatellites and microtechnology systems
Aeroflex Inc.	1937	Plainview, NY	2,030	229.8	Broadband and wireless communications
Aerovironment, Inc.	1971	Monrovia, CA	235	50.0	Power generation / unmanned aerial vehicles
Agilent Technologies	1999	Santa Clara, CA	36,000	6,010.0	Electronic and optical instrumentation
Agility Communications, Inc.	1998	Santa Barbara, CA	160	25.9	Optical networking technologies
Ai Metrix, Inc.	1996	El Dorado Hills, CA	65	7.3	Fully integrated network management software
AirFiber, Inc.	1998	San Diego, CA	70	n.a.	Free space optics technologies
Airnet Communications Corp.	1994	Melbourne, FL	128	14.5	Wireless communications
Alliance Fiber Optic Products, Inc.	1995	Sunnyvale, CA	376	20.4	Fiber optic communications technologies
ALPHATECH, Inc.	1978	Burlington, MA	165	28.5	Artificial intelligence and autonomous computing
Analog Devices, Inc.	1965	Norwood, MA	9,000	2,277.0	DCP technologies
Andrew Corp.	1937	Orlando Park, IL	5,335	1,019.2	Communication systems
Anteon Corp.	1996	Fairfax, VA	5,400	715.0	Information technology products and services
American GNC Corp.	1986	Simi Valley, CA	50	3.2	Wireless networking configuration
Apogee Instruments, Inc.	1996	Auburn, CA	12	1.2	High performance digital imaging systems
APTA Group, Inc.	1993	San Diego, CA	62	5.5	Microelectronic networking technologies
Arroyo Optics	1994	Los Angeles, CA	60	4.0	Optical telecommunications technologies
Ascendent Telecommunications	1993	Los Angeles, CA	21	2.0	Voice continuity and mobility solutions
Ascent Technology, Inc.	1986	Cambridge, MA	30	2.9	Cognitive software
Aurora Flight Sciences Corp.	1994	Manassas, VA	146	8.2	Unmanned aerial vehicles
Aurora Networks	1999	Santa Clara, CA	50	3.5	Fiber optics technologies
Avaki Corp.	2001	Cambridge, MA	40	4.0	Grid software
Avocent Corp.	2000	Huntsville, AL	650	255.9	Multi-platform switching and analog matrix switching
Axeda Systems, Inc.	1997	Malvern, PA	188	7.6	Device data communications technologies
AXT, Inc.	1986	Fremont, CA	1,308	66.3	High-performance compound semiconductor substrates
BAI Aerosystems, Inc.	1990	Easton, MD	155	12.3	Unmanned aerial vehicles
Battlespace, Inc.	1993	Arlington, VA	26	1.7	Unmanned aerial vehicles
Blue Titan Software	2002	San Francisco, CA	39	4.3	Web services and enterprise computing software
Bose Corp.	1964	Framingham, MA	6,500	1,275.0	High volume communications
Brilliant Media Inc.	1986	San Francisco, CA	5	1.6	Network centric battle management software
BroadWare Technologies, Inc.	2000	Cupertino, CA	25	1.0	Networked video applications
Brocade Communications Systems, Inc.	1996	San Jose, CA	1,332	562.4	High-end fiber channel products
California Amplifier, Inc.	1981	Camarillo, CA	400	100.7	Microwave amplifiers, downconverters, and antennas
Celeritek, Inc.	1984	Santa Clara, CA	462	58.0	High volume communications
Ceramic Process Systems	1984	Chartley, MA	91	4.5	Microelectronics and metal matrix composites
Chugach Alaska Corp.	1972	Anchorage, AK	2,500	278.6	Base operating services and telecommunications
CIENA Corp.	1992	Linthicum Heights, MD	3,508	1,603.2	Optical networking technologies
Cirrus Logic	1981	Austin, TX	1,421	313.0	Microelectronics
COMGLOBAL Systems, Inc.	1995	San Diego, CA	176	24.6	Information technology products and services
Colby Films	1988	Santa Monica, CA	2	0.4	3D high resolution terrain maps
Continental Electronics	1946	Dallas, TX	150	22.1	RF broadcast transmissions equipment
Critical Path, Inc.	1997	San Francisco, CA	562	104.2	Internet messaging infrastructure solutions

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Source: Dun & Bradstreet reports, OneSource reports, Standard & Poor's corporate descriptions, SEC filings, and suppliers

REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #5: Integrated Battlespace (cont'd)

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
CSA Engineering, Inc.	1982	Mountain View, CA	44	8.0	Vibration suppression and precision motion technology
Computer Science Corp.	1959	El Segundo, CA	65,000	11,004.0	Information technology and engineering consulting
Cymer, Inc.	1986	San Diego, CA	898	269.4	Excimer light sources
Delta Information Systems, Inc.	1976	Horsham, PA	52	7.0	Video communications technologies
Deskin Research Group, Inc.	1984	Santa Clara, CA	38	4.7	UHF satellite communications protocol for UUVs
DigiLens, Inc.	1997	Sunnyvale, CA	40	0.7	Electro-optic components
Dynamics Research Corp.	1955	Andover, MA	1,517	200.1	Information technology products and services
Eastman Kodak Company	1880	Rochester, NY	8,200	13,324.0	Advanced imaging and analysis
Elumens Corp.	1993	Cary, NC	25	3.5	Hemispherical display systems
EMCORE Corp.	1984	Somerset, NJ	755	104.5	High volume communications
Enerdyne Technologies, Inc.	1998	El Cajon, CA	25	4.0	Advanced digital video systems
ESRI.	1969	Redlands, CA	1,800	384.0	GIS and mapping software
FC Business Systems	1985	Springfield, VA	400	55.0	Information technology systems
FLEXICS, Inc.	1997	Milpitas, CA	16	0.9	Manufacturer of flexible integrated circuits
Foresight Science & Technology Inc.	1979	New Bedford, MA	12	1.1	Information technology consulting
Four Square Productions, Inc.	1973	San Diego, CA	15	1.4	Integrated media solutions
Gemfire Corp.	1997	Palo Alto, CA	90	0.5	Array-based optical fiber components
General Atomics	1986	San Diego, CA	1,150	86.0	Nuclear fuel cycle and remote surveillance aircraft
Genoa Corp.	1998	Freemont, CA	125	10.7	Indium phosphide-based amplifier technologies
Geophysical Environmental Research Corp.	1977	Millbrook, NY	35	5.0	Airborne spectral scanning technologies
Graviton, Inc.	1998	San Diego, CA	55	5.3	Wireless network sensors
GTSI Corp.	1984	Chantilly, VA	608	783.5	Information technology solutions
HYPRES, Inc.	1983	Elmsford, NY	30	4.3	Superconducting electronics
II-VI Inc.	1971	Saxonburg, PA	1,158	113.7	Visible and near infrared laser components
Indigo Systems Corp.	1996	Santa Barbara, CA	120	18.7	Opto-electronic products
Integrated Device Technology, Inc.	1980	Santa Clara, CA	4,815	379.8	Microprocessors and integrated circuits
IntegriNautics Corp.	1994	Menlo Park, CA	21	1.4	Precision control systems
Intelcore Technologies, Inc.	2000	Boston, MA	23	1.6	Fiber optics technologies
Intelligent Systems Technology Inc.	1988	Santa Monica, CA	14	1.5	High volume communications
Internet Security Systems, Inc.	1994	Atlanta, GA	328	25.7	Enterprise intrusion prevention and protection
Irvine Sensors Corp.	1980	Costa Mesa, CA	90	10.7	Solid state microcircuits stacked in 3D
ITN Energy Systems, Inc.	2001	Littleton, CO	60	4.6	Microsatellites
ITT Industries, Inc.	1920	White Plains, NY	38,000	4,675.7	Air traffic control and satellite instrumentation
KaZak Composites, Inc.	1982	Woburn, MA	10	1.4	Composite systems and components
Jackson & Tull	1974	Washington, DC	412	27.5	Satellite and information services engineering
JDS Uniphase Corp.	1979	San Jose, CA	11,100	3,232.8	Fiber optic instrumentation and commercial lasers
KnowNow, Inc.	2000	Sunnyvale, CA	43	0.2	Business critical data sharing software
LightSand Communications, Inc.	1999	Milpitas, CA	30	0.4	High performance wide area storage networking
Lightwave Electronics Corp.	1984	Mountain View, CA	120	28.8	Solid state laser systems
Lightwave Microsystems Corp.	1996	San Jose, CA	42	3.7	Integrated circuits for fiber optic communications
Linear Technology	1981	Milpitas, CA	5,815	512.2	Linear integrated circuits
Mahi Networks, Inc.	1999	Petaluma, CA	215	7.3	Optical telecommunications technologies
MANDEX, Inc.	1994	Fairfax, VA	69	10.1	Imagery and information technology services
Matrics, Inc	2000	Columbia, MD	25	1.7	Data collection technologies
Maxim Integrated Products, Inc.	1983	Sunnyvale, CA	6,172	1,025.1	Linear and mixed-signal integrated circuits
MEMS Optical, Inc.	1996	Huntsville, AL	78	7.0	Refractive and diffractive micro optics
Mercury Computer Systems, Inc.	1981	Chelmsford, MA	490	115.1	Scalable multicomputing systems
Merix Corp.	1994	Forest Grove, OR	1,454	86.5	Advanced electronic interconnect solutions
Metric Systems Corp.	2000	Ft. Walton Beach, FL	500	40.6	Radar systems and equipment
Microsoft Corp.	1975	Redmond, WA	50,500	30,000.0	Microcomputing software
Mohomine Inc.	1999	San Diego, CA	45	6.0	Data extraction tools

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REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #5: Integrated Battlespace (cont'd)

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
MTS Technologies, Inc.	1991	Arlington, VA	213	26.5	Information technology and logistics services
Neomagic Corp.	1993	Santa Clara, CA	144	0.4	Handheld systems applications processors
Netune Communications, Inc.	1999	Culver City, CA	30	1.4	Secure satellite network technologies
Newport Corp.	1938	Irvine, CA	1,653	181.9	Test, measurement, and automation systems
OECO, LLC	1961	Milwaukie, OR	935	54.3	High volume communications
Ophir RF Inc.	1992	Los Angeles, CA	58	5.6	High power RF and microwave amplifiers
Optinetrics Inc.	2000	Torrance, CA	30	2.7	Glass technology platform for planar lightwave circuits
Optiva, Inc.	1997	San Francisco, CA	12	1.5	Optical self-assembling nanomaterials
Orion Scientific Systems	1989	Newport Beach, CA	138	16.4	Intelligence analysis technologies
Panasas Inc.	2000	Fremont, CA	120	11.0	Scalable data storage networks
ParaSoft Corp.	1987	Monrovia, CA	100	25.8	Software debugging technologies
Peregrine Semiconductor Corp.	1990	San Diego, CA	167	11.1	Single chip phased array antenna elements
Photonics Inc.	1987	Philadelphia, PA	12	1.0	Optical devices
PlanetGov, Inc.	1998	Chantilly, VA	150	231.6	Information technology
Plexus Corp	1979	Neenah, WI	5,600	1,062.3	Circuit board development
Polycom, Inc.	1990	Pleasanton, CA	1,269	466.0	Voice and video conferencing software and hardware
Princeton Optronics, Inc.	1989	Trenton, NJ	30	2.0	Externally modulated transmitter components
Procom Technology	1996	Irvine, CA	135	25.0	Unified storage platform solutions
Qlogic Corp.	1994	Aliso Viejo, CA	624	344.2	Fiber channel SANs
Qwest Communications Int'l Inc.	1991	Denver, CO	67,000	16,610.0	Fiber optics
Racal Instruments Group	1977	Irvine, CA	260	22.2	Microelectronics
Rambus Inc.	1990	Los Altos, CA	113	117.2	Advanced chip connection technology
Recon/Optical, Inc	1968	Barrington, IL	200	50.0	High volume communications
RF Micro Devices, Inc.	1991	Greensboro, NC	1,145	45.4	High efficiency triple-band power amplifier module
Sabeus Photonics, Inc.	1998	Chatsworth, CA	45	2.0	Fiber optic communications technologies
Scaled Composites	2000	Mojave, CA	135	17.3	Unmanned aerial vehicles
ScanSoft, Inc.	1992	Peabody, MA	245	63.9	Voice recognition software
Science Research Laboratory, Inc.	1983	Somerville, MA	41	3.1	Solid state pulsed power technologies
SEAKR Engineering, Inc.	1982	Englewood, CO	150	30.0	Solid state mass memory systems
Siebel Systems, Inc.	1993	San Mateo, CA	6,000	2,005.0	Web architectures
Silicon Designs, Inc.	1983	Issaquah, WA	19	1.7	Missile sensors
Simulis, Inc.	1999	Houston, TX	50	4.5	Computer training and simulation software
Solipsys	1996	Laurel, MD	87	27.9	Information processing systems
SpaceDev, Inc.	1997	Poway, CA	30	4.1	Microsatellites and hybrid propulsion
SRA International, Inc.	1978	Fairfax, VA	2,100	361.0	Information technology services
SRS Technologies	1970	Newport Beach, CA	450	64.4	GIS systems and imaging and space services
Standard Microsystems Corp.	1971	Hauppauge, NY	512	159.3	High speed communication and computing solutions
Sumaria Systems, Inc.	1982	Danvers, MA	326	330.1	Software engineering
Swales Aerospace, Inc.	1978	Beltsville, MD	950	144.0	Satellite and thermal management systems
Symbol Technologies, Inc.	1975	Holtsville, NY	5,250	1,452.7	Mobile data management systems and services
Syzygy Technologies, Inc.	1995	San Diego, CA	50	4.8	Computer science and engineering support
Tachyon, Inc.	1998	San Diego, CA	110	10.7	High volume communications
TEAC America, Inc.	1967	Montebello, CA	225	432.8	Video communications technologies
Telephonics Corp.	1976	Farmingdale, NY	1,066	191.0	Information and communications systems
Tellium, Inc.	1997	Oceanport, NJ	508	147.0	High volume communications equipment
Telos Corp.	1993	Ashburn, VA	648	170.3	Computer messaging systems
The Insitu Group, Inc.	1994	Bingen, WA	12	2.0	Unmanned aerial vehicles
Time Domain Corp.	1987	Huntsville, AL	193	1.0	High volume communications technologies
The Titan Corp.	1910	San Diego, CA	7,670	1,132.0	Telecommunications technologies
TRAK Communications, Inc.	2000	Tampa, FL	750	61.0	Microwave communications technologies

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REPRESENTATIVE EMERGING DEFENSE SUPPLIERS WITH TRANSFORMATIONAL CAPABILITIES[1]

Operational Effects Based Sector #5: Integrated Battlespace (cont'd)

Company Name	Est.	Location	Employees	Total Sales[2] ($ Millions)	Enabling Technology
Trellion Technologies, Inc.	1999	San Diego, CA	15	1.0	Updateable digital media presentations
TriQuint Semiconductor, Inc.	1991	Hillsboro, OR	1,073	335.0	Gallium arsenide integrated circuits and transistors
Vanu, Inc.	1998	Cambridge, MA	25	1.8	Software radio technology
Vbrick Systems, Inc.	1998	Wallingford, CT	95	10.7	Video communications technologies
Veridian Corp.	1995	Arlington, VA	5,200	690.0	Communications and energy technologies
Veritas Software Corp.	1989	Mountain View, CA	5,700	1,510.0	Data storage software
ViaSat, Inc.	1986	Carlsbad, CA	886	195.6	Digital and wireless communications technologies
WaveBand Corp.	1996	Torrance, CA	12	1.5	Beam steering and beam forming antennas
Wavestream Corp.	2001	West Covina, CA	11	0.0	High-power millimeter wave amplifiers
Wescam Inc.	1974	Burlington, ON	460	106.2	Laser range finding and payload targeting technologies
Wind River Systems, Inc.	1981	Alameda, CA	1,796	268.7	Efficient embedded software writing technologies
Yau, Inc.	2001	Philadelphia, PA	3	0.0	Long-range wireless networking technologies
YottaYotta, Inc.	1999	Kirkland, WA	73	12.0	High capacity data storage technology
Zaplet, Inc.	1999	Redwood Shores, CA	50	1.0	Collaborative business process management software
Zeta, Inc.	1998	Morgan Hill, CA	100	7.6	Microwave products
Zettacom, Inc.	1999	Santa Clara, CA	85	17.4	Complete network semiconductor solutions
Zoran Corp.	1981	San Jose, CA	285	107.7	Integrated circuits

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Source: Dun & Bradstreet reports, OneSource reports, Standard & Poor's corporate descriptions, SEC filings, and suppliers

APPENDIX B

STUDY METHODOLOGY AND FINDINGS, CASE STUDIES OF SELECTED EMERGING DEFENSE SUPPLIERS, AND SUMMARIES OF BEST PROGRAMS

STUDY METHODOLOGY AND FINDINGS

METHODOLOGY

We selected 24 emerging defense suppliers for in-depth discussions from a compendium of over four hundred companies. Firms with a variety of innovative ideas and technologies were selected to ensure a broad representation of the emerging supplier base. Diversity was achieved based on the following primary criteria: current level of activity with the DoD, stage of the technological lifecycle, size and scope, and geography. The chart below describes these companies.

TWENTY FOUR CASE STUDIES OF EMERGING DEFENSE SUPPLIERS

Company Name	Annual Sales		Location	Enabling Technologies
	Total ($ Millions)	Defense[1] (%)		
Combat Support				
EluSys Therapeutics	$2.0	100%	Pine Brook, NJ	Anthrax Vaccine
iRobot	n.a.	n.a.	Somerville, MA	Intelligent robotics
Nomadics	7.0	80%	Stillwater, OK	Advanced sensors
Oakley	476.9	n.a.	Foothill Ranch, CA	Human form accessories
Sarcon Microsystems	0.0	0%	Knoxville, TN	Infrared sensors
Power Projection				
Aerovironment	50.0	50%	Monrovia, CA	Energy systems and UAVs
Amptek	7.0	5%	Bedford, MA	Space instrumentation
i2 Technologies	986.0	15%[2]	Dallas, TX	Logistics software
Precision Engagement				
C-CAT	2.0	50%	Fort Worth, TX	Carbon-carbon components
Foam Matrix	4.0	100%	Inglewood, CA	Net molded structures
Homeland and Base Protection				
Coherent Technologies	19.2	52%	Lafayette, CO	Laser radar technologies
Riptech	45.0	10%	Alexandria, VA	Managed security services
RSA Security	282.7	10%	Bedford, MA	Network security products
SRD	7.5	50%	Las Vegas, NV	Fraud prevention software
Symantec Corp	1,160.0	n.a.	Cupertino, CA	Network security products
Viisage Technology	30.5	10%	Littleton, MA	Biometrics technologies
Integrated Battlespace				
Actuality Systems	1.0	65%	Burlington, MA	3D visualization technology
AirFiber	n.a.	n.a.	San Diego, CA	Wireless equipment
Delta Information Systems	7.0	40%	Horsham, PA	Communications equipment
Sabeus Photonics	2.0	0%	Chatsworth, CA	Sensor technologies
SRA International	361.0	95%	Fairfax, VA	IT systems and consulting
The Insitu Group	2.0	65%	Bingen, WA	Long-range UAVs
Vanu	n.a.	50%	Cambridge, MA	Software radio
Zaplet	1.0	67%	Redwood Shores, CA	Collaborative software

[1] When military and civil government sales aggregated, most relevant government sales figure presented
[2] Next year's target for new licensing revenue
n.a. = not available
Note: Companies listed are representative; the list is not exhaustive. Inclusion or exclusion does not imply future business opportunities with or endorsement by DoD.

Source: Emerging defense suppliers interviews

We interviewed these emerging defense suppliers to learn how they do business, both commercially and with DoD. We asked them to characterize their strategies, operations, and business relationships across the product lifecycle – market identification, allocation of R&D capital, concept development, contract negotiation, product development, product testing, product delivery, life cycle support, contract administration, intellectual property, and foreign sales. Furthermore, we asked them to candidly discuss the concerns they had regarding doing business with the Department and to make recommendations as to how DoD could improve its relationship with the emerging defense supplier base.

In addition to discussions with emerging defense companies, we drew insight from the largest defense firms and DARPA to help us identify what "works" – innovative and effective ways of delivering critical weapons systems to the warfighter. We asked them to characterize their fastest to field, most important and innovative in the context of transformation, and overall most successful programs.

FASTEST TO FIELD, MOST IMPORTANT/INNOVATIVE, AND OVERALL MOST SUCCESSFUL PROGRAMS

Defense Firm/ Organization	Fastest to Field	Most Important/Innovative	Overall Most Successful
BOEING	***Joint Direct Attack Munition (JDAM)*** Responded to urgent operational need, tripled production in one year, quadrupled inventory in 1/4 normal time	***UHF Follow-on (UFO)*** Innovative acquisition and technical solutions provide and sustain evolutionary, leading-edge communications	***F/A - 18 E/F Super Hornet*** Replaces five separate USN & USMC legacy platforms while expanding capabilities
GENERAL DYNAMICS	***Stryker*** 200 Completely new vehicles delivered to the US Army in 20 Months	***SSGN*** Dramatically transforming bellwether Cold War system to meet new mission needs	***Automated Deep Operations Coordination System (ADOCS)*** Transforming battlefield command and control
LOCKHEED MARTIN	***The Skunk Works*** Time-proven practices for rapidly developing, prototyping and delivering revolutionary advancements in capability for warfighters	***Atlas V/Evolved Expendable Launch Vehicle (EELV)*** Meeting future US & International launch needs at significant cost savings	***F-117 Nighthawk*** Developmentally and militarily revolutionary--established preeminence of airborne precision attack
NORTHROP GRUMMAN	***Global Hawk*** Go-ahead to first flight in less than three years, demonstrated in critical wartime operations before being a formal acquisition program	***Affordable Moving Surface Target Engagement (AMSTE)*** Developing real-time, net-centric targeting solution for tomorrow's war	***E-2C Radar Modernization Program (RMP)*** Transforming legacy system to provide Theater Air Missile Defense
Raytheon	***Adverse Weather GBU-15 Enhancement Program (EGBU-15)*** 50 Weapons delivered to field in 45 Days	***DD (X)*** Increased joint/coalition operating effectiveness and survivability with affordable operating profile	***AMRAAM*** Spiral development has kept system and US tactical aviators 10 years ahead of threats
DARPA	***Phraselator*** 4-Language translators delivered to troops in theater in less than 120 days	***Control of Agent Based Systems (CoABS)*** Provides net-centric integration via run-time interoperability of heterogeneous systems	***Global Hawk*** Pioneered transformation--introduced UAVs as essential and irreplaceable elements of modern warfare

Source: Top-five defense suppliers and DARPA

FINDINGS

The messages heard from emerging defense suppliers resonated strongly with lessons learned from successful programs of legacy defense suppliers. They fell into six primary areas of concern:

- Insufficient visibility into the military enterprise
- Inadequate funding and advocacy for new technology transition
- Difficulty building a strong, interactive relationship with customers
- Cumbersome system design specifications
- Lengthy, laborious sales cycles
- Limited access to development and investment capital

I. INSUFFICIENT VISIBILITY INTO THE MILITARY ENTERPRISE

> ***"Most small companies don't understand the command structure of the military acquisition process."***
>
> *– Emerging defense supplier*

Emerging defense suppliers' first concern is their struggle to identify and access decision-making personnel within the Department. To compound the issue, in many companies' opinion, the military frequently does not effectively communicate future technological requirements and standards to companies on the leading-edge of technological development. Contrarily, large defense contractors are much more in tune with the direction of military programs and technologies, in part due to their scale, which enables them to hire people with extensive defense experience. Most emerging suppliers, which possess many of the innovative solutions DoD is looking to field, do not possess the mass to develop similar resources and connections.

> ***"We have products that are applicable… and we'd like to be able to advertise the fact that we do this…but there's no mechanism for that to happen….it would be nice to have that advertising capability or at least, more visibility in the organization."***
>
> *– Emerging defense supplier*

Consequently, emerging defense suppliers believe that the military should modify its structure to provide centralized points of contact or liaisons to help companies identify relevant military needs and apply their technologies toward those ends. These points of contact or offices, if possessing broad visibility from basic research through procurement, would be able to improve the likelihood of emerging defense suppliers having an impact on how we fight in the future.

II. INADEQUATE FUNDING AND ADVOCACY FOR NEW TECHNOLOGY TRANSITION

A significant number of emerging defense suppliers struggle with the funding and advocacy gap that exists between the military research and acquisition processes. Even with the opportunity to bridge the gap, few of these companies can afford to repeat, in development and in procurement, the laborious sales cycles experienced

during research phases. This complicated and often costly transition is made more difficult by having to deal with different customers, and frequently, different funding sources. The paradox is thus: a few steps short of successful product definition and development, the ground shifts. Military funding often ceases, leaving promising technology insufficiently advanced for acquisition funding, yet too far along for additional research funding.

As a result, emerging defense suppliers often are left to fund the technology transition internally. However, few companies are motivated or able to take the risk of internally funding defense development when higher margins are available in the commercial market. Additionally, companies can access private development capital more easily with the promise of the higher returns on investment available from commercial sector projects. As a result, many suppliers believe that technologies with the potential to create revolutionary leaps in transformational warfare are being used in commercial applications rather than in military systems.

To address this issue, emerging defense suppliers made a number of suggestions. Proposed solutions include bridging the funding and advocacy divide to improve their return on investment for military applications of their technologies, reorganization of the military research and acquisition processes, and creating fused research and acquisition contracts.

III. Difficulty Building a Strong, Interactive Relationship with Customers

> ***It is a "difficult fit at the end of the day to work with the large primes - both to provide financially, survive contractually, and in more than one case, we've ended up getting ripped off."***
>
> *– Emerging defense supplier*

A final reason that emerging defense suppliers have had difficulty delivering advanced technologies and solutions to the U.S. military is the indirect supplier-customer relationship imposed upon them by the Total System Performance Responsibility (TSPR) system. The Department of Defense's elimination of TSPR and other changes in the acquisition system should allow companies to have more direct interaction with the military. Another step in the right direction is DoD's initiative to limit the bundling of smaller contracts, which has improved the ability of small businesses to win government contracts. Nevertheless, many emerging defense suppliers feel that many RFPs are still written with a focus on systems bundling and at such a broad integration level that only prime contractors can bid. Emerging suppliers are forced to transfer their technologies to a systems integrator rather than work with end users to deliver a solution that best addresses the military's needs.

While some companies have had positive experiences teaming with prime contractors, many emerging defense suppliers have not. When not delivering a solution directly to a customer, companies face higher uncertainty and greater risk because their ability to influence the form of the procurement decision is diminished. Suppliers frequently face

> ***"Generally speaking…we would choose to be associate contractors, bringing our highly specialized capability directly to the customer, the end user customer, and supporting the Prime as a staff supporter to the side, as opposed to working through the primes."***
>
> *– Emerging defense supplier*

cultural conflicts teaming with primes that are reported to be unreceptive to helping subcontractors learn new markets and expand the defense applications of their technologies. According to emerging suppliers, DoD has made a step in the right direction by eliminating the TSPR system. Nonetheless, companies still have difficulty establishing tight relationships with military end users. As such, many emerging defense suppliers believe that the military should provide an avenue for them to work more directly with the military and to establish tight, interactive relationships with end customers.

In its selected fastest to field program, Raytheon, through on-site teaming with the customer, stepped-up with a critically needed all-weather GBU-15 solution for the Air Force, the EGBU-15. Raytheon designed, developed, and delivered a remarkable 50 weapons in 45 days in support of Operation Allied Force. Furthermore, iRobot was able to work closely with U.S. soldiers in Afghanistan. Consequently, the company gained valuable firsthand knowledge of the user community's needs and was able to add significant value to its PackBot system by incorporating chemical and biological sensors, different video or audio packages, and other suggested capabilities and improvements into its system throughout the Afghanistan campaign.

IV. CUMBERSOME SYSTEM DESIGN SPECIFICATIONS

Emerging defense suppliers' express concern that defense contracts often define the solution, rather than the mission, or effects-based requirement. Essentially, current DoD procurements often specify a custom system design rather than communicating the mission objectives and allowing suppliers to propose innovative and varied solutions to achieve the mission. While suppliers agree that this might make selection tougher, it would yield more innovation and better technology at significantly lower costs.

Companies also believe that DoD has difficulty procuring innovative, leading-edge solutions because of the risk adverse nature of the defense procurement process. On several occasions, companies cited the "nobody ever got fired for choosing [insert any prime contractor name here]" mentality as a significant deterrent to developing a niche market for a revolutionary technology. As a result, the modern warfighter may lose the opportunity to take advantage of the best and most innovative solutions in the market.

As shown on the groundbreaking Coast Guard Deepwater program, use of performance-based specifications rather than rigid technical specifications can overcome this problem and facilitate transformational results. In this case, through a Lockheed Martin–Northrop Grumman Partnership, the Coast Guard will meet multiple mission needs with fewer operational assets and at lower overall cost by specifying mission needs rather than how it wants the need met. Furthermore, as an Acquisition Reform Demonstration Project, Boeing leveraged such acquisition practices to deliver the Joint Direct Attack Munition (JDAM) to the Air Force. Utilizing a Production Price

Commitment Curve (PPCC) to define price-performance and similar performance-based relationships with suppliers, Boeing ultimately delivered JDAMs to support Operations Allied Force, Southern Watch and Enduring Freedom when they were urgently needed.

V. Lengthy, Laborious Sales Cycles

The fourth issue many emerging defense suppliers have is almost universal: military contracting cycles are too lengthy and very difficult to manage. According to many suppliers, developing the military's interest in a technology is often a repetitive and redundant process involving numerous steps and hurdles. There often are multiple rounds of contracting for a specific program, and negotiations for these contracts are long, drawn-out processes. Furthermore, the military typically issues short-term contracts and requires phased contracting with different organizations during a technology's lifecycle. Many emerging defense suppliers believe that these additional unsynchronized phases slow down delivery to such an extent that the military often contracts for cutting-edge technologies and receives technologically outdated products.

One emerging defense supplier's CEO stopped counting after one government agency's 28th review of its paperwork.

For companies for which generating cash is tantamount to survival, the belabored contracting process, with its high short-term resource demands and long-term payouts, is extremely difficult to manage. The resource intensive nature of military contracting stems from a number of sources, including the accounting and auditing requirements dictated by the government. For some companies, even the paperwork burden in dealing with the government poses a serious threat to the company's profitability. Furthermore, one specific supplier even attributes the fact that it has been unprofitable on every one of its defense contracts to the slow, inflexible, resource intensive contracting process.

"We submitted our 3 page software developer agreement and product license. I got back a 90-page document that outlined more than I wanted to know about anything, and I essentially had no choice…but to capitulate to everything."

– Emerging defense supplier

Many of the military's most effective legacy programs have had success overcoming these lengthy and laborious DoD sales cycles by implementing parallel testing and fielding processes, allowing for continuous improvement, and more rapid satisfaction of operational needs. As demonstrated by the General Dynamics Stryker program, constant feedback from warfighter to engineering and production activities enables continuous improvement not previously possible under traditional acquisition practices. Similarly, the Phraselator, a DARPA Small Business Innovation Research (SBIR) program performed by Marine Acoustics International (MAI), responded to Navy and Army needs by sending prototype phrase-translation devices to support ongoing operations in Kosovo and the Gulf Region. More recently, theater-specific prototypes for use in Afghanistan were developed in 89 days and delivered 28 days later.

Through leveraging technologies developed for commercial products and utilizing more "commercial-like" transaction vehicles, such as Other Transactions Authority (OTA),

Boeing, for example, has been able to rapidly deliver a whole new family of launch vehicles to the Air Force at a savings of 25% over prior launch costs. Likewise, Northrop Grumman's Global Hawk, cited both by DARPA and Northrop Grumman as a highly successful Advanced Concept Technology Demonstration (ACTD) program, made use of OTA to remove unnecessary program constraints to deliver a Tier II-plus UAV solution (moderately survivable, for high altitude long-endurance missions) in record time at affordable cost. Commercial off-the-shelf (COTS) technology, though not a panacea for all challenging military procurements, often can provide an avenue for rapid insertion of both improved and unforeseen capabilities and a foundation for real-time transformation while adding cost and performance improvements. Wider use of COTS technologies also has been show to be an effective solution to the widespread problem of diminishing manufacturing sources associated with many legacy systems.

VI. LIMITED ACCESS TO DEVELOPMENT AND INVESTMENT CAPITAL

> ***"The biggest challenge is cash…cash is king"***
> *– Emerging defense supplier*

Many emerging defense suppliers find it difficult to raise funds for military R&D and project opportunities. Three potential sources of capital are retained earnings, third party investment, either as equity or debt, and DoD project sponsorship. However, companies often face significant challenges accessing any of these sources. For instance, because many emerging defense suppliers are small and rapidly growing organizations, they often generate little or no retained earnings and do not have the capacity to dedicate internal capital towards relatively low margin military R&D projects and programs.

> ***"It's no secret. There's really not a lot of equity capital available for a company where their mission is technology development for the government or where their customer is the Department of Defense."***
> *– Emerging defense supplier*

Emerging suppliers also frequently face hurdles securing equity and debt financing from the capital markets, private equity sources, strategic partners, and other sources. Capital markets are currently extremely tight, with the number of new initial public offerings (IPOs) much lower than recent years.[1] Additionally, venture financing has decreased[2], as start-ups face greater challenges and traditional venture investment exit strategies are less attractive.[3] According to emerging defense suppliers, both financial and strategic investors are often hesitant to support companies in the defense market and to invest in defense projects because the risk-reward opportunity is not attractive enough. This is due to a number of factors, most significant of which are the relatively low profit margins, small production runs, pricing pressures, and uncertainty often associated with military

[1] 30 companies had new IPOs in 3Q02, a 78% decline from the 139 new IPOs in 3Q00, and an 81% decline from the 156 new IPOs in 3Q99.

[2] Venture capital financing fell to $4.5 billion in the 3Q02, a 26% drop from the prior quarter and a level not seen since 1998.

[3] Only 22 venture-backed companies had IPOs in 2002 raising $1.9 billion, down from 35 venture-backed IPOs raising $2.9 billion in 2001, and 226 venture-backed IPOs raising $21.1 billion in 2000.

> ***The "process is set up for the large system integrators."***
>
> *– Emerging defense supplier*

projects. Furthermore, companies must often confront challenges to their intellectual property ownership rights from DoD and other defense contractors. This is detrimental to their efforts to secure funding since investment decisions often hinge on firms' ability to protect and leverage their valuable intellectual property.

The option most frequently utilized by the emerging defense industrial base to access capital to develop advanced military technologies, is obtaining funding directly from DoD. However, many emerging suppliers have had difficulty accessing DoD capital, due to DoD's phased funding and advocacy mechanisms. Many companies also have difficulty identifying and locating sources of DoD and military capital to finance innovative technological development.

> ***"It's still hard to fund things where the federal government is the customer."***
>
> *– Emerging defense supplier*

These concerns weigh heavily on emerging defense suppliers because the capacity to adequately source investment and R&D capital is essential to their ability to grow, compete, and develop innovative and revolutionary technologies. Consequently, companies proposed a number of potential solutions, including ensuring and increasing profitability on military research contracts and leveraging more creative contracting solutions such as matching contracts. Emerging suppliers also suggest increasing profit margins to incentivize investment by making military projects more rewarding endeavors.

CASE STUDIES OF SELECTED EMERGING DEFENSE SUPPLIERS

CHARACTERIZING THE EMERGING DEFENSE SUPPLIER BASE

Innovative and enabling transformational technologies of interest to the Defense Department are currently being developed by thousands of companies all across the United States. Many of these technologies have been developed in academic and research settings and are being commercialized by engineering-focused firms. Consequently, emerging defense suppliers often have highly sophisticated R&D and engineering capabilities and possess cutting-edge technologies with the potential to revolutionize the military battlespace. By optimally managing these resources and limiting bureaucracy and overhead, emerging suppliers are capable of very rapid development cycles and delivery times. These companies leverage their speed and agility to adapt their organizational processes to the dynamic conditions in the commercial marketplace. Furthermore, for many of these companies, their intellectual property is the key to their success, and they protect it diligently with patent portfolios and strict licensing agreements.

Because the complex DoD acquisition processes compare unfavorably to the ease of access to commercial customers, many transformational suppliers focus their development efforts on the commercial marketplace. They conduct traditional market studies and analyses in order to identify customers, markets, and applications for their technologies. This, according to many companies, is a much simpler process in the commercial than in the military arena because commercial markets are more translucent and companies can establish close relationships with their technology's end users. User interaction provides valuable information regarding technological needs and market demand. This helps companies develop technological road maps, market action plans, and product development efforts, which add value to their commercial customers.

A commercial focus also allows suppliers to dedicate their resources and capabilities to developing innovative products, rather than managing a government relationship. Selling efforts are usually less resource intensive, and early adopters are often more easily identifiable among commercial customers. As such, companies align their sales and development efforts to optimize return on investment. Furthermore, the commercial market usually offers higher margins and has faster sales cycles than the defense market, improving access to investment capital for companies with commercial operations.

In spite of these barriers, emerging defense companies frequently develop military technologies to take advantage of specific opportunities in the defense market, particularly when the military funds research and development or when the company can apply technologies developed for military applications to the commercial sector. Additionally, many suppliers often generate revenue by adapting commercial technologies to defense applications or by delivering commercial off-the-shelf (COTS) solutions to meet identified military needs.

Emerging suppliers are frequently supplying the DoD directly through small product development contracts and through military research contracts such as Small Business Innovation Research (SBIR) contracts. However, many companies have difficulty delivering their technologies and products directly to the military on larger programs and often work with a systems integrator or prime contractor to supply to the military. In the past, under the Total System Performance Responsibility (TSPR) system, the military contracted with a prime contractor to deliver an integrated solution. Companies delivering individual leading-edge solutions, frequently small companies competing in dynamic markets, often found it impossible to supply the military without working through a prime contractor. Acting as subcontractors, suppliers' involvement was limited to delivering their specific technology to the contractor.

Since the elimination of the TSPR concept and with direct funding of commercial technologies in OEF, the DoD has begun to interact more directly with emerging suppliers, and a few companies have begun to provide their innovative and advanced solutions directly to the military. Nonetheless, the majority of emerging defense companies, whose advanced technologies are crucial to the success of many of the military's larger programs, still find that the only way to supply the military is through one of the major government contractors.

The following table characterizes how the emerging defense supplier base conducts business, both commercially and with the DoD. Subsequent to the table are 24 case studies that deliver a snapshot of each of the emerging defense suppliers involved in this report and discuss issues highly relevant to the emerging supplier base and its relationship with the Department.

CHARACTERIZING THE EMERGING DEFENSE SUPPLIER BASE		
	Defense Practices	**Commercial Practices**
Market Identification	Consult BAAs, FBOs, ATP, SBIRs, etc. Market to primes and system integrators Hire people with military experience Attend trade shows and conferences	Conduct market studies Market directly to end users Speak directly with best points of contact
Allocation of R&D Capital	Often allocate available funds to sole product Fund with accessible DoD dollars Only fund internally if technology has commercial applications Access DoD funds for cutting-edge research	Often allocate available funds to sole product Access private capital Fund internally according to technological road map and user needs
Concept Development	Try to work with end user to match capabilities with DoD needs and funding Adopt commercial solution to meet DoD needs	Opportunistically follow road map to deliver best solution and to generate highest ROI Adopt military solution for commercial market
Contract Negotiation	Often must contract with primes Lower, government-mandated margins GSA schedule and small, direct DoD contracts	Often contract quickly and efficiently with user Higher margins governed by market forces
Product Development	Development limited by funding Development often focused on commercial applications	Development driven by marketing efforts and tight, interactive relationship with user Commercial focus increases development speed
Product Testing	Test with rigid DoD standards	Test against clear metrics of value added
Product Delivery	Often deliver through primes Deliver directly to DoD on small contracts and research projects GSA schedule	Channel partners incentivized to deliver highest value solutions Often deliver directly to user Clear early adopters
Life Cycle Support	Primes provide support for large programs	Leverage direct support relationship for follow-on sales
Contract Administration	Many contracts are inflexible and constrain innovation Military payment is reliable and recession-proof	Contracts are flexible and support innovation to provide competitive advantage
Intellectual Property	Comprehensive patents and strict licensing agreements Internally fund and develop dual-use technologies	Comprehensive patents and strict licensing agreements
Foreign Sales	Foreign military sales to allies limited by cumbersome export control regulations	Foreign commercial sales often contribute to success

Source: Emerging defense suppliers interviews

– COMBAT SUPPORT –

ELUSYS THERAPEUTICS, INC.

IROBOT, INC.

NOMADICS, INC.

OAKLEY, INC.

SARCON MICROSYSTEMS, INC.

ELUSYS THERAPEUTICS, INC.

10 Bloomfield Ave
PO Box 102
Pine Brook, NJ 07058
Phone: (973) 808-0222
www.EluSys.com

- **Operational Effects-Based Sector:** Combat Support
- **Transformational Goal:** SECDEF Goal 1: Protect the U.S. homeland and bases overseas
- **Product:** The Heteropolymer System, a platform technology to treat a wide variety of blood-borne infections and autoimmune diseases including anthrax, smallpox, plague, Ebola or Marburg virus
- **Primary military sales vehicle:** Military research contracts
- **Military applications:** Antidote for Anthrax and other biowarfare agents
- **Commercial applications:** Lupus antidote, cancer and other infectious disease treatment
- **Approximate annual revenue:** $2 million
  - From research contracts
- **Employees:** 30
- **Established:** 1998

IMPORTANT POINTS

- Large pharmaceutical companies and venture capitalists have little interest in the biowarfare market due to its limited market potential and pricing pressures from the Department of Defense
- Risk-return calculation under current framework does not incentivize companies to invest in biowarfare drug development
- Drug development is a lengthy, expensive process, often requiring at least 3-4 years

MAJOR STRATEGIES

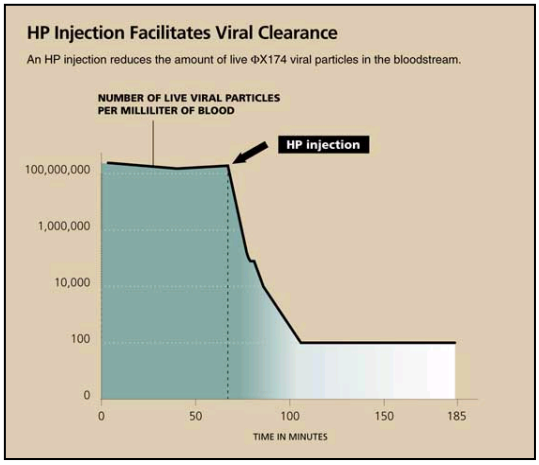
- Secure private funding to support its work in traditional markets in order to ensure company survival
- Utilize available government research funding to develop biowarfare applications

DEFENSE CONCERNS

- There is little collaboration or coordination between the various government agencies
- An extensive, complex procurement process does not support rapid response to attack
- Companies cannot secure more than one-year funding contracts
- Follow-on projects utilize the identical onerous procurement process as initial contracts
- Areas of focus, and therefore primary funding targets, evolve quickly for the DoD
- Individuals within the DoD are not properly incentivized to identify solutions

RECOMMENDATIONS

- Provide multi-year funding agreements contingent upon the completing of project milestones
- Guarantee fair pricing once the product reaches production
- Provide liability protection or indemnification
- Provide additional security to protect against potential terrorist attacks
- Work with the Food and Drug Administration (FDA) to expedite the approval process
- Realign personnel responsible for drug development from various agencies into one department



Biowarfare vs. Traditional Drug Markets

Elusys Therapeutics is developing technology that has the potential to create an antidote to the Anthrax virus. While this seems like important work in the current world environment, it is not compelling enough to capture the interest of healthcare venture capitalists. Moreover, other than applying existing products from traditional markets, large pharmaceutical companies have little interest in developing products for the biowarfare market.

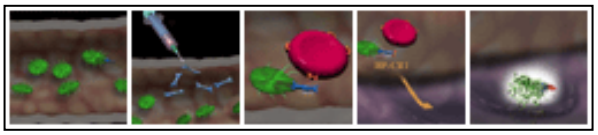
It is not resource scarcity keeping the industry leaders away; both the large pharmaceutical companies and the venture capitalists have plenty of available capital allocated for new product development. EluSys believes the reason for their lack of interest is that there is little economic incentive to compete in the biowarfare market. The cost of drug development for the large pharmaceutical companies can range anywhere from $200 million to $800 million. If the potential market for a new product is anything less than $1 billion, the return on investment would not be sufficient to justify the effort. In analyzing new products, the critical requirements for development are a large market, a product that fills a significant unmet need, price elasticity based upon product demand, and continued market growth. Likewise, in the commercial market, companies enjoy the opportunity for patent protection to ensure that they continue to be rewarded for development over time.

> ***"If you are going to beat up the people who have solutions for you by forcing them to lower their prices, that is not a big incentive."***

However, the biowarfare market is much more limited and unpredictable, with the ideal hope being that the product is never needed. Production is only required for emergency situations and for stockpiling, and unless disaster strikes, continued demand is typically only to replenish stock from outdated material. According to EluSys, this demand usually does not offer nearly enough revenue potential to justify the investment required. In addition, the product typically has only one customer, the Department of Defense, whose procurement process does not support rapid response to an attack. Likewise, pricing pressure from the DoD can further reduce the already limited upside for the product.

For a development company to focus on the biowarfare market, it has to consider its likelihood of success and of survival in comparison to the return on investment possible from the development of a more lucrative product in a traditional drug market. In EluSys's opinion, the reasons that small companies enter this market at all are to generate cash flow and to advance its technology so that it can be applied later in more traditional markets for a larger return. Companies do not expect to make money selling to the DoD.

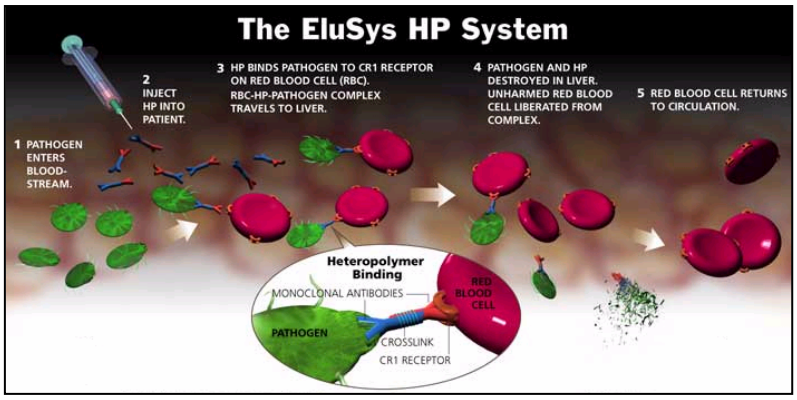
Challenge with Government Funding



Elusys's technology originated from research sponsored by the Defense Advanced Research Projects Agency (DARPA) during the mid 1990s. However, after earning a commendation from DARPA for its efforts, the company's failure to secure sufficient funds to complete development has been frustrating. The lack of coordination between DARPA and the DoD agencies involved in biological and chemical warfare is an unfortunate missed opportunity, according to EluSys.

After the completion of the project, there was little endorsement from DARPA. For EluSys, it seemed like beginning all over again in its search for development funding, having to educate the DoD on the technology it had developed, with which DARPA had been thoroughly impressed. The company was left with several alternatives: develop the technology through private funding, which would require a commercial application that could later be applied to biowarfare, or identify other sources within the DoD. After September 11, 2001, the company was bombarded with inquiries on how fast it could get a product to market. However, as the company worked to respond, it was met with consistent bureaucracy; multiple proposal requests, and long waiting periods before receiving a response.

Specifically, EluSys submitted its proposal to Congress, which stated that an anthrax antidote could be developed with $25 million of funding. Congress responded with a one-year allocation of $3 million. After dedicating two months and significant resources to filling out a grant application, it took an additional six months for EluSys to receive its first reimbursement payment. Although the company had already demonstrated the benefits of the project, once those funds were fully absorbed, it would have to halt the project while it started over in its search for additional funds. This entailed another eight-month application process, despite the fact that it was a continuation of the same project.



This process created a financing gap for the company between the time the initial contract ran out and the approval of the supplemental application. The negative is that without alternative funding sources, development of the project would have to be delayed or cancelled entirely. Furthermore, with a commitment of only one-year at a time, the company is often unable to staff appropriately, make long-term commitments, or purchase necessary equipment. This is

due to the fact that depending on the current focus of the administration, from one year to the next, necessary development funds may become unavailable to the project.

According to EluSys, in the commercial market, if a small company has developed an interesting technology, the most common source of funding is the large pharmaceutical companies. If the larger company is impressed with an initial demonstration and believes there will be an opportunity for a positive return on investment, the two sides will negotiate testing milestones for the next phase of development. This phase would be funded by an equity investment by the larger company. If milestones were met, the team would proceed with development through product test and approvals. The development company would further capitalize through a license fee and a royalty payment based on production.

In the commercial market, the respective parties' needs are clearly delineated and negotiated reasonably. In EluSys's opinion, in order to ensure competition, the DoD has created a process that is not always in its best interests. For example, no matter how wonderful an idea, there is no fast-track program to allocate a significant amount of money from the DoD. In order to encourage drug development, according to the company, the DoD has to incentivize companies to invest the necessary time and resources upfront to overcome the limitations of the biowarfare market.

"If you are going to invest in drug development and you make progress, you need to know ahead of time that the government is going to reward you for hitting your mark....The challenge right now is that even if you are successful, you have no assurance of getting funded."

EluSys has identified a number of modifications the DoD could make to encourage drug development in biowarfare. First, in order to allow developers to plan ahead and take the necessary advanced steps, the DoD could provide a commitment for multi-year funding if certain annual milestones are met. Additionally, as selling to the DoD is often the developer's only revenue source, a fair price agreement for production should be negotiated to allow it to earn a reasonable return. Moreover, due to the critical nature of these products, the DoD could encourage an expedited review process by the Food and Drug Administration. This would help shorten the development cycle.

According to EluSys, drug development can be complex and the DoD does not have extensive experience with the process (nor do traditional defense prime contractors familiar with working with DoD). As such, substantial collaboration and cooperation is needed between the various government agents currently responsible. Drug developers need a better understanding of where to bring their ideas in order to obtain funding. A centralized group for all drug development within the DoD or the National Institutes of Health could oversee this responsibility. This would allow for better communication with developers and likely more successful development programs.

iROBOT CORPORATION

22 McGrath Hwy Ste 6
Somerville, MA 02143-4507
Phone: (617) 629-0055
www.irobot.com

- **Operational Effects-Based Sector:** Combat Support
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 3: Deny our enemies sanctuary
- **Products:** Mobile, intelligent systems that operate on advanced behavior control software and utilize highly integrated sensors and computer systems
- **Primary military sales vehicles:** Research contracts and direct military sales
- **Military applications:** Tactical mobile robotics, explosives disposal, cooperative robotics, surveillance and reconnaissance
- **Commercial applications:** Toy robots, automatic vacuums, research robotics, oil excavation, and search and rescue applications
- **Annual sales:** Withheld
  - Commercial/military sales mix fluctuates, but currently commercially dominated
- **Employees:** 98
- **Established:** 1992

IMPORTANT POINTS

- iRobot developed the first robots ever deployed in combat situations and is becoming the first branded name in commercial robotics
- iRobot believes that large prime contractors often use smaller companies' innovative technologies to win projects without giving the small company anything in return

MAJOR STRATEGIES

- Market commercial and industrial products by partnering with larger companies with experience integrating intelligent systems
- Independently market and distribute to DoD
- Mainstream consumer robotics by making them affordable, practical, and appliance-like
- Develop a core artificial intelligence technology and add different functionalities to meet customers needs
- Work closely with the end user community to develop a more valuable product

DEFENSE CONCERNS

- The Department of Defense seems to have no program dedicated to support a technology's transition from prototype development to production
- Most research is never expected to mature into deployable technologies, and small companies face a huge opportunity cost working on a technology that will never deploy
- Most small companies do not understand the acquisition process or command structure well
- "Nobody ever got fired for choosing Boeing" mentality in the military
- End users of technologies are apparently not involved sufficiently in the acquisition process

RECOMMENDATIONS

- Involve user community in military research to better and more effectively address soldier's needs with technological development
- Combine development contracts with acquisition contracts to incentivize companies to develop better products for the military

"Robot 'babies' go where rescue workers and dogs cannot" (NSF press release headline)

Tight Feedback Loop with User Community

The PackBot, called by soldiers "the most rugged robot in existence," was developed by iRobot and used in the search for survivors after the World Trade Center bombings and as a reconnaissance tool when searching the caves in Afghanistan for Al-Queada. The PackBot project began as a research program for the Defense Advanced Research Projects Agency (DARPA) to build a prototype of a tactical mobile robot and was deployed to the World Trade Center soon after the attack. After successful search and rescue work at Ground Zero, the PackBot was selected for reconnaissance use in the caves of Afghanistan. Since there were only three weeks between selection and deployment, iRobot was forced to fast-track development and integration of technology from the Land Warrior program. However, the software was incomplete when the robots were shipped to Afghanistan, so iRobot finished coding in the United States, uploaded the software to a secure file transfer site, and downloaded it directly to the robots from a secure internet connection at the air base. As a result, iRobot was able to begin training soldiers and conducting missions on schedule.

"Forty percent of combat medics who die, die trying to save a person who's already dead. Imagine if they could send a robot over there, check out the situation, maybe even put a rope around him and bring him back to safety before they have multiple people running out under fire."

During this period of deployment and testing, iRobot engineers worked closely with the soldiers using the PackBot and were able to hear directly from the user what they wanted in a PackBot system. Accordingly, iRobot gained valuable firsthand knowledge of the user community's needs and was able to add significant value to its military product by incorporating chemical and biological sensors, different video or audio packages, and other suggested capabilities and improvements into its system throughout the campaign. Through this direct connection with the soldiers in Afghanistan and numerous other independent conversations with different military users, iRobot has developed a keen understanding of the needs of the military and has been able to focus its resources on making the PackBot a more effective product. This strategy has been successful because iRobot's core technology is highly robust and can easily be modified to suit customer's needs.

Joint Development and Acquisition Contract

Irobot has recently been contracted by the British military through a Joint Development and Acquisition contract to produce Britain's next generation of explosive ordinance equipment. In this contract, product development has been funded, an order has been placed, and service and support

have been provided for. Since the British military can nullify the contract if the robot does not pass a beta test and since iRobot's service and support revenue is fixed, the company is highly incentivized to deliver a quality product to pass the Beta test and limit service and support expenses. More importantly, iRobot has evidence of an acquisition expectation and can afford to mature its technology from development to production with less risk. One of the key aspects of the British system is the fact that the British acquisition team includes scientists, program managers, and end users. According to iRobot, the British military is able to more intelligently decide whether a product adds value because its teams include the end user. Accordingly, the British military has made a more informed acquisition decision, and iRobot is being supported in developing an innovative product and is incentivized to meet its customer's needs.

Strategic Partnerships

One of iRobot's principal strategies in entering new markets is to partner with larger organizations that have already attempted to integrate intelligent systems into its products. The company believes that Hasbro, Halliburton, John Deere, S.C. Johnson, and other current and future partners understand the need for intelligent systems in their products and welcome iRobot's specialized capabilities. Without the larger industrial players inherently understanding that iRobot adds significant value to its products, the mutually beneficial relationship would not be possible. Larger industrial players offer iRobot well-developed distribution channels, large-scale manufacturing capabilities, and important industry knowledge that helps iRobot transition its technology into new applications. For instance, through its relationship with Hasbro, iRobot has gained valuable experience in application design, built important manufacturing relationships, and developed other capabilities that have helped the company develop its own line of commercial products. Furthermore, by partnering with an established brand, iRobot is working towards its goal of mainstreaming robotic technologies by associating its highly innovative technologies with a trusted name. In doing so, the company is trying to guide robotics along the same path as the personal computer, from esoteric device only used by tech-savvy individuals to a common and valuable household object.

NOMADICS, INC.

1024 S. Innovation Way
Stillwater, OK 74074
Phone: (405) 372-9535
www.nomadics.com

- **Operational Effects-Based Sector:** Combat Support
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 5: Use information technology to link U.S. forces
- **Products:** Portable instrumentation products, landmine detectors and advanced sensors, and wireless and mobile products
- **Primary military sales vehicle:** Military research contracts
- **Military applications:** Landmine and explosives detection, advanced sensors, mission critical data communication, and wireless communications products
- **Commercial applications:** Advanced sensing, detection, and wireless communications products for the medical, environmental, and chemical analysis fields
- **Annual sales approximation:** $7 million
  - Generally 20% commercial, 80% defense
- **Employees:** 70
- **Established:** 1994

IMPORTANT POINTS

- Significant improvements have been made by the Department of Defense in recent years in terms of on-time payment practices, online contract administration, and the move towards government e-business
- Lack of funding strategies often causes DoD customers to not have critical technologies developed in line with requirements

MAJOR STRATEGIES

- Fill the "fetch-and-carry" role by working with scientists and researchers to bring early-stage technologies to fieldable prototype and implement them in devices that can be tested in the marketplace
- Form strategic partnerships with universities, national research labs, and other organizations to assist in the development of key technologies
- Potential exit strategies are in-house production, intellectual property licensing, partnership formation, and spinning-off a new company

DEFENSE CONCERNS

- Interest in innovative products is often episodic and tapers before funding can be arranged
- It is significantly more difficult to raise independent capital to pursue federal objectives vis-à-vis commercial objectives
- Long contracting time frames and onerous auditing requirements are difficult for a small company to manage
- The military acquisition attitude and outlook is highly risk-averse

RECOMMENDATIONS

- Establish a transitional funding mechanism to support promising early stage technologies through to the production stage
- Enable and encourage the use of broader, more "catch-all" Small Business Innovation Research (SBIR) contracts to give highly creative and innovative technologies the opportunity to obtain SBIR funding
- Better align the use of SBIR contracts and other research and development contracts to military needs and goals

"Technology Cultivation" Model

Nomadics employs amplifying fluorescent polymers discovered by researchers at the Massachusetts Institute of Technology to form the technological backbone of advanced sensors that exhibit extremely sensitive and selective chemical detection properties. These sensors were initially developed for landmine detection applications and have since been adapted and leveraged to form a suite of exceptionally sensitive sensors and platforms with explosives detection, medical, and chemical applications. Along with other technologies, such as instrumentation and wireless products, these technologies have all been developed through a product development strategy that Nomadics executives call the "technology cultivation" model.

Nomadics focuses its efforts on a key period along the technological lifecycle it calls the "Valley of Death" or the phase after early-stage research and before product demonstration where there are relatively fewer players and accessing capital is extremely challenging. Essentially, Nomadics works with scientists at universities, national research labs, and other organizations in a "fetch and carry" role to add value to a technology by moving it forward along its development cycle until production, licensing, or another exit point. As a technology traverses the "Valley of Death," Nomadics applies its expertise in a number of different manners. The company technologically carries development forward to prototyping and implements it in devices that can be validated in the marketplace. This is essential for successful product development because product testing helps the company technologically perfect the product, and it provides invaluable insight into user needs. This insight is essential to driving product demand by increasing the technology's value to the end user.

The company believes that an important factor in successfully navigating the Valley of Death is maintaining the involvement of the initial innovators. According to Nomadics, academic innovators frequently lose interest in product development in favor of developing other new technologies. However, the company keeps the innovator involved through an advisory, consulting, or director role to continue to leverage the initial creative genius behind the technology and produce a fieldable product.

The Valley of Death

"It's just very difficult to get money for technology that's past DoD blue-sky research, that's fundable by SBIR's and DARPA, but not yet ready to be accepted and put into production by the Army or the Air Force, and that gap there, it's immense and it's very difficult to traverse. It's especially difficult for small companies to get across, and we have not been able to find equity, venture capital, or any other investment capital to fund that gap."

Furthermore, Nomadics improves the prospects of developing a winning technology by rapidly pruning the space of opportunities. This helps bring the technology down just

enough development paths to test different technological applications and configurations and to identify the technology's best strategic positioning. By quickly determining technologically what will and will not work, Nomadics "fails early" and can focus valuable resources on a few high potential technology prospects. By identifying the needs of potential customers, Nomadics is able to direct the technology to the most strategic markets and applications.

Nomadics is also adept at protecting the technology and its intellectual property. The company frequently licenses the early stage technology from the university or research lab and often uses military research and development funding to develop that technology. Nomadics retains all the rights to the intellectual property developed under government contracts subject to government usage. Additionally, Nomadics is diligent in establishing a robust portfolio of protective patents and licensing agreements with other interlocking technologies to ensure a full and fair return on intellectual capital.

"In the case of revolutionary technologies, there's no road map of where the technology can go and where it can be used, and that's a need we fill."

Perhaps the most difficult aspect of traversing the "Valley of Death" for a technology is funding its development. However, Nomadics is experienced and adept at navigating the government research and development contracting systems. By matching its expertise and strategic objectives with the needs identified by Department of Defense, the company has successfully used government research and development funds to nurture its technologies. However, the company believes that there is no well-defined funding source designed specifically to support technologies past initial stage research through pre-production. For example, Nomadics has been developing strategically important technologies related to explosives detection and homeland security. The company asserts that when the USS Cole was attacked by terrorists, military procurement officials were extremely interested in Nomadics' technology, but neither contracted for products nor funded future development because the technology was still in the development phase. The military was again interested in the technology after September 11th. However, since Nomadics had not received funding earlier and since access to private capital was tight, large-scale production was still in the future. Once again, the military decided not to contract for development or production.

"Whenever there is a problem, we want an immediate solution, and then if the immediate solution isn't available, then there's no interest in beginning the investment to get the solution. We just stop and wait for the next crisis."

As a result, Nomadics has had to rely on funding from other government agencies and research labs to develop the technology for alternative applications. Defense applications of the technology are therefore maturing slower than they would if they were supported by Defense Advanced Research Projects Agency (DARPA) or the military. According to the company, if the military provided more emphasis and better funding to later stage research and development such as phase III Small Business Innovation Research (SBIR) contracts, valuable technologies such as its landmine and explosives detection system would reach the hands of the modern warfighter more rapidly.

Finally, once a technology has overcome the challenges posed by the "Valley of Death," Nomadics' exit strategy typically follows one of three main paths: partnering with a larger established company for production and marketing capabilities while still producing a vital system component; entering into a licensing agreement with another organization to help bring the technology to market; or producing a complete product and making sales in the marketplace, often through spinning off a new entity structured around that product.

According to the company, it has been successful with this strategy for several reasons. First, Nomadics' teams achieve a high level of dexterity through their diversity of competencies. Each team consists of a broad array of scientists, implementers, and managers from different backgrounds working together for a common goal. These teams are also strategically formed to synergistically align Nomadics' areas of technological expertise in advanced polymers, nanomaterials, nanoassembly, microsensors, and biosensors with the company's engineering capabilities in handheld and portable instrumentation and wireless technologies. According to management, this allows the company to rapidly develop a technological breakthrough into a product, often in a matter of months; whereas, the process frequently takes years for other organizations. Finally, Nomadics believes it operates with "very low inertia," or small teams in a very flat organizational structure. Essentially, the company is structured and organized to allow its talented scientific, engineering, and managerial staff to succeed.

OAKLEY, INC.

One Icon
Foothill Ranch CA 92610
Phone: (949) 951-0991
www.oakley.com

- **Operational Effects-Based Sector:** Combat Support
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
- **Products:** Fashion, athletic, and military human form accessories incorporating high technology and propriety designs
- **Primary military sales vehicle:** Direct post/base exchange sales through the Army and Air Force Exchange Service
- **Military applications:** Lens protection from weapon targeting lasers, lightweight assault boots, general eye protection
- **Commercial applications:** Fashion and athletic sunglasses, apparel, footwear, and watches
- **Annual sales:** $477 million
- **Employees:** 1,685
- **Established:** 1975

IMPORTANT POINTS

- Oakley has an independent line of products only available to active duty military personnel; the military often does not want information about the products it uses in the field in the public domain
- Unlike the primes, Oakley does not have a lobby in Washington
- Bids on only select government contracts where they can maintain high quality and field a quality product on its merits
- Similar development schedules for commercial and military products; however, military takes about three times as long
- Interaction with Natick Special Operations Forces–Special Projects has been excellent

MAJOR STRATEGIES

- Capitalize on consumer awareness, loyal following, exceptional brand equity
- Target key athletes and Special Operations forces; general community usually follows the lead
- Heavy investment in technology
- Strong design in products to maintain the "cool" factor that is important for early adopters
- Maintain strong personal relationships with user community
- Credibility from military sales brings selling power to the commercial world

DEFENSE CONCERNS

- Due to an unfamiliarity with new technologies, funding personnel do not compare value when choosing between new and old products, only the costs
- Working with a system integrator is difficult for a small company because it is impossible to influence decisions on a program as a small subcontractor
- Potential concern with engaging the military at large due to perceived bureaucracy

RECOMMENDATIONS

- Identify old technologies and products in current deployment and inventory and determine efficacy and cost compared with newly available products
- Have contracting officers be more familiar with the latest technologies

Competitve Advantage

Although not heavily advertised, Oakley has been selling directly to the military for over ten years. Using an effective word of mouth campaign, the company has been able to leverage its considerable commercial recognition to become the supplier of choice for soldiers in the field.

Oakley has developed extensive design and development capabilities, with hundreds of patented technologies. Founded in a garage in 1975 by current Chief Executive Officer and Chairman, Jim Jannard, Oakley has grown to become the market leader in precision eyewear. In 1995, Oakley went public (NYSE: OO), and at about the same time, began leveraging its expertise into other areas of human form accessories such as footwear, watches, and apparel.

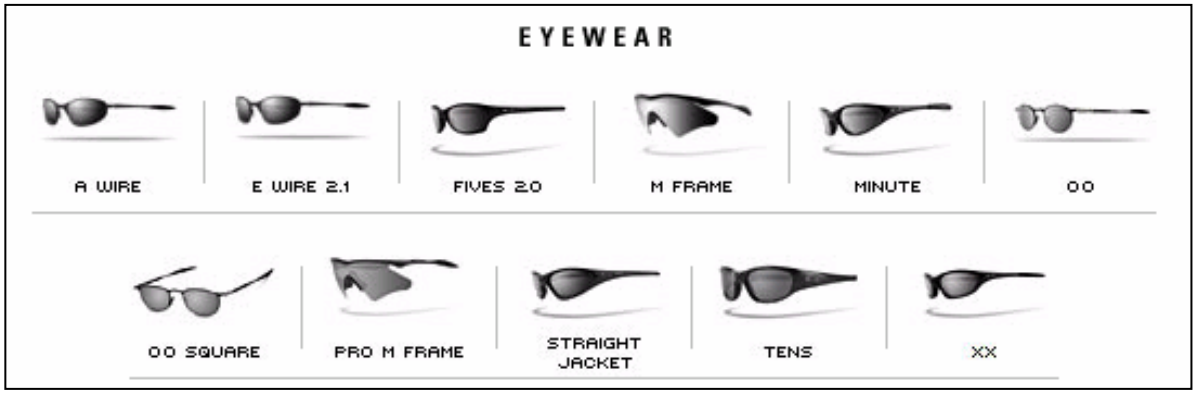
"As much as I'd like to tell you that I knock on the front door of the big Department of Defense, to be honest, the side door and the back door…if you really want to provide product to the soldiers to give them a better tool to use in their profession, [that] is the more expedient method."

Oakley's general sales approach in the athletic markets is driven from the top down, and targets the very best athletes, the stars, and leaders of various sports. By appealing to the trendsetters through a combination of leading technology and high style, Oakley's products have been adopted by the top athletes. Once the community sees that leading athletes recognize the competitive advantage Oakley's products give them, a much broader adoption begins.

Military Sales

Using a similar approach, Oakley has targeted Special Operations groups for its military sales. In the early 1990's special ops soldiers began ordering Oakley eyewear directly. These war fighters are typically very resourceful, and Oakley's unrivaled reputation in the commercial world led them to recognize the benefits of the superior designs, materials, and durability. In effect, Oakley's consumer brand was able to provide the military with something they could not find anywhere else. Over time, traditional soldiers in the field saw that the Seals, Rangers, Green Beret's, and other specialists, were using Oakley products. This market acceptance by the various elite forces was a virtual stamp of approval and encouragement for a larger, more pervasive adoption throughout the armed forces.

"Athletes who were performing knew that our products gave them a competitive advantage, that same philosophy transcended into our work with the military, and just as when I see Lance Armstrong cranking through the Alps, demonstrating time and time again why we're number one, I get the same if not more of a high when I hear of our guys kicking somebody's butt overseas wearing our product… and if we can do more for the military, more for the government, I'm going to be a number one fan of doing that…"



Oakley believes its interactions with the Department of Defense and various personnel have generally been very good. Initial contact came from Special Operations use. Commercial off-the-shelf (COTS) products were working very well, and several within the military were interested in having Oakley expand on its technologies to cater to specific needs within the armed forces. Concept development has been conducted in a very open forum, with Oakley discussing with the various communities, the technologies it is working on, and the user base coming to Oakley to discuss threats they are trying to mitigate or objectives of interest. For example, the laser lens eyewear program was developed when military personnel came to Oakley with the need to protect from weapon sighting and targeting technology. Procurement is still done directly through the Post Exchange (PX); Oakley has investigated placing their products on a GSA schedule but feel that doing so would be a long and somewhat arduous task.

Oakley has had a very good relationship with the military (Oakley's president, Colin Baden is on a first name basis with many in the field). Furthermore, after positive experiences with eyewear and goggles and after entering the commercial footwear market, Oakley is now working with Natick Special Operations Forces-Special Projects, U.S. Army Special Operations Command, and Naval Special Warfare Development group to produce Laser Eye Protection and an alternative Assault Boot for Elite Special Forces.

Through a chance meeting at an industry conference, the relevant parties were put into contact with each other. Natick issued a small testing contract focused on R&D. Oakley was able to put together a complete product from scratch in 14 months. While this seemed fast for the DoD, Oakley was somewhat frustrated by the length of time as compared to the relatively short turnaround cycles within the commercial world. However, development followed a pattern similar to commercial product development,

"…in the competitive, commercial world, [if] we take 14 months to get a product to market, it's outdated, somebody else has come out with something better, and nobody here is happy..."

with Oakley delivering several iterations as the military fielded and then provided feedback on the products. This close cooperation has led to a very highly regarded product that will be used by the elite soldiers of the U.S. military.

Technology Adoption

One of Oakley's key recommendations to the DoD is to implement a better system to identify aging technology and provide a means for adoption of newer, more powerful and more capable replacement technology. Oakley listed several examples of times where contracting officers or funding personnel, because of their unfamiliarity with new technology, were often not in a position to make choices based on value, but rather cost.

"The price discrepancy is marginal, the performance discrepancy is infinite."

One of them involved 1972-designed assault boots that were being produced in Germany. These boots were costing the military between $250 and $300 and had virtually none of the advanced technology or capabilities of the Oakley boot, for roughly the same price. Another example was a 1950s era dust goggle that was still being fielded. In both these cases, outdated products were in the procurement system and were therefore automatically purchased without regard for alternatives that were available at relatively similar costs and had much better specifications and properties. Because the procurement personnel were unfamiliar with the advances in the commercial market, U.S. soldiers were going into the field with inferior products and the military was overpaying for obsolete technology.

"…we spend millions of dollars on smart bombs and smart weapons, and yet we will put a distorted lens on a soldier and ask him why he missed [the target]…that's where you save pennies and lose hundreds..."

SARCON MICROSYSTEMS, INC.

Pellissippi Center
9737 Cogdill Road, Suite 110
Knoxville, Tennessee 37932
Phone: (865) 966-3506
www.sarcon.com

- **Operational Effects-Based Sector:** Combat Support
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 3: Deny our enemies sanctuary
- **Products:** Microcantilevered, uncooled infrared sensors and detectors
- **Primary military sales vehicle:** Research contracts
- **Military applications:** Thermal weapons systems, night vision viewers, border control, surveillance, and military vehicle vision systems
- **Commercial applications:** Fire fighting, security and surveillance, automotive night vision, medical applications, and radiometric applications
- **Employees:** 9 direct employees, consultants and external technical teams at Sarnoff and Siemens
- **Annual sales:** Sarcon is a pre-production, pre-revenue firm
  - Expects sales to be initially all commercial and to mirror the broader market profile, 35% military, 65% commercial, in the long term
- **Established:** 1997

IMPORTANT POINTS

- Sarcon was formed by Consultec Scientific and Sarnoff Corporation to commercialize a technology that both companies developed simultaneously
- Sarcon is currently pre-production; an Alpha version release has been scheduled for January 2003
- Microcantilevered IR sensors are projected to deliver 5x to 10x the sensitivity as the current leading uncooled sensors at a much lower cost

MAJOR STRATEGIES

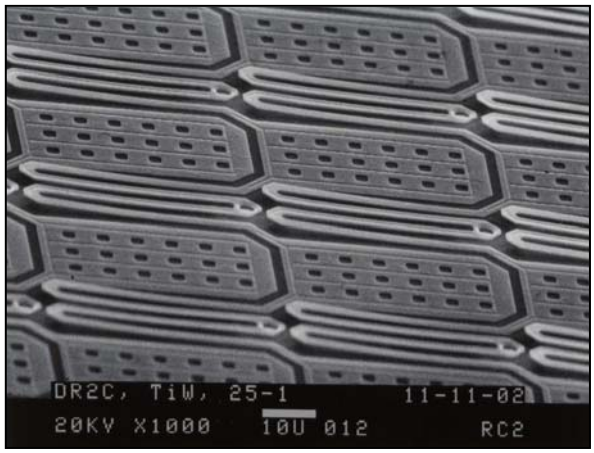
- Initially target traditional infrared sensor customers with a "drop-in replacement" technology
- Pursue commercial market before military market because of sales lead times
- Use the same technology to deliver either a higher performance, similar cost solution or a similar performance, lower cost solution
- Eventually expand infrared market through performance-cost tradeoff capability and lower costs
- Leverage Sarnoff's relationships and technical capabilities

DEFENSE CONCERNS

- Long sales lead times lead companies to develop products for commercial applications rather than military applications

RECOMMENDATIONS

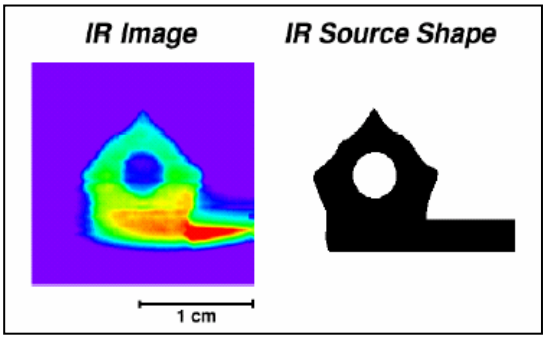
- Use matching R&D contracts more frequently to validate contracting decision and to leverage private capital for military technological development



Unique Capabilities

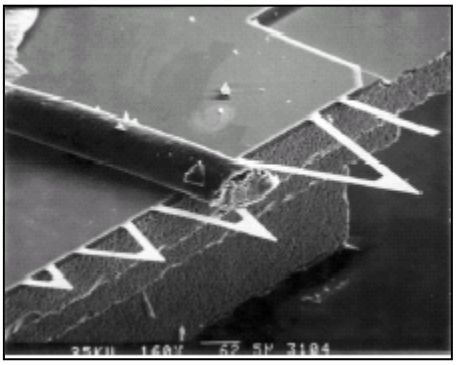
Microcantilevers for infrared detection were simultaneously and independently developed at both the Oak Ridge National Laboratory (ORNL), in collaboration with Consultec Scientific, and the Sarnoff Corporation. Upon realizing this, Sarnoff, previously RCA Laboratories, which developed color television, high definition television, and liquid crystal displays, collaborated with Consultec to form Sarcon to commercialize their technology. Over the past few years, Sarcon's relationship with Sarnoff has helped the company in many ways, including in developing and marketing its products and in raising investment capital.

Perhaps the most important reason Sarcon has been successful to date is the unique microcantilever design of the company's infrared detector engine, which has enabled the company's strategic positioning of superior performance at a lower cost. According to the company, the technology's mechanical properties provide temperature conversion sensitivities of between 20% and 50% per degree, as opposed to traditional uncooled microbolometer technologies with sensitivities of between 2% and 3% per degree. This leads to an inherent performance advantage over existing devices. Furthermore, the company asserts that the microcantilevered design enables incurring variable increases in operational speed in order to achieve a high sensitivity for long distance aircraft detection and shorter distance tracking of high-speed aircraft maneuvers. However, the technology's most valuable strategic enabler is the ability to substitute different materials in the same mechanical design to offer improved performance at a cost similar to traditional infrared sensors or similar performance at a cost much lower than traditional infrared sensors.



This capability will be crucial in enabling the company to penetrate the commercial and defense market successfully in the future. According to the company, a sensor's price tag most often drives a customer's decision, and the major cost drivers are the infrared detector engine and the lenses. Because "the market has always been interested in and receptive to products that will reduce those two main elements," Sarcon believes that its technology will provide it a unique competitive advantage over

its competitors. For instance, firefighters currently use infrared viewing technologies to locate people in burning buildings and to help strategically fight fires. However, the current technology is so expensive that local fire departments usually only have one device. Without widespread infrared capabilities, firefighters currently crawl through the rooms of a building, painstakingly searching for people trapped by the smoke and the fire. Alternatively, Sarcon believes that its products would be inexpensive enough to equip each firefighter with infrared sensing devices, significantly improving a fire department's ability to save lives and fight fires.



The company has chosen to focus initially on marketing to traditional commercial customers of infrared sensors because they represent an existing and educated market and the microcantilevered technology would be a "drop-in replacement." As such, Sarcon intends to target OEMs producing infrared cameras for security, surveillance, and firefighting; addressing radiometric or Industrial measurement applications next. Sarcon will begin the long-term process of entering the automobile drivers' vision enhancement systems market. According to the company, these systems, currently only in high-end vehicles, will eventually be an optional or standard feature on all cars. Sarcon believes that its capability to provide an infrared technology at a lower cost than its competition will give it a significant competitive advantage as the market grows. Furthermore, according to the company, its cost-performance tradeoff ability will eventually permit it to develop infrared applications for newer and less-traditional markets such as biometrics, aircraft landing vision systems, and marine vessels.

"What we anticipate is that the cost drivers that we realize in our commercial strategy will be transferable into our military strategy so that we can provide a range of systems to satisfy those applications too."

Sarcon expects to leverage its commercial production experiences and to use revenue generated from commercial sales to expand into military markets. The company believes that the same technology and the same value proposition that commercial customers find so attractive will incentivize military customers to procure its technologies. However, the company believes that the military is unlikely to be an early adopter because the sales cycles into the military market are much longer than into the commercial market. Consequently, the Department of Defense will likely procure cutting-edge and life-saving technology years after the first commercial customers.

Matching Research and Development contracts

Sarcon entered into a matching research and development contract issued by the Office of Naval Research (ONR) in January 1999. It was similar to the company's other R&D contracts in that it had a fixed payment schedule based on a series of well-defined milestones and required standard disclosures subject to auditing

review. However, as the contract was a 50/50 matching contract, the ONR funded half of the project's development cost once the company found a private source to fund the remaining half. As a result, ONR and Sarcon's angel investors each provided the company $750,000 to develop a functional prototype.

"It became an extremely attractive benefit [to the ONR] that they could put in a dollar, but we would be able to do two dollars worth of work."

According to Sarcon, the matching R&D contract had a number of significant advantages over more traditional contracts. For the ONR, the matching contract provided a hedge against entering into an unreasonable contract since it only became effective if a private organization or individual believed in the company and its technology enough to invest in it. Additionally, ONR indirectly provided Sarcon twice the development capital it would otherwise not been able to access. Sarcon also believes that the contract made an investment in the company much more attractive to angel investors because it validated the company's technology and helped lower the minimum investment necessary to commercialize its technology. The matching contract enabled the company to develop its microcantilevered technology into an engineering prototype, which was crucial in helping the company access further private investment capital. Sarcon believes that matching contracts are highly efficient and mutually beneficial vehicles of funding R&D of advanced technologies.

– POWER PROJECTION –

AEROVIRONMENT, INC.

AMPTEK INC.

I2 TECHNOLOGIES, INC.

AEROVIRONMENT, INC.

825 S. Myrtle Avenue
Monrovia, CA 91016
Phone: (626) 357-9983
www.aerovironment.com

- **Operational Effects-Based Sector:** Power Projection
- **Transformational Goals:** SECDEF Goal 1: Protect the U.S. homeland and bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 3: Deny our enemies sanctuary
- **Products:** Innovative technologies, products, and services based on efficient energy systems, unmanned aerial vehicles (UAVs), and electric vehicle systems research and development
- **Primary military sales vehicles:** Direct military sales and teaming with prime contractors
- **Military applications:** Miniature UAVs, backpackable and gun-launched UAVs, hybrid electric military vehicles, miniaturized avionics, systems integration, power electronics, and other products
- **Commercial applications:** Telecommunications infrastructure, distributed energy, electric and hybrid vehicles, industrial battery charging, energy and power systems, atmospheric systems, renewable energy
- **Annual Sales:** $50 million
  - Generally 50% commercial, 50% government
- **Employees:** 235
- **Established:** 1971

IMPORTANT POINTS

- The company has developed over 50 "never been done before" technologies
- Aerovironment has had problems teaming with prime defense contractors but has had successful relationships when both management teams have been committed to the relationship
- Aerovironment has achieved recent success with innovative government contracting methods such as the Joint Sponsored Research Agreement with NASA and Section 845 Other Transaction Authority with the DoD
- The company sees the government as its least risk-averse customer

MAJOR STRATEGIES

- Focus and structure teams around a specific product with a project manager who balances technical goals, resources, and risk while maintaining close contact with the customer
- Eventually develop this team into a new business line and then into an independent business unit to focus on the challenges faced in a particular market
- Promote rapid technological development from concept to prototype to production
- Retain intellectual property within the parent company to cross-pollinate and add value to other ventures in different markets

DEFENSE CONCERNS

- It is difficult to inject external technologies, especially innovative and cutting-edge technologies, into the procurement process
- Traditional government contracting can minimize many of the benefits of contracting with small and innovative companies because contractual or marketing requirements often force a company to act as a subcontractor rather than as a prime
- If the company's defense business expands, it will soon need to implement a CAS accounting system, significantly increasing costs and decreasing operational flexibility

RECOMMENDATIONS

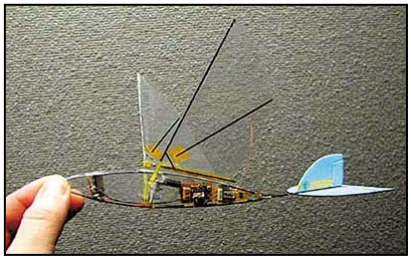
- Create an evaluation program to test unique processes for adopting new technologies and procedures to evaluate how to best develop, procure, and support advanced technology acquisition

AeroVironment's Pathfinder Aircraft Flies Over Niihau, Hawaii. NASA Photo By Carla Thomas

Focused Product Teams

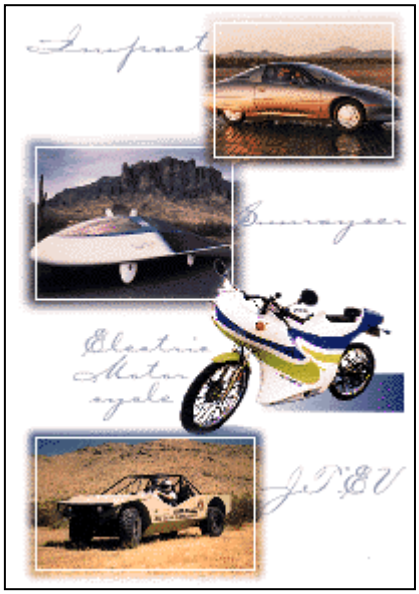
Aerovironment has developed the world's first human powered airplane, the world's first solar powered manned airplane, the world's first backpackable small unmanned aerial vehicle (UAV), the world's first modern electric car, the world's most advanced electric vehicle charger, and numerous other "world's first" technologies. The company has combined its technical expertise with a business-focused culture to turn its innovative research and development into successful business ventures. Critical to the company's innovation success has been its model of product-oriented and highly dedicated teams. Aerovironment avoids implementing matrix-like organizational reporting structures to keep its teams focused on developing a specific product for a specific application or set of applications. Project managers assume a high level of responsibility and are expected to balance a project's technical goals, internal resources, and overall risk while developing and maintaining a very close relationship with the customer. The project manager and his team are responsible for dealing with potential military customers and tying customer demands and feedback to Aerovironment's development efforts.

This team structure has been extremely successful in rapidly bringing ground-breaking technologies through the development process. Teams begin a project with flexible design specifications and establish a close relationship with the end user so they can creatively collaborate with the customer to find the best solutions. Additionally, Aerovironment has built its culture to support highly motivated and talented technical people in designing creative systems engineering solutions. These people thrive at Aerovironment, where the development process is well understood and employees are given high levels of responsibility for participating on a project at all levels, from original discussions with a customer through delivery. A good example of the success of Aerovironment's development process is the Sunracer, a solar powered vehicle developed for General Motors' entry in the World Solar Challenge. From contract to the race, only six months of development were necessary to



build a vehicle that won the race by a 2 ½ day margin. According to Aerovironment, General Motors was extremely pleased with its development speed because GM's fastest prototyping for a solar car was 36 months.

Developing Independent Businesses



Over the past decade, Aerovironment has been shifting from a research and development focus to a business development focus. Essentially, while maintaining its innovative research and development culture, the company has begun establishing independent businesses with production capabilities to take technologies to market. Since the company is privately held, it has been able to reinvest capital from operations to take a long-term perspective and dedicate resources to business and market development. Aerovironment's strategy is to organize a new business around a specific technology and to mitigate some of the initial risk by developing the technology until a prototype has been demonstrated to initial customers. At that point, a new business is formed with a dedicated management team to focus on the relevant markets for that technology. The relationship between Aerovironment and its independent businesses is mutually beneficial, as Aerovironment provides support services and intellectual property licensing, while at the same time uses the businesses' internally developed intellectual property to add value to its own technologies and products. All major structural changes to new businesses are closely timed with customer demand and the capital markets.

Without the critical mass to internally fund the new businesses, Aerovironment currently looks to outside strategic and financial investors to finance its independent businesses. For instance, iPower is a joint venture with Delco Remy International to commercialize power distribution technologies, and SkyTower is a subsidiary, currently seeking external investment, that develops commercial and military UAVs for telecommunications applications. PosiCharge is a division that has been organized to produce and sell intelligent and rapid battery charging systems. These three ventures are prime examples of Aerovironment's strategy of launching new businesses to focus on marketing a core technology to the relevant markets.

AMPTEK INC.

6 De Angelo Drive
Bedford, MA. 01730
Phone: (781) 275-2242
www.amptek.com

- **Operational Effects-Based Sector:** Power Projection
- **Transformational Goals:** SECDEF Goal 5: Use IT to link U.S. forces to fight jointly
  SECDEF Goal 6: Maintain unhindered access to space
- **Products:** Space qualified satellite components, full satellite instrumentation, thermoelectrically cooled x-ray and gamma ray detectors, and nuclear pulse instrumentation
- **Primary military sales vehicle:** Contracts with the Air Force Research Laboratory (AFRL)
- **Military applications:** Satellite instrumentation and space qualified preamplifiers for Air Force satellites
- **Commercial applications:** Ground and space research instrumentation and satellite communications
- **Employees:** 25
- **Approximate annual sales:** $7 million
  - Approximately 95% commercial, 5% military (Air Force)
- **Established:** 1977

IMPORTANT POINTS

- Amptek's defense revenue, initially almost 70% of total sales, has fallen to 5% of total sales as commercial sales have grown and available military development funding has decreased
- Amptek was awarded R&D magazine's "R&D 100 Award" for its XR-100 X-Ray Detector

MAJOR STRATEGIES

- Identify military contracting opportunities by searching listed Federal Business Opportunities
- Focus internal research and development funds towards commercial applications
- Use technologies developed for military use in commercial applications
- Actively market technologies to commercial users through conferences, advertising, etc.
- Communicate with scientific community to identify commercial niche applications and markets

DEFENSE CONCERNS

- Contracting process is lengthy and laborious
- Long-term planning difficult for development of military technologies due to changing DoD requirements
- Cycle time between SBIR phase I and phase II contracting too long
- Lack of funding to keep technology developed for the military from obsolescence

RECOMMENDATIONS

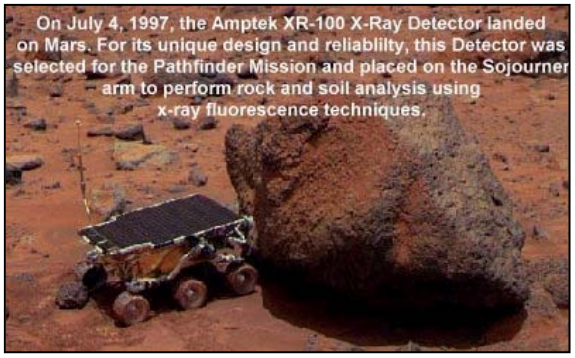
- Reduce contracting burden and lag time for small companies and small contracts
- Allocate funding to maintain existing technologies and to keep them from obsolescence

Commercial Focus

Amptek was formed in 1977 to develop off-the-shelf, high performance instruments and satellite components for the space and defense industries. Originally, nearly 70% of the company's revenue stemmed from direct contracting with space and defense agencies. However, over time, this percentage has fallen to roughly 5%. The company attributes this marked drop-off to a decrease in available military funding for its technologies and, like many other transformational suppliers, to the company's allocation of internal research and development capital for commercial applications.

The company applies its internal funds toward the development of commercial products rather than military products because of the complexity and scope of defense projects. According to the company, developing military products and technologies is more resource intensive than most commercial applications. Typical development cycles for military products last between two and five years. On the other hand, the company usually develops a commercial product, from concept through production, in under one and a half years. Amptek attributes this disparity to two different sources: the greater technological complexity of its military products and the lengthy and laborious nature of military contracting. In addition to being more challenging, according to the company, fulfilling military contracts is a more arduous process than fulfilling commercial contracts because of the multiple rounds of proposals, difficult negotiation processes, and strict audits by the Defense Contract Audit Agency. As such, the company believes that focusing its internal funding on developing commercial products rather than military products generates a higher return on investment.

> ***"If today, we had to choose between a one million dollar commercial or DoD contract and we had the choice of one of the two, we'd definitely take the commercial. It's too much paperwork, too much overhead in order to deal with the DoD."***


On July 4, 1997, the Amptek XR-100 X-Ray Detector landed on Mars. For its unique design and reliablilty, this Detector was selected for the Pathfinder Mission and placed on the Sojourner arm to perform rock and soil analysis using x-ray fluorescence techniques.

Additionally, Amptek looks to transfer technology developed through military research and development contracts into commercial devices and applications. By leveraging its previous research and development efforts, the company invests less additional capital to bring a technology to market. For example, a technology that the company developed for the Air Force has recently been contracted for use in a broadband communications satellite being developed by Alcatel for SES Global.

Maintaining Military Technology

Over Amptek's history, the company has developed a number of different technologies for military applications. However, many of these technologies are quickly becoming obsolete as the Air Force, which funded the initial research and development, has decided not to provide the minimum funding necessary to keep the technologies functional and current. Amptek currently has approximately five instruments "on the launch pad," waiting to be put into space. According to the company, the Air Force is providing barely enough funds to maintain launch operability, let alone modernize the technology. Furthermore, according to Amptek, the military is not even updating the instrumentation on the currently operational spacecraft. The company believes that the Department of Defense should allocate a certain portion of its development capital to maintaining, modernizing, and adapting current technologies to assure that its technologies do not become obsolete and larger development costs do not occur in the future.

> ***"The beautiful technology that we've developed through the years is starting to be outdated….The principal customers who have funded this technology and can use it in the future also, have not bothered to put some money to keep up the technology. I think within 2 or 3 years we're going to have to start from scratch."***

Military and Commercial Marketing

According to Amptek, marketing to commercial customers is more effective than marketing to military customers. Essentially, to create new business with military customers, the company responds to Request For Proposals and Request For Quotations for new instrumentation. Amptek would seriously consider magazine advertisement directed toward DoD needs; but such advertising is not an allowable expense covered by the auditing requirements. The company does not believe that directly marketing to military customers has much affect on generating new business opportunities. However, in the commercial market, the company actively markets its technologies through a number of channels that it believes directly lead to sales more effectively than military marketing efforts.

For example, the company maintains consistent communication with scientists from academia and industry to identify additional niche markets for its commercial products. The company believes that this generates important information regarding technological needs and potential applications of its technologies. Furthermore, Amptek attends conferences and advertises in trade magazines to introduce its products to commercial customers. In fact, the company attributes its contract with Alcatel to a magazine advertisement. According to the company, these advertising and marketing efforts result in sales more effectively in the commercial market.

> ***Generating business is "not as simple in the military as it is in the commercial world. In the commercial world…we can go in and advertise in 25 magazines and send new product announcements and go to conferences; whereas, in the military or DoD, that vehicle doesn't exist."***

I2 TECHNOLOGIES, INC.

One i2 Place
11701 Luna Road
Dallas, TX 75234
Phone: (800) 800-3288
www.i2.com

- **Operational Effects-Based Sector:** Power Projection
- **Transformational Goals:** SECDEF Goal 1: Protect the U.S. homeland and bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 5: Use IT to link U.S. forces to fight jointly
- **Products:** Enterprise software applications and solutions for dynamic value chain management
- **Primary military sales vehicles:** The GSA schedule, its network of small business providers, and initial consulting arrangements to engage customer
- **Military applications:** Transportation, distribution, service asset management, procurement, and content management
- **Commercial applications:** i2 provides similar off-the-shelf solutions to commercial and military customers
- **Annual sales:** $986 million
  - Next year's target for new license revenue 85% commercial, 15% government
- **Employees:** 4,800
- **Established:** 1988

IMPORTANT POINTS

- i2 assists its customers to operate more efficiently
- i2's corporate mission statement is to provide $75 billion of audited "value" to customers by 2005
- Variability drives inefficiency and increases cost in both the commercial and military markets

MAJOR STRATEGIES

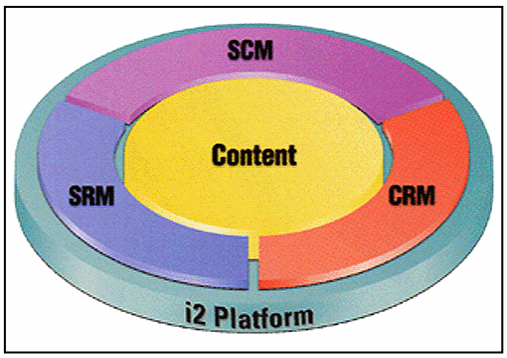
- Treat Department of Defense like its commercial customers
- Implement best commercial practices
- Work to provide value and reduce costs for its customers
- Spend the equivalent of $1 million per day on R&D to maintain technological competitive advantage

DEFENSE CONCERNS

- Unsuccessful bidders on DoD Request For Proposals can protest contract awards without significant foundation—smaller companies cannot afford delay costs or litigation
- DoD procures based on feasibility, addressing "how to solve a problem," while I2 systems are designed to minimize time and costs, additionally addressing "how to do it more effectively and efficiently"
- Senior leaders are apparently not equipped with state-of-the-art decision support and analytical tools to optimize performance while minimizing time and cost
- Contracting system does not incentivize contractors to deliver the best solution

RECOMMENDATIONS

- Streamline acquisition process
- Provide more flexibility to allow decision makers to procure selected solutions
- Continue to encourage personnel to implement best commercial practices where possible



Delivering COTS Solutions

Founded in 1988 by Sanjiv Sidhu and Ken Sharma, i2 provides enterprise software applications and solutions for dynamic value chain management. i2 views its role as helping customers perform their jobs more effectively. While the company has traditionally focused on the commercial sector, the same trends and operating characteristics are present in the military market. Furthermore, i2 believes that its commercial off-the-shelf (COTS) systems are easily as robust, if not further ahead of the optimization tools currently employed by the military. According to i2, military systems have historically been developed addressing feasibility, answering the question "how can I do it?" i2's COTS systems are focused on completing identical tasks, while driving down costs and time. Its systems address the question, "How can I do it effectively and efficiently?"

i2 identified one such example from data gleaned during recent Department of Defense efforts in Afghanistan. After a quick review, i2 calculated that the DoD could have saved over $120 million in 30 days had certain non-essential items been shipped in containers on commercial transports. i2 attributes the reason that this optimization did not occur to the fact that the DoD does not have a good system to provide senior leaders with the economic impacts of their decisions. The DoD is not equipping its combat leaders with state-of-the-art decision support tools, which are available in the commercial market. Software readily available from i2 could have allowed DoD to identify the opportunity above and realize dramatic cost savings through exploitation of commercial transportation.

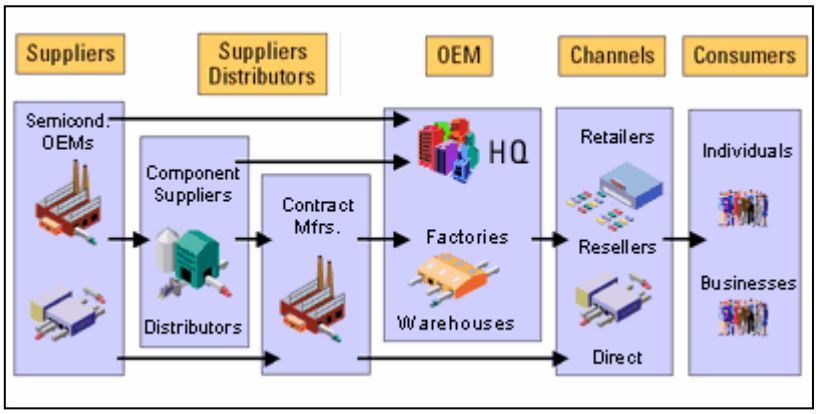
According to i2, despite their apparent benefits, the DoD user base has been largely unable to procure these COTS solutions from the commercial market. The users have been exposed to and encouraged to work under more efficient, commercial business practices, but have encountered difficulties procuring the systems within current acquisition policy.

Issues Selling to the Military

Likewise, i2 has found frustrating the knowledge that it possesses products that will likely provide value to the DoD, but the DoD cannot easily procure them. The company would like to help, but it has even encountered obstacles in the contracting process when trying to give its products away. From its experience, i2 believes that there is genuine interest on the part of the DoD in procuring COTS

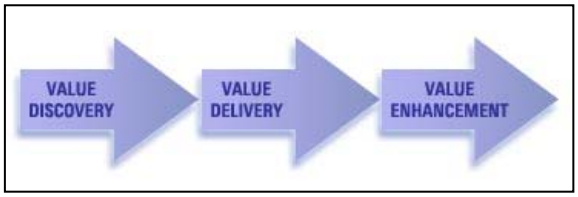
> ***"The General said after reviewing our product, 'If I were a commercial company I would shake your hand and put this in place right away because obviously this could have a huge impact/added value to our organization…but with our contracting process, I have no idea how long this is going to take.'"***

solutions; however, because of the ability of vendors to protest contract awards, the acquisition process has paralyzed itself.



According to i2, any vendor who is unsuccessful in its bid on a DoD Request For Proposal (RFP) has the ability to protest the contract award, potentially tying up the program for what could be up to a year. This has left procuring officials in fear of protests and associated project delays. This fear has made it difficult for the user base to make procurement decisions. While the DoD has issued a COTS mandate, there are a number of traditional defense contractors that have been developing legacy systems from the ground up for many years that have a lot to lose. These companies believe they can supply identical solutions built from the ground up, and threaten to protest if a COTS solution is the preferred solution. The protest significantly increases the DoD's costs of doing business, while there is no penalty to the protester, even in the event of a baseless claim. As a result, DoD personnel use whatever methods possible to limit the exposure to protests.

In i2's opinion, this attitude is a result of the rules of the acquisition process and the contracting system. The system was designed to habituate certain, established programs, policies, and relationships with prime contractors, leading to a number of additional issues. For instance, on a recent program, the customer specifically directed the prime contractor to integrate i2's solution because of past success with i2's prototype solution. However, the prime deliberately decided not to use i2's technology and instead decided to "burn through" its contract and return to the contracting agency without a successful product, expecting to receive more money in order to integrate i2's solution. In another example, a prime contractor violated the Non-Disclosure Agreement it had signed with i2 and tried to convince another prime not to do business with i2 after it made the decision to work with the second contractor over the first. i2 believes that the contracting system, which perpetuates the predatory practices of many large defense contractors, makes it very frustrating for both uniformed personnel and commercial companies to break through the bureaucratic processes and supplant traditional ways of doing business in the DoD.



The company faces competition in the commercial sector as well. However, according to the company, the system is much more straightforward. When operating in the commercial market, i2 contacts the

customer and engages him or her in a discussion of the company's value proposition. Frequently, i2 will perform a study for the customer in order to identify the "low hanging fruit," where i2's systems can create value immediately. If the study identifies an opportunity for i2, the parties will negotiate until they reach an agreement. Conversely, in the defense market, the company faces direct competition on every occasion, prolonged processes, and multiple decision makers.

According to the company, variability drives inefficiency and increases costs in both the commercial and defense sectors. Also, i2 believes that the current system has conditioned DoD officials into thinking that they must operate differently from the commercial market, when in fact they face many of the same issues and challenges. Realizing this point, i2 is attempting to minimize operational variability by competing in the defense sector as it does in the commercial sector. It is trying to implement best commercial practices and provide value while lowering costs for the DoD.

– PRECISION ENGAGEMENT –

CARBON-CARBON ADVANCED TECHNOLOGIES, INC. C-CAT

FOAM MATRIX, INC. FoamMatrix

CARBON-CARBON ADVANCED TECHNOLOGIES, INC.

C-CAT

5144 Southeast Loop 820
Fort Worth, TX 76140
Phone: (817) 483-3878
www.c-cat.net

- **Operational Effects-Based Sector:** Precision Engagement
- **Transformational Goal:** SECDEF Goal 6: Maintain unhindered access to space
- **Products:** Structural carbon-carbon composite components and test specimens
- **Primary military sales vehicle:** Through prime contractors
- **Military applications:** Space shuttle nose caps, missile parts, and high temperature military test equipment
- **Commercial applications:** Internal components for vacuum furnaces and motor sports brakes, disks, and clutch plates
- **Average annual sales:** $2 million
  - Approximately 50% government, 50% commercial
- **Employees:** 10
- **Established:** 1988

IMPORTANT POINTS	MAJOR STRATEGIES
– Carbon-carbon is a highly advanced material, capable of thermal stability at temperatures up to 3100ºF, suitable for a number of specialized applications	– Leverage strong reputation in materials processing to generate new business opportunities – Work with prime contractors to design specifications and then develop components in-house – Establish competitive advantage through experience and core talent level – Maintain capacity and capability to produce large, complex carbon-carbon components

DEFENSE CONCERNS	RECOMMENDATIONS
– Subcontractors face great uncertainty and high risk because of inability to directly influence procurement decision – Small Business Innovation Research contracts seem to be won by companies preselected for awards prior to open competition	– Assure open and fair competition on all contracts subject to bidding – If the government has selected a firm it deems uniquely qualified to provide a specific product, do not involve other bidders in a competition that essentially has a pre-determined outcome

Carbon-carbon leading edge panels under 3200°F arc jet test

Engineering Competitive Advantage

Carbon-Carbon Advanced Technologies (C-CAT) designs and manufactures structural carbon-carbon composite components. These composites, made by embedding carbon fibers in a carbon matrix, can maintain their strength and structural properties at temperatures up to 3200ºF. Typical composite materials have limiting temperatures from 350ºF to 400ºF. Carbon-carbon's extremely high thermal stability makes the material ideal for very specific aerospace and defense applications such as nose caps and missile parts. Furthermore, because of C-CAT's highly advanced engineering capabilities, the company is able to use carbon-carbon composites to fabricate shaped parts such as compound, curved parts with technically challenging characteristics, as opposed to the typical "flat sheets" produced by most carbon-carbon manufacturers.

Carbon-Carbon believes that its competitive advantage stems from its highly talented team of engineers. The company attributes its ability to establish potential barriers to entry to its highly advanced capabilities and years of experience with carbon-carbon composites. According to the company, processing carbon-carbon is a very risky and highly challenging procedure. Consequently, the company hires detail-oriented, talented personnel in order to assure quality deliverables. The company's focused collaborative effort on each project has led to its very high processing success rate, with less than 1% rejection. Furthermore, the company's manufacturing equipment enables it to produce very large, unique, high temperature components. With these capabilities and experience, C-CAT has established a reputation as a leader amongst materials processing specialists, generating significant new business opportunities for the company. According to the company, when a prime contractor has a need for a highly specific, high temperature technology, it frequently looks to C-CAT for the solution.

"One thing we have learned and why we have been successful, it's not the recipe, it's not the cookbook, it's what to not do that's important, that enables us to build very complicated components in thicknesses that other people haven't been able to succeed with."

Issues as a Subcontractor

Since C-CAT produces such highly specialized components, its primary military sales channel is through a prime contractor. As a subcontractor, the company faces significant uncertainty due to the lack of control over the final deliverable and final procurement decision. The risk of expending resources developing a component for a system and

having the system not contracted for is an important issue for the company to face. For example, C-CAT was a subcontractor on the X-33 project. The project cancellation was a significant loss of business for a company as small as C-CAT. Furthermore, once the project ended, an entire year passed before the company received final payment for the work it performed. Meanwhile, C-CAT was forced to raise debt financing to cover its expenses. In another example, C-CAT was the only company from approximately fifteen bidders able to build components for the National AeroSpace Plane (NASP) thermal protection system that passed all the required tests and demonstrated production capability. However, despite the fact that C-CAT technologies performed extremely well, the program ended because the required engine technology was not mature. Once again, despite the company's superior performance, it missed a valuable opportunity to play a larger role in a program. This issue poses a large problem for the company and others in similar situations. As a result, C-CAT has become more active in the commercial market and has focused its highly specific capabilities towards delivering its technologies to commercial customers rather than to the military.

"We've been unfortunate in that…it seems like, when we get down selected to build something, it seems like for some other reason, the program goes away."

Small Business Innovation Research Program

Over the last fourteen years, C-CAT has bid on more than fifty Small Business Innovation Research (SBIR) contracts for projects that it believes it had demonstrated the capabilities and competencies to handle. Of these, the company was only awarded a contract for one project. According to C-CAT, it won this contract because it had already been speaking with the contracting agency about this project. The company believes that agencies often write a contract for a specific company before collecting bids, and the final contract is usually awarded to the company the contract was written for. C-CAT considers this contrary to the government's desire for open competition and would like the DoD to either do more to ensure fair competition or to contract directly with preselected companies, when such a determination has been made by the procuring activity.

FOAM MATRIX, INC.

1123 E. Redondo Blvd.
Inglewood, CA 90302
Phone: (310) 680-0777
www.FoamMatrix.com

- **Operational Effects-Based Sector:** Precision Engagement
- **Transformational Goals:** SECDEF Goal 1: Protect the U.S. homeland and bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 3: Deny our enemies sanctuary
  SECDEF Goal 6: Maintain unhindered access to space
- **Product:** The Foam Matrix Core System™ (FMC) is a unique, patented process for producing net molded structures without the need for multi-piece assemblies
- **Primary military sales vehicles:** Military research contracts and subcontracting to primes
- **Military applications:** Structures such as wings, fins, and doors for unmanned and transport aircraft
- **Commercial applications:** None currently; however, the technology was initially developed for building surfboards and sailboards. Future commercial applications may include truck and bus bodies and components, marine vessels, shelters, specialty packaging, and architecture applications
- **Approximate annual Sales:** $4 million
  - 100% government sales
- **Employees:** 12
- **Established:** 1995

IMPORTANT POINTS

- Foam Matrix's goal is to grow by focusing on innovation and developing technology; not building infrastructure and becoming a smaller version of its customers and competitors
- Small companies are driven and constrained to a great extent by cash flow and are often unable to fund technology development on their own

MAJOR STRATEGIES

- Insert technology into the market through role as a subcontractor to the large prime defense contractors
- Remain lean and innovative to offer low cost solutions
- Improve service to its customers by providing complete systems rather than parts
- Utilize subcontractors to add value to its systems outside of the company's core capabilities

DEFENSE CONCERNS

- Cost share contracts often do not work well for small companies as they cannot afford to expend the time or money
- Calculating G&A rates for cost analysis is not reliable for small companies
- Request For Proposals (RFPs) from the Department of Defense on large programs cannot be won by a small company; they essentially require a Prime
- DoD does not do enough to publicize small companies with highly innovative technologies

RECOMMENDATIONS

- Improve Small Business Innovation Research (SBIR) program to allow some programs to go directly into a phase II
- Better incentivize larger companies to support the development of technologies of small companies
- Help promote small and large companies with innovative solutions and evolutionary technologies
- Help connect small, innovative companies with identified DoD needs and with the prime contractors bidding on the associated RFPs

A Subcontractor to the Primes

Kent Sherwood founded Fiber Foam Inc. to develop new, better, and less expensive ways to build surfboards and sailboards in 1985. As a leading innovator of new technologies in the sporting goods industry, he then leveraged the company's capabilities to allow Fiber Foam to reinvent itself as a defense supplier of composite structures to the aerospace industry and in 1995, founded Foam Matrix.

As a small company with limited available capital, Foam Matrix concluded that competing with the Department of Defense's prime contractors on large government Request For Proposal (RFP) programs would be nearly impossible. As a result, the company determined providing solutions to identified problems as a subcontractor as its best opportunity to promote its technology in the marketplace. In addition to providing a necessary segment of the program, Foam Matrix adds value by offering technology and innovation to bring down the overall cost of the program as well as to help the prime contractor innovatively address problems. This creativity is a competitive advantage for the program team in meeting the contract requirements at the most attractive price. Concurrently, the prime contractor can provide support to Foam Matrix, allowing the company to overcome its specific deficiencies such as limited infrastructure.

"We have been successful because the primes were ready to listen, where 5 or 10 years ago the 'not invented here' factor would have ruled out people like us without lots of experience building fighter airplane wings."

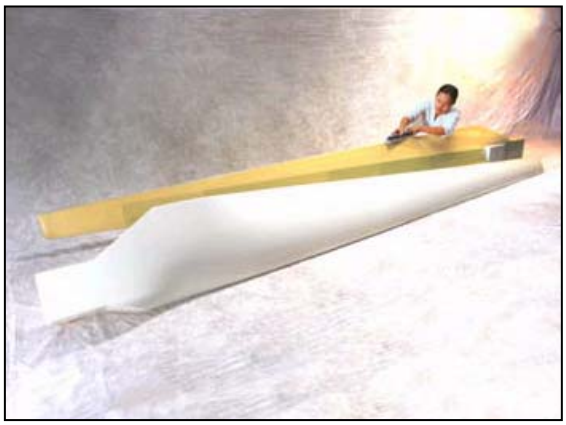
Foam Matrix has taken advantage of a growing receptiveness of the prime contractors to explore innovate, low-cost solutions, most recently linking up with Boeing on the Unmanned Combat Air Vehicle (UCAV) X-45A program as the provider of the wings. According to Foam Matrix, Boeing was amenable to holding discussions with Foam Matrix because the engineers responsible for bidding the UCAV contract were aware that Lockheed Martin had proposed using Foam Matrix to produce the wings for the Joint Air Surface Standoff Missile (JASSM). The Boeing engineers recalled how Foam Matrix was able to apply its technology on the JASSM program and were easily convinced that the same could be done on UCAV. Since Foam Matrix did not have a large testing facility, it suggested using a large bag inflated with water for testing. This non-traditional testing solution saved the team from significant equipment expenditures.

The Catalytic Alliance

According to Foam Matrix, a common misconception is that the goal of every small defense company is to become a smaller version of the prime contractors. While smaller companies do want to grow, the company believes that the key is to do so

"The incentive structure in the current system is focused on Foam Matrix becoming a smaller version of our customers and competitors."

without building infrastructure, as infrastructure development tends to eclipse the company's primary focus. Instead, Foam Matrix would prefer to focus on its strengths: technology innovation and process development, while leaving other value-added areas to the larger companies.



Foam Matrix's ideal role is to provide a steady source of innovation for the larger companies. However, the traditional exit scenario for innovative companies such as Foam Matrix is an acquisition by or a partnership with a larger company. Upon integration, the small company often loses its innovative culture and is forever changed. Foam Matrix wants to avoid being absorbed or otherwise becoming captive to a larger partner. As such, the firm has identified a new approach for small companies with new technologies: forming a "catalytic alliance" with a strategic partner. A catalytic alliance teams a small, innovative company with a larger company interested in acquiring the production rights to the technology after development. This allows the small company to keep its focus and reduce its capital requirements.

According to the company, for this strategy to succeed, the DoD would have to transform the way larger companies currently work with small companies. Larger companies would need to be incentivized to license and invest in the critical technologies of smaller companies, improving the risk-reward formula for all the parties involved. According to Foam Matrix, small companies are driven by cash flow and often unable to fund the development of their technology. As such, under this structure, both the DoD and the alliance partner would contribute capital to the small company for design, tooling, and testing. In exchange, the DoD would receive a guaranteed price reduction over the current solution upon development completion. Likewise, the alliance partner would receive a license to use the technology, as well as manufacturing rights to the product at an improved margin. The small company would earn revenue during the development period as well as profit from the product license and a manufacturing royalty. In Foam Matrix's opinion, the DoD is looking for new technology at lower cost, and the best way to achieve that is to incentivize large companies to team with small companies in new ways.

– HOMELAND AND BASE PROTECTION –

COHERENT TECHNOLOGIES, INC.

RIPTECH INC.

RSA SECURITY INC.

SYSTEMS RESEARCH AND DEVELOPMENT

SYMANTEC CORPORATION

VIISAGE TECHNOLOGY, INC.

COHERENT TECHNOLOGIES, INC.

655 Aspen Ridge Drive
Lafayette, CO 80026
Phone: (303) 604-2000
www.ctilidar.com

- **Operational Effects-Based Sector:** Homeland and Base Protection
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 3: Deny our enemies sanctuary
- **Products:** Advanced laser radar technologies
- **Primary military sales vehicles:** Small Business Innovation Research (SBIR) contracts and working with prime contractors
- **Military applications:** Chemical and biological agent detection, coherent-detection hard-target laser radar, direct-detection imaging hard-target laser radar, helicopter multifunction laser radar, and laser transmitters
- **Commercial applications:** Detection of aircraft-produced wind-turbulent events, enhance safety at airports with hazardous wind alerts, increase airport capacities, wind and smoke detection for fire progress analysis, chemical and biological agent detection, and meteorological research
- **Annual sales:** $19 million
  - 23% commercial, 52% military, 25% other government agencies
- **Employees:** 150
- **Established:** 1984

IMPORTANT POINTS

- WindTracer® is the first commercially available Doppler laser radar system
- Over the past twenty years, there has been an order of magnitude of erosion in the military laser radar technology competitive base, as measured by the number of suppliers

MAJOR STRATEGIES

- Maintain core focus on leading edge research and development in laser radar technologies
- Build division to produce, market, and distribute Doppler laser radars and laser transmitters and other commercial products
- Initially penetrate commercial market with sales of the WindTracer® to interested airports, principally overseas
- Develop manufacturing infrastructure to add valuable production capabilities and to compete more successfully with larger defense contractors

DEFENSE CONCERNS

- Low defense margins make it difficult to obtain private financing and incentivize small companies into commercial market
- Military acquisition processes make it difficult for small firms to compete with large contractors
- Subcontractors rarely get the opportunity to develop the infrastructure to compete with the large contractors
- Once a prime integrates a small company's intellectual property into its product, it is often difficult to restrict its use

RECOMMENDATIONS

- Establish an investment fund for U.S. high-tech businesses serving defense markets that is willing to accept low returns inherent in government contracting
- Create small business "set-aside" contracts to build systems and help smaller high-tech companies compete with larger defense contractors
- Update the SBIR program contracts and encourage the growth of Small Business Administration (SBA) loans

Cash Management

For eighteen years, Coherent Technologies, Inc. (CTI) has been conducting advanced laser radar research and development and has become a world leader in demonstrating state-of-the-art, laser radar technologies. The company has been profitable every year of its history, with an average annual sales growth rate of between 30% and 40%. However, sustaining such rapid growth poses a significant array of managerial, cultural, and strategic challenges.

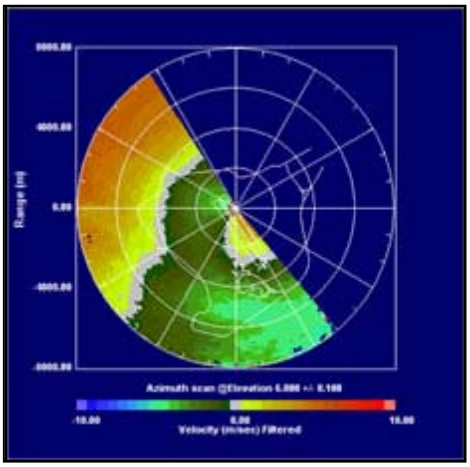
Two of the most important issues currently facing the company and other rapidly growing small organizations are managing the firm's cash and obtaining the capital to fund growth and expansion. Coherent is currently in the process of consolidating its operations from four leased facilities totaling 44,000 square feet into a new 65,000 square feet facility to centralize operations and to provide for near term growth. Another large resource management issue facing Coherent is the lack of upfront payments on government contracts. As a small company with growing infrastructure demands, the company frequently has difficulty financing military development contracts and is thus incentivized to sell to commercial customers. For instance, based on CTI management's experience selling the WindTracer® in Hong Kong, foreign governments usually pay up to 30% to 40% upfront, with around 60% of the remaining cost covered by relatively inexpensive Export-Import financing. This was the company's experience selling. Additionally, commercial customers often make an upfront payment of between 40% and 50% of the total contract. However, the U.S. government provides little or no upfront money for a small company to grow its business and successfully complete a project. As a result, Coherent has turned to the commercial market for initial sales of its first commercially-adapted laser radar product, the WindTracer®. A breakthrough in the prediction of aircraft-produced wind-turbulent events, the WindTracer® system has been successfully installed at the Hong Kong International Airport, with the installation of four additional systems budgeted for the following year. Italian airport officials have also expressed an interest in making a tender offer for up to fifteen systems.

Faced with the costs of rising capital expenditures for infrastructure growth, the company has had to diligently review its spending strategies and has investigated a number of different opportunities to infuse cash into the business. According to CTI, there are three primary vehicles

> ***"A big challenge is cash. You can only really grow at a rate that's allowed by your retained earnings, and when you're in a low profitability business that means that your growth is constrained….It's a question of being too successful and not [being] successful enough."***

through which to infuse cash into its business: retained earnings, debt financing, and equity financing. However, each of these channels poses different challenges to the company.

Growth through retained earnings is restricted by bottom line margin performance. As over four-fifths of the company's revenue is generated from government contracts with relatively low margins, retained earnings alone are insufficient to finance the company's rapid growth. Furthermore, CTI has a relatively highly leveraged capital structure, making debt financing an expensive alternative. The third vehicle available to Coherent involves a cash infusion in return for an equity investment. However, with venture capital financing falling to $4.5 billion in the third quarter, a 48% decrease from the same time last year and a level not seen since 1998[4], private equity investment is particularly challenging to obtain. CTI executives claim that venture capital investors are only interested in investments that offer "astronomical" returns in order to assure the twenty to forty percent return demanded by their investors. Given the lower margins that the company believes are inherent to government contracts, the company has been unable to secure private equity financing without giving up significant equity at a very low valuation.



As one part of a complex solution to the financing challenges currently faced, Coherent Technologies has investigated and secured smaller strategic investments from larger defense contractors. The company has entered into technology licensing contracts in return for investment capital in the past. In these situations, CTI has meticulously protected its intellectual property by restricting the technology's licensed applications through highly structured contracts. In a two year agreement, a multi-million dollar investment in Coherent was made by one of the larger defense contractors in exchange for exclusive licensing rights for the use of Coherent's laser radar in all-weather turbulence detection. The larger company bundled its microwave radar technologies with CTI's technology to build, sell, and distribute an integrated product to customers. This is a good model of how a company can leverage its technology into a product, get paid for the engineering and manufacturing development (EMD), help build its capabilities, and fund some of the growth necessary to succeed.

Military Sales Channels

According to Coherent Technologies, over 200 U.S. laser radar suppliers primarily targeting defense applications existed in 1984; whereas, today there are only about twenty military laser radar suppliers, consisting of government labs,

[4] Liedtke, Michael. "Shellshocked VCs continue to shy away from new risks." Associated Press Newswires 29 Oct. 2002.

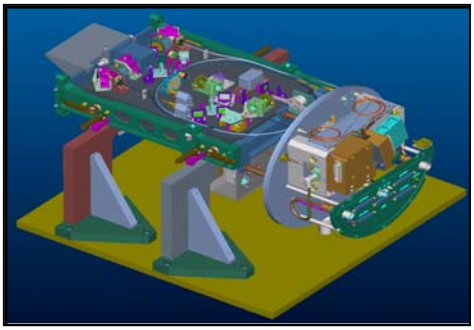
Primes, and less than ten credible U.S.-based small businesses. The major reasons cited by the company for the substantial shrinkage in the supplier base include companies seeking greater profitability through alternative applications, being acquired by larger defense contractors, and having difficulty inserting their technologies into military products. To overcome these challenges and transition its research and development efforts into military products used by the modern warfighter, CTI has identified and evaluated the principal sales channels to the end user. The company can partner with a prime contractor to help bring its technology to market, as the prime contractors have the necessary infrastructure in place to integrate the technology into a military platform. However, Coherent believes subcontractors' roles are tightly managed and held to a minimum to avoid double-burdening on tasks the prime contractor has the capability to accomplish. As a result, subcontractors rarely have the opportunity to expand their capabilities and to implement systems to help them compete with larger defense companies.

> ***"The military competitive base that's available to our U.S. government to get new laser radar technologies into products for our military, that competitive base is eroding, and it's eroding because companies are seeing a lot of difficulty in succeeding in those areas and a lot of opportunity for success elsewhere."***

Alternatively, a small company can decide to grow by competing for EMD contracts from the federal government. However, the current shift is toward pushing EMD activities onto the contractors, leading to the same issues resulting form working with a prime contractor outlined above. Furthermore, Coherent believes that even small programs pose significant risks because of the frequent lack of upfront cash payment and difficult cost sharing structures. According to CTI, contracting mechanisms specifically targeted for the advanced prototyping and early product demonstration of innovative technologies developed by small firms are very rare.

The third option CTI believes that the small military supplier has is distributing its technology to the military by developing products for sale in the commercial marketplace and spinning them back into military applications. The company believes that having commercial sales offers significant long-term benefits as well as margins three to four times greater than those earned on government projects. However, for an organization focused on military research and development, producing commercial products requires infrastructure advances similar to military production. As a result, valuable capital and human resources are required to manage the addition of production capabilities, leading to the same capital management issues discussed above.

Nonetheless, Coherent has been developing its commercial business since 1992, when it formed CLR Photonics, Inc., a division established to produce, market, and distribute laser radar technologies to the commercial market. While the company faces many challenges in growing its production capabilities, the long-term strategic value of both



production capabilities and commercial sales are vital to helping CTI sustain long-term growth. The WindTracer® is currently in use at the Hong Kong International Airport and has seen significant demand from other foreign customers. This is a major step in the company's strategy of slowly and incrementally making commercial sales and adding capabilities while navigating the considerable capital constraints faced as a rapidly growing military supplier.

RIPTECH INC.

2800 Eisenhower Ave
Alexandria, VA 22314
Phone: (703) 916-8886
www.symantec.com

- **Operational Effects-Based Sector:** Homeland and Base Protection
- **Transformational Goal:** SECDEF Goal 4: Protect our information networks from attack
- **Services:** Riptech maintains a relational database that collects data from a user's security sensing technologies to enable sophisticated intrusion detection on a user's IT environment
- **Primary military sales vehicle:** Through a prime contractor
- **Military applications:** Real-time security monitoring and management services
- **Commercial applications:** The company's technology is used in similar applications in the commercial and defense market
- **Pre-acquisition employees:** 170
- **Approximate pre-acquisition annual sales:** $45 million
  - Approximately 90% commercial, 10% federal government agencies (only one DoD customer)
- **Established:** 1998

IMPORTANT POINTS

- Riptech was acquired by Symantec in August 2002 for $145 million
- Despite demonstrated demand for its services, Riptech was largely unsuccessful in selling to the military market prior to the acquisition
- Riptech believes that visibility into the Department of Defense is no more challenging that into large commercial enterprises

MAJOR STRATEGIES

- Combine Riptech's leading technology with Symantec's financial strength, reputation, and worldwide reach
- Serve customer through a services model to maintain technological sophistication
- Target large enterprises with strict security requirements and an understanding of advanced network security technologies
- Deliver primarily through channel partners

DEFENSE CONCERNS

- Long budget cycles
- Multi-year decision making process
- Software certification and accreditation process is lengthy and obsolete
- DoD is often reluctant to abandon traditional projects despite poor results

RECOMMENDATIONS

- Create a better focus around best practices
- Eliminate need to certify and accredit all security software
- Realize mistakes and abandon bad projects quickly

Acquisition by Symantec

Riptech was formed in April 1998 by Amit Yoran to provide security monitoring services using "next generation" commercial security products. Riptech uses a relational database that collects data from customers' own intrusion sensing technologies and analyzes the data to enable highly sophisticated, real-time security monitoring. The relational database is maintained at the company's operations centers and monitoring services are typically contracted through multi-year agreements. By hosting the database and selling a service rather than a packaged product, the company provides real-time security intelligence that is current with the over 450 new viruses and 250 new vulnerabilities discovered each month.

Prior to its acquisition by Symantec in August 2002, the company had been monitoring the networks of 55 companies listed on the Fortune 500 and 10 companies listed on the Global 100. Large enterprise customers had highly sophisticated security requirements and understood the benefits of Riptech's security services, making the company the "clear leader in managed security services, with the strongest vision for the future of the industry" according to Symantec's Chairman and Chief Executive Officer. At the same time, Symantec has been shifting its focus from developing consumer-based anti-virus products to becoming a security solutions provider. Consequently, Symantec has been moving into enterprise markets and growing its services business, and the combination of Symantec and Riptech is in line with its corporate strategy. Riptech also believed that the acquisition was in the best interests of its shareholders.

The combination of Riptech's advanced technology and growing customer base with Symantec's capabilities provide Riptech, now a majority of Symantec's Managed Security Services (MSS) division, a valuable competitive advantage. For instance, the MSS division now has the financial leverage and brand recognition of a billion dollar company. The organization also has much more visibility within the security market and an expanded global marketing and sales reach through operations centers across the world. Furthermore, the MSS division now offers a much more complete product and service line and can provide a bundled security solution, ideal for remote and small office customers. According to the company, Symantec is now the leader in every category customers use to make an MSS provider decision.

Despite the minor issues related to integration into a larger organization, the organization believes that the acquisition is proceeding very smoothly. Penetration into the very large enterprise market has accelerated behind Symantec's strong brand and capable sales force. Additionally, the MSS division is optimistic that it will be able to successfully leverage Symantec's experienced Department of Defense sales force to enter the military marketplace.

Both Symantec, a billion dollar, global corporation, and Riptech, a start-up, delivered a similar solution to both their commercial and military customers. In this case, the larger company acquired the smaller organization in order to obtain its unique capabilities and to increase sales to both large commercial enterprises and to the military. As the DoD transforms to focus on more of the innovative and unique technologies of companies such as Riptech, this paradigm is likely to repeat itself many more times in various situations.

Selling to DoD

Prior to its acquisition by Symantec, Riptech was aggressively marketing its services to the government and to the DoD. However, despite its rapidly growing commercial customer base, the company was unsuccessful in selling its services to military clients. The organization believes that its product was "in line with, I think, what the requirements were for the DoD," and businesses with similar security requirements purchased its technologies. Riptech also tried to utilize its personal relationships with military personnel and even offered to recreate its infrastructure within the DoD to assure that all security data would stay in-house. However, Riptech only signed one service agreement with a DoD customer and its efforts were largely unproductive in the military marketplace. Beyond visiting the technical military personnel, the company was stymied by a protracted process that led to no clear signs of significant contracting possibilities.

"There was kind of this mindset that 'Hey, we've already started down this road. We're going to look pretty silly. How would we position it to stop and change directions?'"

According to the organization, it encountered difficulty delivering its solutions to the DoD in part because of internal politics that kept the military from abandoning inferior solutions developed through Defense Advanced Research Projects Agency (DARPA) funding or by a company that had a relationship with the DoD. In a number of cases, the organization believes that military officials realized that Riptech's products were superior to legacy systems but were unwilling to halt the legacy systems' implementation and switch to a new solution.

Complicating the process further, according to the company, contracting with the DoD is a very long and complex process that neither the company nor the customer wanted to go through. A good example of the bureaucracy and prolonged nature of the military sales cycles occurred when Riptech wanted to sell its services to an agency that employed a relative of someone at Riptech in its purchasing division. According to the company, the purchasing official was reluctant to move the contracting process forward without official notice that there was no conflict of interest. Obtaining this notice, a simple and easy task in the commercial marketplace, took months. Repeated instances of similar bureaucracies led the company to dedicate the majority of its resources to marketing to commercial enterprises and prevented the DoD from taking advantage of Riptech's highly sophisticated network security services.

"It's just a slow process and the procurement cycles are just so long…we basically said, 'we'll continue to keep these opportunities alive but if there's Fortune 500 business and they're able to make their purchasing decisions in a more nimble fashion, then let's just market and sell our services and technology to those markets."

RSA SECURITY INC.

174 Middlesex Turnpike
Bedford, MA 01730
Phone: (781) 515-5000
www.rsasecurity.com

- **Operational Effects-Based Sector:** Homeland and Base Protection
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 4: Protect our information networks from attack
  SECDEF Goal 5: Use IT to link U.S. forces to fight jointly
- **Products:** RSA SecurID software for two-factor authentication; RSA ClearTust Web Access Management Technology; RSA BSAFE software; RSA Keon CA Certificate Authority / PKI Technology
- **Primary military sales vehicles:** GSA schedule, Value Added Resellers (VARs), integrators, and channel partners
- **Military applications:** Commercial-off-the-shelf (COTS) products delivered to military customers for similar applications
- **Commercial applications:** Secure, trusted foundations for e-business through two-factor authentication, access management, encryption and PKI technologies
- **Annual Sales:** $283 million
  - 10% government sales, 90% commercial sales
  - Investment is currently 10% government, 90% commercial
- **Employees:** 1,218
- **Established:** 1986

IMPORTANT POINTS

- The company believes that it is not necessary to develop specialized products to sell to the Department of Defense
- As in the commercial markets, it is important to listen to the requirements of the military customers
- Government is on a cycle of procurement; a longer sales cycle with a larger payoff
- Success in selling to the DoD is based on experience, thorough research, and capable salespeople

MAJOR STRATEGIES

- Offer a clear value proposition
- Gain an understanding of the customers' requirements through research and direct interaction
- Increase investment in government markets to capitalize on previously missed opportunities
- Develop a strong action plan and have confidence in the execution of that plan
- Invest in marketing and a first-rate sales force

DEFENSE CONCERNS

- Procurement processes can be drawn out by substantial information requests and conflicting requirements in documents
- Major integrators selected to lead programs often do not have product/technology expertise
- Products, rather than best technologies, are selected
- The military sometimes contracts for lowest cost in place of best value solution

RECOMMENDATIONS

- Engage in a fluid procurement process led by a small team and assisted by a handful of technology experts
- Consult industry experts to develop the system architecture, and then choose the integrator to execute and implement it
- Focus on best value at the component level
- Hire experts to research and evaluate technologies and interface with small companies

Selling to the Department of Defense

Formed out of the combination of Security Dynamics and RSA Labs, RSA Security assists its customers in the creation and assumption of trusted digital identities as well as in the development of new cryptological offerings. RSA is a commercial organization providing commercial off-the-shelf (COTS) solutions to its customers. The DoD has historically been an area of focus for RSA; the company believes that the government market, including the DoD, represents its largest opportunity for growth. Although recent spending increases for security will likely contribute to this growth, the company's decision to increase investment in this market has been based more on its ability to balance its resources to better take advantage of opportunities that were previously not taken advantage of.

According to RSA, the sales process in the commercial market is very straightforward; companies can market their products by directly targeting the Chief Information Officer. However, in the defense market, the process is more complicated; there is a certain mysticism involved in selling to the DoD. Most companies do not understand the required steps and as a result, this has created a great deal of confusion. Consequently, RSA believes that it is critical for companies to ensure that they understand the process and have formulated a plan before investing in the defense market. Furthermore, RSA has found that the DoD has done an excellent job mapping out the required steps and providing information about the organizations and the appropriations process on the Internet. However, RSA believes that many companies do not spend the time conducting the necessary research. RSA attributes its understanding of the defense market and its success selling to the DoD to its experience and to having likely made many of the same mistakes as others. Through this effort, RSA now has a much better understanding of where to start and how to navigate the system.

"It's a matter of having the solution that the government needs and finding the people that can bring that solution to them. I don't think you can hire a salesperson to sell to the government that has no government experience."

In RSA's opinion, in order to succeed in selling to the DoD, it is critical to understand how funds are allocated and which agencies have specific needs. This requires performing as much research as possible and speaking directly with the program managers responsible for those areas of interest. RSA believes that the DoD has traditionally been a leader in adopting new technology and is much more willing to entertain discussions regarding the value proposition of an opportunity. The challenge is identifying the appropriate personnel with whom to hold these discussions. Through its experiences, RSA has built a strong reputation in both the commercial and defense markets, which is helpful in reaching these key individuals. Additionally, the company has hired effective salespeople that possess a strong understanding of the military

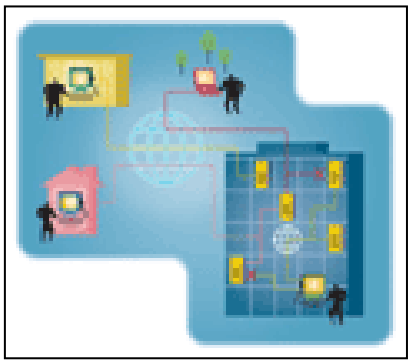
market and have developed strong DoD contacts in order to gain market access. The company's experienced sales force helps it sell to the U.S. military by effectively communicating its value proposition to the customer.

Soliciting the Experts

One critical challenge faced by the DoD highlighted by RSA is the balance between process timeliness and open competition. According to RSA, while it is necessary for the DoD to maintain a competitive process, it is important that a competition should not be too broad or open-ended. Consequently, it is unnecessary for the DoD to solicit the entire marketplace for proposals, as the result of this can be a lengthy period of information requests. Rather, RSA recommends tasking a small group to identify a handful of industry experts and research their potential solutions. Through this process, the group will likely assemble a competitive environment not hindered by a multitude of letters and phone calls. After evaluating the technologies and best practices of the identified bidders, the group can then select its preferred solution and work with the winning company, or team, through production.

> ***"In the solution discovery process, you can spend more time trying to educate people, trying to find out which way to go, when you already know the right answer. If you were going to implement solutions x, y, and z, if you talk to the three leading companies who supply x, y, and z, you will know probably all of the issues within three or four meetings with those folks."***

Although developing a successful program team may be an involved process, RSA recommends against simply assigning this task to a large integrator, when the integrator may not be an industry expert. In these situations, rather than having the product specialists developing the solution, the result is often an integrator developing the architecture and finding the appropriate products to fit into that architecture. According to RSA, integrators typically have a canned solution they will try to implement whenever they can because it is familiar to them. Furthermore, in order to keep costs down to win the bid, the integrator does not always select the best products. While this may save money in the short-run, it might prove more costly later on, as additional requirements emerge that should have been considered during the initial design.



Nevertheless, RSA does acknowledge that the large integrators do provide value and can be especially helpful during the implementation phase. According to the company, ideally, the DoD would work with the technological innovators to develop the architecture, bringing in the integrator to execute and implement the approved design. In RSA's opinion, it is important for the DoD to maintain some level of control before handing over the program to the integrator. Furthermore, as the DoD attempts to optimize its organizational structure, it

will have to rely on third parties to serve as its experts. RSA recommends allocating an appropriate amount of available funding to hire these experts who will evaluate the various vendors through research, identification, review, and selection of the best technologies. Thereafter, the small companies can interact with these experts to design the most efficient and effective solution before implementation by the integrator.

SYSTEMS RESEARCH & DEVELOPMENT (SRD)

PO Box 19576
Las Vegas, Nevada 89132
(702) 731-6001
www.srdnet.com

- **Operational Effects-Based Sector:** Homeland and Base Protection
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 3: Deny our enemies sanctuary
  SECDEF Goal 4: Protect our information networks from attack
- **Product:** Real-time data warehousing that allows for entity resolution and fraud and collusion prevention
- **Primary military sales vehicle:** GSA Schedule
- **Potential military applications:** Screening civilians and military personnel with access to important military sites, homeland security, etc.
- **Commercial applications:** Fraud detection in the casino, hospitality, transportation, finance, retail, banking, and insurance industries
- **Approximate Annual Sales:** $8 million
  - 50% commercial, 50% government
  - Government customers include DoD, law enforcement, and intelligence agencies.
- **Employees:** 28
- **Established:** 1984

IMPORTANT POINTS

- Because of the complexity of activities and resources required for marketing to the government, SRD does not have direct access to potential government users, buyers, and decision makers. On the other hand, given the transparency of the private sector, SRD can market directly to commercial users.
- To maintain the ability to think creatively and productively about a wide range of customer and technical problems, and to avoid restrictions imposed by access to secure material, SRD's Chief Scientist has not accepted a security clearance.

MAJOR STRATEGIES

- Leverage relationship with CIA venture arm In-Q-Tel to access the CIA market and to help develop other government relationships
- Focus resources on selling and supporting a standardized product
- Hire people with specific capabilities and relationships to grow the company into a successful business and government contractor

DEFENSE CONCERNS

- Slow, and complicated contracting and procurement processes
- Tedious and confusing communication
- Overwhelming process to access development funds from the Department of Defense
- Listing on the Federal Supply Service (FSS) is an expensive, slow, and resource intensive process that poses challenges to a small company

RECOMMENDATIONS

- Improve access to development funds for small organizations
- Shorten (or eliminate) the FSS negotiation process from the currently forecast 3-6 months. Investigate the possibility of users buying direct.
- Remove one of the two price negotiation phases SRD believes a company often faces in selling products from the FSS: listing on the schedule and selling from the schedule

In-Q-Tel Relationship

Systems Research & Development (SRD) is the premier supplier of real-time data warehousing that allows for entity resolution and fraud prevention for Fortune 1000 companies. The company's proprietary software has the capability to manage terabytes of data and identify non-obvious relationships that would indicate fraud or collusion. The product is a combination of SRD's SI Warehouse software, an application that creates and manages a sizable database by merging data from multiple sources in real-time, and Non-Obvious Relationship Awareness™ (NORA™) software, a detection system that integrates with the SI Warehouse database to identify present and prior relationships that indicate likely fraudulent behavior. The NORA™ system's detection approach is unique because it relies on non-obvious relationship detection rather than the less robust fraud identification technique of pattern recognition. By highlighting potential problems with people's backgrounds, the NORA™ system has the capability to identify card counters in a Las Vegas casino or prescription pad thieves in a physician's office.

To help develop other government relationships SRD has established a strategic relationship with the Central Intelligence Agency's venture arm, In-Q-Tel. In-Q-Tel contracted with SRD to upgrade its system capabilities to be able to identify highly complex relationships in large data sets. Furthermore, In-Q-Tel has helped open doors with government customers for SRD through the exposure it receives as an In-Q-Tel partner. By funding product development and by helping develop the company's sales channel, In-Q-Tel has been a vital part of SRD's success in both the commercial and government markets.

Tight Customer Feedback Relationship

As a small firm focused on organic growth from customer revenue and alliance partnerships, SRD makes it a practice to identify common ground among its customers to focus on selling and maintaining a standardized product. SRD believes that this product standardization helps control costs and counteracts the systems integrators' strategy of bundling systems to complete a project. Additionally, the company markets its system directly to customers, a focus the company has preserved as its software has evolved around understanding customer needs and the corresponding functionality. Even today, the company maintains a close relationship with clients and integrates their suggestions into future software releases.

Government agencies began to contact SRD regarding participation in product evaluations after its founder's banquet speech at the NSA & NIST NISSC conference

two years ago. Some of these evaluations are still ongoing and some have evolved into subscription licenses. Furthermore, through CIA, SRD has developed a relationship with the CIA venture organization, In-Q-Tel. As part of the relationship, SRD has received financing from In-Q-Tel, and has provided certain use rights for CIA for its technology. Over time, SRD has relied heavily on word-of-mouth among the intelligence and other government forums such as trade symposiums, panel participation and press activities, to generate new business opportunities with government agencies. Additionally, the company has examined and continues to investigate opportunities to work with a major systems integrator to bundle the NORA™ system for government and defense agency projects.

> ***"If I wanted to crack General Motors, I could find a plant site. I could call on somebody, have independent purchasing authority, etc. If I show up here at Nellis (AFB), they don't let me in the gate. I just don't know where to start."***

According to SRD executives, one of the major roadblocks companies trying to market to the Department of Defense face is understanding the purchasing procedures of the U.S. military. As a small company not located on a technology or defense beltway, SRD believes that it is at a distinct disadvantage in terms of navigating the Request for Proposal (RFP) process, learning about new defense contracts, and understanding the needs of the U.S. military. As a result, the majority of SRD's government customers have initially contacted the company with interest in the NORA™ system, rather than being introduced to the product by SRD. On the other hand, the company feels that it is able to generate commercial business more seamlessly through direct marketing. SRD can more easily develop a commercial marketing strategy for a particular customer because customer's' needs, productivity improvement expectations, and return on investment objectives are clearly understood with commercial customers.

Personnel

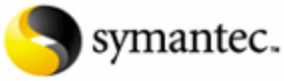
To grow the company into a successful government contractor, a number of people with specific capabilities and relationships have been hired. CEO John Slitz was brought on to provide the marketing and managerial talent necessary to lead the company as it grows from a start-up into a much larger venture. Prior to his work at SRD, John oversaw government operations in senior marketing positions at Novell and IBM, founded a software company that was later bought by Microsoft, and was a partner at a Silicon Valley venture capital firm. Furthermore, John has since hired additional employees, like Controller Brian Sullivan, former Financial Operations Manager at Lockheed Martin and Loral, for their government and military experience.

> ***"I refuse to allow my founder to get a security clearance because heaven forbid he's talking to somebody and writes on a white board and they say 'that's cool, we now own it'….I could find myself defending against such a claim… and that's a life threatening event for a small company… and that means I won't play at all, because I won't play any game where I might lose my life."***

Intellectual Property

SRD's CEO has prevented the company's Chief Scientist from obtaining a security clearance to any government agencies. This policy was enacted to ensure that the ability of the Chief Scientist to think creatively and productively about a wide range of customer and technical problems would remain unfettered by the restrictions imposed by access to secure material. SRD currently has several "cleared" employees, with more being added as government business increases.

SYMANTEC CORPORATION



20330 Stevens Creek Blvd.
Cupertino, CA 95014
Phone: (408) 517-8000
www.symantec.com

- **Operational Effects-Based Sector:** Homeland and Base Protection
- **Transformational Goal:** SECDEF Goal 4: Protect our information networks from attack
- **Products:** Core product is anti-virus software; also offers a full suite of security products for hardware and software protection: firewalls, intrusion detection, content filtering, vulnerability assessment, and enterprise security management
- **Primary military sales vehicles:** With prime contractors and through the GSA schedule and Indefinite Delivery, Indefinite Quantity (IDIQ) contracts
- **Military applications:** Virus protection, software and hardware security, and security management
- **Commercial applications:** Symantec's solutions have similar commercial and military applications
- **FY 2002 Revenues:** $1,070 million
- **Employees:** 3,900
- **Established:** 1982

IMPORTANT POINTS

- Because of high military demand, Symantec designs all its products to meet the sophisticated technology needs of the Department of Defense
- Symantec develops and produces security products only in the United States, a conscious decision to assure national security
- Symantec's Norton Antivirus software is one of the top commercial anti-virus software packages

MAJOR STRATEGIES

- Develop a single product that serves both commercial and military customers
- Target those doing business over the Internet
- DoD product specifications drive final product, especially with regard to scalability
- Become a major player in hardware & software security; in conjunction with this, Symantec is attempting to increase business with the DoD

DEFENSE CONCERNS

- DoD bureaucracies and traditional practices often prohibit using commercial technologies for defense applications
- Decentralized decision-making processes and lack of standardization lead to inefficient procurement and operations
- Cost-plus development contracts often result in labor rate competition rather than effective development of useful military technologies

RECOMMENDATIONS

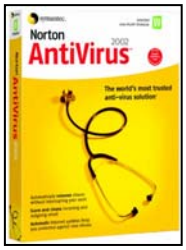
- Treat defense suppliers as "solution providers" rather than the traditional "vendors"
- Encourage cooperation amongst DoD, prime contractors, and sub-suppliers during product development
- Centralize military procurement decision-making
- Minimize the use of cost-plus contracting
- Do not purchase security software developed in foreign countries for national security reasons

Government Research

As an integral part of a corporate decision to become a security company, Symantec has pursued an increased relationship with organizations that procure leading edge security technologies, including the Department of Defense. A major reason for this new relationship strategy is boosting Symantec's stature as a security expert. At the same time, Symantec sees an opportunity to access government funding to research those technologies and applications important to the DoD, a potentially key long-term customer, but not yet an integral piece of Symantec's product planning "road map."

An obvious first step toward this goal has been the establishment of a relationship with DoD research agencies. Unfortunately, Symantec has found it "difficult" to foster a meaningful relationship due to the traditional methods of conducting business and general culture. Somewhat troublesome in Symantec's opinion is the government's apparent preference to work with the same defense prime contractors over and over again, which has regrettably entrenched contracting practices that do not cultivate the imaginative and innovative thinking central to creative research in new security technologies. Furthermore, the company feels that DoD's use of cost-plus contracts is detrimental to the goal of creating new advanced technologies as it promotes competition on the basis of cheap labor rates as opposed to strong technical ability and creative problem solving skills. "Having an approved accounting system to do cost-plus contracting is not an inexpensive thing to do, either… The government requires a lot of infrastructure in order for you to do business with them" according to the company. Then, at the end of the day, "profit is negotiated," typically as a function of labor, General & Administrative (G&A), and other overhead, which is contrary to traditional business practices of aligning compensation with the fulfillment of project goals. These barriers to cooperation and innovation unfortunately discourage partnerships between DoD and commercial enterprises, ultimately hindering the use of leading-edge technology in the battlefield. "It isn't worth our trouble."

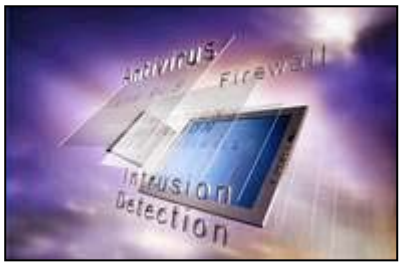
> ***"[Prime contractors] do not bring commercial products to market. To really bring [a product] to market, you have to work with the commercial providers. But, cost-plus contracting gets you into the whole battle of who can have the lowest labor rate – not who can do the job the best; not who can actually produce something. [Commercial providers] are not in the business of doing the lowest labor rate."***



Conversely, Symantec has had a positive experience teaming with EDS and Raytheon on the Navy/Marine Corps Internet (NMCI) project. The company greatly appreciates the project's working environment in which all involved parties treat it like a "solution provider" as opposed to the traditional "vendor" notion. "Everyone [in the NMCI program] is trying to figure out something that's never been done before," boasts Symantec. Furthermore, the company was brought into the program in its early

stages, which has allowed the company to integrate NMCI project needs into its corporate R&D "road map."

National Security



One concern highlighted by Symantec is that of the DoD's policy regarding foreign sourced security products. In the 1980s, the Reagan administration passed the Made in America Act mandating that hardware components purchased by the government be sourced from within our national borders. At the time, this law was designed to help protect American electronics jobs, but Symantec recommends re-visiting the concept in the software market with the intentions of protecting our national security. Symantec consciously develops and produces all of its security products in the United States with the intention of drawing attention from potential Federal government customers. The DoD is conscious of this fact and Symantec is hopeful that in time they will begin to purchase more from U.S. companies and less from abroad. According to the company, over 90% of DoD unclassified Internet communication is conducted over public Internets. This could be a security concern depending on the origin of the security products in use. Furthermore, foreign countries, including allies of the U.S., have been known to provide relatively "hospitable" environments for hackers. In Symantec's opinion, given the current priorities of national security, it is perhaps time for the DoD to promote new Made in America mandates regarding software, as well.

VIISAGE TECHNOLOGY, INC.

30 Porter Rd.
Littleton, MA 01460
Phone: (978) 952-2200
www.viisage.com

- **Operational Effects-Based Sector:** Homeland and Base Protection
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 3: Deny our enemies sanctuary
- **Products:** Secure digital identification systems and facial recognition technologies
- **Primary military sales vehicles:** Through research and development contracts from the Technical Support Working Group (TSWG) and directly to end user through purchase orders or agency contracts
- **Military applications:** Access control, surveillance, large database searches for counter-terrorism, security, and law enforcement
- **Commercial applications:** Facial recognition, digital-identification documents including driver licenses and social services cards for law enforcement, preventing casino fraud
- **Annual Sales:** $32 million
  - 80% state and local government, 10% federal government, 10% commercial
- **Employees:** 100
- **Established:** 1995

IMPORTANT POINTS

- Viisage is a spin-off from a larger defense contractor, and its employees have experience working with the military
- All algorithm and basic science research efforts have been internally funded to protect ownership of intellectual property
- Department of Defense has usage rights, but not ownership of applications it funded

MAJOR STRATEGIES

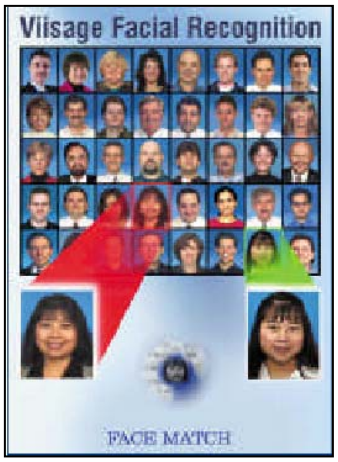
- Work with Department of Defense technology consortiums (TSWG, Biometric Fusion Center) to secure development funding and to identify customer needs and identities
- Identify DoD applications for commercial products
- Locate early adopters
- Target end users
- Interact with acquisition personnel only after securing a commitment from end user

DEFENSE CONCERNS

- Sole source justification process is resource intensive and repetitious for multiple users
- DoD is too conservative in implementing technology in the development phase
- Federal Supply schedule "cookie cutter" requirements are too restrictive

RECOMMENDATIONS

- Streamline sole source contracting process for embryonic technologies and new ideas
- Judge programs' success upon value of deliverables, rather than upon absolute compliance
- Apply TSWG concepts and processes to other technologies and other areas of the DoD



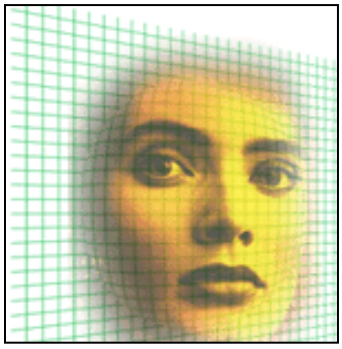
Targeting Early Adopters

Founded in 1995, Viisage Technology competes in the emerging field of biometrics by providing digital identification systems and solutions. The company is segmented into three business units: Homeland Defense, Commercial Solutions, and 3SI (Solution for Smart and Secure Identification). Its facial recognition technology, originally developed at the Massachusetts Institute of Technology, uses "eigenfaces," which map characteristics of a person's face into a multi-dimensional face space.

While Viisage's technology is still in its embryonic stage, the existence of several logical defense applications has provided the company with a basis on which to explore opportunities within the Department of Defense. Nevertheless, the narrow applications of its technology lend only to a small handful of likely interested parties at this stage. In addition to substantial research efforts and regular attendance at industry conferences and trade shows, the company is targeting its sales efforts towards these potential early adopters. Fortunately for the company, early adopters are typically not waiting around for technology to come to them, but are out searching for new and innovative opportunities.

> ***"[The technology] was a logical match with an early adopter group, which the Department of Defense traditionally is on many technologies."***

One example of how the DoD is working to identify innovative solutions in this market is through the creation of the Biometric Fusion Center (BFC). Funded by the DoD, the BFC was created in order to bring industry and government users together to further the usage of biometrics. The BFC is tasked with investigating biometric opportunities and working with the companies to develop their technologies. The center, divided into a research and development arm and a systems integration arm, has proved to be a useful resource for Viisage.



Another DoD effort to access advanced technology is the Technical Support Working Group (TSWG). TSWG, organized into eight distinct technology subgroups, is chartered with identifying, prioritizing, and coordinating research and development requirements for the government's efforts to combat terrorism. Funded primarily by the DoD's Combating Terrorism Technology Support Program, the TSWG Program is overseen and directed by four agencies with a common interest in combating terrorism: the DoD, the Department of State, the Department of Energy, and the Department of Justice. Furthermore, membership includes representatives from nearly eighty different organizations across the federal government including the National Security Agency, the Federal Bureau of Prisons, the U.S. Customs, the Immigration & Naturalization Service, Sandia labs, and the Federal Aviation Administration. Viisage works with the

Group to outline the current state of the art of its technology and to explore the issues that Congress would like to address. In essence, the Group creates a technology roadmap and funds and follows the technology through prototyping. Viisage's experience with TSWG to date has been positive, and the company is currently contracted on a number of TSWG-funded research and development projects. Furthermore, with TSWG funding, the company has developed several applications that have since been transitioned into the field and are helping combat terrorism.

Navigating the Acquisition Process

Viisage compares the federal government acquisition process to a series of switches that all have to be set to "yes" to complete the circuit. To ensure that there is a closed circuit, it is necessary to identify the naysayers in the process and figure out how to either work with them or work around them. Additionally, according to Viisage, the acquisition process begins with the end user. The company has little interaction with procurement officials until after a sale has effectually been completed. In Viisage's opinion, while the acquisition people may write the contracts, the end users are the ones who make the decisions and set the requirements. Furthermore, working directly with the end user has added benefits as the relationship develops. For example, if individuals have had success using a product and they are then moved to a new department or agency, they are likely to use an applicable solution again. Likewise, if a product is successful, strong references from the customer may lead to additional applications by new users.

> ***"It is critical to find the end users and get in and talk to them. Don't talk to purchasing until you've got someone who wants to write the requisition."***

Through its experiences, Viisage has identified a few challenges in working with the DoD. For instance, although Viisage is the only company that possesses its technology, it finds the DoD's sole source justification process quite onerous. In addition to consuming substantial resources and requiring multiple steps, the process must be repeated in its entirety for each interested party. While Viisage recognizes the need for fair and open competition and the potential problems without it, the company points out that when working with an embryonic concept or idea, a prolonged acquisition process can delay product delivery and lower project enthusiasm.

In order to alleviate some of these issues, Viisage would like to sell to the DoD through a federal supply schedule or large agency contract. However, as its technology is still in its initial stages and not fully developed, Viisage does not believe it is able to meet the strict, "cookie cutter" requirements necessary to list on a schedule. Likewise, while there is demand for the company's technology, Viisage has not yet developed a product that users are able to specifically identify and request.

Another of the company's frustrations stems from the DoD's conservative attitude towards technological implementation. While the company acknowledges that its technology is not perfect, Viisage believes that it has advanced to the point where there are a number of attractive military implementations in its current state. In the commercial market, according to the company, customers understand that a product with a 70% success rate is significantly better than one with a 0% success rate. As such, they are able to make a calculated decision regarding the benefit of making an investment and often procure the technology. An example is Viisage's success marketing its not-yet-100% facial recognition technology to the casino industry to identify card counters and cheats. However, the company believes that military users do not entertain utilizing a technology until it reaches a 100% success rate and relinquish the decision making responsibility to consultants. In Viisage's opinion, this process hinders the rapid introduction of innovative and advanced technology.

– INTEGRATED BATTLESPACE –

ACTUALITY SYSTEMS, INC.

AIRFIBER, INC.

DELTA INFORMATION SYSTEMS, INC.

SABEUS PHOTONICS, INC.

SRA INTERNATIONAL, INC.

THE INSITU GROUP

VANU, INC.

ZAPLET, INC.

ACTUALITY SYSTEMS INC.

164 Middlesex Turnpike
Burlington, MA 01803
Phone: (781) 229-7812
www.actuality-systems.com

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goals:** SECDEF Goal 1: Protect the U.S. homeland and bases overseas
  SECDEF Goal 3: Deny our enemies sanctuary
- **Product:** Perspecta™ is a 20" diameter crystal dome and associated software, which creates 10" diameter floating 3D imagery that can be seen by multiple people without goggles. The Perspecta™ Display uses MEMS devices with over 3 million tiny mirrors and drivers that integrate with existing off-the-shelf applications. The product is the world¹s leading spatial 3-D visualization technology in terms of resolution, computation, interactivity, and usefulness
- **Primary military sales vehicles:** Military research contracts and direct military sales
- **Military applications:** 3-D presentation of Ladar data, 3-D terrain visualization and interaction, and 3-D homeland security screening
- **Commercial applications:** 3-D imaging in the medical, drug discovery and pharmaceutical, and oil and gas industries
- **Approximate annual Sales:** $1 million
  - 65% commercial, 35% government
- **Employees:** 9
- **Established:** 1997

IMPORTANT POINTS

- Like other small firms, access to capital is an important issue
- Actuality claims that military customers are sometimes secretive about the intended use of Perspecta™, as opposed to commercial customers who collaborate with Actuality to achieve a common performance goal

MAJOR STRATEGIES

- Integrate previously independent visualization and computation capabilities into one platform
- Use participation in Silicon Graphics' (SGI) developer program and word of mouth to grow military and commercial customer base
- Use vertical and horizontal relationships with companies like Hewlett Packard, IBM, Texas Instruments, and SGI to improve technological functionality, lower prices, understand customer needs, and increase sales
- In the long term, design hardware and software, license hardware production, and add value through software development

DEFENSE CONCERNS

- Military needs are not elucidated as clearly as commercial needs
- When the government grants a firm development capital, it can allow other companies to build products based on that technology for government applications, limiting a company's ability to protect its intellectual property
- Small companies lack the resources to challenge or negotiate DoD supplier contracts, processes, and roles

RECOMMENDATIONS

- Establish a forum or liaison within the Department of Defense for small companies to learn about military needs and contracts, receive guidance for managing military relationship, and access examples of previously successful military proposals
- Establish a technological developer program similar to that of Microsoft, Palm, or SGI
- Outline clear technical performance benchmarks regarding military needs and leverage metric system to help new technologies access development funding

Technological Developer Programs

According to Actuality Systems, the most successful international technological development programs have been the software development programs established by software platform companies like Microsoft, Palm, Silicon Graphics (SGI), and others. In programs such as these, sponsors freely provide technological developers the technical tools to build applications for use on the sponsor's platforms. Additionally, program sponsors offer members discounts on conferences, consulting, and technical assistance and frequently give developers access to their distribution channels, and sales and marketing forces to help them build relationships with potential customers and other developers. In return, program sponsors benefit from their platform's expanded functionality and usefulness. As an example, Actuality has leveraged its technological developer role with SGI on its OpenGL platform to improve the usefulness and integration of Perspecta™ and grow its customer base. SGI's connections have helped Actuality identify commercial and military demand and demonstrate the Perspecta™ system to make new sales. SGI benefits directly when Actuality installs both the Perspecta™ system and SGI's IRIX operating system for the end user.

> ***"The most successful international programs for technological development are the large software development programs."***

According to Actuality, through taking an active role in creating a developer program similar to the software developer programs, the Department of Defense would support and improve military procurement of transformational technologies from small companies. As opposed to the systems integrators – which Actuality feels are focused on distinct program or project requirements and structured to succeed in a two-tiered, contractor and sub-contractor system – the DoD has a more global perspective to help identify and allocate valuable, enabling transformational technologies. As the DoD continues to transform by integrating its systems and establishing specific standards around this integration, a developer program could be launched around systems bases to bring new technologies to market quicker and to facilitate more seamless integration of new technologies.

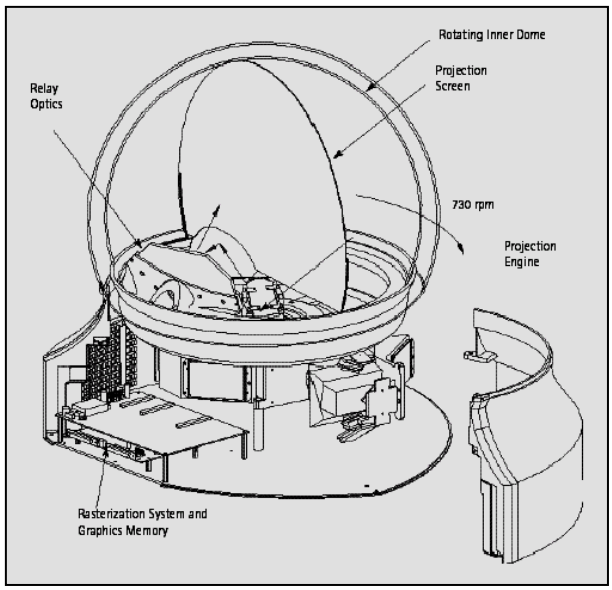
DoD Performance Specifications

> ***"There needs to be a set of criteria and set of metrics produced, which would allow for [an] outcome of which visualization would be a part, and experimenting around visualization would be that developer relationship."***

Another issue Actuality feels is important to a small company dealing with the government and the DoD is the often ambiguous and tedious communication with such a large and complex organization. To make dealing with the DoD less complicated for small

> ***The "government doesn't have to fund [development]; the government could actually use its leverage as a purchasing agent to get capital outsourced, and that gives the government for more reach in terms of its ability to affect technology."***

companies, Actuality suggests establishing well-defined, standardized or project-specific performance specifications by which to evaluate potential project solutions. For instance, Actuality is evaluating Perspecta™ for medical applications with Siemens. The two commercial organizations are working together to create a solution that achieves a specific objective and performs to a certain Return on Investment (ROI). On the other hand, military clients often lack performance specifications to evaluate a product and frequently leave Actuality in the dark as to Perspecta's™ intended use. However, if the DoD outlined clear project or product performance standards, the risk to Actuality of trying to comply with unreasonable military expectations would decrease and the company could closely collaborate with the DoD to find creative solutions to meet their goals.



Actuality believes that another advantage to establishing clear performance specifications would be the government's capacity to use its purchasing power, through an expressed purchasing intent or a restricted purchase order, to help transformational technologies obtain development funding. For instance, as is the case in SGI's and Actuality's relationship, the DoD could issue a letter of intent to purchase certain transformational technologies when specific performance metrics were achieved. With this assurance, a small company with valuable enabling technologies would be in a better position to obtain private development funding. Furthermore, the company believes that if the DoD also sponsored a developer program, it could leverage the established performance specifications to foster the growth of important and transformational military technologies identified through the program. A team in the DoD could be tasked with the technological systems integration, identifying transformational technologies, and leveraging the government's purchasing power to help enabling technologies access the billions of dollars of private capital available for technological development.

AIRFIBER, INC.

16510 Via Esprillo
San Diego, CA 92127
Phone: (877) 576-7000
www.airfiber.com

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goals:** SECDEF Goal 5: Use IT to link U.S. forces to fight jointly
  SECDEF Goal 2: Project and sustain power in distant theaters
- **Products:** Last mile broadband wireless equipment to create an ultra-broadband fixed wireless network using free space optics and high frequency millimeter wave radio at fiber-like bandwidth capacities
- **Primary military sales vehicles:** No current military sales; working to sell direct through the GSA schedule and through Value Added Resellers (VARs)
- **Military applications:** Rapid, portable command and control center network system with greatly reduced emissions detection, establishing network connections across runways, all weather redundant medium networking solutions, last-mile building interconnects; ship to shore communications; and future applications being air to air, ship to ship, air to ground, air to space and vehicle to vehicle communications
- **Commercial applications:** Fiber extension, disaster recovery, fiber backup, mobile wireless backhaul, and wireless networking across buildings (ideal for university campuses)
- **Annual Sales:** Withheld
- **Employees:** 70
- **Established:** 1998

IMPORTANT POINTS

- AirFiber's initial success in the commercial market has significantly eased the timing and financial pressures involved in working with the Department of Defense
- Has successfully raised significant private investment capital in three rounds of funding since 1998
- AirFiber's technology is ideally suited for rapid and flexible deployment of wireless networks

MAJOR STRATEGIES

- Leverage products developed for commercial market to relevant applications for the military
- Maintain ownership of intellectual property by funding R&D internally
- Approach new markets and new opportunities carefully before allocating significant resources

DEFENSE CONCERNS

- Working with the DoD can be a complicated process for those who have no previous experience doing so
- Learning the DoD requirements and procedures as well as gaining initial entry can consume significant resources often unavailable to small companies
- While the intent of the GSA schedule is good, the process can be complex and the DoD response time can be lengthy
- Dealing with classified information and required clearances can make managing a relationship with the DoD very cumbersome

RECOMMENDATIONS

- Work closer with small companies new to working with the DoD to ease and expedite the process and to improve the companies' understanding of Department of Defense procedures and requirements
- Improve response time to company inquiries and applications to supply the DoD

Beginning work with the Department of Defense

Launched in 1998 during the peak of the recent telecom upsurge, AirFiber has developed laser-based wireless communication technology capable of delivering ultra-broadband services through the air. Though initially focused on commercial applications, the strict requirements for carriers fortuitously meet DoD requirements as well. As such, the decision for the company to explore new market opportunities with the military was not a difficult one.

One of the current applications of AirFiber's technology is in disaster recovery. While brainstorming in the boardroom, it did not take long to begin thinking of logical technology extensions, which included recent homeland security initiatives and other DoD activities. Furthermore, a number of AirFiber's executives have previous DoD experience and were aware of some of the military's information technology needs and requirements.

> ***"We created a product that met the standards that the carriers demand. That's the way the product was designed and it turns out that the military requirements are very similar. We had that advantage – the product was already there."***

The challenge for AirFiber has been converting its solutions into new business. According to the company, without any previous experience doing business with the DoD, the intricacies of the procurement process are more complex than in the commercial marketplace. As a result, in order to gain a better understanding on becoming a DoD supplier, the company has invested a significant amount of its own capital. For example, management has had numerous visits with various contacts within the DoD, as well as identified departments who might have a need for their technology. In addition, the company routinely attends trade shows and conferences in order to build its network of contacts within the DoD. Furthermore, the company hired a consultant to advise on doing business with the DoD and more specifically, to assist it with filing the necessary paperwork required to be placed on the GSA schedule. While these activities have not translated into sales yet, the company believes it is closing in on a number of opportunities.

Without previous experience selling to the DoD, the company's strategy for penetrating these markets has been to begin slowly and gain a better understanding of the process. Once an initial relationship has been established, AirFiber believes it will try to increase its presence, potentially accessing available sources of R&D funding such as the Defense Advanced Research Projects Agency (DARPA). The reason for a phased approach is due to the

significant commitment of resources the company believes is required to become an active supplier to the DoD. Business with the DoD often deals with classified information, which can require certain clearances when discussions occur at specific levels. In order to monitor these issues, AirFiber would likely establish a dedicated group within the organization whose responsibility would be managing the company's relationship with the DoD. This group would not only carry necessary clearances, but would also be well versed in the procurement procedures. Due to AirFiber's initial success in the commercial market, it has the luxury of allocating the necessary resources to investigate these new opportunities, where other small companies may not.

Selling Methods

As part of its foray into the defense marketplace, AirFiber is exploring various methods under which to serve as a supplier. One avenue utilized by a number of small companies to penetrate the defense market is as a supplier to or in partnership with established prime contractors. However, according to AirFiber, while it is exploring this avenue, the primes have not been very open to sharing information regarding the projects currently in process or the applications in which they would incorporate AirFiber's technology.

Therefore, the company believes the most promising sales channel is also the most common in its commercial business: selling direct. In order to sell direct to the DoD, AirFiber concluded that the simplest way was to register on the GSA schedule. In the company's opinion, despite the lengthy, complicated process for a company completing it for the first time, the GSA schedule was the optimal solution under the current policy. Once listed on the schedule, the company's products could be easily referred to by the DoD and would reduce paperwork for future sales. With the assistance of its defense consultant, the company has completed the necessary paperwork to be on the GSA schedule. Recently, the company has also joined the Small Business Administration (SBA) SBA*Exchange* pilot program, which utilizes an electronic purchasing tool to improve efficiency and accountability of the procurement process and to assist small businesses. SBA*Exchange* enables agencies to award small businesses simplified contracts of under $100,000 through a streamlined and simplified electronic system. The company believes that participation in this pilot program will enable it to penetrate the military marketplace quickly and effectively.

"In terms of selling, supporting and future R&D projects, you have to be very close to the end customer, ultimately. That means you need to invest the time, money, and resources. Alternatively, you could outsource to those companies that have already built up that infrastructure…as long as the end user is happy with the product."

Another selling method, one which the company also employs in the commercial world, is using a Value Added Reseller (VAR). In the commercial market, the company typically utilizes VARs for specific market segments or for individual opportunities. In the company's opinion, a negative for using VARs exclusively is that the company often becomes captive to the VAR, forfeiting margin as a result of the VAR markup to the customer. Furthermore, with the additional markup, the customer also does not receive the best price. The company does acknowledge that using a VAR may benefit certain companies without the resources or capabilities to sell direct as the VAR enables the company's products to immediately appear on a schedule for purchase. Nevertheless, as AirFiber operates in the commercial market, the company has concluded that its best practices for selling to the DoD will likely be selling direct, using VARs on an opportunistic basis at first and increasing as specific relationships are proven.

DELTA INFORMATION SYSTEMS, INC.

300 Welsh Road Building 3
Horsham, PA 19044-2248
Phone: (215) 657-5270
www.delta-info.com

DELTA INFORMATION SYSTEMS, INC.

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 5: Use information technology to link U.S. forces
  SECDEF Goal 6: Maintain unhindered access to space
- **Products:** Video compression equipment, telemetry equipment, and protocol testing equipment and software
- **Primary military sales vehicles:** Sub-contracting to prime contractors and military research contracts
- **Military applications:** Air-to-ground video transmission, satellite command and control links, network security, video communications, etc.
- **Commercial applications:** Video transmission, videoconferencing, satellite communications, telemetry equipment, network analysis, surveillance, video broadcasting, traffic monitoring, etc.
- **Approximate annual sales:** $7 million
  - Approximately 25% commercial, 40% military, 35% other government agencies
- **Employees:** 52
- **Established:** 1976

IMPORTANT POINTS

- The company believes that despite its network of military contacts, its manufacturing representatives, and its other information channels, it is aware of only 10% of relevant government contracts
- The company believes that the research and development it has undertaken for the Department of Defense has led to some of its most advanced and state of the art technologies

MAJOR STRATEGIES

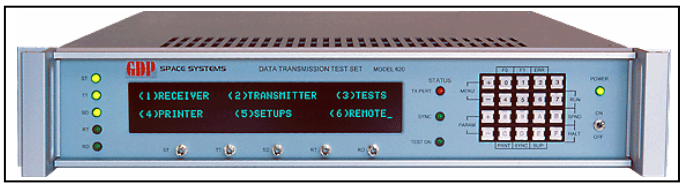
- Expand sales and marketing capabilities to broaden company's engineering focus
- Increase commercial focus because of more direct market access, larger market size, faster sales cycles, etc.
- Leverage commercial vendor relationships with larger organizations, or "golden customers," to enter new markets and for sales and marketing capabilities
- Bootstrap growth with capital from retained earnings
- Retain intellectual property as a sub-contractor by manufacturing a pre-programmed key component

DEFENSE CONCERNS

- Visibility into military programs and military organizations is highly limited
- Military sales cycles are lengthy, resource intensive, and difficult for a small company to manage
- The company sees no easy insertion point into the Armed Services for technology developed through military research

RECOMMENDATIONS

- Provide a liaison that would increase visibility into and across military programs by informing companies more directly regarding programs' status, participants, managers, etc.
- Assure that every program is immediately announced and that there is fair and open competition for programs



"Hit or Miss" Research Contracts

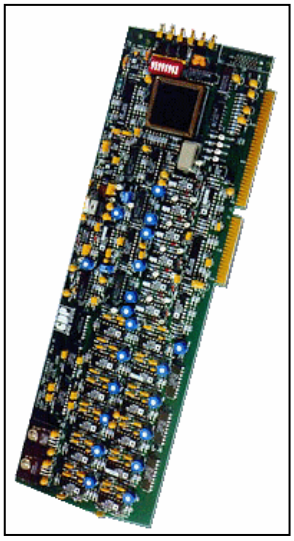
Delta Information Systems, Inc., a privately held and employee-owned business, is organized into three divisions, supplying both military and commercial customers. Delta Digital Video produces video compression, conversion, and scanning equipment; GDP Space Systems develops telemetry equipment, primarily for satellite communications; and Delta Protocol Test Solutions develops videoconferencing and Voice over IP protocol test equipment. Engineering and sales personnel are decentralized and only responsible for products within a certain division. Along with the company's low employee turnover, decentralizing these capabilities has enabled Delta to rapidly develop products and to deliver quality support to effectively service customer needs. At the same time, Delta adheres to the same standards as larger, more production-oriented organizations such as proper documentation, tight quality control, and good standardization procedures.

> ***"Small businesses offer the Department of Defense something that larger businesses don't, which is the ability to react very quickly to changes."***

The company leverages its engineering focus (75% of employees are engineers) to compete successfully for military research contracts, primarily through the Small Business Innovation Research (SBIR) program. Regarding these military research contracts, Delta feels that many technologies developed under research contracts do not often transition to an acquisition program and that companies have no way of knowing whether a research program will lead to a procurement program before dedicating valuable resources towards the research. The company believes that products developed through military research reach the soldier most effectively when the acquisition program manager is heavily involved with the process, has a desire to eventually procure a product, and has identified a military insertion point for the technology. Otherwise, afterwards, companies have difficulty developing a technology or have to expend significant resources to convince military customers to acquire the technology. For instance, Delta worked for ten years to convince Department of Defense officials that its video technology could add significant value to its unmanned programs before the technology was finally integrated into a defense program.

On the other hand, Delta was engaged through a SBIR contract to develop video conference terminals structured around Integrated Services Digital Network (ISDN) technologies. According to the company, the program manager was closely involved with the company's research efforts and had previously identified a need for the technology in the Army. Therefore, upon successful program completion, the program manager facilitated the demonstration of the

technology to officials across the Army whom he believed had a need for the technology. Technology developed through research sponsored by DoD was deployed successfully because the program manager used the research program to develop a new and innovative technology that addressed a specific military need.



However, when such conditions are absent and there is no clear path after research contracts have been fulfilled to an acquisition contract, Delta believes that there are challenges associated with executing on a research contract. For a small company, the opportunity cost of dedicating valuable and limited resources to fulfilling a research contract without the potential return from an acquisition contract is very high.

Bootstrapping Development

After research contracts have been fulfilled, if no clear and foreseeable military sales path exists and technological development is no longer supported by DoD, the company is forced to seek other means to continue to develop its technology and to generate revenues. To address this problem, Delta Information Systems' solution involves strategically allocating government research funding and opportunistically relying on the commercial market to generate sales to bootstrap technological development and future growth. The company allocates its research funding to focus on developing an eventually marketable technology. According to the company, good performance on half the available measurement criteria makes a technology more useful to the end user and easier to market and sell than does mediocre performance on all the available performance metrics. Revenue from these initial sales can then be used to fund development and improve execution along the other criteria. When technology developed under military research contracts fails to be acquired, Delta has turned to the commercial marketplace to generate these development dollars.

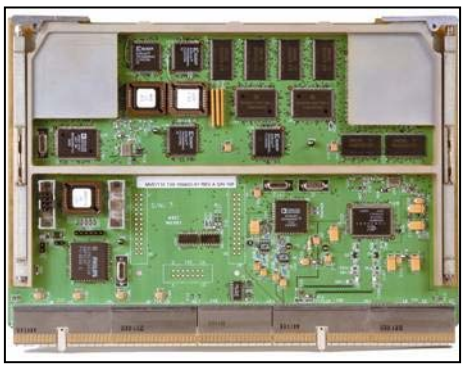
"In the DoD area, it's mostly knocking on doors. We know where the test ranges are; we know where the test programs are run out of, so we try to knock on those doors, but we probably miss 90% of what's going on ….On the commercial side, it may be possible to reach a broader audience because we can hire marketing people, hire PR people, do the whole commercial sales and marketing effort, and maybe reach a much broader audience."

For instance, in developing video compression and decompression (codec) technology under an SBIR contract for the Army, the company feels that there was not a tight, cooperative relationship between the R&D activity and the program manager that would have been necessary for a follow-on acquisition effort. As a result, the company feels like it received little direction regarding technological development, and demonstrations did not result in military sales. However, since Delta had remained focused on developing a marketable technology, it has been able to generate commercial products from the research, and has had success selling a version of the codec technology, unique amongst competing products because of its stand-alone nature and lower software

development costs. Delta has effectively transitioned its technology into security, traffic, and intelligence applications, helping the company generate revenue to move forward with development of this and other technologies.

"Golden Customers"

Technology developed by the company independent of an acquisition contract often requires a strong marketing effort to demonstrate its value when market demand for the product is not very high. In these instances, and in the case of its evolutionary technologies, Delta has marketed its products directly to customers through trade shows, conferences, contacting the major players in the sector, and other means. However, according to the company, the key to market acceptance is through a "golden customer," or a customer who helps it understand the market and build demand for its product.



Essentially, through a vendor-customer relationship, the golden customer obtains a custom-tailored product, offering improved functionality, lower costs, and discrimination from competing systems. Concurrently, Delta, a small engineering-focused firm, is able to leverage the golden customer's strong brand and sales and marketing capabilities to enter a new market and to publicize the company's technologies. This exposure is vital to growing its business and helping Delta develop its marketing and sales capabilities for the future. Additionally, and even more importantly, the golden customer educates Delta Information Systems about the new market, allowing the company to create its own marketing strategies and to expand the applications of its technology in the new market.

For example, the company currently has several customers in the broadcast radio and video market. However, prior to entering the broadcasting market, Delta had little knowledge regarding the potential applications, the market structure, the major players, etc. By working with a broadcasting vendor to understand the industry needs and how its product integrates with the vendor's system, the company was able to improve the vendor's product at a lower cost than the alternatives. At the same time it developed the market understanding, which has been crucial to successfully growing its customer base in the broadcasting market.

However, Delta feels like it is often difficult to establish similarly symbiotic relationships with the prime defense contractors. According to the company, the primes are usually very "tight-lipped" regarding their technology and its defense applications. As such, the company often has limited customer interaction and does not get the same opportunity to learn the market in order to increase sales that it does with commercial vendors. For instance, at a recent military conference, company executives discovered that a major prime contractor had integrated its technology into two airborne projects that the

company was unaware of. While the projects had increased the application of the company's technologies, the company was not given the opportunity to benefit from participation in these projects from both a publicity and market learning standpoint. The company feels like this missed opportunity would have been helpful in expanding its defense businesses in the future.

SABEUS PHOTONICS, INC.

20630 Nordhoff Street
Chatsworth, CA 91311
Phone: (818) 407-6000
www.sabeus.com

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goals:** SECDEF Goal 1: Protect the U.S. homeland and bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 3: Deny our enemies sanctuary
  SECDEF Goal 5: Use information technology to link U.S. forces
- **Products:** Telecommunications network components and pressure, temperature, and vibration sensing equipment using proprietary "cold-writing" Fiber Bragg grating technology
- **Primary military sales vehicle:** Working with prime contractors
- **Military applications:** Fiber optic towed arrays, embedded fiber optic health-monitoring systems for UAVs and composite aircraft structures, and perimeter sensing security equipment
- **Commercial applications:** Telecommunications networks, oil services, and biosensors
- **Approximate Annual Sales:** $2 million in 2002; $8 million expected in 2003
  - Currently 100% commercial, 0% military; eventually 80% commercial, 20% military
- **Employees:** 45
- **Established:** 1998

IMPORTANT POINTS

- Protracted procurement practices are not conducive to the technology-based, high-growth business model of most start-ups
- The lack of efficient communication to the small business community of specific military goals and requirements prevents rapid and cost-effective deployment of leading-edge technologies

MAJOR STRATEGIES

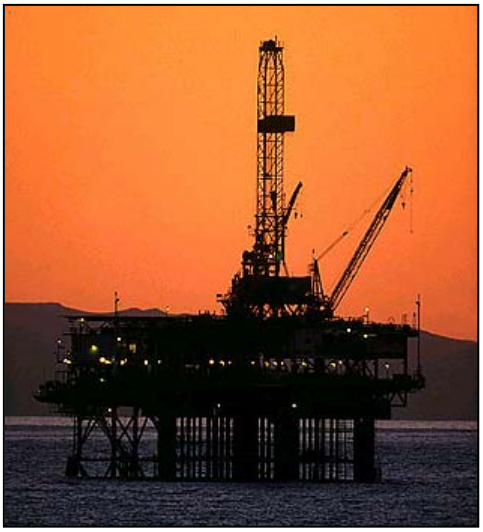
- Develop technology into commercially viable products with similar defense applications
- Establish separate business lines to focus development and sales efforts and prepare the company for a potential sale to a larger competitor
- Maximize defense-related revenues by producing entire sub-assemblies rather than components

DEFENSE CONCERNS

- Lengthy procurement cycles often make virtually all purchased technologies obsolete before use
- Limited engineering dialogue between the end user and small suppliers, as well as typical "start-and-stop" procurement practices, add significant time and cost to the product development cycle
- Prime contractors seem motivated to maximize their role in military contracts, limiting the cost-effective deployment of leading-edge and "best of breed" technologies

RECOMMENDATIONS

- Remove several layers of decision making in the procurement chain in order to expedite fielding of new technologies
- Establish communications between subcontractors, prime contractors, and end users in order to disseminate product specifications to all potential suppliers and promote "best of breed" technologies



Commercial First, Defense Second

Sabeus, like many small, technology-based start-ups, sees several applications of its proprietary technology in the defense industry. An important selection criterion for Sabeus R&D projects is the potential "dual-use" of the application in both commercial and defense operations. However, Sabeus' corporate strategy specifically follows a "commercial first, defense second" mantra that focuses product development efforts on meeting the needs of commercial end users first. Sabeus recognizes the need to quickly achieve market success with all products in order to fund development expenses. Therefore, the company greatly appreciates the ability (and preference) of its commercial customers to clearly state their technology needs upfront, quickly evaluate Sabeus' products, and promptly finalize purchase decisions. Military customers on the other hand, move too slowly, according to the company, with engineering discussions following a "start-and-stop" pattern extending over several years in many cases. "We have to pursue the commercial applications or else we won't survive."

> ***"[The commercial and military systems] are the same type of products. [The commercial product] is essentially a towed array for the commercial oil industry. We can have it produced within 12 months…but [the oil companies] want it even sooner. The Navy doesn't plan for the fiber optic towed array until 2006 or 2007," despite a recent decision to switch to fiber optics.***

Sabeus illustrates its predicament by relating the example of the company's dual-use fiber- optic pressure, temperature, and vibration sensing equipment. Sabeus' patented "cold writing" Fiber Bragg grating techniques allow the company to make optical fibers of virtually any length at a low cost, without degrading the fibers. Commercially, this technology translates into durable and cost-effective optical fiber components packaged into highly reliable sensing equipment for use in the harsh environments of oil & natural gas exploration and production. On the military side, the technology can produce durable towed arrays for naval surveillance and border security that are 10 times less expensive than traditional systems. Sabeus plans to develop this technology for oil companies within a year; the military has no plans to use it until at least 2006.

Such disparity in the pace of commercial and defense customer procurement has led Sabeus to undertake some rather unorthodox marketing gimmicks in recent months. Despite the high cost of designing and producing prototypes, Sabeus intends to send the Navy "free samples" of their fiber optic towed arrays along with axes inviting naval officers to "cut the arrays loose if

they don't like them." The Department of Defense's four to five year (or more) current timetable for such purchases is "unworkable" in the eyes of Sabeus management and the company is keen to try and change this if at all possible.

Relationship with Prime Contractors

In Sabeus' opinion, the large prime contractors are almost always motivated to maximize their participation in DoD contracts, regardless of potentially better technologies available outside of their organizations. Such behavior limits the probability that "best-of-breed" technologies are being fielded in modern war-fighting equipment. Furthermore, the large primes shy away from purchasing entire sub-assemblies from outside their organization, preferring instead to purchase components and integrate them into their system. At the same time, Sabeus believes that there is limited communication between the primes and lower-tier suppliers regarding the technical specifications required by the end user, further impairing the chances of fielding the most operationally effective product.

> ***"You're never sure if you're being used to validate an internal program or whether [the prime] needs to source something truly innovative from the outside. For the supplier, there's never any visibility to the overall product that's being engineered."***

According to the company, the solution to this problem requires drastically improving communications between the DoD and its lower-tier "sub-suppliers." With visibility to the end user and knowledge of the technical specifications on a given product, Sabeus could more efficiently spend its R&D dollars developing a technically advanced solution in conjunction with a prime contractor. Without such visibility, "a third party doesn't have much room to think ahead or be creative." In their commercial business, Sabeus can openly talk to their customers (e.g. Shell or Chevron) in order to best understand their concerns and discuss the technology. "Then we work with the people that supply [Shell and Chevron]" in order to integrate the appropriate technologies into a final product. Furthermore, "on the military side, we don't have the opportunity to discuss the overall application with the end customer." Ideally, according to Sabeus, the prime contractor would also remain an integral part of the improved communication link, although the company believes that many of the primes will require significant cultural changes before a truly effective relationship with their third party suppliers can be established.

SRA INTERNATIONAL, INC.

4350 Fair Lakes Court
Fairfax, VA 22033
Phone: (703) 803-1500
www.sra.com

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goal:** SECDEF Goal 5: Use information technology to link U.S. forces
- **Services:** Highly advanced information technology consulting and systems integration
- **Primary military sales vehicle:** As a prime or lead contractor for approximately 95% of its engagements
- **Military applications:** Strategic consulting; systems design, development and integration; outsourcing and operations management; text and data mining; contingency and disaster response planning; information assurance; and enterprise systems management
- **Commercial applications:** SRA services and solutions have similar commercial and military applications
- **Fiscal Year 2002 sales:** $361 million
  - Approximately 95% government, 5% commercial
- **Employees:** 2,100
- **Established:** 1978

IMPORTANT POINTS

- SRA was the only IT services company named by Fortune magazine as one of the 100 best companies to work for in America in 2002. This was the third consecutive year for that listing
- SRA contracts subject to re-competition are won by the company 95% of the time

MAJOR STRATEGIES

- Focus on the government IT services market
- Use IT and knowledge of the client's business to solve mission critical problems
- Leverage Government-Wide Acquisition Contracts (GWACs) and other ID/IQ contracts to expand services to various government agencies
- Use publicly listed stock and cash to acquire companies having complementary capabilities

DEFENSE CONCERNS

- Customers sometimes rely on very large contractors when medium size firms ($300M to $1B) can do the job better
- Some customers are not amenable to innovative solutions
- There are still too many large, inefficient single awards
- Customers sometimes resist outsourcing when contractors can do the job faster, better, and cheaper
- Customers sometimes have unrealistic expectations about fair reimbursement rates for top engineering talent

RECOMMENDATIONS

- Consider medium size firms with proven track records for more of the big jobs
- Encourage and support government contracting officials who are receptive to innovative solutions and technologies
- Use more indefinite delivery, indefinite quantity contracts which are much more effective and efficient for the government
- Use more outsourcing
- Realitically reward the talent required to perform difficult jobs

Technology With Multiple Pay-offs

SRA International is a publicly held information technology consulting and systems integration company that delivers services and solutions to the federal government. Founded by Dr. Ernst Volgenau in 1978, SRA has grown rapidly and now exceeds 2,100 people. The company currently focuses on three core federal markets: national security, health care and public health, and civil government. SRA views the federal government as the largest IT customer in the world and believes that the government information technology market will grow indefinitely. The company believes that as the demand for efficiency and effectiveness in government increases and as the government IT workforce ages, the IT services market will expand and SRA core business will grow.

As a result of delivering IT services to government and commercial customers, SRA has developed solutions that have government and commercial applications. A SRA solution involves methodologies, computer code, and other capabilities that make it useful in a variety of applications. SRA is currently selling solutions to many customers in the federal government and in the past has spun out several solutions as independent companies having commercial customers. Examples of SRA solutions include: text and data mining, information assurance, emergency planning and response, and enterprise system management.

During the mid 1980s and at the height of the Cold War, SRA developed natural language processing software that was capable of reading Soviet publications such as newspapers and journals. Given the political climate of the times, intelligence agencies procured this technology which became the basis for SRA text mining solution. (SRA later developed a similar capability for data mining.)

"Over the years DoD has supported the development of technology that not only contributed to national defense, but also benefited other government agencies and the U.S. economy."

After the Cold War ended and before the Internet became mainstream, SRA marketed technology to publish documents on the Internet. SRA entered into a partnership with a venture capitalist who understood the marketplace and was experienced in the software business. Navisoft was formed and eventually named as an influential company in the history of the World Wide Web. SRA has spun off three additional commercial product businesses: Picture Network International, Mail2000, and Mantas. These companies were purchased by other firms except for Mantas, which remains independent and currently provides data mining for anti-money laundering in the financial services market. These companies, and other solutions which SRA currently provides to the federal government, are examples of how DoD technology initiatives have benefited national defense, other parts of the government, and the U.S. economy.

Government-Wide Acquisition Contracts

SRA has won four out of the five largest Government Wide Acquisition Contracts (GWACs) in the information technology services space. GWACs are indefinite delivery, indefinite quantity contracts that came about as a result of government acquisition reform. Contracting begins with an initial competitive round of bidding, during which a large number of top suppliers bid for a set of awards. On one of the larger GWACs, Millennia, 25 companies bid and 12 were selected. The final twelve selected companies are now eligible to compete for around $20 to $25 billion in contracts under the Millennia program over the next five to ten years. Four additional GWACs have been issued for the IT services sector, and SRA has been selected on four of the total five. In the future, SRA intends to leverage its position on these and other ID/IQ contracts to compete for work across all the agencies of the government.

SRA believes that GWACs and other ID/IQ contracts are a highly efficient and effective contracting vehicle for the government to procure the best solutions. In many awards, which may not have been solely on defense contracts, contracting officials consult the previous clients of each bidder to judge performance. By relying heavily on prior performance, acquisition decisions are made with a clear understanding of the bidders' capabilities and the likely quality of the final deliverable. Furthermore, SRA believes that since the companies best positioned and qualified to handle a contract are the only companies bidding on the project, the military receives a better solution in a timelier fashion. GWACs also allow for cross-agency communication; they encourage a government agency to contract with companies that other agencies have identified as highly capable and qualified.

"Indefinite delivery, indefinite quantity contracts are a very efficient way of contracting as opposed to large single award contracts....ID/IQ contracts make the government sector more like commercial business in the sense that performance and technical capability are just as important as cost….We believe that ID/IQ contracts are much better for our country."

A Strong Corporate Ethic and the Importance of People

SRA believes that its success is primarily the result of its ethic – Honesty and Service – which is based on the following principles: highly ethical behavior, delivering value to clients at a fair price, helping one another, and serving our country. The Honesty and Service ethic leads to high client satisfaction and a feeling by employees that their contributions are valued.

THE INSITU GROUP, INC.

154-D East Bingen Point Way
Bingen, Washington 98605
Phone: (509) 493-8600
www.insitugroup.net

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 3: Deny our enemies sanctuary
- **Products:** Seascan and ScanEagle, the commercial and military version, respectively, of a very low-cost, extremely long-range, small unmanned aerial vehicle (UAV) that can be fitted with a custom-developed, inertially-stabilized, video imaging system or other sensor package
- **Primary military sales vehicle:** Partnership with a prime contractor
- **Military applications:** Intelligence, surveillance, reconnaissance, covert target acquisition, target laser illumination, communications relay, and search and rescue
- **Commercial applications:** Land and sea surveillance for the commercial fishing industry, as well as potentially law enforcement, environmental researchers, agriculture, entertainment, and other industries
- **Annual Sales:** $2 million
  - Ultimately 35% commercial, 65% military
- **Employees:** 12 employees and 7 on-site contractors
- **Established:** 1994

IMPORTANT POINTS

- A small, innovative company can work with a large systems integrator in a mutually beneficial manner without damage to its culture or independence
- There are people and groups within the top tier defense suppliers that understand the issues facing a small organization
- Insitu's Aerosonde became the first UAV to cross the Atlantic Ocean, with a takeoff weight of only 29.1 lb. The flight lasted just under 27 hours and the UAV used only a gallon and a half of aviation gasoline

MAJOR STRATEGIES

- Leverage low-cost, long endurance, and flexible basing capabilities to provide a unique UAV solution for commercial and military needs
- Focus first on the commercial market to build demand, secure funding, mitigate risk of supplying the military, smooth military procurement process, and finance defense initiatives
- Team with Boeing's Unmanned Systems Group to fund, market, and sell ScanEagle to military customers

DEFENSE CONCERNS

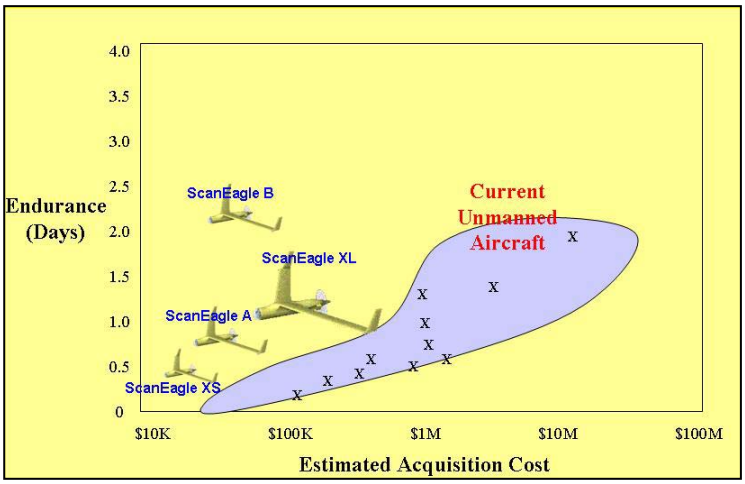
- The Department of Defense usually defines mission solutions rather than being open to a diverse array of potentially more creative solutions
- Inflexibility of large contract scheduling often promotes the acquisition of outdated technologies
- Classification of dual-use technologies for commercial and export sales is a complex process and can often significantly impede a small company's growth

RECOMMENDATIONS

- Encourage large systems integrators to work together with small companies in a symbiotic manner
- Encourage contract terms that improve small companies' ability to access private capital investment by permitting commercialization and allowing for higher profit margins
- Define missions (not solutions) and be open to innovative solutions

Strategic Product Positioning

The Insitu Group, developer of the first unmanned aerial vehicle (UAV) to cross the Atlantic Ocean, has designed and tested a highly unique UAV for both commercial and military applications. The ScanEagle, the military version of the Seascan, was developed to provide a unique, inexpensive, long-endurance UAV solution with the capacity for sensor interchangeability. With an expected list price of around $60,000 and total weight of approximately 38 pounds, a ScanEagle or Seascan will be capable of staying aloft for up to three days. Furthermore, Insitu's UAVs can be launched from land vehicles or from a land-based or ship-based catapult system, and can be recovered without damage using a patented "Skyhook" recovery system. According to the company, shipboard recovery damage of fixed-wind UAVs of different sizes has been an impediment to their use by the Navy and Coast Guard.



Insitu believes that no other UAV manufacturer provides a similar product at a similar price, and the company has been able to capitalize on its unique market positioning. Insitu has targeted non-traditional UAV markets such as the fishing industry and environmental research and has proposed highly creative solutions to military and commercial problems. For instance, Insitu proposes the idea of five different ScanEagle UAVs with five different sensor packages at a cost of approximately 5 percent of one Predator UAV. If not for the SeaScan's low-cost and long-endurance capabilities, fishing boats would not be so keenly interested in it. The Seascan can replace dangerous helicopter-based surveillance at an affordable cost and tuna fisherman are eager to acquire Seascan UAVs.

"Some vendors may complain about Mother Boeing…but they've really worked hard to be concerned about our issues. Many in the Unmanned Systems Group and the Phantom Works consider themselves as Mavericks. For example, we have noticed a refreshing willingness to try do what is right now and then later work to catch up the bureaucracy paperwork with the activity."

Insitu has achieved success to date in filling its market niche for a low-cost, long-endurance UAV because of a number of factors. Most importantly, and since it was founded, the company has focused on "delivering a low-cost, capable vehicle to the commercial side." Along the way, both Insitu and its partner, Boeing, have refused to be distracted by the numerous "committees" calling for increased functionality at higher costs and shorter endurance.

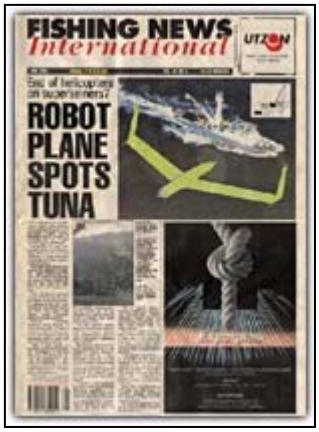
Furthermore, to achieve its low-cost and long-endurance goals, Insitu has built its vehicles with commercial-off-the-shelf (COTS) components and has developed a number of creative engineering solutions. For instance, to increase the vehicle's range and functionality, Insitu developed a technologically unprecedented stabilized video imaging system that will cost roughly one-tenth and weigh less then one-twentieth that of similar cameras currently available on the market. Insitu's strict focus on maintaining its low-cost, long-endurance market positioning despite requests for expanded capabilities has been a key factor to its success to date.

Strategic Partnership

Another important reason Insitu cites for its success to date has been its mutually beneficial relationship with Boeing. Through introductions by friends and engineers to senior management within Boeing, Insitu began a relationship with Boeing officials that eventually led to the signing of a strategic development contract. In exchange for an investment, Boeing has received certain exclusive marketing and teaming rights to ScanEagle for large military orders. Furthermore, according to Insitu, Boeing has gained access to unique capability that can restructure the way it approaches customers.

According to Insitu, when asked why Boeing did not buy Insitu outright, a senior executive in Boeing's Phantom Works replied "One, we don't want to ruin the entrepreneurial environment. Two is that if every time a small company comes to us, our only solution is to buy them, then we're not going to get a lot of small companies coming to us. And three, it's also risk mitigation….We think it's all going to work, but if we put in less money now, we get a chance to see how it all comes together."

Insitu has also benefited significantly from its relationship with Boeing. Through its venture capital relationships and as a potential acquirer, Boeing has helped Insitu enormously in accessing capital to fund the development of ScanEagle and Seascan. Insitu has retained the intellectual property rights and has been encouraged by Boeing to build commercial demand and establish its product as COTS to smooth the military procurement process. Boeing also provides Insitu access to its skilled and experienced sales force to help the small company build important industry relationships and increase demand for its UAVs. Furthermore, Insitu has benefited significantly from Boeing's understanding of the various constraints and demands of military missions. The support from Boeing and its Unmanned Systems Group has been crucial to Insitu's success. Contrary to the commonly cited concern regarding large firms acquiring smaller, more innovative firms to suppress competition, Boeing chose to not immediately acquire Insitu and has been sensitive to Insitu's need to maintain its niche focus and innovative culture. In fact, Insitu's offer to move its headquarters closer to Boeing was declined in order to keep Insitu's high-tech and fast-paced culture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independent of Boeing. Insitu gives Boeing a great deal of credit for understanding the challenges it faces and helping develop an important technology without damaging Insitu's innovative culture.

VANU, INC.

Porter Square Galleria
1 Porter Square, Suite 18
Cambridge, MA 02140
Phone: (617) 864-1711
www.vanu.com

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goals:** SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
  SECDEF Goal 5: Use information technology to link U.S. forces
- **Technology:** Vanu supplies Software radio (SWR) software. SWR implements all signal processing for a wireless device through software, including the physical layer. This allows one device to interoperate with a variety of waveforms, such as tactical analog voice, tactical digital voice and data, video, SATCOM, etc.
- **Primary military sales vehicle:** Through prime contractor
- **Military applications:** Solving interoperability problems for military wireless devices, coalition operations, and interactions with civilian and public safety wireless systems. Rapid operational capability upgrades through waveform software downloads in the field for communications and surveillance equipment. Reducing acquisition and deployment costs for new waveforms.
- **Commercial applications:** Solving interoperability problems for commercial and public safety wireless devices through multifunction mobile units and multistandard field-upgradeable base stations. Eliminating standards lock-in for users. Reduced infrastructure costs through use of high-volume COTS hardware.
- **Approximate sales composition:** 50% commercial, 50% government (Department of Defense, Department of Justice, Missile Defense Agency, National Science Foundation, intelligence agencies)
- **Employees:** 25
- **Established:** 1998

IMPORTANT POINTS

- Vanu Inc. has developed and demonstrated systems (laptop, rackmount, and handheld) that receive and transmit a variety of waveforms, including civilian cellular voice and data (GSM, TDMA, CDMA, AMPS, Mobitex), APCO 25 for public safety, FRS, legacy AM and FM
- Vanu Inc. has also developed and demonstrated a GSM cellular telephone base station

MAJOR STRATEGIES

- Focus initially on niche markets to prove and improve software radio to expand its application base
- Market software radio by demonstrating to customers and beginning a dialogue with the end user regarding how software radio can meet their needs
- Cultivate relationships with military suppliers to integrate software radio into military products and programs

DEFENSE CONCERNS

- Defense niche markets are rare and it is difficult for a revolutionary technology to find early adoptrs
- Contract rate calculations methodology is unsuited for rapidly growing businesses
- End user uninvolved in procurement process, which reduces DOD ability to recognize the operational value of innovative approaches

RECOMMENDATIONS

- Provide agencies small prototyping budgets – i.e. establish smaller procurement programs with a more streamlined process to allow small companies to compete for prime contracts
- Involve operations personnel in the procurement process
- Have a separate, simpler, and more flexible contract pricing system for smaller and more dynamic companies

"The Innovator's Dilemma"

Vanu Bose formed Vanu, Inc. in September 1998 to commercialize the software radio research that formed the basis of his PhD thesis at the Massachusetts Institute of Technology. Vanu, Inc. supplies software that carries out all the signal processing for a wireless device, allowing a single device to support many different communications standards. Using Vanu, Inc.'s software, a wireless device for the commercial market can be re-programmed to act as an analog cellular phone, digital PCS phone, cordless home phone, wireless data network, or garage door opener. Moreover, Vanu, Inc. builds portable software that exploits standard high-volume processor chips and software engineering tools, so manufacturers benefit from reduced development cycles and an increased rate of component improvement over time.

Such a technology could revolutionize the wireless communications industry. However, Vanu Inc. faces what Clayton Christensen, Harvard Business School professor and author, has termed the "Innovator's Dilemma." When a disruptive technology appears, its success is initially held back since customers use traditional performance metrics to compare the technology to established products, metrics which do not capture the new value offered by the technology. To overcome this, a company must focus on a niche market that requires the new features of the technology and can tolerate its shortcomings, until the technology has developed to the point that it does well on traditional metrics as well. Even in such a market, it is necessary to identify "early adopters" who recognize and who will invest to realize the significant long-term benefits that can come from the new technology.

In the case of software radio using portable software, the new benefits are the flexibility to support multiple waveforms and a radically reduced cost to develop and deploy new waveforms, while the current shortcomings are reduced battery life and increased size/weight. Traditional metrics for radios do not consider flexibility or reduced waveform cost, so the technology will lose in any procurement competition that uses those metrics.

Vanu, Inc. targeted public safety and surveillance as early niche markets for its technology. Many of the communications devices used in these markets have access to line power. For mobile devices, these customers' critical need for rapid and cost-effective waveform development and deployment frequently outweighs their need for long battery life and minimum size. Vanu, Inc. is using revenue from sales in these niche markets to fund ongoing development until the technology satisfies the needs of a wider market.

Military applications of software radio using portable software have not yet been fielded. For military applications, the innovator's dilemma is a particularly significant challenge, so it is vital to identify and work with "early adopters" in the Department of Defense.

White Knights and Internal Champions

The U.S. military recognized the strategic importance of software radio in the 1990s, and set up the Joint Tactical Radio Systems Joint Program Office (JTRS JPO) as a central point of standardization and software acquisition.

As one of the research leaders in the software radio field, Vanu, Inc. was asked in 1998 to participate in JTRS Step I by both consortiums competing for the contract. Vanu was selected for a significant role in one of the consortiums despite the fact that it was a 6-person company at the time. The company believes this was a direct result of the fact that the JPO pushed its suppliers to look for innovative solutions.

> ***"For a small company to get a contract at any level directly from the DoD, it takes a high level champion. Going through the normal contracting process, you're going to get weeded out due to the risk analysis part of the process. It's the 'nobody ever got fired for choosing Motorola or Raytheon' argument. So it takes a vision at the top that says 'we need something different, let's go out and find it.'"***

Eventually, Vanu, Inc. was selected as one of the four JTRS Step IIb prime contractors by the JPO. Vanu Inc. attributes its success at this stage primarily to the efforts of a white knight, or internal champion, within the JPO. This leader saw that the high potential value to the Department of Defense justified making a relatively small direct investment in Vanu's technology, alongside the much larger investment the JPO was making in the technology offered by the large primes. Without its white knight, Vanu, Inc.'s software radio solution would have likely been passed over because of the risk associated with contracting with a smaller, lesser-known company, even though it may have a ground-breaking solution.

Because of its direct contracts with the JPO, Vanu, Inc. is now recognized in the JTRS field. The company draws on the expertise it developed in its JPO contracts to help build supplier relationships with the large primes developing JTRS-compliant radios for the military and other markets. Vanu's success in breaking into this field is a good example of "vision at the top."

ZAPLET, INC.

3000 Bridge Parkway
Redwood Shores, CA 94065
Phone: (650) 620-2900
www.zaplet.com

- **Operational Effects-Based Sector:** Integrated Battlespace
- **Transformational Goals:** SECDEF Goal 5: Use information technology to link U.S. forces
  SECDEF Goal 1: Protect our homeland and our bases overseas
  SECDEF Goal 2: Project and sustain power in distant theaters
- **Product:** An enterprise management software platform that enables Appmails: secure, collaborative, task-based, live software applications presented in users' email inbox
- **Primary military sales vehicles:** Primarily GSA schedule, sometimes with a systems integrator
- **Military applications:** Automating military processes, enabling cross-agency information sharing, improving organizational transparency, and managing secure collaborative military projects
- **Commercial applications:** Enabling and facilitating the monitoring and management of human interaction in business processes such as sales force automation, recruiting, supply chain management, etc.
- **Approximate annual sales:** $1 million
  - Approximately 2/3 government, 1/3 commercial
- **Employees:** 50
- **Established:** 1999

IMPORTANT POINTS

- Zaplet is supported by In-Q-Tel through a licensing agreement for use of its technology in the Central Intelligence Agency
- The Appmail system helps transform large organizations by improving task transparency and by enabling secure process collaboration

MAJOR STRATEGIES

- Leverage its relationship with In-Q-Tel to sell to other government agencies with funding and under heavy pressures to collaborate
- Market its enterprise software to areas where little customization and support services are required
- Use customer feedback to refine the product and enhance functionality

DEFENSE CONCERNS

- Identifying and dialoging with military acquisition decision makers is difficult
- The military sales cycles are very slow and difficult for a start-up to manage
- Technological standards compliance is a costly, lengthy, and complex process
- Military sales efforts are frequently redundant
- Security clearance process is lengthy and slow

RECOMMENDATIONS

- Improve visibility into acquisition timelines for start-up firms
- Accelerate the procurement process by creating a separate process for short lifecycle technologies
- Adopt the In-Q-Tel model from the CIA
- Implement a new type of trade show, which gives companies more significant access to senior level officials
- Centralize requirement briefings and help partner smaller companies with systems integrators

A Software Start-up

Zaplet, inc. began when founders David Roberts and Brian Axe recognized the deficiencies in internet collaboration through the attempt to use net-based technologies to make group decisions. The company was initially focused on being a consumer services organization, leveraging its Appmail System™ as the core of an internet based service similar to Yahoo or America Online. However, over time, the company began to question the subscription and ad-based revenue model and eventually shifted its focus to providing enterprise software to the business environment. Currently, the company is targeting both commercial and government applications to deliver its collaborative process and actionable information management software. Government early adopters include defense agencies and the intelligence community.

The company began in a Stanford University incubator called Reactivity in 1999 and received initial venture funding from Kleiner Perkins Caufield & Byers. Since then, the company has raised approximately $100 million in private capital through three rounds of funding involving strategic and financial investors. Through October 2000, the company had raised capital in three different rounds of financing.

In-Q-Tel Relationship

In January 2002, Zaplet announced the signing of a licensing agreement with In-Q-Tel, the technology venture group funded by the Central Intelligence Agency. Under the agreement, In-Q-Tel uses the Zaplet Appmail System™, is piloting Zaplet technology at the CIA, and holds the Appmail enterprise license. According to the company, In-Q-Tel formed a strategic relationship with Zaplet through a product development agreement, license agreement, and a small equity stake.

> ***In regards to In-Q-Tel: "they have enormous flexibility; they have speed; communicating with them, I think, is much simpler. On our side, we don't necessarily have a lot of government experienced people to be communicating with the government, and as you guys know, there's just a language, a set of acronyms, in the process. I think it's been really helpful for us."***

Zaplet believes that the CIA's model of In-Q-Tel, an independent organization that understands the challenges companies face working with the government, is very successful and recommends that the Department of Defense consider establishing a similar organization. In-Q-Tel is an independent, non-profit corporation with employees experienced in investing in and building successful companies and a team of technology subject matter experts and practitioners. The organization has locations in Washington D.C. and Silicon Valley, and according to the company, it has the flexibility, speed, and commercial experience necessary to streamline

relationships with companies with the potential to serve the national security market. As such, In-Q-Tel seeks out and screens advanced information technologies to identify companies with commercial technologies or products that can be applied to CIA's priority needs.

Companies identified by In-Q-Tel are then introduced to the In-Q-Tel Interface Center (QIC) for introduction within the Agency. QIC is the CIA-staffed interface that links In-Q-Tel to the CIA by developing the problem set In-Q-Tel uses to identify solutions and by actively working with CIA users to introduce In-Q-Tel-identified solutions. According to the company, QIC is its primary contact and supporter in the CIA. Through its understanding of the technology adoption process, QIC and In-Q-Tel work through technological transfer issues with Zaplet and gather feedback from users and pilot programs in the Agency so Zaplet can direct its efforts toward developing its products to meet customer demands.

Zaplet's relationship with In-Q-Tel has benefited the company in a number of ways in addition to introducing the technology to decision makers and users at CIA. Through In-Q-Tel, Zaplet has identified other government and military organizations with significant funding and under considerable pressures to collaborate. According to the company, these new markets are good strategic targets for further sales of the Appmail System™. In-Q-Tel has also helped the company demonstrate its technology to government and military clients, saving it the time and resources necessary to reach initial demonstrations. On the whole, Zaplet believes that the In-Q-Tel model has been extremely beneficial in helping it deliver its unique collaborative business process software to the government and to the military.

GSA Schedule

Zaplet has encountered a number of difficulties listing its software products on the GSA schedule. According to the company, as it is not large enough to hold its own schedule, the company must list its product on a third party's schedule and pay a listing fee of between 10% and 15%. Additionally, since government agencies frequently buy from multiple specific schedules, the company believes there are a number of schedules it must list on to reach its target market. To deal with this issue, Zaplet hired an outside consultant in order to identify and join these schedules.

> ***"If we had been required to be on a GSA schedule before we could sell at all, we probably would not be where we are today with respect to the government, in the sense that, I suspect, even as of today, we would not have a single sale done with the government."***

> ***"The technologies that are really transforming or can allow you to leapfrog your current technologies don't fit into these standards, and we're one of those….and so when you don't fit the standard, you're trying to make a round peg fit into a square hole."***

The entire identification and listing process, one the company found extremely expensive and laborious, lasted over six months. Zaplet also encountered difficulty pricing its software since in commercial applications its product is

value-priced based on the size and scope of the software implementation. According to the company, this made it difficult to set a standardized price, and it may eventually lead to lower returns and missed opportunities.

SUMMARIES OF BEST PROGRAMS

(SUBMITTED BY THE BOEING COMPANY, GENERAL DYNAMICS, LOCKHEED MARTIN, NORTHROP GRUMMAN, RAYTHEON, AND DARPA)

– FASTEST TO FIELD –

BOEING	JOINT DIRECT ATTACK MUNITION (JDAM)
GENERAL DYNAMICS	STRYKER
LOCKHEED MARTIN	THE SKUNK WORKS
NORTHROP GRUMMAN	GLOBAL HAWK
Raytheon	ADVERSE WEATHER GBU-15 ENHANCEMENT PROGRAM (EGBU-15)
DARPA	PHRASELATOR

JOINT DIRECT ATTACK MUNITION (JDAM)

Steve Wingfield
JDAM Business Development Manager
(636) 925-4197
steven.l.wingfield@boeing.com

The Joint Direct Attack Munition (JDAM) Program has leveraged transformational acquisition practices to become one of the fastest to field weapons programs in history. The JDAM guidance set converts unguided gravity bombs into near-precision weapons by adding inertially guided, Global Positioning System (GPS) aided controllers in the tail kit. JDAM's combat performance has radically transformed aerial warfare's focus on combat effectiveness from multiple sorties per target in daylight under fair weather conditions to multiple targets per sortie 24 hours per day under all weather conditions. This paradigm shift was allowed by considerable improvements in accuracy, operational flexibility, reliability, supportability, and most importantly, affordability that all exceeded the Government's requirements. JDAM's combat successes have transformed the way we plan and fight wars. Newly developed tactics now allow bombers to perform Close Air Support, allowing Ground Forward Air Controllers to direct JDAMs to targets for real-time targeting with minimal collateral damage. The demonstrated flexibility, accuracy and reliability of JDAM enables planners to prosecute more targets with less risk to aircrews and ground forces, using any US bomber and most types of tactical aircraft.

Contributing to JDAM's success, acquisition fast-track reforms and pilot programs have allowed JDAM to concurrently become one of the most responsive programs in DoD. No other major weapon system has been fielded as quickly or as successfully as JDAM. From mid 1991 when JDAM was first conceived to its outstanding combat successes in Kosovo, JDAM enjoyed unmatched support throughout its accelerated acquisition processes. As an Acquisition Reform Pilot Program (the only one of 6 lightning bolt programs to survive and flourish), JDAM has enjoyed unprecedented partnering with the Government and industry. Boeing remains the sole source for JDAM only by meeting its Production Price Commitment Curve (PPCC) arrangement with the government for the first eleven production lots, demonstrating continued performance and reliability, and meeting all delivery commitments.

A key enabler in Boeing's ability to meet the PPCC promise was Boeing's ability to spiral in technology insertions, reducing the risk to the government of the design changes by offering a 20-year warranty. Boeing has sustained its commitment to the

PPCC and has delivered every JDAM on time at the agreed upon price. The JDAM PPCC has allowed unforeseen contractual flexibility to provide additional weapons as required by operational expenditures during Operations Allied Force, Southern Watch, and Enduring Freedom to meet National Command Authority requirements.

When the unexpected war on terror drove the need for increased procurement, the entire JDAM Team (Government, Boeing, and JDAM suppliers) jumped into action to accelerate production. In September 2001, the JDAM team produced approximately 700 units. In October 2002, the JDAM Team produced over 2200 JDAMs. Application of DFMA and Lean Manufacturing techniques have provided high speed and high quality production and allowed JDAM and its suppliers to respond to dramatic production increases. The performance based, long-term relationship strategy with the JDAM suppliers has been another enabler in the success of the JDAM program.

All teammates are committed to performance expectations and to sustaining current suppliers as long-term partners in the JDAM program. The strong JDAM Team commitment, along with acquisition streamlining, has provided JDAMs to the warfighter more quickly and at a higher reliability than ever expected. This commitment provided unprecedented production acceleration to meet National Security needs that called for the doubling in one year of an inventory that took 4 years to build.

STRYKER

GENERAL DYNAMICS

Robert L. Earl
Staff Vice President, Strategic Planning
(703) 876-3516
bearl@gd.com

The US Army Stryker wheeled combat vehicle program has broken the traditional acquisition cycle paradigm and provides a baseline from which to model the transformation of the Defense Industrial Base. In essence, the Program is serving as a catalyst to simultaneously evolve acquisition policy as well as development and fielding processes to reduce the time between contract award and providing a new capability to combatant commanders. While there are discrete innovative elements within each of these program activities, five common themes form a core of positive change:

Commercial-Off-the-Shelf (COTS) Approach

The leveraging of existing or mature technologies that can be rapidly modified to address emerging requirements reduces development risk and production timelines. For Stryker, the LAV III design and production base provided facilities to produce vehicles while higher capacity facilities ramped up. This product line allowed existing suppliers to qualify more sources, expanding the supplier base. In addition, this effort focused R&D products on likely production programs such as the Low Profile Turret Advanced Technology Demonstrators (ATDs), enabling them to quickly transition to a full development phase.

Integrated Product Team (IPT) Culture

The Stryker management hierarchy has fully embraced the use of integrated product and process teams to resolve the full spectrum of requirements, technical, program and production issues. This cooperative solution-focused environment includes membership from the full customer and industry spectrum, minimizing miscommunication in both vision and execution. One key benefit has been the broad concurrent engineering of the product and logistics infrastructure for this multi-variant family of vehicles.

Shared Customer-Contractor Commitment

All of the program stakeholders are focused on reducing the time-to-market for the product. Coupled with effective IPTs, this encourages innovation and compromise to

get the best available solutions with the most cost effective value-added features. Examples include joint industry-Government efforts to develop solutions meeting C-130 transportability criteria.

Extensive use of Modeling and Simulation

These tools have directly contributed to drastically reducing the expensive cycles of soldier / user-to-engineer input, configuration control of design / product interfaces, and product improvement. The result is a better product to the fielded unit the first time.

Parallel Testing and Fielding

This initiative specifically supports moving beyond the traditional concept-prove-design-test-field phased acquisition approach. While still meeting strict safety and performance requirements, the first fielded units are included in the test regime and provide continuous feedback to engineering and production. This product input is coupled with parallel developmental testing. The approach has allowed the fielding of more than 200 vehicles within 20 months after start of work – one of the fastest-to-field programs in company history.

THE SKUNK WORKS WAY - A MODEL FOR TRANSFORMATION

Mr. Gus Villanueva
Director, F-117 Program
(661) 572.7732
gus.villanueva@lmco.com

For the past sixty years, Lockheed Martin's Advanced Development Programs organization (or "Skunk Works") has demonstrated a unique ability to rapidly prototype, develop and produce a wide range of highly advanced aircraft for the U.S. armed forces and intelligence agencies. These include the P-80, U-2, F-104, SR-71, and more recently, the F-117 stealth fighter. These programs vary in terms of type of contract, technologies, customer, contracts, specifications, support requirements, and other parameters. However, there are some general characteristics that emerge:

- Requirement for new technology breakthroughs
- Need to rapidly field a new capability
- Willingness to accept risk – contractor and customer
- Use of prototyping to reduce development risk
- Low rate and low quantity production
- Need and/or desire to maintain tight security
- Specialized management methods required and accepted
- Small, focused integrated program teams - customer, prime contractor and subcontractors

The Have Blue stealth technology demonstrator and F-117 stealth fighter are two programs that illustrate these characteristics. Following initial technology development and radar cross section (RCS) model testing, two Have Blue technology demonstrator aircraft were successfully developed and flight-tested under an accelerated DARPA/USAF program. First flight was accomplished in 20 months, and the two aircraft flew 88 test flights over 18 months. Have Blue validated that breakthrough VLO signatures could be successfully integrated into a fighter-type aircraft. The program was accomplished for $43 million (TY$) including $32.6 million DARPA/USAF funds and $10.4 million Lockheed funds.

The success of the Have Blue program led to development and production of the F-117 – an operational aircraft with full avionics, weapons and systems that met specific USAF

requirements. The first of five development test aircraft was initially test flown on June 18, 1981 – only 31 months from go-ahead. With the exception of breakthrough stealth technologies, overall utilizing many proven systems from existing aircraft mitigated F-117 development risk. Total development cost for the F-117 was $2 billion (TY$), including the initial full-scale development; follow-on development of system upgrades and some USAF related costs. Total procurement cost for the 59 production aircraft was $4.2 billion. The average unit flyaway cost was $42.6 million including GFE with a peak rate of 8 aircraft per year. This is favorably comparable to other twin-engine fighters of the era.

Those are the details that define this program that was developed, was produced, went into service, and was fully supported on a streamlined schedule. The Skunk Works philosophy and a willing partner for a customer allowed industry to apply this set of rules to this program. These rules are also applicable to a range of Defense Department (DOD) programs, and could be used to approach the DOD goal of reducing procurement cycle time by half. C. L. "Kelly" Johnson established the rules, and these are those rules with clarification or addition through the years of experience of applying them:

(1) The program manager must be delegated practically complete control of his program in all aspects. He should report to a division president or higher. She must have the authority to make decisions quickly regarding technical, finance, schedule, or operations matters.
(2) Strong but small project offices must be provided both by the military and industry. The customer program manager must have similar authority to that of the contractor.
(3) The number of people having any connection with the project must be restricted in an almost vicious manner. Use a small number of good people, on the order of 10 to 25 percent of a so-called normal allocation to a program. Bureaucracy makes unnecessary work and must be controlled brutally.
(4) A very simple drawing and drawing release system with great flexibility for making changes must be provided. This permits early work by manufacturing organizations, and schedule recovery if technical risks involve failures.
(5) There must be a minimum number of reports required, but important work must be recorded thoroughly. Responsible management does not require massive technical and information systems.
(6) There must be a monthly cost review covering not only what has been spent and committed but also projected costs to the conclusion of the program. Don't have the books ninety days late and don't surprise the customer with sudden overruns. Responsible management does require operation within the resources available.
(7) The contractor must be delegated and must assume more than normal responsibility to get good vendor bids for subcontracts on the project. Commercial bid procedures are very often better than military ones. Essential

freedom to use the best talent available and operate within the resources available.

(8) The inspection system as currently used at the Skunk Works fulfills the needs of both Air Force and Navy. This system should be used on new programs. Push more basic inspection responsibilities back to the subcontractors and suppliers. Don't duplicate so much inspection. Even the commercial world recognizes that quality is in design and responsible operations, not inspection.

(9) The contractor must be delegated the authority to test his final product in flight. She can and must test it in the initial stages. If she doesn't, she rapidly loses the competency to design other vehicles. Critical, if new technology and the attendant risks are to be rationally accommodated.

(10) The specifications applying to the hardware must be agreed to in advance of contracting. The Skunk Works practice of having a specification section stating clearly which important military specification items will not knowingly be complied with and reasons, therefore, are highly recommended. Standard specifications inhibit new technology and innovation, and are frequently obsolete.

(11) Funding a program must be timely so that the contractor doesn't have to keep running to the bank to support government projects. Rational management requires knowledge of, and freedom to use, the resources originally committed.

(12) There must be mutual trust between the military project organization and the contractor with very close cooperation and liaison on a day-to-day basis. This cuts down misunderstanding and correspondence to an absolute minimum. The goals of the customer and producer should be the same: Get the job done well.

(13) Access by outsiders to the project and its personnel must be strictly controlled by appropriate security measures. This is a program manager's responsibility even if no program security demands are made. It's a cost avoidance measure.

(14) Because only a few people will be used in engineering and most other areas, ways must be provided to reward good performance by pay not based on the number of personnel supervised. Responsible management must be rewarded, and responsible management does not permit the growth of bureaucracies.

The success of this approach to program management is that it provides an environment that fosters individual creativity and innovation within both the contractor and customer organizations. The Skunk Works has demonstrated a consistent ability to prototype, develop and produce highly advanced systems in minimum time and at an affordable cost. These rules, though simply stated, are as applicable today as they were when Kelly created the Skunk Works and wrote the rules in 1943.

GLOBAL HAWK

Dr. Matthew W. Ganz
Vice President, Strategy & Technology
(310) 332-7298
ganzma@northropgrumman.com

Background

In 1994, OSD developed a strategy for a series of unmanned systems defined as Tier II, Tier II Plus, and Tier III Minus. Tier II was competed in 1993 and was won by the General Atomics Predator system. The Tier II Plus and Tier III Minus systems were intended to provide a balanced ISR capability for highly survivable penetrating missions (Tier III Minus) and moderately survivable high altitude long endurance missions (Tier II Plus). Tier III Minus was a sole source award for the Lockheed Dark Star system, and Tier II Plus was competed and won by the Teledyne Ryan Aeronautical (TRA) Global Hawk system. Northrop Grumman acquired TRA in 1999.

Procurement Approach

Global Hawk was a Section 845 (other transactions authority) procurement. The entire contracting process was highly streamlined, and the only firm requirement was the unit flyaway price (UFP) of $10M averaged in '94 dollars for vehicles 11 through 20, assuming a continuous buy rate of 2, 8 and 10 for the development, LRIP and 1st production lot respectively. With an objective of maximizing military utility, all performance parameters were expressed as goals, and could be traded to maintain the $10M UFP.

ACTD Approach

Northrop Grumman's response to the DARPA solicitation was:

- A low risk strategy of an experienced team, off the shelf technology, early test philosophy and growth margin.
- An integrated product development approach whereby DARPA, the USAF, the prime contractor, and all of the subcontractors were represented on the various IPTs, which were given complete developmental responsibility, authority, and accountability
- Value added application of the DoD specifications and acquisition regulations
- Minimal reviews – all the key people were already involved
- A stand alone Business Unit to avoid unnecessary internal and external oversight
- Accomplishments:
    - ATP May '95
    - 1st machined fuselage frame Oct/Nov '95
    - Roll-out Oct 96 - 17 months from go-ahead

- 1st taxi Oct 97
- 1st flight Feb 98

} **Delayed ~ 6 months due to Dark Star accident**

- Development of entire system including production of 2 Air Vehicles, 2 Ground Segments and the complete Payload System for ~$230M
- Zero requirements creep

Military Utility Assessment: Global Hawk's Military Utility Assessment (MUA) accomplishments are summarized in the following graphic.

Transition to USAF and Spiral Development

As the ACTD program neared completion in 1998, planning for transition from DARPA to the USAF began. Continuity of funding during the 2-year period of transition (1999 through 2001) was a critical issue that needs to be addressed for all ACTD programs. This was finally resolved when the USAF funded the program in 2001. The program was recognized as a transformational initiative, and development of the Global Hawk system is now being accomplished using the Spiral Development approach.

Summary: The Section 845 Other Transactions Authority allowed Global Hawk to be developed in record time at an affordable cost. The joint Government/Contractor team maintained focus on UFP, and controlled requirements. The contract was simple, flexible and permitted the use of commercial and other non-standard procurement practices. Without adequate bridge funding, transition to the USAF was difficult, but has now been completed. The new Spiral Development approach allows the incorporation of new system capabilities at an affordable pace with minimum program risk.

ADVERSE WEATHER GBU-15 ENHANCEMENT PROGRAM (EGBU-15)

Darryl B. Kreitman
Director, System and Concepts Integration
(703) 284-4319
dbkreitman@raytheon.com

EGBU-15 is an all-weather upgrade (adds INS/GPS) of inventory GBU-15s (2000 lb. standoff precision glide bomb).

Citing an urgent and compelling need, the Air Force Chief of Staff, directed an adverse weather capability for the GBU-15 to address a critical shortage of adverse weather weapons during Operation Allied Force (Kosovo). Raytheon designed, developed and delivered 50 operationally capable weapons in June 1999, less than 45 days from contract award. The first 50 upgraded EGBU-15s precision weapons were delivered to the Air Force less than 45 days after contract award. In a very fast paced environment, the government selected Raytheon's EGBU-15 immediately available design, then Raytheon produced 54 weapons, completed initial aircraft integration, flight tested the weapons, and delivered operationally capable weapons to the Air Force. Raytheon empowered the team and team leader to make decisions, moved them onsite with the Eglin AFB customer for the entire development, test and fabrication period. As a result, the team delivered their high quality product meeting an extremely important milestone.

During the test program the F-15E pilots and Weapon System Officers were ecstatic about the weapon's capabilities. The program office was delighted that Raytheon was so responsive, as well as performing on schedule and cost. As a result, Raytheon and its teammate, ASEI, were awarded a follow-on $46.3M contract to modify 1206 additional GBU-15s to EGBU-15 configuration.

Raytheon's performance demonstrated that the company and a dedicated group of engineers and managers, teamed with the warfighter, could react to our customer's urgent and compelling requirement and quickly deliver a critically needed operational capability.

PHRASELATOR

Lt Col James D. Bass
USA, Program Manager, Babylon
jbass@darpa.mil

The order came down: "Medical personnel in foreign locations providing humanitarian aid require the ability to select English medical phrases that would then be mapped to a recording of the same phrase in the required language. This technology must be robust enough to operate in military environments." As a result, DARPA initiated a Small Business Innovation Research (SBIR) effort to advance portable and hand-held translation technology. DARPA solicited SBIR performers to tackle the problem. From the pool of potential organizations came one with a novel idea and a crack team of experts.

Marine Acoustics International (MAI) and principal investigator, retired SEAL Ace Sarich, proposed not only performing the task, but taking the technology two steps further. MAI proposed eliminating the requirement to select phrases. Instead, the researchers proposed to develop translation technology with the ability to perform noise-robust automatic speech recognition, and to expand the domain from just medical support to an adaptable toolkit format supporting any military domain, including force protection and humanitarian support (refugee reunification).

This innovative proposal represents the very spirit and essence of the SBIR process. Over the next 12 months of the Phase I effort and the first year of Phase II, MAI moved through three major platform generations, from notebook platform, to Pentium-based wearable, to handheld Personal Digital Assistant. During this time, in addition to hardware changes, MAI improved the automatic speech recognition and optimized the user interface for field operations.

As the technology matured, MAI provided prototype systems to U.S. Navy and U.S. Army organizations in the Gulf region for maritime intercept operations, and to units in Kosovo for force protection and medical support.

Through coordination with Unified Combatant Command science advisors, we were able to capture critical user requirements and build a case for eventual procurement requirements for transition to a Service or joint program office.

The system participated in a force protection scenario in a training exercise in September 2001.

DARPA Director Tony Tether then called for rapid insertions of the new technology in support of Operation Enduring Freedom. The SBIR team–now called the "Phraselator" team–proposed to deploy a robust tactical Phraselator system with U.S. forces in Afghanistan to support medical triage, force protection, and refugee reunification.

The program was approved for a 10-month, high-risk/high-payoff technology insertion effort known as rapid multilingual support (RMS). In 89 days, the first prototypes were built, stress-tested, and loaded with all 3 mission packages supporting the languages of Pashto, Dari, Urdu, and Arabic. Less than a month later, 28 systems were delivered to the operational area, including the embassy in Kabul. The prototypes – with coordination from the science advisors and local military staff – were delivered with formal training sessions and a toolkit that allowed 2 modifications of mission packages and the addition of new languages. While in the field, the Phraselator team created 2 completely new mission packages using the toolkit. The new packages were then used for detention facility operations and special local medical missions. The team was in-theater a total of 4 weeks.

An additional 30 next-generation prototypes are being delivered to the operational area plus other regions as mission requirements dictate. Planned prototype production is approximately 500 units based on expected expenditure rates. The Navy is separately funding an additional 250 units that will incorporate a more advanced CPU and noise-canceling and power management technologies. As of June 2002, program officials have been supporting the establishment of a joint program office for continued development and first article delivery. The mission needs analysis is complete, and transition efforts are continuing.

– MOST IMPORTANT/INNOVATIVE –

BOEING	UHF FOLLOW-ON (UFO)
GENERAL DYNAMICS	SSGN
LOCKHEED MARTIN	ATLAS V/EVOLVED EXPENDABLE LAUNCH VEHICLE
NORTHROP GRUMMAN	AFFORDABLE MOVING SURFACE TARGET ENGAGEMENT (AMSTE)
Raytheon	DD (X)
DARPA	CONTROL OF AGENT BASED SYSTEMS (COABS)

THE UHF FOLLOW-ON (UFO) PROGRAM

Marty Weekley
Program Manager, UHF Follow-On Program
(310) 416-5505
marty.weekley@boeing.com

The UHF Follow-On Program provides satellite-based tactical global communications for the joint services and other Department of Defense users. Boeing Satellite Systems is the prime contractor under a fixed price contract with the US Navy to provide 11 satellites. The contract is managed by the Space and Naval Warfare Systems Command (SPAWAR).

This program exemplifies an innovative acquisition approach, effective government-contractor teamwork, and a flexible implementation which accommodates evolutionary development of capability.

Innovation

Since its inception in 1988, the program has been an outstanding example of acquisition reform. The US Navy implemented a performance-based specification and allowed the contractor to utilize commercial designs and processes to the extent practicable. This permitted the procurement to be conducted under a fixed price contracting arrangement and resulted in significant cost savings to the Navy. Boeing utilized the commercial Boeing 601 spacecraft bus, modified to provide radiation hardening as required by the application. Commercial processes, tailored where appropriate, were utilized throughout the program.

Building on its experience in the commercial arena, Boeing offered satellite "delivery-in-orbit". Under this approach, the contractor takes responsibility not only for building the satellite, but also for procuring launch services, managing satellite-launch vehicle integration, and performing on-orbit testing. Only when the satellite is demonstrated to be fully compliant with all requirements is it formally delivered to the Navy. Under the terms of the fixed price contract, Boeing is incentivized to produce a high quality product through on-orbit incentives.

Teamwork

Program success is due in large part to the excellent working relationship among Boeing, the Navy, and the various support contractors which provide technical services to the government. Government-Contractor Integrated Product Teams (IPTs) have been used throughout the program to provide the Navy insight into technical issues and program status. This arrangement has provided the government the insight needed to effectively manage the procurement, while enabling Boeing to successfully perform under the fixed price contract.

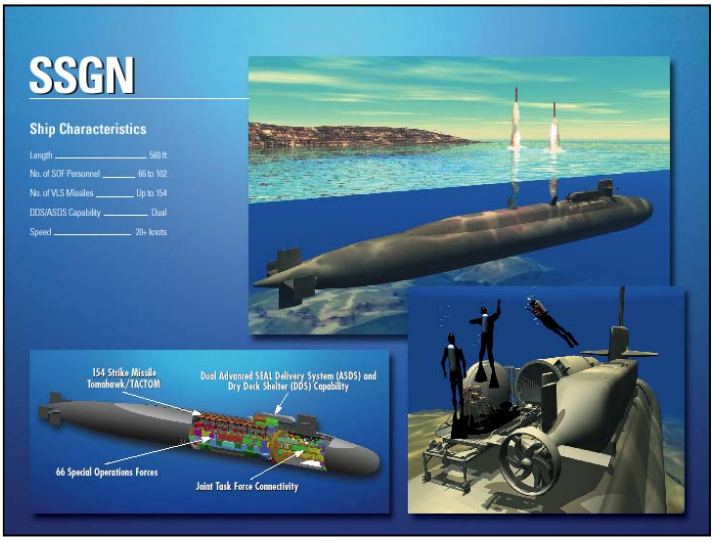
Flexibility

The use of Boeing's commercial 601 bus provides an extremely adaptable platform to host various communication payloads. As a result, the Navy was able to pursue an evolutionary acquisition approach. In addition to the baseline UHF payload, an EHF Payload, providing protected communications services, was added starting with the fourth satellite. The Global Broadcast Services payload, which provides high data rate communications capability, was added starting with the eighth satellite. Each of these new payloads was procured very cost effectively, with only minor impacts to the satellite bus and associated launch costs.

SSGN

GENERAL DYNAMICS

Robert L. Earl
Staff Vice President, Strategic Planning
(703) 876-3516
bearl@gd.com



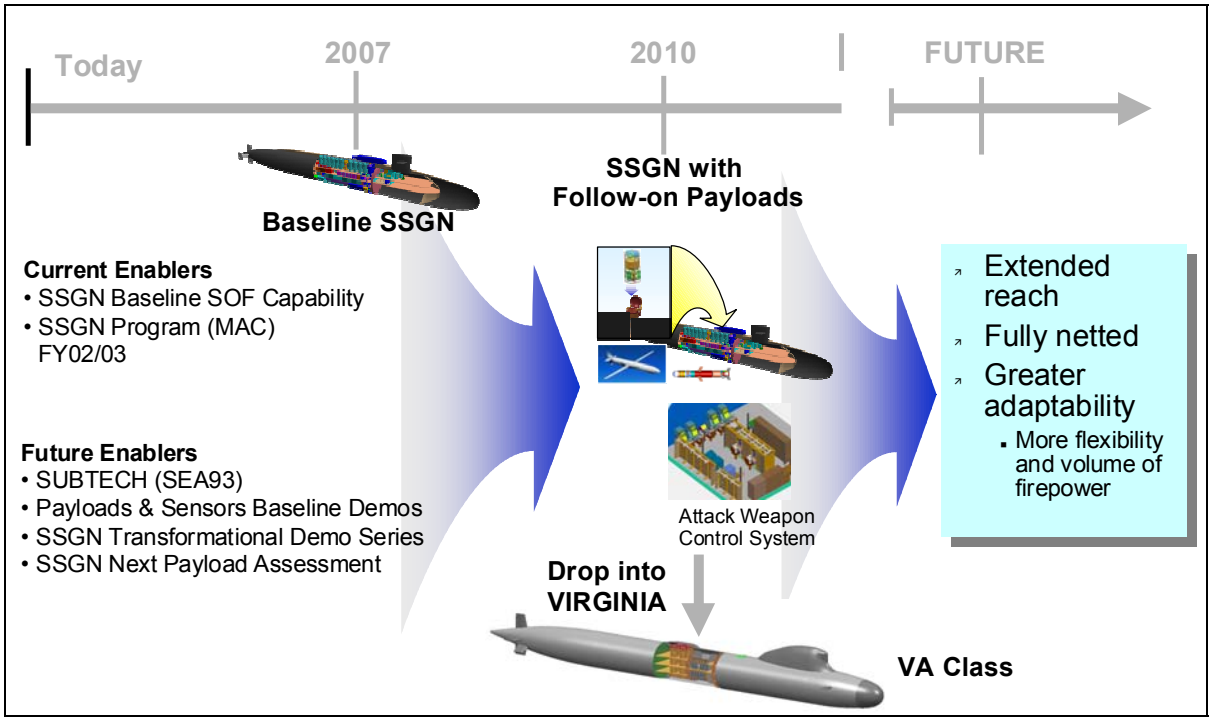
The U.S. Navy is converting four Trident ballistic missile submarines (SSBNs), which would otherwise be decommissioned, to conventional guided missile submarines (SSGNs). The SSGN will provide commanders with a covert military capability to deliver 154 cruise missiles and 66 special operations forces. In addition, SSGNs will have sufficient high volume capacity to host a variety of other payloads and sensors including UUVs, UAVs, ballistic missiles or other weapons/packages that can be delivered via their 24 84-inch diameter tubes.

The SSGN will also function as an experimental test-bed to develop innovative operational concepts and payload / sensor alternatives for incorporation on new Virginia-Class submarines currently under construction. The large missile tubes inherent to this platform provide the volume to demonstrate and deploy “non-traditional” submarine payloads in an operational environment – for example, maritime-based national missile defense. Transformation is a continuous process, not an end state. SSGN future modifications will ensure an uninterrupted test and validation process for future payloads and sensors that will play a critical role in achieving future Navy goals – transforming the submarine force into the future.

The SSGN program not only accomplishes the “transformation” of a weapon platform and its capability, it also demonstrates the innovative business capability of the nuclear submarine industrial base.

The SSGN program leverages General Dynamics’ experience as the designer and sole builder of Trident submarines, its recent design and construction experience with the major modification of the third SEAWOLF submarine, *Jimmy Carter*, and the design and construction of the Virginia-Class attack submarine. GD will employ state-of-the-art design tools and processes developed and proven on the Virginia Class and the SSN23 *Jimmy Carter* to produce high quality, accurate and timely SSGN design products. GD’s Quonset Point, Rhode Island manufacturing facility will manufacture much of the ship structure required for the ship conversion, minimizing the production cost of this

material. These manufactured parts and assemblies will then be staged at the Naval Shipyards for installation on the ships. Finally, as the prime contractor for SSGN conversion, GD's Electric Boat will be responsible for accomplishing the conversions at the Puget Sound and Norfolk Naval Shipyards.



The SSGN Program provides a most important example of transformation of an existing Cold War asset to a weapons system with the versatility and agility to adapt to an ever-changing threat environment – now and in the future.

ATLAS V/EVOLVED EXPENDABLE LAUNCH VEHICLE

Ray Ernst
Senior Director, Military Programs, Space and Strategic Missiles
Lockheed Martin Washington Operations
(703) 413-5762
ray.ernst@lmco.com

In 1998, the US Air Force partnered with industry in the evolutionary development of enabling technologies, modifications to industrial capability and launch facilities for the next generation of U.S. launch capability. The program involved a mix of US Air Force and industry investment, with the objective of reducing the cost of space launch by at least 25%. The EELV launch systems will competitively support the commercial and U.S. government markets for space launch services, and will replace the current Titan, Delta, and Atlas expendable launch vehicles with two families of vehicles and associated infrastructure. The new EELV launch systems will fulfill the need for higher capability space launch services to geostationary transfer orbit and the near-term deployment of a number of large-scale commercial satellite constellations. The USG will purchase commercial launch services through the EELV program.

The Atlas V/EELV program provides the DOD transformational capabilities for the following reasons:

- The EELV program utilized an “Other Transactions” contract that streamlined the acquisition process and enabled the first major military/commercial integrated program development
- The Atlas V was fielded in 4 years, demonstrating a streamlined development program. The Atlas V launched successfully on August 21, 2002
- The Atlas V/EELV program has exceeded the projected 25%cost savings from existing launch systems
- Using a spiral development process, the Atlas V/EELV program has reduced production cycle times from 48.5 months for Atlas II to 18 months for the first Atlas V, with the steady state production goal of just 10 months
- The Atlas V/EELV program utilized the Russian NPO Energomash redesigned RD-180 engine, a world class LOX/Kerosene staged combustion engine that minimized program cost and risk
- The LM Atlas V/EELV/NPO Energomash RD-180 engine program demonstrated a successful international commercial business partnership and imported key propulsion technology into the U.S.

- The Atlas V/EELV program developed “clean pad” launch facilities that significantly reduced launch pad infrastructure and streamlined operations from months to days. Lockheed Martin reduced launch site processing facilities from 36 for Atlas II and Titan IV to 3, required launch site personnel from 1200 to less than 200, and the number of days on pad from 28-38 days for heritage Atlas to just one day for Atlas V
- The Atlas V/EELV program developed enabling technologies for future U.S. launch capabilities:
    - Honeycomb composite structures
    - Largest monolithic graphite solid motor case
    - Programmable open bus architecture
    - Fault tolerant inertial navigation system
- The Atlas V/EELV program provides standard payload interfaces that enable rapid mission flexibility and interoperability compared to heritage launch systems

AFFORDABLE MOVING SURFACE TARGET ENGAGEMENT (AMSTE)

Dr. Matthew W. Ganz
Vice President, Strategy & Technology
(310) 332-7298
ganzma@northropgrumman.com

Tank During AMSTE

Background

Northrop Grumman's AMSTE program is a 3-year DARPA sponsored effort initiated in FY01 with the objective of developing a technical solution to precision engagement of moving targets in all weather using existing seekerless weapons. An overarching objective was to deliver solutions ready for rapid transition to the services. Key technologies that have emerged from AMSTE:

- Development of advanced automatic tracking solutions using data from multiple sensor platforms. These solutions have the precision necessary to command guide GPS weapons against moving targets.
- Integrated sensor-to-sensor data fusing for sub-GPS target location
- Sensor-to-Weapon Automation to accomplish millisecond targeting solutions
- Open architecture sensor network between manned surveillance C2 platforms and UAV and Fighter systems

AMSTE crosses traditional program boundaries by linking together capabilities that were not originally planned to work together. This technology provides an enabling capability to rapidly provide a warfighter with the ability to precisely engage multiple moving targets in all weather conditions from extended ranges and at very low cost.

Recent Events

AMSTE is in its third year of experimentation. The total investment made by DARPA since it began working on moving target data exploitation represents over $ 100 million dollars of R&D investment. AMSTE is the culmination of that investment in a sensor-to-shooter capability. Two highly successful live demonstrations were completed in FY01 and FY02 (see graphics below) using inert JDAM and JSOW weapons and an experimental precision weapon designated as PDAM. In August 2002 a simultaneous JDAM attack against multiple moving targets was completed with both weapons scoring CEPs inside 10 meters. During the same week a JSOW scored a direct hit on a moving tank destroying the vehicle.

Development Program Achievements

- AMSTE, for the first time, provides the Armed Forces with the ability to rapidly engage and destroy targets on the move in all weather conditions using seekerless weapons. The AMSTE architecture shifts the burden of precision guidance from the expensive, but expendable, weapons seeker to the network of ISR sensors.
- AMSTE provides the ability to seamlessly network existing systems, weapons, sensors and attack assets into a system of systems capability that provides a new capability. The machine-to-machine fusion of Ground Moving Targets (GMTI) collected from both theater and tactical sensors are fused into a common operational picture, with enough definition to provide a precision fire control solution.
- AMSTE has conducted five weapons delivery tests using three different sensors, three different fighters, three different weapons and data links from two services. Each test exceeded the objective test requirements.
- A COTS GPS application developed for use in the farming industry was integrated into military capability. In this case, the COTS application provided better accuracy than any other product evaluated, military or commercial. This relationship between the military and civilian arena has come full circle; DoD developed GPS, the civilian market improved upon it, and the military is the benefactor of those improvements.
- AMSTE is ready for transition and can position DoD to field a unique warfighting capability that leverages sunk cost in mature operational systems and provides a foundation for network-centric future combat systems.

Summary

The AMSTE program is truly transformational. The program couples rapid development with new technologies and applies the results to existing combat systems. The resulting networked components work together to achieve a system-of-systems solution. It brings new capabilities to the warfighter at a dramatically lower cost.

The greatest challenge to the fielding of AMSTE technology is the fact that it crosses so many areas of interest and does not naturally fall into the domain of a traditional acquisition sponsor. Command and Control for surveillance and targeting is a critical area. Weapon employment and modification are equally important in the AMSTE construct as is the collection and exploitation of intelligence data. Despite its success in the field, AMSTE does not have a single champion and faces a challenge moving from development to the field.

DD (X)

Darryl B. Kreitman
Director, System and Concepts Integration
(703) 284-4319
dbkreitman@raytheon.com

DD (X) is a highly capable, multi-mission 21st century Destroyer with unsurpassed capability in all mission areas. DD (X) is designed to be flexible and scalable and to easily support changing missions, including missile defense as the Air Dominance Cruiser (CG (X)). Its survivability rivals, and in some cases, exceeds the battleship and it fills a critical fire support shortfall in today's joint arsenal.

Overall Most Important

Provides an opportunity for the Navy to be truly "transformational," not just more of the same evolution

- Preeminent technical expertise in maritime composite structures, signature control, radars, electronically steered apertures and integrated electric drive and propulsion systems
- Transformational ideas and technology
- Offers an Inclusive Open Business Model
  - Navy gets the "Best Value" integrated solution based on "Best of Breed" solution regardless of source
  - Competitive selection of technology solutions; strong Navy participation

DD (X) brings "Transformational" technologies to the fight

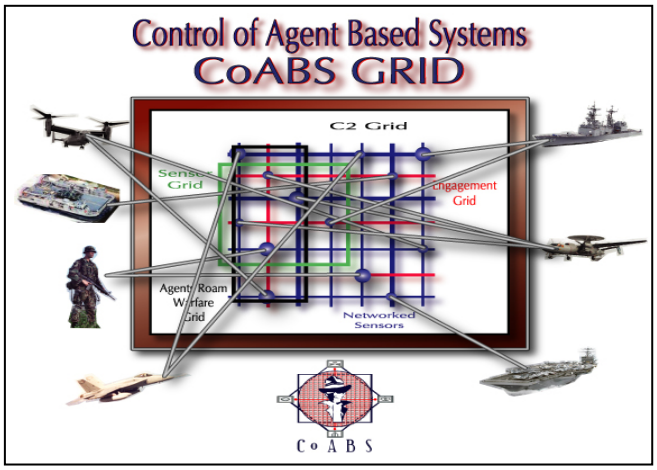
- Technology engine focuses development and engineering efforts critical to the future of the Navy
  - Affordable shipbuilding processes with cost savings that lead to:
    - Lower manning
    - Sailor-centric design
    - Crew quality of life and habitability improvements
    - Lower maintenance
  - Increased Joint/Coalition Warfighting Capability
    - Network-centric Operations
    - Integrated ISR – node on global information network
    - Increased connectivity
    - Joint and coalition warfare – inclusive and easy to join networks
    - Collaborative environment
    - Common C2 that is both forward-fit and back-fit capable
    - Increased survivability

- New vertical launch systems
- Integrated sensors
- Clustered mainframes that are spatial distributed for survivability

The win for Raytheon was strategic in that it allowed Raytheon to enter a new market i.e., a total ships system integrator vice the supplier of products or commodities.

CONTROL OF AGENT BASED SYSTEMS (COABS)

LCDR Dylan Schmorrow
(703) 696-4466
dschmorrow@darpa.mil



Modern warfare and rapid response contingencies require that the military rapidly assemble disparate information systems into a coherent, interoperating whole. This system integration must be done without system redesign and may include interoperation with non-DoD governmental systems, systems separately designed by coalition partners, or commercial-off-the-shelf and open-source systems not built to a pre-existing Government standard. The Control of Agent Based Systems (CoABS) is a six-year, $60M program of the Defense Advanced Research Projects Agency (DARPA) that has forged the technology for run-time interoperability of heterogeneous systems by creating the CoABS Grid. The CoABS Grid has been demonstrated to three of the four Military Services and is a key technology enabler for the Navy's Expeditionary Sensor Grid, a lead exemplar of net-centric warfare.

In FY 2002, CoABS used agent technologies and tools in military scenarios to demonstrate the run-time integration and interoperability of heterogeneous systems in applications that address present and future command and control problems. The Navy's Expeditionary Sensor Grid experiment demonstrated that hundreds of individual sensor systems associated with weapons and tracking systems can be rapidly linked to produce a "network" that provides for a "net-centric" capability in near-real-time.

Another significant demonstration in the current fiscal year was a coalition exercise involving five NATO nations and 14 CoABS performers in a military contingency, Binni, which represented, realistically, contingencies similar to Somalia, Haiti, Bosnia, and Afghanistan. In addition, CoABS will transition run-time integration capabilities to the Military Services by providing the command and control infrastructure for Joint Forces Command's Millennium Challenge '02, operating in the Army's Agile Commander Advanced Technology Demonstration, and facilitating new operational capabilities for the Air Mobility Command. In FY 2003, the follow-on phase will establish the CoABS grid as a standard for collaborative teams of agents.

– OVERALL MOST SUCCESSFUL –

BOEING	F/A-18E/F SUPER HORNET
GENERAL DYNAMICS	AUTOMATED DEEP OPERATIONS COORDINATION SYSTEM (ADOCS)
LOCKHEED MARTIN	F-117 NIGHT HAWK
NORTHROP GRUMMAN	E-2C ADVANCED HAWKEYE RADAR MODERNIZATION PROGRAM
Raytheon	ADVANCED MEDIUM RANGE AIR TO AIR MISSILE (AMRAAM)
DARPA	GLOBAL HAWK

F/A-18E/F SUPER HORNET

David Schweppe
Director Naval Aircraft Program
(314) 233-3474
david.j.schweppe@boeing.com

The Super Hornet program has consistently provided unprecedented solutions for the warfighter. This highly successful program is the result of foresight and innovation in partnering between the Department of the Navy and Industry. The program focused first and foremost on a continuously upgradeable, integrated system of systems, housed in a highly refined, high-performance aircraft. The Super Hornet program emphasizes rapid development and delivery of war fighting solution.

Affordability is a cornerstone of the program. Production has successfully contained cost through innovative design, fabrication, and risk reduction initiatives, while providing all the necessary provisions necessary for long-term spiral development.

Beginning in 1992 the Super Hornet was designed to recapitalize Naval Aviation. The result is a design that replaces five legacy Navy and USMC platforms absorbing their mission, while expanding solutions for future capabilities. The Super Hornet design provides uncompromised aerodynamic performance, parts and logistics commonality, and true multi-mission flexibility in air superiority, fighter escort, close air support, day/night/all-weather precision strike, air defense suppression, aerial refueling tanker, reconnaissance, and electronic attack warfare, while retaining its strike fighter capabilities. The ultimate flexibility of the design is the ability to integrate this platform into foreseeable network centric operations through 2025.

The Super Hornet program pioneered fully integrated computer 3-D graphic design, fit, and manufacturing, using Low Rate Expandable Tooling to reduce tolerances, cycle time, touch labor, and increase quality. As a result forward and aft fuselage splice time was reduced from one week to one day. To further decrease cycle time and increase long-term reliability, maintainability, and survivability, intense design effort to reduce parts count has yielded 40% fewer parts across the airframe.

The program completed EMD below the $4.88B cap. It has maintained its original schedule, un-reprogrammed, and is today 8 aircraft ahead in total deliveries. It has met or exceeded all of its performance parameters and its cost has been steadily decreasing toward an ultimate goal of $40M per unit. It was awarded the 1999 DoD Acquisition

Excellence Award for “excellence and superior performance in the engineering and manufacturing development phase of the [program].” The Department of Navy and Boeing led industrial team received the 1999 Collier Award for “significant safety, performance, and innovative design achievements.”

At the completion of OT&E it was awarded a five-year multi-year contract (FY00-04), which has resulted in over $700M savings. Further risk reduction initiatives have steadily reduced aircraft cost in the journey to achieve a goal of $40M. More than $1B of US Navy procured dollars can be saved if a second MYP is approved.

In summary, the F/A-18E/F Super Hornet Program: demonstrates the power of a government/industry partnership; sets performance standards/records in cost, manufacturing, delivery, and warfighter performance; consistently exceeds expectations; fields battlefield relevant systems and more capability in record times; and demonstrates best value for Naval Aviation recapitalization.

AUTOMATED DEEP OPERATIONS COORDINATION SYSTEM (ADOCS)

GENERAL DYNAMICS

Robert L. Earl
Staff Vice President, Strategic Planning
(703) 876-3516
bearl@gd.com

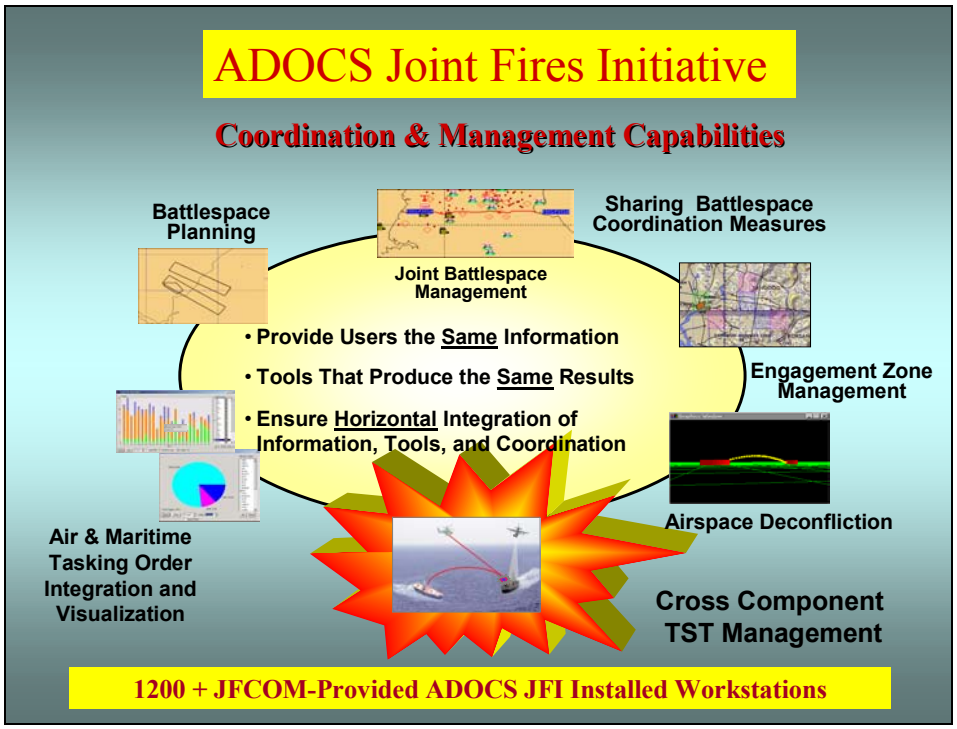
The Automated Deep Operations Coordination System (ADOCS) is an example of a most successful battlefield command and control system that is transforming joint operations because of its interoperability and widespread use, making it the preferred "go-to-war" system for joint, combined, and coalition operations.

ADOCS fulfills a key QDR Critical Transformational Goal: "Leveraging information technology and innovative concepts to develop an interoperable, joint C4ISR architecture and capability that includes a tailorable joint operational picture."

The Defense Advanced Research Projects Agency developed ADOCS – a Windows™ software application that uses existing theater communications infrastructures – in response to the inability of US forces to acquire, track, and engage Iraqi missile systems during Operation Desert Storm. ADOCS successfully evolved from DARPA sponsorship into the Theater Precision Strike Operations Advanced Concept Technology Demonstration (ACTD), where its development is performed by General Dynamics C4 Systems and is managed by the Joint Precision Strike Demonstration Office. ADOCS supports deep operations, time-sensitive targets, and other joint mission planning, coordination, and execution functions in Combined Forces Command / US Forces, Korea; US European Command; US Central Command; US Special Operations Command; and US Joint Forces Command with over 1200 installations worldwide.

Under the Joint Fires Initiative, ADOCS provides, for the first time, a common capability to manage Time-Sensitive Targets (TST) using a jointly integrated suite of targeting tools that increases fires situational awareness and knowledge, thus enabling more effective strike decision-making and execution. ADOCS functionality includes overlays and data managers that enable operational processes such as airspace de-confliction, fires and airspace planning, Air Tasking and Airspace Coordination Order visualization, combined special operations forces (SOF) mission management, TST mission

management, limited and protected targets, engagement zone management, fires management, and targeting.



ADOCS has evolved through absolute insistence on a spiral development process to ensure that capabilities and refinements receive thorough testing by operational forces and early fielding. Results of warfighter evaluations are rapidly injected into the development process, ensuring both prompt response to user requirements and continuous relevance to actual warfighter needs. ADOCS has been transformed from its original focus on deep operations to become a superbly capable C4ISR system with broad applicability across the entire joint warfighting domain. Today's ADOCS forms a solid basis for continuous development and fielding of transformational C4ISR capabilities.

F-117 NIGHT HAWK

Scott Ogden
F-117 Director, Sustainment Support
(661) 572-7541
scott.ogden@lmco.com

When OSD began the first phase of business practice transformation in the mid-1990s, the F-117 program was identified by the Air Force as a "Pilot Program" to reduce weapon system Total Ownership Cost (TOC) through the establishment of a Total System Performance Responsibility (TSPR) contract. On October 1, 1998, an eight-year, $1.8 billion TSPR contract for the F-117 was implemented, providing a streamlined management structure, improved processes, and consolidated functions and subcontract management. The contract was written with the warfighter in mind, not the contracting officer. The Air Force let the end user define what was important to him, and then set out to define the processes needed to manage the program from cradle to grave and to ensure that all requirements were met. Transformational aspects of the program contract include:

Cost Reduction Initiatives

The Air Force has reduced System Program Office personnel from 242 to less than 50, resulting in savings estimated at $82 million over the term of the contract. An additional $80M in savings was negotiated as part of the TSPR contract, assuming a stable F-117 sustainment budget over the eight-year period of performance. This long-term contract arrangement will lower program investment risk and reduce annual contract proposal, fact finding, and negotiation costs. Program continuity and workload scheduling have been optimized with increased flexibility and efficiencies from cost reduction initiatives.

Reducing Duplicative Infrastructure and Activities

The contractor capitalized on the infrastructure created to develop and build the F-117 from engineering and manufacturing development through production. The contractor built a Low Observable Depot and committed the needed engineers to a sustainment logistics center, eliminating the need for full duplication of facilities or skilled engineers with the Air Force. In addition, most equipment used to develop aircraft systems and sub-systems were the prototypes used to deliver today's support and test equipment, and most of the Automatic Test Procedures (ATP) for avionics assemblies and

subcomponents were the prototypes of the ATP and test acceptance used to deliver production assets.

Full Life-of-Program Resource Management
While reducing the need for duplicative infrastructure in the Air Force, the contractor undertook responsibility for life-of-program support. As noted above, the contractor provides the facilities and staffing for program logistics and sustainment. The contractor also has full responsibility for item management and warehousing of parts. The contractor is the original source for all technical manuals and instructional material, meeting the customer's demand for user-friendly guides for the F-117 system.

Spiral Development
By building this aircraft while mission requirements evolved, the contractor was using spiral development before the phrase was coined, creating the ultimate system engineer for sustaining this legacy or beyond-production system.

Incentive Fee Metrics
The TSPR contract contains incentive-based elements structured to ensure support to the war fighter and reduce TOC. One element is an incentive fee objectively based on a set of weighted metrics established with the goal of providing the best possible support to the operational wing. Another element is an award fee that allows the 49th Fighter Wing, the System Program Office, the Air Combat Command, the 410th Test Squadron, and the Defense Contract Management Agency to evaluate customer satisfaction. An additional element is a cost share incentive that established a 50/50 share ratio of savings between the government and the contractor. There are seven TSPR incentive fee metrics in all, and all were designed to measure the contractor's ability to sustain and enhance war fighter readiness. Performance in key areas includes supply of parts, on-time delivery of parts, and the percentage of parts needed in the Readiness Spares Package. Meeting these metrics has consistently enabled availability of more combat-capable aircraft on a daily basis for fighter wing scheduling, and has allowed the contractor to earn 100 percent of the incentive fee throughout the four years of the TSPR contract.

E-2C ADVANCED HAWKEYE RADAR MODERNIZATION PROGRAM (RMP)

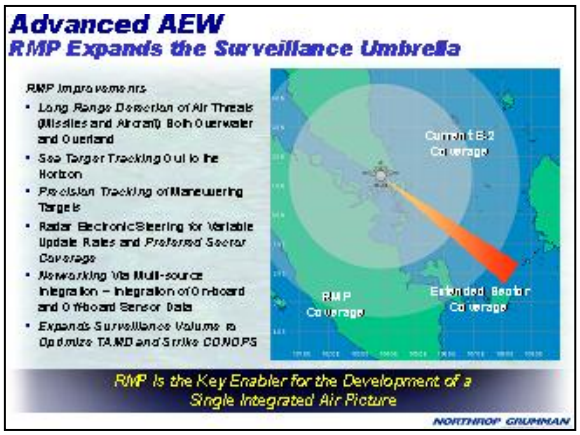
Dr. Matthew W. Ganz
Vice President, Strategy & Technology
(310) 332-7298
ganzma@northropgrumman.com

Background

Over the past ten years, the three U.S. leaders in radar system development and production have been investing and supporting the Department of Defense on Airborne Early Warning (AEW) surveillance radar technologies. These three premier companies, Lockheed Martin, Northrop Grumman Electronic Systems and Raytheon formed a union in 2001 under the leadership of Lockheed Martin Syracuse to develop and produce a revolutionary new radar system for the E-2C as part of the pending System Design and Development (SDD) phase. This union combines the strengths of each company and leverages significant investments during the 1990s in advanced radar system development and testing. It is focused on giving the U.S. Navy an unprecedented surveillance and battle management capability to achieve Theater Air Missile Defense (TAMD), updated littoral warfare presence, and expanded power in coalition warfare. These objectives are summarized in the graphic below.

Transformational Objectives

The Advanced Hawkeye/RMP will provide the warfighter with greatly expanded capability and flexibility in defending the carrier battle group, making it a more formidable asset for assured access world-wide, and leveraging the Navy's network-centric warfare strategy to new levels of effectiveness. This enables transformational warfare, and is also being accomplished in a transformational business approach across contributing company efforts.



The union of the three premier radar companies surpasses the outcome of any set of individual competing segments. It focuses the collective resources and energies toward ensuring timely initiation, execution, and fielding of this critical program. It leverages the involvement and experience in related RMP Advanced Development Model (ADM) system ground testing in Hawaii in 1997/1999 and pending flight testing in an EC-130V AEW

aircraft this year. Northrop Grumman Integrated Systems has been working with this premier group for the past six months to prepare for the SDD phase. An open exchange of information among the four parties has been implemented to address execution and keep the program moving forward in supporting key milestones.

The combined efforts of the U.S. Navy, Northrop Grumman, Lockheed Martin and Raytheon will ensure the E-2C Hawkeye RMP meets timely and successful systems development, fielding and operational objectives this decade. The collective resources and commitments of the Navy / Industry team are providing the essential ingredients to keep the program focused on critical milestone objectives. This union has established an unparalleled industry precedent for this essential program.

Summary

Transformation and execution are the foundation of a successful E-2C Advanced Hawkeye RMP fielding of TAMD capabilities by 2011. The E-2C RMP has been recognized as a leading transformation initiative, and program execution is being orchestrated by industry leaders in advanced radar technologies and systems integration. These industry leaders are engaged in ensuring a successful RMP SDD, an effective transition through production, and long-term fleet and theater operational support.

ADVANCED MEDIUM RANGE AIR TO AIR MISSILE (AMRAAM)

Darryl B. Kreitman
Director, System and Concepts Integration
(703) 284-4319
dbkreitman@raytheon.com

AMRAAM is the world's premier radar guided air to air missile. Currently in the 16th lot of production, AMRAAM has been continually upgraded in a series of spiral/P3I efforts to consistently remain 10 years ahead of the threat.

Overall Most Successful

AMRAAM Vision 2000 was created in 1997 during the Raytheon – Hughes merger. The Vision essentially changed the business relationship between government and prime to reflect an agile, trust based, and fully empowered integrated team. Vision 2000 was established with three basic contractual vehicles, referred to as "Cornerstones" in the Vision. The contracts; Production, Development, and Sustainment are interconnected to form the AMRAAM Business Deal. The three AMRAAM contracts, with overlapping periods of performance for multiple production lots, provide heel to toe infrastructure that is essential for a healthy program. Vision 2000 contracting interrelated linkages were initiated with the first sole source March 1998 award of AMRAAM Lots 12-15. In 1998, the AMRAAM P3I Phase 3 contract was awarded and included technical and business exit criteria that linked to the recently awarded 2002 production Lots 16-21, with associated sustainment contracts.

Examples of how AMRAAM's Business Practices facilitate agility:

- A Review-Discuss-Concur (RDC) team (U.S. Government/Raytheon) process is used for contract negotiation – empowered team gets results – no undefinitized contracts. The team does what it takes to work to common needs in all contract negotiations…the government needs affordability, Raytheon needs a certain amount of profit to stay healthy – it works because all players know the variables up front
- Total System Performance Responsibility (TSPR) is awarded to Raytheon in all contracts; TSPR is implied in all Raytheon does - Raytheon will "just fix it" instead of looking for a contract and $$…that's the attitude in the program
    - "Raytheon will do whatever they deem necessary and sufficient to deliver, warrant, and support affordable, combat capable and readily available weapons systems"

The AMRAAM business model and relationship is a flagship program within DoD. The rallying cry within the program has been, "Government insight, not oversight."

GLOBAL HAWK

Dr. Allen Adler
(703) 696-2304
aadler@darpa.mil

The Global Hawk Program has been one of the most successful programs for the Department of Defense in recent years. Not only was this program a remarkable technology achievement in its own right, it has heralded the arrival of UAVs as an irreplaceable element of modern warfare. Among the many successful accomplishments achieved by this program are the following:

- Meeting or exceeding almost all of the technical performance goals established for the program – achieving full realization of an economical, efficient and effective high altitude long endurance unmanned surveillance system. The program did not just develop an airplane, it developed the entire missionized system.
- Fielding of a revolutionary developmental capability in a remarkably short period of time – sketches on paper to limited operational capability in seven years.
- Demonstrating the tremendously powerful and transformational impact of unmanned systems in offensive military operations – proven to be a powerful battlefield surveillance system in Afghanistan. After decades of failures in attempting to widely field unmanned air vehicles, the Global Hawk, as well as the Predator, fully established UAVs as a mature technology for the warfighter.
- Demonstrating new acquisition paradigms allowing for unique constructive interaction between developers, operators and users and industry throughout the entire developmental process – this program absolutely validated the principals inherent in Section 845 acquisition and the ACTD process. The extraordinarily tight and non-adversarial interaction between DARPA and the prime contractor, Teledyne Ryan, was derived from these processes and was critical to the overall program success.

APPENDIX C

STORIES FROM COMPANIES EXITING DOD BUSINESS

TRADITIONAL DEFENSE SUPPLIERS EXIT STORIES

Many of the well-known companies of today once had large defense operations; all of the "Big Three" automakers, GM, Ford, and Chrysler, as well as IBM for example, were at one point major military suppliers. However, after the Reagan defense procurement buildup and the Cold War ended, the entire defense industry began a system wide consolidation to adapt to military spending cuts that were to help reduce the country's federal deficit. Furthermore, defense-focused companies were eager to combine to build economies of scale to manage the high bidding costs and low returns of military contracting. In addition, there was a strong growth potential in commercial markets with the onset of the information technology revolution.

During this time many "traditional" suppliers to the defense industrial base began examining the economics of their defense business units. Options open to firms included becoming a pure defense operation (Lockheed Martin), a pure commercial operation (IBM), a combined operation large enough to insulate against cycles and procurement schedules (Boeing), or a combination that only included considerably synergistic product lines (General Electric).

At around the same time, the GE mantra of market dominance swept through corporate America. In the simplest terms, this concept, pioneered by GE to tremendous success, was to either be the number one or two player in a business, or to exit that business. If a firm could not organically grow to that point, according to GE, it should either acquire one of the firms that would make it such, or divest / spin off that business. GE did this itself with its defense divestitures to Martin Marietta in 1992. At the time GE had been a major supplier to the DoD.

These two paradigms, the considerably reduced military procurement, as well as the corporate unwillingness to be less than a market dominator, resulted in a massive consolidation of defense suppliers.

SOME OF THE DEFENSE SUPPLIERS OF YESTERDAY:

Westinghouse, Lucent Technologies, Ford, MAGNAVOX, CHRYSLER, IBM, LORAL, GE, TEXAS INSTRUMENTS, HUGHES

THE SUPPLIERS OF TODAY:

BOEING, NORTHROP GRUMMAN, Raytheon, GENERAL DYNAMICS, LOCKHEED MARTIN

TEXAS INSTRUMENTS

When Jerry Junkins, who built Texas Instruments into a leading semiconductor manufacturer, unexpectedly passed away in 1996, he was replaced by Thomas Engibous as President and CEO. Engibous spent much of the following year unloading operating divisions to realign the company's focus on its primary business in semiconductors. This shift involved three acquisitions and nine divestitures, one of which was the sale of the Defense Systems and Electronics division, during 1997.

By 1996, the contribution of aerospace and defense to TI's revenues had dropped to less than 20% from almost 30% in the early 1990s, and it was believed that Texas Instruments had insufficient critical mass to compete effectively long-term in the rapidly consolidating industry. At the time, the prediction on Wall Street was that competitors' expanding technology base and growing economies of scale would eventually put the company at a significant cost disadvantage. In combination with the strategic shift in focus to its core semiconductor business, this was a strong motivating factor behind the sale of Texas Instruments' Defense Systems & Electronics division, which was announced on July 11, 1997.

Texas Instruments' Defense Systems and Electronics Unit produced guided missiles, electro-optical systems, and defense electronics equipment. The unit's 1996 sales were about $1.3 billion. It was acquired by Raytheon, helping that company become one of the top five prime contractors.

LORAL

Loral was founded in 1948 and became a major defense player through a long series of acquisitions. Target companies included Xerox's electro-optical defense and aerospace business (1983), Rolm's military computer unit (1985), Ford Aerospace (1990), LTV Missile (1992), IBM Federal Systems (1994), and Unisys Defense (1995).

In 1996 Lockheed Martin spent $9.1 billion to acquire Loral's defense business, leaving the satellite operations to Loral. Lockheed added three major programs to its Electronics & Missiles division. The remaining company became Loral Space & Communications and now focuses on producing satellites and providing high-speed data access. Lockheed maintains a small equity interest in Loral.

Lockheed's stated reason for this merger was that as DoD budgets tightened, electronics and communications were becoming growth businesses. Analysts believed that this sector would take an increasing portion of defense procurement funds as the military would rather upgrade equipment than purchase new fleets of aircraft and ships. Lockheed, in a struggle with Boeing to become the top weapons contractor in the world, saw the Loral acquisition as means to increase scale and to capitalize on Loral's position in electronics and communications.

At the time of the acquisition, Loral employed 38,000 people and was regarded as very strong in communications and radiation-hardened components for spacecraft. Other products included the Sidewinder missile and airborne radar warning systems. Market insiders felt the transaction was structured to prevent antitrust issues, i.e., an outright merger between the two companies was preferred but splitting of Loral's space business assured federal approval. In addition, Loral Chairman and CEO Bernard Schwartz, had stated his desire to focus on building a global Satellite network, along with the support services to go with it, in order to capitalize on the huge expected increase in data transfer in the new economy.

WESTINGHOUSE

When Westinghouse Electric sold its defense division, it virtually exited the industry, after having been among the top twenty-five military contractors for decades.

On 3 January 1996, Westinghouse announced that it had signed a definitive agreement to sell its defense and electronic systems division, its largest business, to Northrop Grumman Corporation. Under the agreement, Westinghouse received $3.0 billion in cash and Northrop Grumman assumed approximately $600 million in pension and other post retirement liabilities. The defense-related electronic systems business was by far the largest component of Westinghouse's Electronic Systems Group, with 12,000 employees. The company retained several smaller commercial electronic businesses including those serving residential security and telecommunications markets.

Westinghouse, which itself had bought Norden Systems to augment its radar operations and other smaller defense companies over the years, had begun selling off businesses to gain funds for its 1995 acquisition of television network CBS for a total consideration of $5.4 billion. Previously, Westinghouse had operated a radio and television broadcasting business to vertically integrate with some of its manufacturing capabilities. Over time, however, it saw broadcasting outperforming other areas and decided to acquire CBS. Westinghouse's transformation continued with the sale of virtually all non-entertainment businesses, including its furniture, appliance, and nuclear power operations, to focus on broadcasting and to repay debt.

To refinance existing long-term debt and to fund the CBS acquisition, the company had borrowed approximately $7.5 billion in 1995. However, as the company divested operations to focus on broadcasting, the pace of Westinghouse's debt reduction was more rapid than many expected, fortuitous because loan agreements required it to pay approximately $2.5 billion over the two years following the acquisition. Eventually, after several major entertainment acquisitions, Westinghouse changed its name to the CBS Corporation, with little left to resemble its earlier days as a major defense supplier.

GENERAL ELECTRIC

On 23 November 1992, General Electric announced the sale of its aerospace division to Martin Marietta Corporation for a total consideration of more than $3 billion in cash and preferred stock. With the addition of the GE operations, Martin Marietta's annual revenues nearly doubled, from $6.1 billion to $11.4 billion, launching it to the top position among defense firms.

GE Aerospace was a major supplier of satellites, radar and sonar systems, simulation systems, communications systems, government technical services and other aerospace and defense systems. Like many other predominately commercial companies, GE decided to exit the defense market because of plunging Pentagon budgets and low contractor profits. Furthermore, the aerospace division's relatively flat performance made it a prime candidate to be cut, as GE had often signaled that it was strategically focusing on its core businesses that dominate or are No. 2 in their particular fields. As such, GE decided to exit the defense business to focus on markets where it could dominate.

Industry analysts and investors applauded the acquisition. Following the announcement, Martin Marietta's stock soared 10 percent, closing at $63.25, and shares of General Electric jumped 3 percent.

Martin Marietta

APPENDIX D

HISTORICAL SUMMARIES, PRODUCT BATTLESPACES, AND CASE STUDIES OF THE FIVE LARGEST U.S. DEFENSE FIRMS

BOEING

GENERAL DYNAMICS

LOCKHEED MARTIN

NORTHROP GRUMMAN

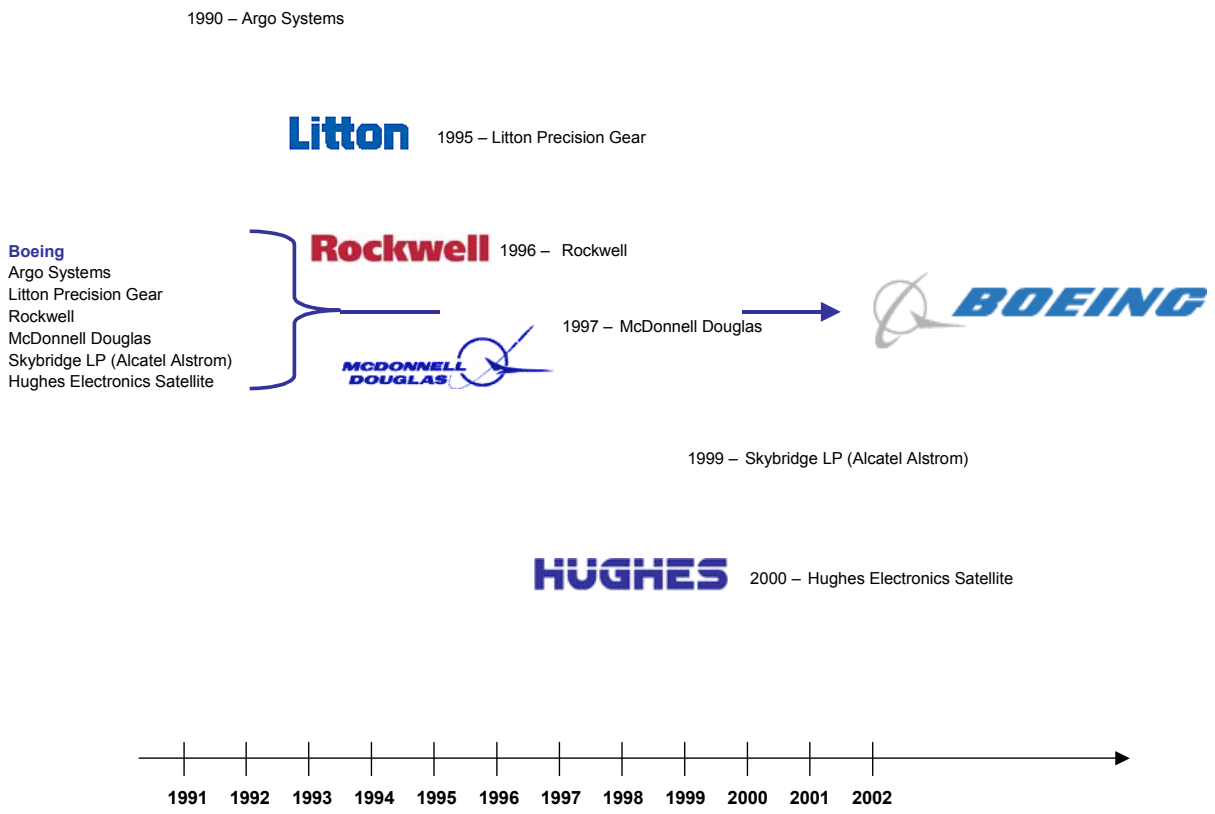
Raytheon

APPENDIX D

HISTORICAL SUMMARIES, PRODUCT BATTLESPACES, AND CASE STUDIES OF THE FIVE LARGEST U.S. DEFENSE FIRMS

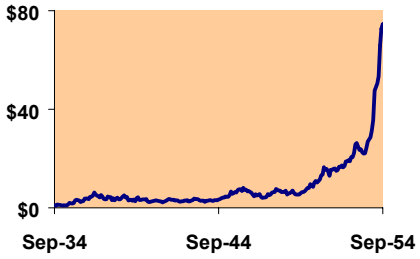
BOEING

THE BOEING COMPANY (BA) SUMMARY

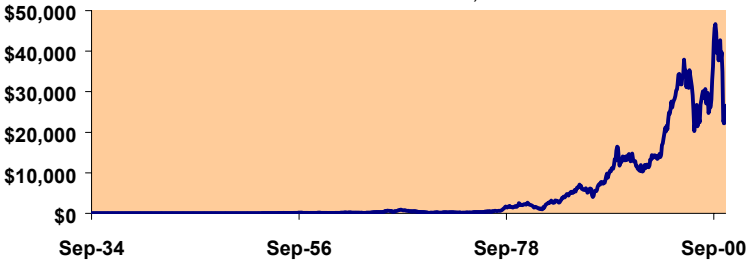


- 1916 – **The Boeing Company** is founded by **William Boeing;** the lowest wage of the the 21-person payroll is 14 cents an hour, while the company's top pilots make $60 to $160 a month
- 1917 – The Navy orders fifty of the company's second production aircraft, the Model C; by the end of 1918, 337 people are on the Boeing payroll
- 1934 – **BA starts trading on the NYSE** on September 4 at $7.00, or 14 cents per share adjusted for subsequent stock splits
- 1934 – William Boeing Holdings becomes three entities: **United Air Lines**, **United Aircraft** (later United Technologies), and the **Boeing Airplane Company**
- 1946 – Following the end of World War II, the military cancels its bomber orders; Boeing factories shut down and 70,000 employees are terminated; Boeing develops the country's first multiengine, swept-wing jet bomber, the XB-47
- 1950s – BA's **B-52** is the US's first long-range, swept-wing heavy bomber; BA develops the **Dash 80**, prototype for the KC-135 and the **707-120**; over 700 KC-135's are delivered between 1957 and 1965
- 1960-70s – Two BA 707-320B airframes are adapted for **Air Force One**; BA wins contract to develop America's first supersonic transport; the Model 707 airframe is modified as the platform for the **AWACS**
- 1990s – BA's military production includes the B-2 and advanced weapons; BA merges with **Rockwell Corp's** aerospace and defense units; BA and **McDonnell Douglas** merge and begin operations as a single company with more than 220,000 employees
- Today, BA is the largest aerospace and defense company in the world and the second largest defense contractor in the United States
- 2002 sales were over **$54 billion**
- BA moves corporate headquarters from Seattle to Chicago

BA generated a **compound annual return of 12.0%** in its first 20 years as a public company: **each $1.00 invested would have grown to $74.60** (includes dividend returns)



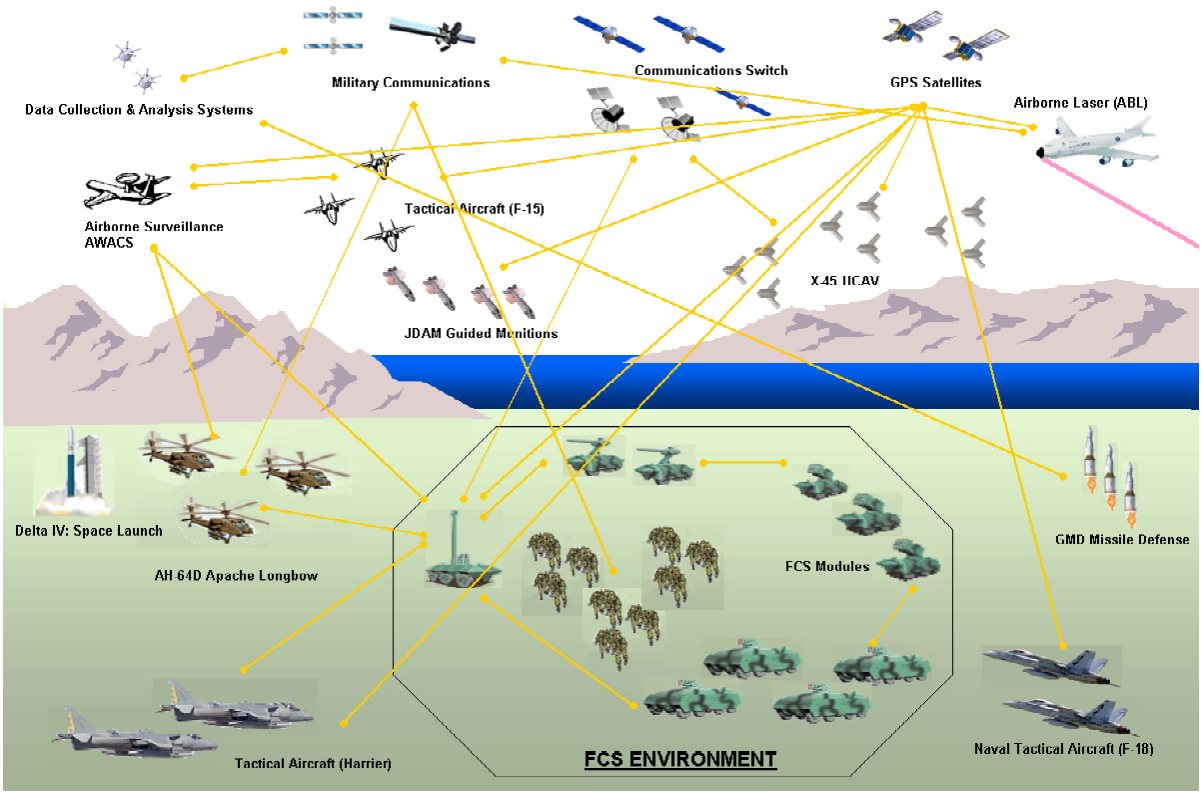
BA has generated a **compound annual return of 16.3%** through the end of last year: **each $1.00 invested at the beginning of the sixty-seven year period would have grown to $26,547.00** (Chart begins with the Boeing Airplane Company in 1934 and includes dividend returns)



Source: ODUSD (Industrial Policy). Institute for Defense Analyses, and First Equity

THE BOEING COMPANY (BA) SUMMARY

Network-Centric Posture



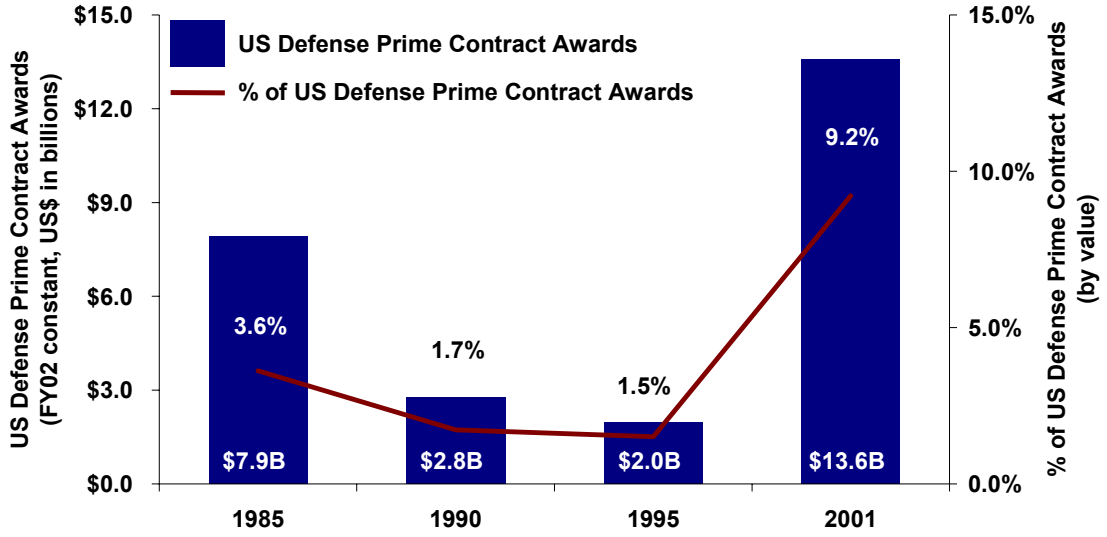


Chart does not reflect revenue received through subcontracts

Source: ODUSD (Industrial Policy). DoD Washington Headquarters Service, Institute for Defense Analyses, and First Equity

THE BOEING COMPANY

100 N. Riverside Plaza
Chicago, IL 60606
(312) 544-2000
www.boeing.com

- **Operational Effects-Based Sectors:** Combat Support, Power Projection, Precision Engagement, Homeland and Base Protection, and Integrated Battlespace
- **Products and Services:** The world's largest aerospace company manufactures commercial and military jet aircraft and is active in the defense, intelligence, communications, and space markets
- **Primary military sales vehicle:** As a prime contractor and systems Integrator
- **Military applications:** Military aircraft, including fighter, bomber, transport, training and attack aircraft, unmanned aircraft, weapon systems, VTOL aircraft and helicopters, space systems, missile defense systems, satellites, satellite launch vehicles, rocket engines, information and battle management systems, simulators and trainers, and aerospace support – for the United States and many other nations
- **Commercial applications:** Global sales of commercial jet aircraft, communication satellites, satellite launch vehicles, space applications and after-market support, air traffic management, financing, and internet communication systems
- **Annual Sales:** $58 billion in 2001
  - 40% government, 60% commercial
- **Employees:** 188,000
- **Established:** 1916

IMPORTANT POINTS

- Boeing provides incentives to and welcomes smaller suppliers as partners
- The company is organized to react more quickly to customer needs and dynamic market conditions, as well as long-term growth
- Separate Phantom Works organization for company-wide research and development, rapid prototyping, and new process development

MAJOR STRATEGIES

- Focus on the customer
- Nimbly respond to changing global market conditions
- Be "the preferred customer to suppliers" by leveraging best partnership practices from other industries
- Utilize technology "capture teams" to develop and capitalize on new business opportunities
- Separate management headquarters from operating units and a world-class corporate Learning Center for leadership development

DEFENSE CONCERNS

- Barriers to commercial – military business integration (i.e. defense and commercial products on the same production line) are often very cumbersome
- Frequently, funding and interest in authorized programs are unstable
- Consolidation is eroding the availability of non-captive suppliers

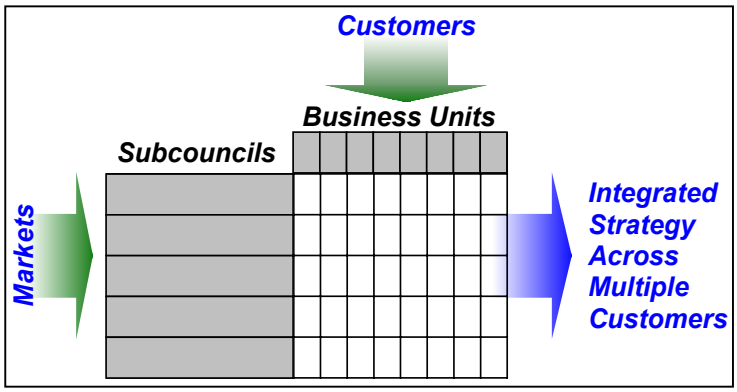
RECOMMENDATIONS

- Continued movement toward commercial environment for acquisition and support
- Sustain and upgrade technology in legacy platforms
- Reform export controls to streamline the process in recognition of the global business environment
- Use multi-year funding more frequently in contracting

The Integrated Defense Systems Group

Boeing, the largest aerospace and defense contractor in the United States, is strategically organized to maintain its leadership position by continuing to develop the most advanced weapons systems for our fighting forces. As such, the company has aligned its operations to improve customer focus and quickly and effectively respond to dynamic market conditions. By orienting itself to deliver high-performance, integrated solutions to the military marketplace, Boeing is positioned to develop the warfighting solutions of the future.

Boeing formed the Integrated Defense Systems Group by combining its Military Aircraft and Missile Systems and Space and Communication Systems groups. The group is organized around a matrix, comprised of customer-focused business units, market-focused business subcouncils, and a functionally-focused enterprise integration board. Customer-oriented business units are structured around end user groups to enhance understanding and response to customer needs. Business unit examples include Space and Intelligence Systems, Army Systems, and NASA Systems. Business development-oriented subcouncils to the Strategic Business Council have been formed to develop market-driving strategies and to ensure common architectures and technologies, reduce recurring costs, and provide for horizontal integration. These subcouncil examples include Launch and Orbital Systems, Network Solutions, and Precision Engagement. Subcouncils work together with the business units to improve corporate performance by developing integrated strategies across multiple customers. Finally, the Enterprise Integration Board has been created to integrate and focus the people, processes, and tools necessary to accomplish the company's goals. It oversees the functional process councils that provide the best people, processes, training and systems for executing all of Boeing's programs. For example, the Program Management Council has identified a set of Best Practices that are implemented by all Boeing programs – commercial, space and military. Routinely, all programs undergo an examination, using subject matter experts in these program management practices, to provide a critique of deployment and use. One practice deals with the use of Earned Value Management, which has been adopted as a company-wide best practice with a single system description for all programs.



The Unmanned Systems Group

Part of the Air Force Systems business unit, Boeing has formed its[1] Unmanned Systems Group as a Center of Excellence to aggressively pursue the trend in military aircraft toward unmanned vehicles. By creating a highly talented group to develop cutting-edge, innovative unmanned solutions through in-house development and strategic partnership relationships, Boeing hopes to lead the transformation in unmanned warfare systems.

> ***"Unmanned systems are the future of aerospace," Jerry Daniels said. "We intend to lead the transformation they will bring by leveraging the best from across Boeing."[1]***

A key enabler of Boeing's unmanned strategy has been the use of technology "capture teams," which are very similar to the "business scouts" utilized throughout General Electric's organization. These teams consist of highly skilled engineering, business development, and partnering talent that collaborate to identify new opportunities and deliver highly innovative solutions to meet market demand. Additionally, these teams serve to facilitate the comprehensive and well-rounded development of entrepreneurial-spirited individuals. To date, Boeing has achieved such success with this mechanism that it is considering implementing it company-wide.

Furthermore, Boeing's Unmanned Systems Group, as well as other areas within the company, has set a precedent by partnering with smaller organizations and leveraging the best practices of other industries like biotechnology and pharmaceuticals to become the "preferred customer to [its] suppliers."[2] According to the company, the foundation of each of its partnerships is a personal relationship based on respect and a deep and abiding trust. Through honest dealings and upfront relationships, the company successfully implements collaborative partnering approaches to leverage other organizations' entrepreneurial cultures, rapid development capabilities, and revolutionary technologies. In exchange, Boeing offers its partners a number of capabilities and resources including a strong bridge to senior DoD, government, commercial, and venture capital contacts, an understanding of government regulations and export controls, and an extensive sales, marketing, production, and distribution network. The company also receives credit from its partners for understanding and respecting their intellectual property rights, a significant concern of many companies working with large primes.

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[1] Ratnam, Gopal. "Boeing Lands On Feet With UAV Unit." Defense News 26 Nov. – 2 Dec. 2001: 16.
[2] Hyde, Dina. "Unmanned Systems Partnerships & New Ventures." Presentation to ODUSD(IP) 24 Sept. 2002.

Boeing frequently "mines" the Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programs to identify organizations that it can establish win/win arrangements with in order to capitalize on new business opportunities. Good examples of Boeing's partnership model have been the relationships formed between Boeing and two of the 24 emerging defense suppliers highlighted in this report: The Insitu Group and Foam Matrix. Each of these suppliers believes that its relationship with Boeing has been rewarding, mutually beneficial, upfront, and honest.

Relocating to Chicago

Another important part of Boeing's repositioning for the future has been the relocation of its corporate headquarters to Chicago from Seattle. From three prospective locations including Denver and Dallas-Ft. Worth, the company selected Chicago as the site of its new headquarters due to its central location and distance from the companies' major operating units. To encourage leaner decision-making, Boeing has only 500 employees in its corporate headquarters.[3] At the same time, the leaders of the company's largest business units were appointed chief executive officers and given broader responsibilities for improving operating performance and achieving growth objectives. By moving its senior decision makers from its operating units into a leaner headquarters and empowering the chief executive officers of the operating units to grow their businesses, Boeing believes that it will be more responsive to customers needs, share information across divisions more effectively, and react more quickly to changing market conditions in the future.

> ***"We're continuing to transform our company with a focus on long-term growth and value creation. Our new corporate architecture – with a leaner headquarters located separately from our major business units – is a fundamental element of our business strategy."*** [3]
>
> *– Boeing chairman and CEO Phil Condit*

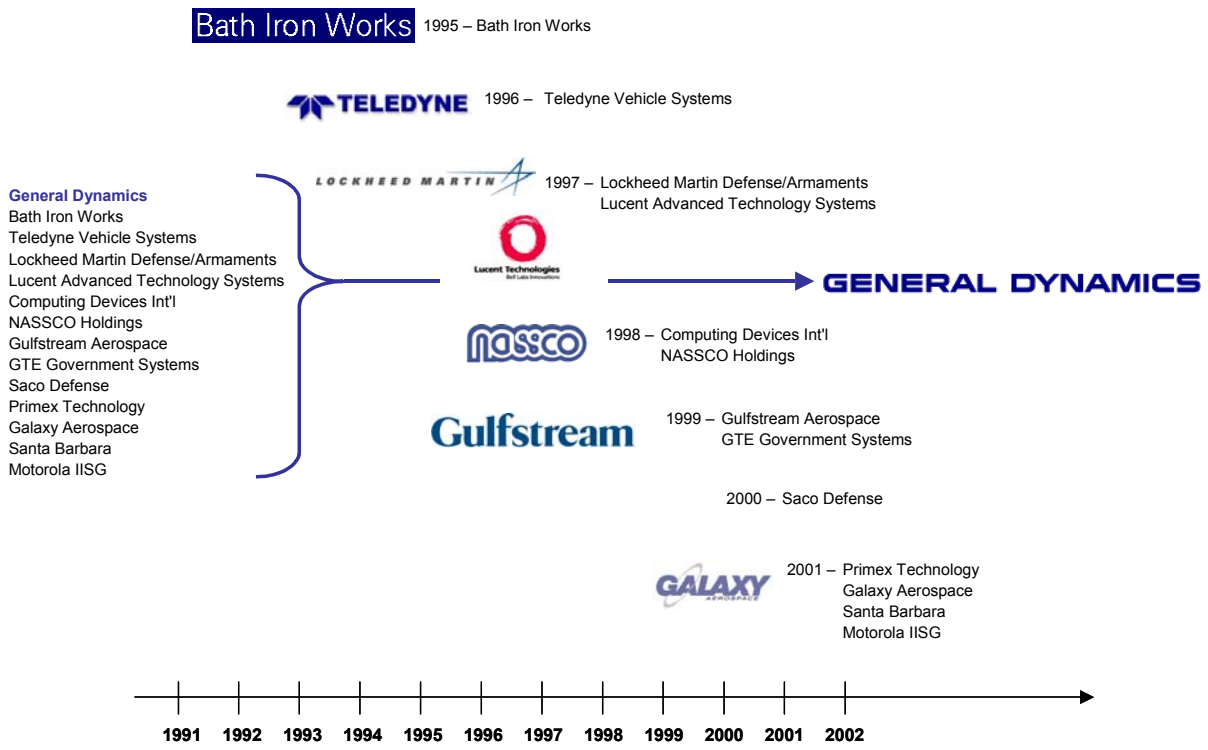
[3] Landers, Amanda and Ken Mercer. "Boeing Chooses Chicago as Center of New Corporate Architecture." Boeing News Release 10 May 2001. <http://www.boeing.com/news/releases/2001/q2/news_release_010510a.html>

APPENDIX D

HISTORICAL SUMMARIES, PRODUCT BATTLESPACES, AND CASE STUDIES OF THE FIVE LARGEST U.S. DEFENSE FIRMS

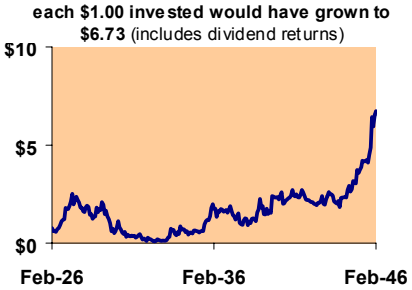
GENERAL DYNAMICS

GENERAL DYNAMICS (GD) SUMMARY

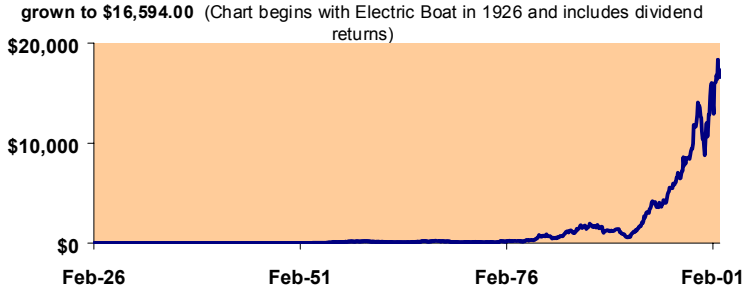


- ❑ 1899 – Financier Isaac Rice founds the **Electric Boat Company**
- ❑ 1900 – GD marketed the US's **first submarine**
- ❑ 1914-18 – During World War I and just after, Electric Boat receives orders to build 85 submarines for the U.S. Navy, 722 submarine chasers, and 118 Liberty ships
- ❑ 1941-45 – Over the course of World War II, Electric Boat produces 74 submarines and 398 PT boats
- ❑ 1952 – GD officially established February 21, when Electric Boat acquired **Canadair Ltd.** and began building the first nuclear-powered submarine, the **USS Nautilus**
- ❑ **1970's – 1980's – Pioneered the use of optical communications**
- ❑ 1926 – The company's stock starts trading on the NYSE in February at around $8.13, or 0.5 cents per share adjusted for subsequent stock splits
- ❑ 1972 – The company lays the keel for its first Los Angeles-class attack submarine, the **Philadelphia (SSN690)**
- ❑ 1979 – First operational **F-16A** delivered in January
- ❑ 1982 – GD added its first Combat Systems business unit, Land Systems, its first Information Systems and Technology business unit
- ❑ 1989 – Begins construction of **Seawolf** (SSN21), the lead ship in what will be the most advanced class of attack submarine in the world
- ❑ 1990s – Sells **Cessna to Textron,** acquires **Bath Iron Works and Gulfstream,** and adds **Advanced Technology Systems**
- ❑ Today, GD employs over 54,000 people worldwide, and has annual revenues of over $13 billion

GD generated a **compound annual return of 10.0%** in its first 20 years as a public company: **each $1.00 invested would have grown to $6.73** (includes dividend returns)

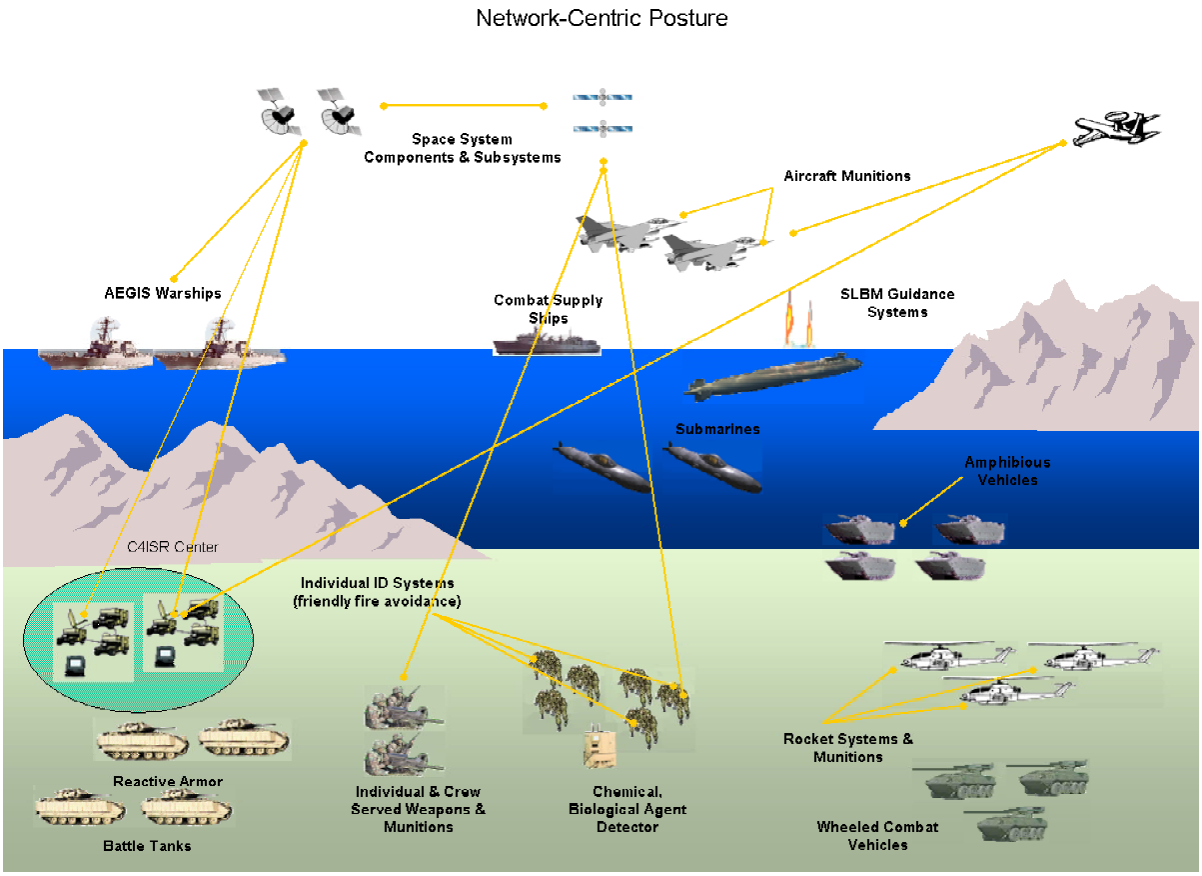


GD has generated a **compound annual return of 13.6%** through the end of last year: **each $1.00 invested at the beginning of the seventy six year period would have grown to $16,594.00** (Chart begins with Electric Boat in 1926 and includes dividend returns)



Source: ODUSD (Industrial Policy). Institute for Defense Analyses, and First Equity

GENERAL DYNAMICS (GD) SUMMARY



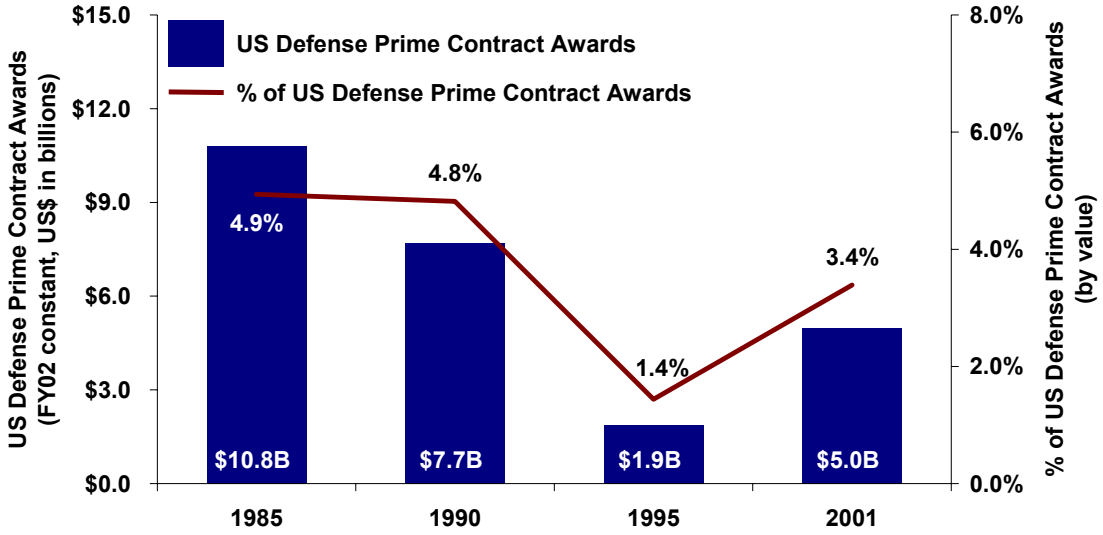


Chart does not reflect revenue received through subcontracts

Source: ODUSD (Industrial Policy). DoD Washington Headquarters Service, Institute for Defense Analyses, and First Equity

GENERAL DYNAMICS CORPORATION

3190 Fairview Park Drive
Falls Church, VA 22042-4523
(703) 876-3000
www.generaldynamics.com

- **Operational Effects-Based Sectors:** Combat Support, Power Projection, Precision Engagement, Homeland and Base Protection, and Integrated Battlespace
- **Products and Services**: The company has leading market positions in business aviation and aircraft services, land and amphibious combat systems, mission-critical information systems and technologies, and shipbuilding and marine systems
- **Primary military sales vehicle:** Prime contractor and systems integrator
- **Military applications:** Wireline and wireless voice and data networking products and services, armored vehicles, armaments, munitions, special mission aircraft, and combat vessels
- **Commercial applications:** Business jet aircraft and aviation maintenance and support services
- **Annual Revenue:** $12 billion in 2001
  - Total U.S. government sales: $7.3 billion (60% of total)
- **Employees:** 54,000
- **Established:** Officially established in 1952, although organizational roots date back to late 1800s

IMPORTANT POINTS

- According to General Dynamics, the Department of Defense did an excellent job resolving the issues around the LPD-17, making it a win-win-win situation for the government and the two shipyards involved
- General Dynamics believes that many commercial firms decide not to deal with DoD's smaller production quantities, unique requirements, and smaller profit margins

MAJOR STRATEGIES

- Grow business by developing and acquiring capabilities in high growth markets
- Enter into partnership, licensing, joint venture, and other agreements to provide a "bridge" for "best of breed" technologies to enter military market
- Maintain low overhead and agility to facilitate rapid information sharing and to adapt to the highly dynamic military market
- Leverage diverse technological capabilities to cross-fertilize programs with innovative technologies of significant value to customers
- Establish operating relationships to interface with customers to discover and understand future needs

DEFENSE CONCERNS

- Inherent instability in the defense market may sometimes be a barrier to entry for small or commercial suppliers
- Lengthy military sales cycles may be difficult to manage for some organizations

RECOMMENDATIONS

- Ensure fair and equitable competition in contracting process
- Endeavor to establish systems and processes that lead to acquiring the "best of the best" warfighting systems and technologies
- Strive to assure financial health of defense industrial base

The Current Defense Environment

General Dynamics Corporation is a global aerospace and defense firm, with leadership positions in business aviation, mission-critical information systems and technologies, shipbuilding and marine systems, and land and amphibious combat systems. With over $7.3 billion in sales to the U.S. Government, representing nearly 60% of total sales, General Dynamics is a top-five player in the military marketplace. The company conducts business in four primary business groups: Information Systems and Technology (IS&T), Combat Systems, Marine Systems, and Aerospace.

With the national defense budget projected to increase at approximately five to ten percent annually, the company expects U.S. defense spending for research, development, test, and evaluation (RDT&E) and procurement to grow proportionately. Additionally, some at General Dynamics believe that the market still resembles a contractionary environment, where commercial organizations are likely to continue to divest or exit military businesses that do not meet their financial objectives. This will lead to significant opportunities for firms like General Dynamics to add capabilities to their portfolios by acquiring divisions from exiting companies or by establishing partnerships and joint ventures with other organizations.

Over the past ten years, the company has taken advantage of these opportunities. After a divestiture period that trimmed General Dynamics from $10 billion to $3 billion in annual revenue during the early 1990s, the company began a series of over 25 acquisitions that grew its core defense businesses, expanded its systems integration and command and control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) capabilities, and added business aviation products and services to its portfolio. The company's underlying acquisition strategy has been to acquire well-positioned businesses in high growth markets, as evidenced by acquisitions in its IS&T sector, which has grown from zero revenue in 1995 to become General Dynamics' highest revenue generating sector.

Technology Bridges

According to General Dynamics, it is often very difficult for a commercial firm or a defense firm to "cross the bridge" and to compete successfully in the other's market. For a commercial firm trying to sell warfighting technologies to the

military directly, small production volumes often offer slight rewards and are frequently difficult to manage. For instance, outfitting every Stryker contemplated for production means that tire or commercial electronics manufacturers would only outfit 2,100 units, an opportunity significantly smaller than most in the commercial arena.

"It's just a different kind of market…the track record is terrible for both sides [commercial and defense] trying to play on the other's field."

Additionally, General Dynamics contends that many small and commercial companies may have issues dealing with the instability inherent in government contracting. Since decisions are often influenced by changing Congresses and shifting senior military personnel and civilian Pentagon officials, defense programs change frequently. Consequently, the defense industrial base "needs a cadre of suppliers that are used to dealing with [frequent changes] and [that] are nimble enough to play the cards that are dealt to them." This often precludes smaller and commercially-focused organizations. Furthermore, General Dynamics believes that many large defense suppliers, because they possess the scale and breadth of capabilities necessary to successfully manage large defense contracts, can have problems competing in commercial markets.

"I think that we would consider ourselves to be a bridge to the technology…. there certainly are technologies that we are focused on, but we have to be cognizant of technologies that exist in the commercial sector and serve as the bridge to them."

Consequently, the company believes that "bridges" to transfer "best of breed" technologies from small and commercial organizations into military systems and programs are required. In most cases, the Department of Defense acquires the most technologically advanced systems at the best value from a partnership between a systems integrator and commercial and other organizations.

According to General Dynamics, the Littoral Combat Ship (LCS) program is a good example of this because almost every major defense player involved has teamed with a commercial partner to understand and implement best commercial practices to produce lighter and faster trimaran and catamaran hull shapes. At the same time, experience in military shipbuilding is required in order to develop a ship with the ruggedness, redundancy, and structural integrity necessary for combat situations. Through its partnerships and by acting as a bridge and interface between DoD and subcontractors, General Dynamics believes that it can develop and manufacture the most beneficial, valuable, and successful military systems and platforms.

Another interesting example in which the company acts as a bridge to the military marketplace is its 2001 acquisition of Motorola's Integrated Information Systems Group. As part of the transaction, General Dynamics and Motorola negotiated a Strategic Alliance Agreement that provides a framework for continuing certain technology and teaming synergies. The acquired business focuses on military applications but sometimes uses and integrates commercial technology from Motorola. As a result, one of the first highly successful pieces of equipment from the acquisition was a module that can be attached to Motorola GSM cell phones to provide NSA-certified type I encryption. This is a result of the matrimony of a top-level/military security encryption product with a COTS device that was enabled by a commercial understanding of the technology within a military organization. In the future, the benefits of commercially viable product enhancements can continue to be leveraged between Motorola and General Dynamics.

Subcontractor – Prime Contractor – Competitor Relationships

General Dynamics has witnessed the consolidation of the global defense industrial base over recent years as the number of military contractors has decreased. Because of this consolidation and the increasing size and decreasing frequency of military contracts, the company is frequently involved with a multitude of different programs in different roles and with varying levels of involvement. On some programs, the company partners with other contractors in a consortium or acts as a prime contractor; whereas, on other programs, the company acts as a subcontractor. Frequently, General Dynamics finds itself competing for awards against the same firms with which it has partnership agreements. According to the company, these strategic partnerships help the company develop new business opportunities, but also make it critical to distinguish itself from other large defense contractors.

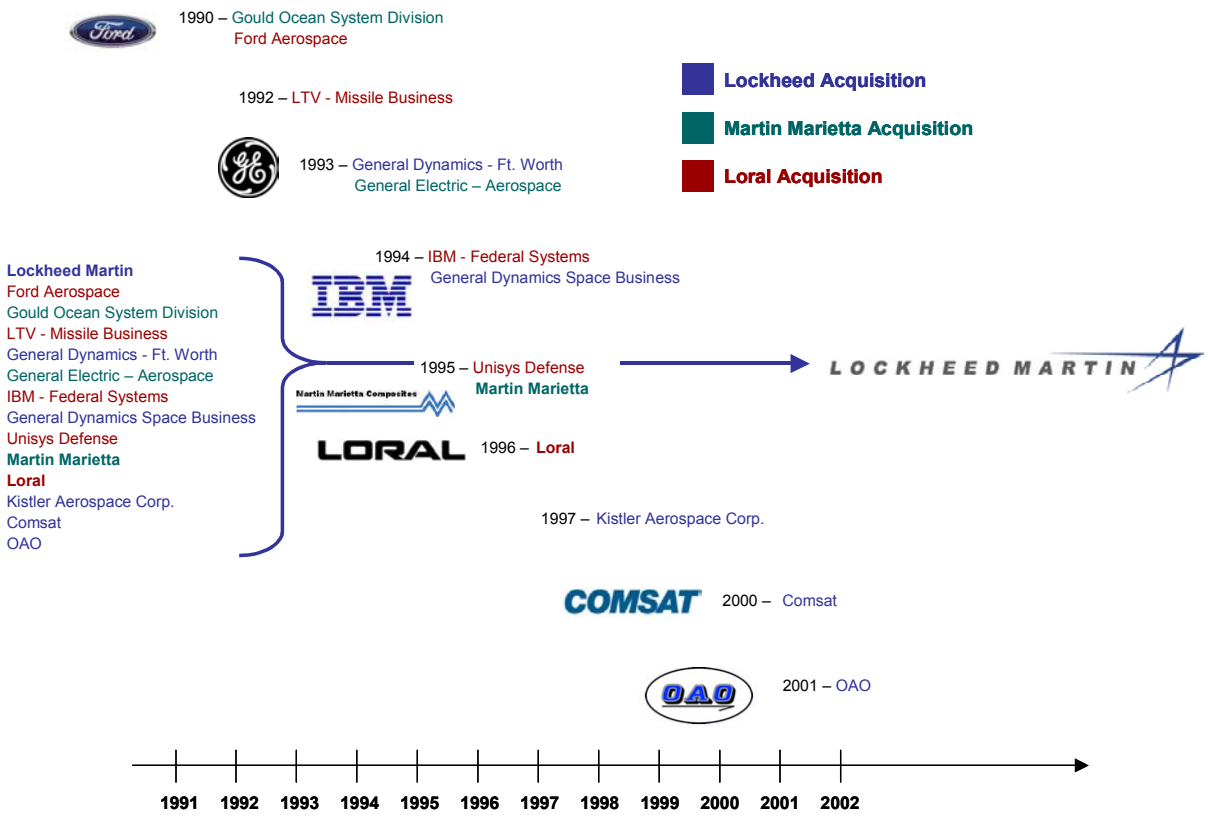
"We partner on select programs, we're suppliers to some. That's the way you have to survive in this business. You can't play winner take all and stay in business. You have to find ways to participate across the board in as many ways as you can…you have to get yourself integrated into as many programs as you can."

APPENDIX D

HISTORICAL SUMMARIES, PRODUCT BATTLESPACES, AND CASE STUDIES OF THE FIVE LARGEST U.S. DEFENSE FIRMS

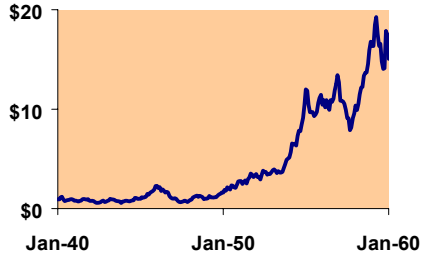
LOCKHEED MARTIN

LOCKHEED MARTIN (LMT) SUMMARY

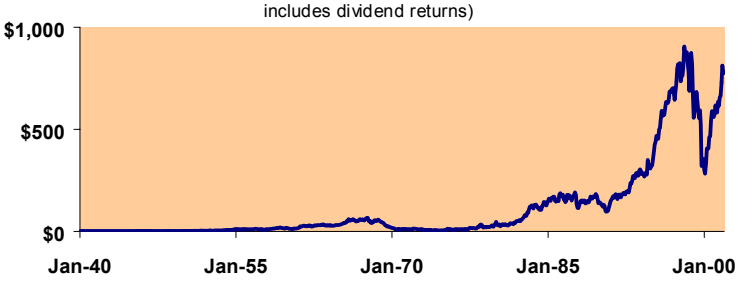


- ❑ 1916 – Allan and Malcolm Loughead found **Loughead Aircraft Manufacturing Company**
- ❑ 1918 – The Loughead F-1 Flying Boat makes its first flight; Loughead makes its first military sale, of Curtiss HS-2L flying boats, to the U.S. Navy
- ❑ 1920s – After the demise of the original company, Allan Loughead officially forms the **Lockheed Aircraft Company;** the Lockheed Vega is designed and produced, eventually completing the first nonstop transcontinental flight in 19 hours; Lockheed Aircraft becomes a division of Detroit Aircraft (A group of investors buys the company back in 1932)
- ❑ 1930s – The DL-1 becomes the first Detroit-Lockheed military aircraft; Lockheed produces its first fighter, the XP-900; Amelia Earhart, in a Vega, is the first woman to solo across the Atlantic
- ❑ 1939 – **The company starts trading on the NYSE** in December at $31.88, or 50 cents per share adjusted for subsequent stock splits
- ❑ 1940-50s – Lockheed forms Skunk Works; XP-80 Shooting Star is the first American jet fighter; U-2 reconnaissance aircraft makes its first flight
- ❑ 1974 – **SR-71** sets the first of many records, this one for speed – 3 3/4 hours from London to Los Angeles
- ❑ 1980s – Lockheed and the USAF disclose the existence of Lockheed's **F-117A Stealth Fighter**
- ❑ 1990s – **Hubble telescope** is deployed; with General Dynamics and Boeing, LMT begins making the F/A-22, acquisitions – see above
- ❑ 1999 – **LMT wins JSF contract**

LMT generated a **compound annual return of 15.4%** in its first 20 years as a public company: **each $1.00 invested would have grown to $17.51** (includes dividend returns)



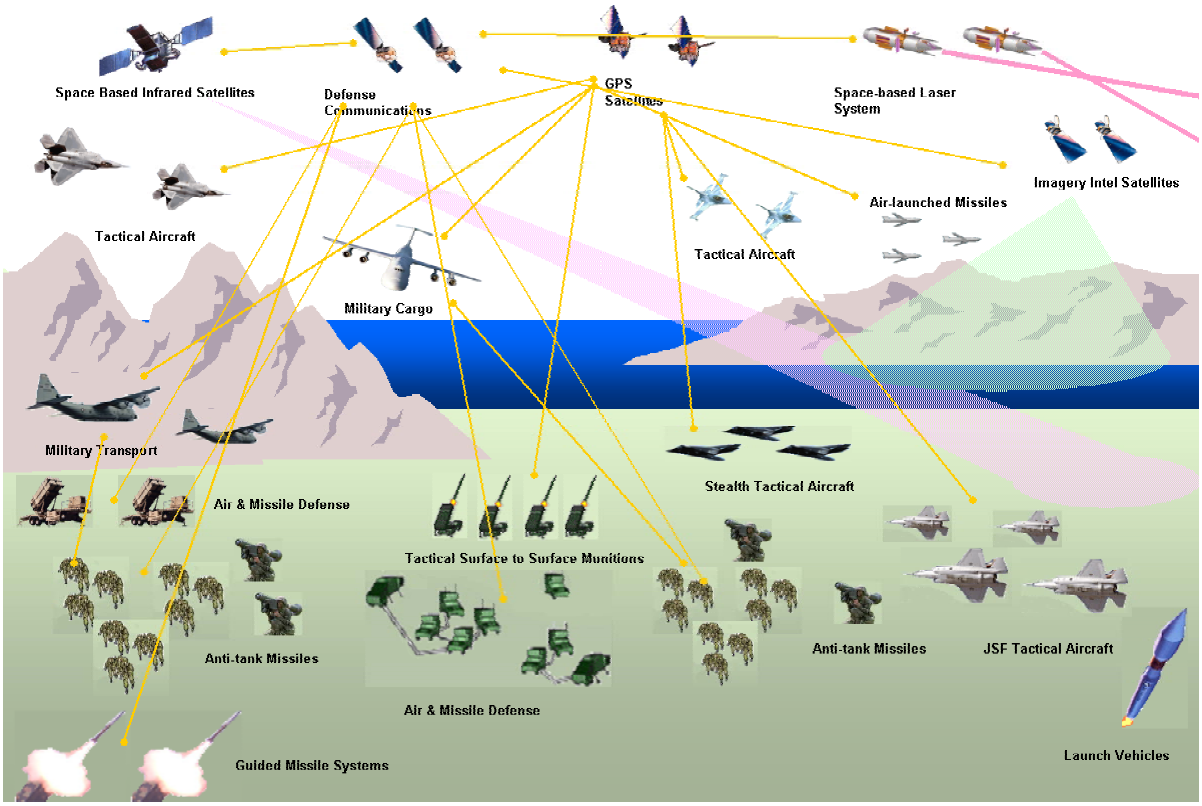
LMT has generated a **compound annual return of 11.3%** through the end of last year: **each $1.00 invested at the beginning of the sixty two year period would have grown to $779.00** (Chart begins with Lockheed Aircraft Company in 1939 and includes dividend returns)



Source: ODUSD (Industrial Policy). Institute for Defense Analyses, and First Equity

LOCKHEED MARTIN (LMT) SUMMARY

Network-Centric Posture



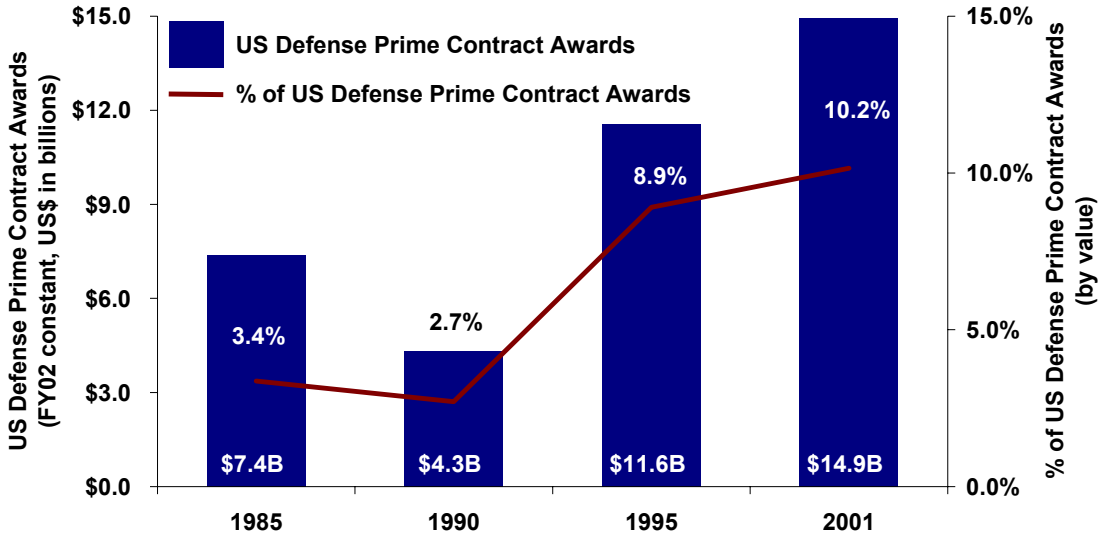


Chart does not reflect revenue received through subcontracts

Source: ODUSD (Industrial Policy). DoD Washington Headquarters Service, Institute for Defense Analyses, and First Equity

LOCKHEED MARTIN CORPORATION

6801 Rockledge Dr.
Bethesda, MD 20817
(301) 897-6000
www.lockheedmartin.com

- **Operational Effects-Based Sectors:** Combat Support, Power Projection, Precision Engagement, Homeland and Base Protection, and Integrated Battlespace
- **Products and Services:** Lockheed Martin's principal activities include systems integration, space systems, aeronautics, and technology services
- **Primary military sales vehicle:** Prime contractor
- **Military applications:** Missiles and fire control radar, combat / mission system integration, communication satellites, submarine-launched missiles, fighter and transport aircraft, management, engineering, and logistic services
- **Commercial applications:** Communication satellites, engineering and information technology services, air traffic control systems, and postal automation systems
- **Annual Sales:** $24 billion in 2001
  - 94% government, 6% commercial
- **Employees:** 125,000
- **Established:** 1926

IMPORTANT POINTS

- While the outsourcing of Operations and Maintenance (O&M) services has been identified as a growth area for the Department of Defense, these opportunities are not always readily accessible to defense contractors
- Limited budget growth will create competition between various need areas including procurement, O&M services, existing research and development, and future investment in technology

MAJOR STRATEGIES

- Maintain a "cautious optimism" in its approach to DoD budget growth and future opportunities
- Work with DoD to identify transformational needs as well as technologies that should be targeted with future investment
- Map best interests of shareholders with identified needs of DoD

DEFENSE CONCERNS

- The rewards for developing highly sophisticated military products are often inconsistent with the effort and the results
- Contractors rarely receive much of the savings they create for DoD
- DoD's interests are not always aligned with the best interests of a contractor's shareholders
- Program instability: budget constraints often reduce order quantities originally planned for
- The available labor pool may be limited in the near term due to aging of the current workforce and a scarcity of talented replacements

RECOMMENDATIONS

- Increase contractor participation in savings to encourage operating efficiency and creativity
- Provide profit margins on high-risk R&D contracts that are commensurate with the levels of technology development and risk.
- Work closely with industry to identify and develop future warfighting needs to encourage long-term research and development investment
- Maintain budget and program stability

Evolving Role of Primes

Lockheed Martin is currently the Department of Defense's leading prime contractor, with major programs such as the F-16 and F/A-22 fighters, Trident II ballistic missile, C-130J transport, and recently the F-35 Joint Strike Fighter. As a prime contractor, Lockheed Martin realizes that it cannot develop all the optimal systems and subsystems for each of its programs. As such, the company views its role as that of a systems integrator, combining the most advanced technologies into its systems at the best price for the customer. In this role, the company relies heavily on numerous subcontractors for technological innovation, utilizing their products on its various platforms. Many of these second-tier suppliers have developed innovative, transformational technologies, but do not possess the system concepts to accompany them. These companies tend to migrate to Lockheed Martin in search of a context for their technologies.

Lockheed Martin sees itself as a conduit for many of these small companies in establishing a military marketplace for their products. Unlike many of its subcontractors, Lockheed Martin believes that it understands DoD operations and its needs, and the best ways to bring a product to market quickly and effectively. As a result, despite transformational efforts encouraging less traditional companies with new technologies and creative solutions to interact directly with DoD, Lockheed Martin believes that there will continue to be a critical role for prime contractors as facilitators.

In order to connect with these less traditional companies, Lockheed Martin has implemented a number of supplier outreach programs. The company has organized a few of these programs at the corporate level. However, as the company's operating units are much closer to the customer and are more familiar with DoD needs, the company has established more outreach programs at the operating level. In these efforts, Lockheed Martin works with a myriad of organizations: small companies, universities, and other research and development facilities. Additionally, a variety of companies approach Lockheed on a daily basis with new opportunities. Lockheed Martin has concluded that in order for transformation to be successful, there needs to be an amiable relationship between the prime contractors and their potential subcontractors.

However, according to Lockheed Martin, the success of these relationships, and the companies themselves, is fully dependent on the availability of funding. The company

believes that the availability of funding is one of the most critical components to the viability of the defense industrial base. DoD's budget vacillates in cycles, and the associated peaks and valleys radiate to the defense industrial base. In the company's opinion, over the last forty years, the defense industry has been able to weather the peaks and valleys quite effectively. Currently, the defense market is near a spending peak, and Lockheed Martin is concerned that there may not be enough flexibility in the defense industrial base to weather another deep valley in funding, potentially resulting in further consolidation.

> ***"The thing that drives people into the marketplace is funding. If the budget continues to hold strong, that's naturally going to draw new players into the marketplace."***

Balance between Shareholders and DoD

As the leading DoD contractor, Lockheed Martin, like other defense contractors, faces a delicate balance between meeting DoD needs and acting in the best interests of its shareholders. Frequently, these objectives are aligned because meeting customer needs typically translates into profits.

However, in Lockheed's opinion, this is not always the case, as presently evidenced in the space industrial base, where a lack of market demand means that meeting DoD needs may decrease shareholder value. According to the company, both Boeing and Lockheed Martin, in conjunction with DoD, invested substantial capital to develop technologies for Evolved Expendable Launch Vehicle (EELV) programs while the defense or commercial market has declined significantly. DoD has identified assured and reliable access to space as a primary objective, and the company is committed to continuing to provide the technology and services to meet that objective. However, as a public company, Lockheed must balance the needs of the customer with its fiduciary responsibilities to its shareholders. Lockheed Martin is working with its DOD customer to develop a solution to the problem of insufficient market opportunities to sustain the space industrial base.

The satellite market aside, according to Lockheed Martin, over the last thirty years, managing this balance has been reasonably straightforward. During this period, defense contractors have been able to direct their research and development efforts towards specific technological applications. For example, stealth technology was identified and highlighted for development. Consequently, research and development on stealth technologies could be converted into products, which readily would earn a return for the company's shareholders.

However, with the transformation of the industrial base, Lockheed sees the defense landscape in a state of flux and believes that specific areas for targeted R&D funding are more difficult to identify. According to Lockheed Martin, while companies continue to invest in R&D to provide for the future, they are more apt to do so in areas where they are more likely to earn an adequate positive return. Therefore, without a well-defined long-term technological strategy from DoD, companies will tend to focus their research on the near-term. In Lockheed's opinion, in order to ensure that companies are exploring new technologies and searching for innovative solutions for the future, it is critical for DoD to establish a reasonable strategic technological direction, even if it may change.

"It's very hard to establish technology directions without an understanding of the evolving nature of warfare."

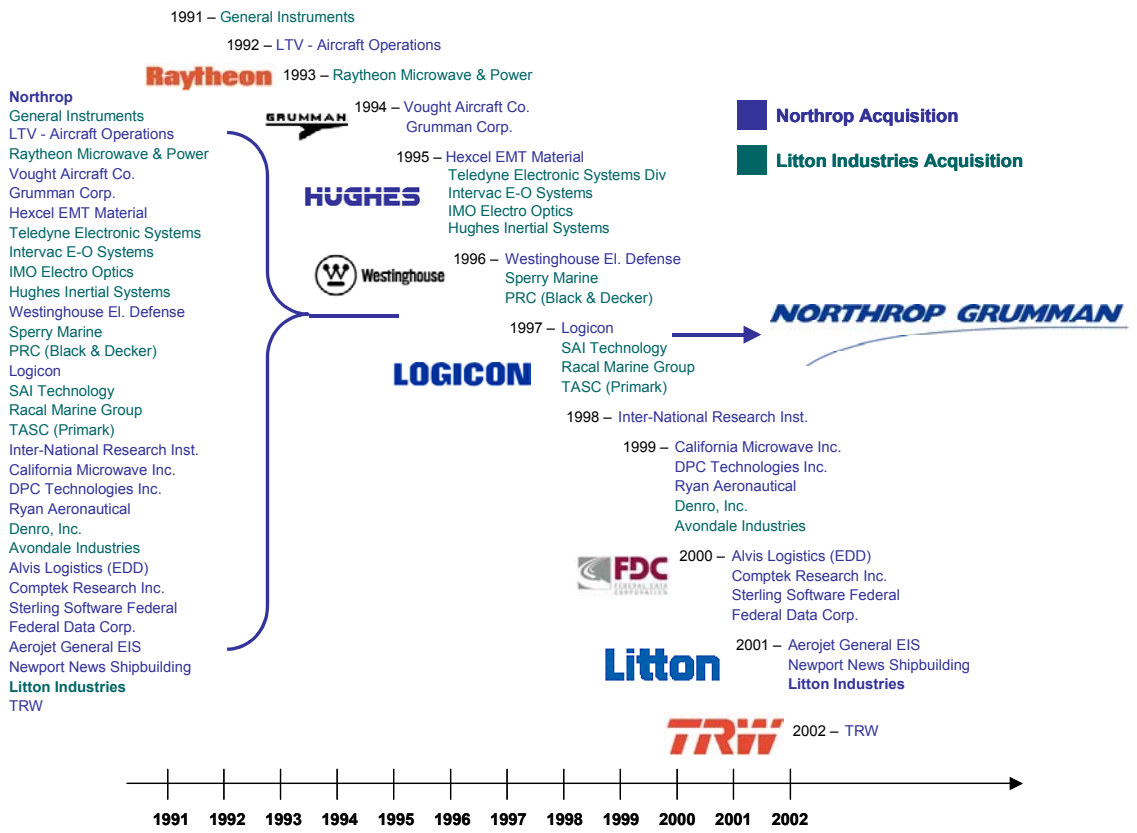
Lockheed Martin recognizes the positive steps the Secretary of Defense has been making, such as defining six goals for transformation. However, the company believes that the most effective way to support future warfighting capabilities is for DoD and industry to work together in developing the architectures on all levels that will guide development of the systems and technologies of the future.

APPENDIX D

HISTORICAL SUMMARIES, PRODUCT BATTLESPACES, AND CASE STUDIES OF THE FIVE LARGEST U.S. DEFENSE FIRMS

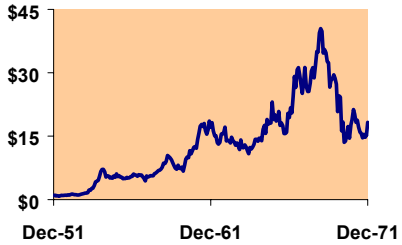
NORTHROP GRUMMAN

NORTHROP GRUMMAN CORPORATION (NOC) SUMMARY

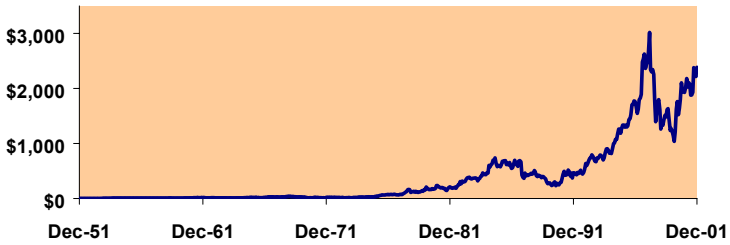


- ❑ 1903 – At eight years old, **John K. Northrop** witnesses the **Wright Brothers'** first flight
- ❑ 1920s – Northrop joins Allan Lockheed to form **Lockheed Aircraft**, where he designs the Vega, flown by Amelia Earhart; Northrop leaves Lockheed to start Avion Corporation, later a division of **Boeing's** United Aircraft and Transportation Corp
- ❑ 1930s – Northrop leaves to form Northrop Corp., 51% owned by **Douglas Aircraft**; Northrop employs six people in a leased hotel room in Hawthorne, CA
- ❑ 1940s – Develops and produces the first successful "flying wing", the "**Black Widow**" (the US's first aircraft designed specifically as a night fighter), the Rocket Wing MX324 (America's first military rocket airplane), the N-3 patrol bomber, "Vengeance" dive bombers and the **B-35**
- ❑ 1952 – **NOC starts trading on the NYSE** in January at around $14.75, or 34 cents per share, adjusted for subsequent stock splits
- ❑ 1990s – Acquisitions have helped Northrop diversify and become a **leading defense electronics, systems integration, shipbuilding and governmental information technology enterprise**
- ❑ **Today, Northrop is a global defense leader, with annual sales over $25 billion (including the acquisition of TRW)**
- ❑ **Northrop employs nearly 100,000 people and has operations in 44 states and 25 different countries**

NOC generated a **compound annual return of 15.6%** in its first 20 years as a public company: **each $1.00 invested would have grown to $18.26** (includes dividend returns)

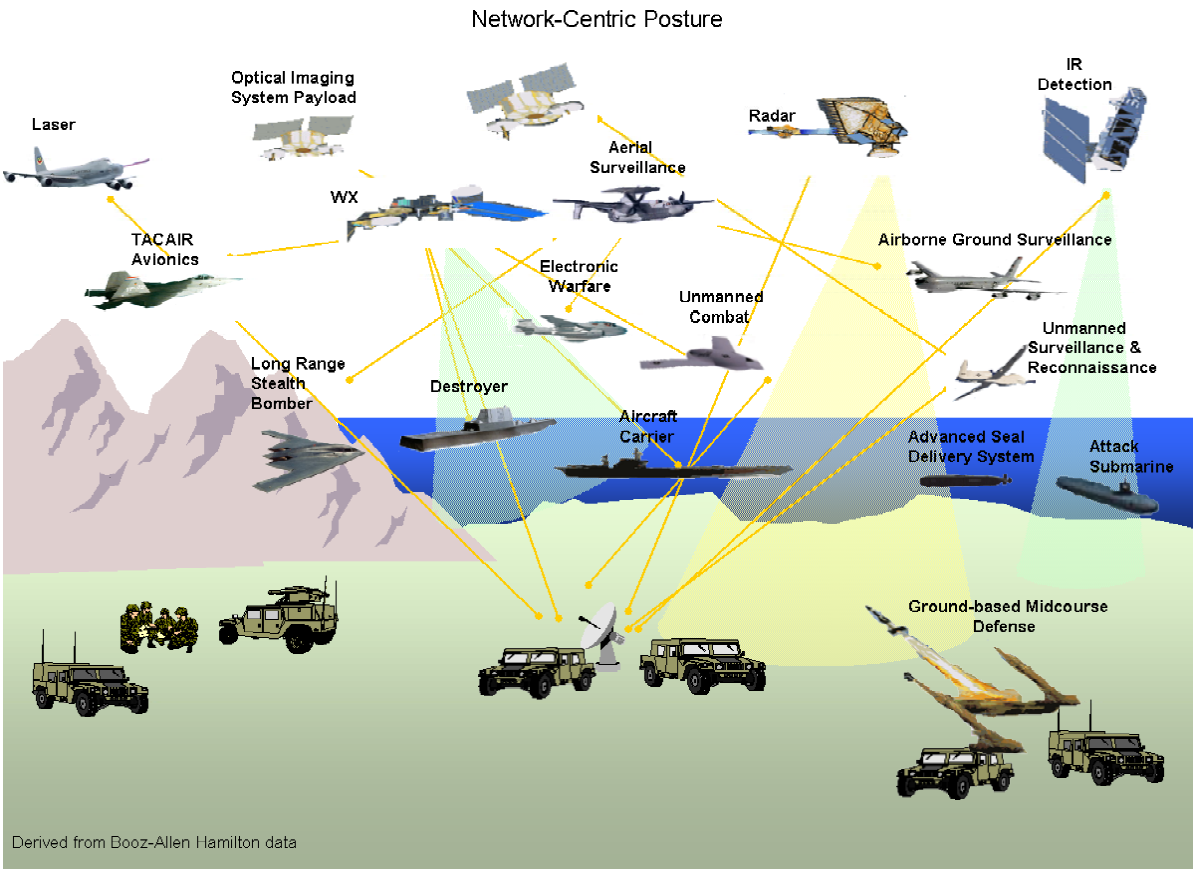


NOC has generated a **compound annual return of 16.8%** through the end of last year: **each $1.00 invested at the beginning of the fifty year period would have grown to $2,384.00** (Chart begins with Northrop Aircraft in 1951 and includes dividend returns)



Source: ODUSD (Industrial Policy). Institute for Defense Analyses, and First Equity

NORTHROP GRUMMAN CORPORATION (NOC) SUMMARY



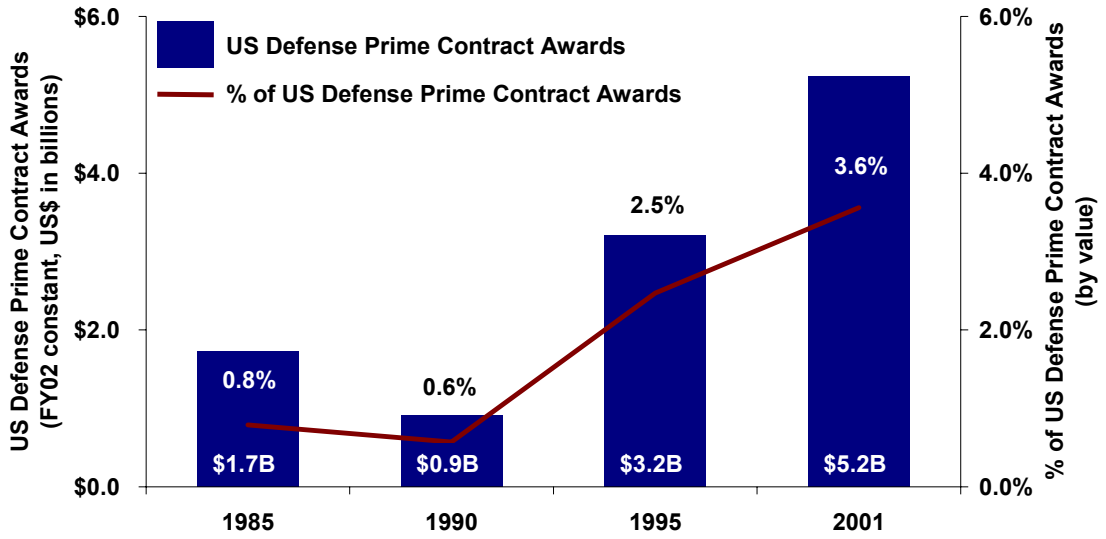


Chart does not reflect revenue received through subcontracts

Source: ODUSD (Industrial Policy). DoD Washington Headquarters Service, Institute for Defense Analyses, and First Equity

NORTHROP GRUMMAN CORPORATION

1840 Century Park East
Los Angeles, CA 90067
(310) 553-6262
www.northgrum.com

- **Operational Effects-Based Sectors:** Combat Support, Power Projection, Precision Engagement, Homeland and Base Protection, and Integrated Battlespace
- **Products and Services**: Northrop operates in seven sectors:
  - Electronic Systems, Information Technology, Mission Systems, Integrated Systems, Ship Systems, Newport News, and Space Technology
- **Primary military sales vehicle:** As a prime contractor
- **Military applications:** Information technology, electronic systems and sensors, satellite systems, aircraft, unmanned systems, submarines, aircraft carriers, surface combatant ships and assault ships
- **Commercial applications:** Communication satellites, engineering and information technology services, air traffic control systems, and postal automation systems
- **Annual Sales:** $25 billion (2003 estimated sales including revenue from TRW acquisition)
- **Employees:** 120,000
- **Established:** 1939 (Acquired companies established beginning in 1886)

IMPORTANT POINTS

- Northrop Grumman recognizes that many of the most advanced technologies are developed by commercial companies, which frequently do not want to be burdened by government regulations
- Commercial Off-The-Shelf (COTS) and other commercial solutions are not always feasible in military situations and under conflict conditions

MAJOR STRATEGIES

- Leverage a robust portfolio of transformational capabilities to develop highly advanced military solutions
- Look to other companies to supply needed components rather than developing and manufacture them in-house
- Partner with nontraditional companies to field innovative, revolutionary new technologies
- Become the system integrator of choice

DEFENSE CONCERNS

- It is oftentimes very difficult for commercial companies to develop warfighting technologies because of the overhead associated with operating under the Federal Acquisition Regulations (FAR)
- As potential partners, smaller companies are often invisible to the company

RECOMMENDATIONS

- Offer incentives to current defense contractors to integrate commercial subsystems and components in their systems
- Rather than working directly with them, DoD should encourage commercial and small firms to partner with current defense contractors
- Allow some requirements to be determined by system integrators, rather than stipulate all contract requirements
- Facilitate communication between system integrators and small companies

Current Situation

Northrop Grumman, due to sixteen strategic and often large acquisitions (including Grumman, Westinghouse, Logicon, Litton, Newport News, and most recently TRW), is now the second largest defense contractor and the number one ship builder in the United States. High profile products include the B-2 stealth bomber, Joint STARS aircraft, satellite systems, nuclear aircraft carriers and submarines, amphibious assault ships, and the Global Hawk UAV.

Key to securing the company's position as one of the premier system integrators has been its industry leading acquisitions. According to Northrop, it was one of the first companies to recognize the need for incorporating transformational capabilities from a strategic perspective. Acquisitions have been driven by the need to address new capabilities of the 21st century warfighter. Interoperability, Network-Centricity, Cyberspace, and Information Warfare have all been areas of concentration for strategic transformation. Northrop believes that it has generally moved ahead of DoD in putting its portfolio of businesses together to compete in a transformed environment.

Northrop remains bullish on the defense budget over the next few years, although it is aware of the uncertainties the current environment may bring. For example, while the general consensus within the defense community is that there will be an increase in military spending in the future, Northrop sees potential risks due to the situation in Iraq, the ongoing war against terrorism, and the increasing needs for Operations & Maintenance funding. While the DoD Budget uncertainty of the 1990's has diminished, the actual allocation of military budget dollars is always dependent on the current defense arena as well as the immediate needs for personnel and equipment upkeep. As such, Northrop has taken an aggressive yet cautious approach to the future.

The Defense Industrial Base

Northrop contends that significant over-capacity remains in the defense industry, even with the consolidation that has occurred since the late 1980's. According to the company, theory would dictate that the market would respond with continued consolidation. Some at Northrop, however, think that the Pentagon would be unreceptive to further consolidation at the top level but that there will be consolidation at the mid-tier level. The company believes that this is where there is the greatest risk in maintaining a diverse and robust supplier base.

> ***"We're a systems integrator, and systems integration is done at several levels. It's done at the very top level when you want to talk about integrating platforms…all the way down to when you're integrating a radar or a black box. [That's] still systems integration."***

The Federal Acquisition Regulations

Northrop understands that it is often difficult for commercial companies to operate under the Federal Acquisition Regulations (FAR). Frequently, according to Northrop, commercial companies do not understand the intricacies of doing business with the United States government. Consequently, the company believes that prime contractors should be given incentives to work more closely with smaller commercial suppliers. These smaller suppliers would then be able to utilize the system integrators' resources without having to support the necessary overhead required to deal directly with the government procurement system.

Commercial Partners

As a systems integrator, Northrop has seen the benefit of working with select commercial and non-traditional companies in order to develop leading-edge warfighting solutions. In fact, Northrop has developed a highly successful model of working with leading-edge second and third tier suppliers to field some of the most advanced technologies available. In these cases, Northrop believes that it should be able to contract with a commercial company without having all of the FAR requirements flow down to the smaller company from the government. This would allow the smaller commercial company to operate without being burdened by some of the inevitable restrictions under the FAR.

"[At] Northrop Grumman, we're looking for the supplier who can supply the component we need rather than developing it and manufacturing it ourselves."

As part of this process, Northrop's primary focus is on developing and fielding the best technology and products for the warfighter. This means that the company evaluates both internal and external supply sources and selects the best technologies available. One issue Northrop encounters frequently is its limited visibility of some of the smaller companies. Often, these firms are below the company's radar due to their size. There is a need for the smaller companies to network aggressively within the industry to make their capabilities known. Afterward, Northrop can help support the smaller companies through investment, teaming, partnership agreements, or subcontracting in order to facilitate further development of their technology or production capacity.

Strategic Positioning – Domain Knowledge

Developing and harnessing "domain knowledge," or a depth of expertise in a specific area, is one of Northrop's primary approaches to increasing its military presence. Often, Northrop develops key technical capabilities in-house for use in a wide range of potential systems, e.g. in-house military electronics expertise used in both UAV and aircraft carrier programs. The company has created an environment to

nurture this technical capability and to enable effective domain knowledge sourcing for application in different markets and on different platforms. Additionally, when Northrop lacks sufficient in-house expertise in an area, it forms a lasting and steady relationship with other companies (both large and small) that possess the necessary skills.

According to Northrop, establishing a portfolio of transformational domain knowledge is one of the most significant moves it has made to position itself to compete in the long-run. Developing breadth in this portfolio is crucial to the company's continued success from the standpoint of being able to meet the myriad needs of the 21st century warfighter.

Additionally, the firm stresses that each of its portfolio businesses is a leader in its market or is in the process of becoming a premier player. Consequently, Northrop can leverage competitive capabilities and domain knowledge from each of its businesses across the entire company. This leads to Northrop's challenge of maintaining businesses that are both premier in their market and possess the requisite domain knowledge, while focusing on effectively and competitively accessing that knowledge from across the company. This process is key when attempting to develop integrated systems solutions for the customer. As such, the company has developed the systems engineering and systems management capabilities (domain knowledge) to coordinate and execute as a premier systems integrator in the aerospace and defense industry.

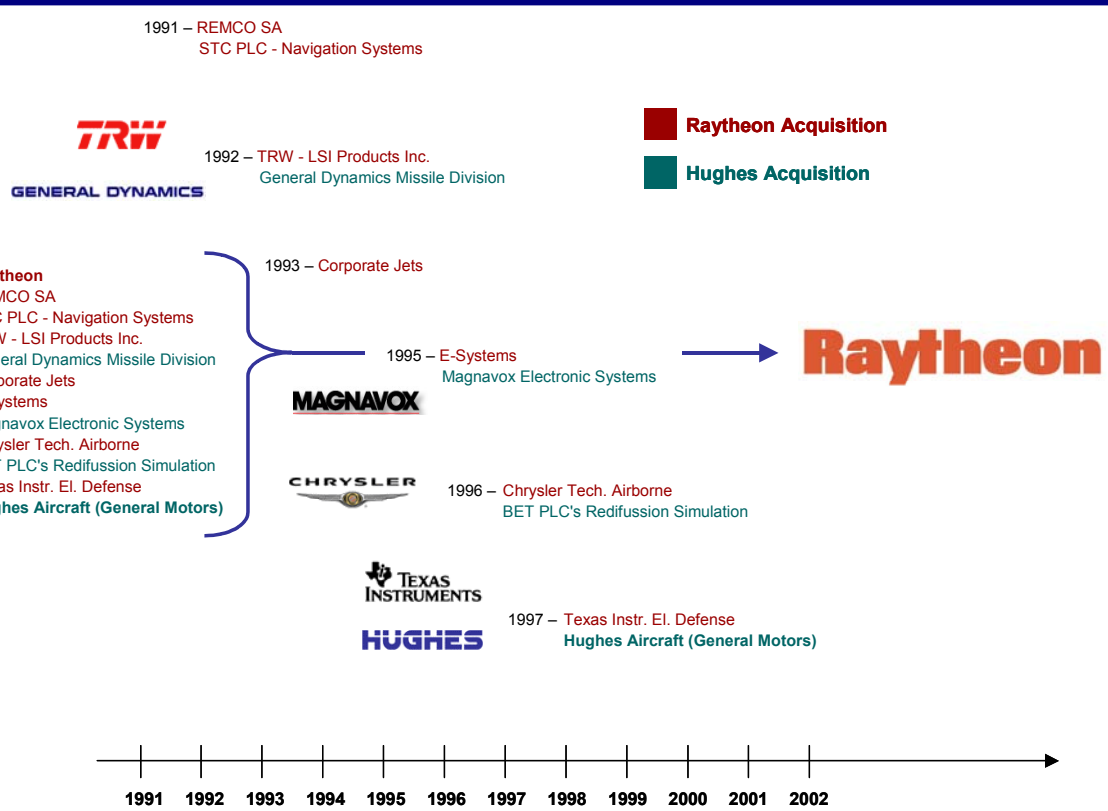
"We (the aerospace and defense industry) have become a very incestuous industry. We prime one time; we're a teammate another; we use other people's subsystems, depending on the programs…. It's pretty impressive what the defense contractors are doing with regard to being able to be a prime in one case or be a teammate in another case and to have the people support in whatever capacity they are in (and with) the same level of intensity (as) if they were a prime or not a prime. I think it's probably just a handful…or just a few areas that you can look to and say, 'well, that didn't work out too well.'"

APPENDIX D

HISTORICAL SUMMARIES, PRODUCT BATTLESPACES, AND CASE STUDIES OF THE FIVE LARGEST U.S. DEFENSE FIRMS

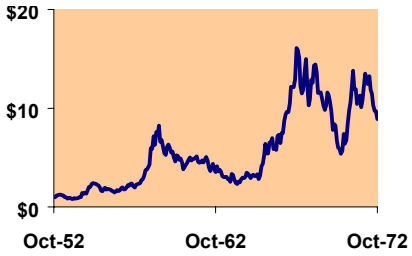
Raytheon

RAYTHEON (RTN) SUMMARY

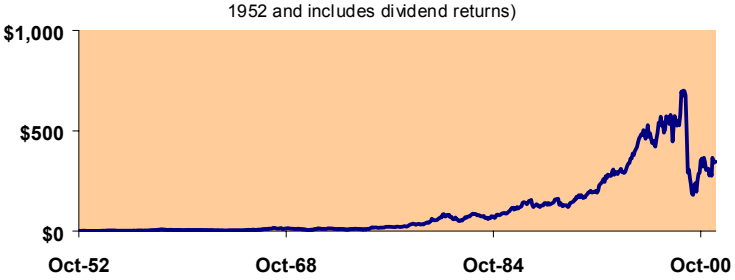


- ❑ 1922 – Former college roommates, Laurence K. Marshall and Vannevar Bush, along with scientist Charles G. Smith, form the American Appliance Company in Cambridge, MA to market a compressor-less cooled home refrigerator
- ❑ 1925 – Refrigerator failed, and the company found commercial success with a gaseous rectifier marketed under the name Raytheon, a device that led to widespread use of radio by allowing units to be plugged into the wall
- ❑ 1925 – changed name to **Raytheon**
- ❑ Innovations over time: the first commercial microwave ovens, sub-miniature tubes for hearing aids, the Fathometer depth sounder, the mass production of magnetron tubes, an early shipboard radar, the first successful missile guidance system, a space communications system, mobile radio telephones, the first combat-proven air defense missile system, and Terminal Doppler Weather Radar
- ❑ 1952 – **Raytheon starts trading on the NYSE** in October at around $11.00, or 3 cents per share adjusted for subsequent stock splits
- ❑ During WWII, became the primary supplier of Magnetrons, the key component of radar technology, arguably the most important military technological advantage of the war
- ❑ Contributed at the highest level to **Apollo XI**, the first spaceship to land a man on the moon
- ❑ 1967 – 1986 – developed **Patriot** missile system
- ❑ Today, Raytheon is a global aerospace and defense corporation, with **annual sales of almost $17 billion**
- ❑ Raytheon **employs over 76,000 people** and has operations **throughout the U.S. and in over 40 countries**

RTN generated a **compound annual return of 12.0%** in its first 20 years as a public company: **each $1.00 invested would have grown to $9.67** (includes dividend returns)

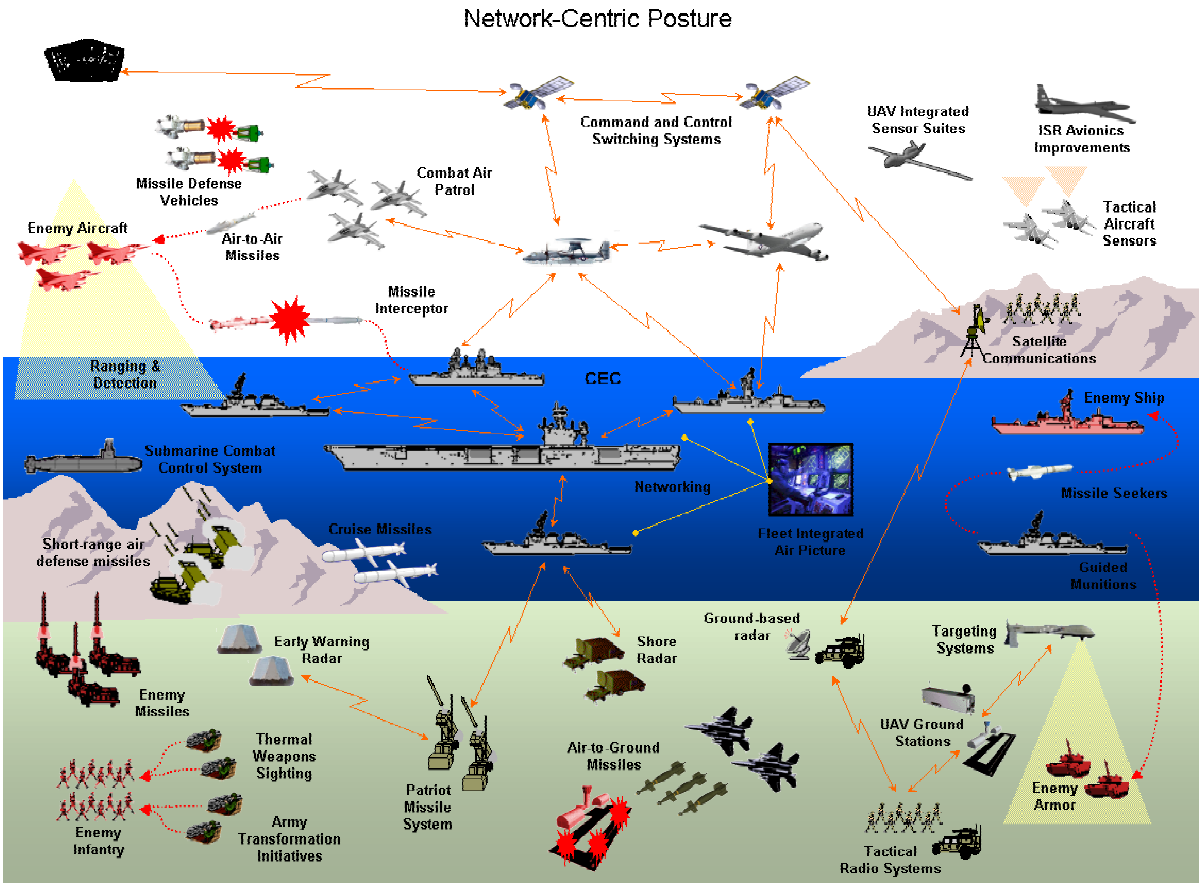


RTN has generated a **compound annual return of 12.6%** through the end of last year: **each $1.00 invested at the beginning of the forty nine year period would have grown to $345.46** (Chart begins with Raytheon Manufacturing Company in 1952 and includes dividend returns)



Source: ODUSD (Industrial Policy). Institute for Defense Analyses, and First Equity

RAYTHEON (RTN) SUMMARY



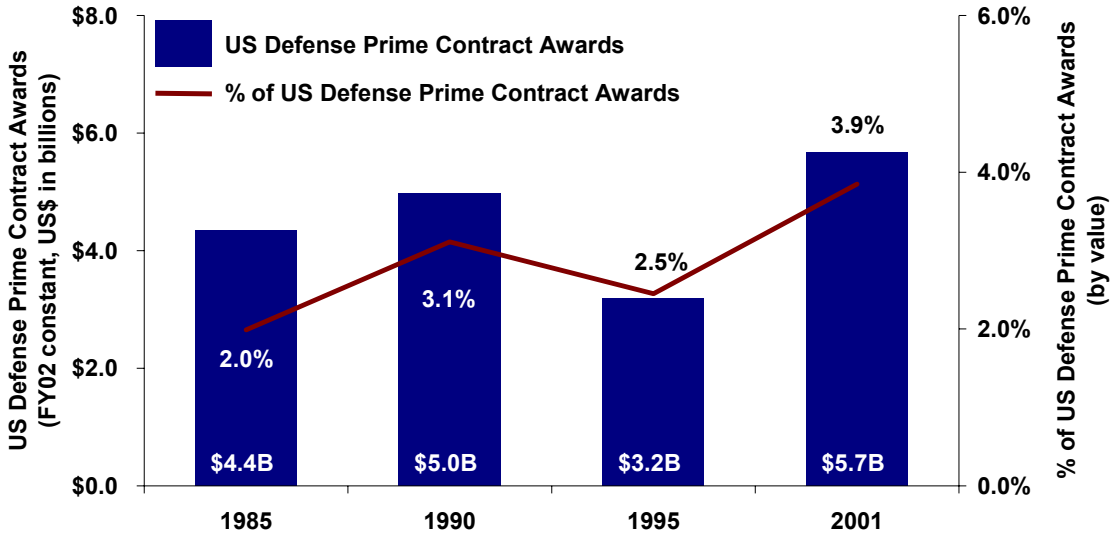


Chart does not reflect revenue received through subcontracts

Source: ODUSD (Industrial Policy). DoD Washington Headquarters Service, Institute for Defense Analyses, and First Equity

RAYTHEON COMPANY

141 Spring Street
Lexington, MA 02421
(781) 862-6600
www.raytheon.com

- **Operational Effects-Based Sectors:** Combat Support, Power Projection, Precision Engagement, Homeland and Base Protection, and Integrated Battlespace
- **Products and Services:** Raytheon is a leading provider of defense electronics and other products
- **Primary military sales vehicles:** Direct and as a subcontractor to primes
- **Military applications:** Missiles; radar; sensors and electro-optics; intelligence, surveillance and reconnaissance; and command, control, communication and information systems, services and support
- **Commercial applications:** Optical communications products, wireless broadband solutions, thermal imaging products for the public safety, industrial and automotive markets, and automobile radar systems
- **Annual Sales:** $17 billion in 2001
  - 70% government, 30% commercial
- **Employees:** 77,500
- **Established:** 1922

IMPORTANT POINTS

- The Advanced Technology Demonstration (ATD) program and Advanced Concept Technology Demonstration (ACTD) program are good ways to accelerate technology for the Department of Defense
- In the 1980s, companies were more willing to invest internal funds toward military requirements because of longer production runs and larger quantities involved
- Spiral development and shorter production provides continued improvements and early fielding. This will also result in Industry recouping capital investment over shorter timeframes

MAJOR STRATEGIES

- Work closely with DoD to understand future warfighter needs
- Invest internally in science and technology
- Employ former DoD personnel to provide a more intimate knowledge of government processes
- Create organizational emphasis on high growth strategic business areas: Missile Defense; Precision Strike; Intelligence, Surveillance, and Reconnaissance; and Homeland Security
- Utilize these areas to cross-reference against each of its business units

DEFENSE CONCERNS

- DoD demands COTS technology, but increases technological requirements for military use and only procures in small lots
- Systems integrators are often given too much responsibility
- Small companies are not well suited to perform on DoD contracts as a result of the undependability of budgets, quantities, and deliveries and unique DoD operating requirements.
- Fewer new starts increase the risk of being shut out of the product life cycle
- Small companies face higher risk of failure, resulting in costly process of qualifying new suppliers

RECOMMENDATIONS

- Operate like a consumer to procure Commercial off the Shelf (COTS) technology
- Establish product requirements and ask the critical questions during the Request for Information (RFI) contracting stage
- Reduce bundling of programs and evaluate specific technologies based upon their merits

Offering Specific Product Expertise

Stemming from Raytheon Company's identified need for industry consolidation in response to the constricting military markets of the 1990s, between 1995 and 1997, the company acquired E-Systems, Texas Instruments, and Hughes' defense business. These acquisitions increased the company's sales from approximately $11 billion to over $17 billion in 1998. Furthermore, the resultant organizational structure is composed of a sizable collection of software and electronics businesses with strong technical capabilities and knowledge of mission support systems. By focusing on those markets where the company has developed expertise and is a market leader and avoiding projects outside its core capabilities, the company is able to provide high quality products to its customers, specifically the Department of Defense.

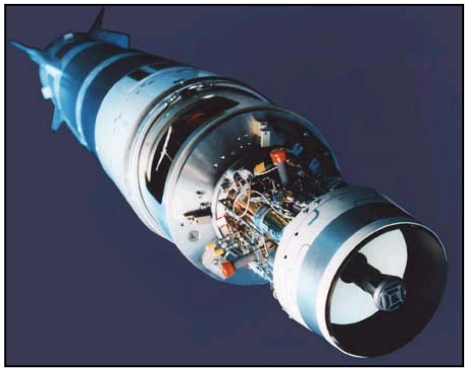
Raytheon is employing a horizontal integration strategy of developing equipment for platforms, differentiating it from the other leading defense suppliers that tend to be more vertically integrated, platform companies. While the prime contractors control selection and integration of a program's subsystems, Raytheon believes its targeted business focus allows it to offer superior products at lower costs than those developed by diverse, platform companies. Raytheon believes its products and applicability across multiple platforms lead to greater economies of scale. As a result, many large companies often partner with Raytheon to integrate its products in order to improve their chances of being selected for large, complex projects.

> ***"50% of something is better than 100% of nothing. For the platform primes, if you don't win a program because you try to keep it all for yourself, you can end up with 100% of nothing."***

Raytheon believes it has approached consolidation with the strategic vision of becoming a strong provider of mission solutions. Raytheon also believes that platform companies find it difficult to maintain the same level of commitment to electronics because they lack the resources and intense management attention to remaining competitive. According to Raytheon, it is a challenge to maintain the internal capabilities to be a market leader in all areas without a strong strategic focus. The company believes that as long as DoD ensures a fair and level playing field, which is open to competition and where the prime is held to standards of fairness in selection process, it will continue to be successful.

Furthermore, in Raytheon's opinion, as a result of its strategic direction, it is optimally positioned to take advantage of DoD's trend towards transformation. Specific examples of areas where the company is well positioned include: Network-Centric Warfare, ISR,

Missile Defense, Precision Strike, and mission support equipment for UAVs. Likewise, as an advanced mission solutions provider rather than as a prime contractor, the company is not subject to the revenue volatility inherent in priming the major programs, nor is the company dependent on any one platform. By operating through smaller value contracts and a wider contract base, the company believes it has enormous staying power and reduced market risk.



Investing in Technology

In order to continue to meet the needs of the future warfighter, Raytheon works closely with DoD to identify technological requirements and understand military challenges. Likewise, the company is continuously investing internal research and development funds in science and technology. Investment is focused on new technologies, improving existing products, as well as reducing costs and improving productivity.

Raytheon currently has a strategic provider relationship with Kuchera Industries, a circuit card assembly manufacturer in Johnston, PA.

In addition to internal investment, the company also explores acquisition opportunities by targeting niche technology companies offering a competitive advantage. However, in a number of cases where it identifies that an acquisition may not be the optimal structure, Raytheon has implemented a strategic-provider relationship. The company continues to identify a number of small companies with impressive capabilities. Frequently, rather than acquire the company and integrate it into its large company cost structure, Raytheon has established strategic-provider relationships. In this process, Raytheon can open new markets for the company, and allow it to remain innovative and cost effective. Furthermore, Raytheon can actually help improve profitability for the company by streamlining some of the company's systems using Raytheon's expertise in contracting and financial management. Raytheon benefits by obtaining capabilities it would not otherwise have. The structure of the partnership, including the level of financial participation by Raytheon, varies based on the opportunity and the company's requirements.

A Vision for the Future

According to Raytheon, advances in technology to supply DoD will continue and will likely be driven to a great extent by the commercial market. As a result, in order to continue to be successful, companies like Raytheon will have to figure out how to package those capabilities for military applications. Raytheon believes that in the future, it will look and operate very similarly to the way it does today, as a large electronics company with depth and breadth of products. Those areas where it has not developed core

technology will be supplemented by strategic alliances with small companies for specific programs and subsystems. In Raytheon's opinion, the platform companies may undergo considerable changes upon realizing that DoD will be evaluating technology on a best value basis and that their systems may therefore not be selected. Consequently, those businesses which are not among the top two or three in a particular market may be sold off so that the platform companies can focus on their core capabilities: as platform systems integrators rather than as mission systems suppliers.

APPENDIX E

SMALL BUSINESS INNOVATION RESEARCH (SBIR) AND SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAM DESCRIPTIONS AND POINTS OF CONTACT

Department of Defense

SBIR/STTR

SMALL BUSINESS INNOVATION RESEARCH (SBIR) AND SMALL BUSINESS TECHNOLOGY TRANSFER (STTR) PROGRAMS

OVERVIEW

The purpose of DoD's SBIR and STTR programs is to harness the innovative talents of our nation's small technology companies for U.S. military and economic strength. For additional information and references to online resources, see the following website: http://www.acq.osd.mil/sadbu/sbir/overview/index.htm

SBIR

DoD's SBIR program funds early-stage R&D projects at small technology companies – projects which serve a DoD need and have the potential for commercialization in private sector and/or military markets. The program, funded at approximately $773 million in FY 2002, is part of a larger ($1.5 billion) federal SBIR program administered by ten federal agencies.

As part of its SBIR program, the DoD issues an SBIR solicitation twice a year, describing its R&D needs and inviting R&D proposals from small companies -- firms organized for profit with 500 or fewer employees, including all affiliated firms. Companies apply first for a six-month phase I award of $60,000 to $100,000 to test the scientific, technical, and commercial merit and feasibility of a particular concept. If phase I proves successful, the company may be invited to apply for a two-year phase II award of $500,000 to $750,000 to further develop the concept, usually to the prototype stage. Proposals are judged competitively on the basis of scientific, technical, and commercial merit. Following completion of phase II, small companies are expected to obtain funding from the private sector and/or non-SBIR government sources (in "phase III") to develop the concept into a product for sale in private sector and/or military markets.

STTR

In 1992, Congress established the STTR pilot program. STTR is similar in structure to SBIR but funds cooperative R&D projects involving a small business and a research institution (i.e., university, federally-funded R&D center, or nonprofit research institution). The purpose of STTR is to create, for the first time, an effective vehicle for moving ideas from our nation's research institutions to the market, where they can benefit both private sector and military customers. DoD's STTR program, funded at $42 million in fiscal year 2002, is part of a larger federal STTR program administered by five federal agencies. DoD issues one STTR research solicitation each year.

Historically, about 15 percent of SBIR and STTR proposals are awarded a phase I contract; approximately 40 percent of phase I projects subsequently are awarded a

phase II contract. (However, in recent solicitations, a much higher percentage of STTR phase I proposals was awarded a phase I contract.)

For information on the ten-agency federal SBIR program and five-agency STTR program, call the Small Business Administration at (202) 205-6450.

GETTING STARTED IN SBIR AND STTR

FIRST, REVIEW THE CURRENT SOLICITATION –

The SBIR and STTR solicitations list all the research topics under which DoD is seeking phase I proposals, and also contain detailed information on the parameters of the SBIR and STTR programs and how to submit a proposal. DoD issues two SBIR solicitations and one STTR solicitation each year, according to the following schedule:

- **STTR solicitation 2003** -- was posted on the Web on January 2, 2003; will begin accepting proposals on March 3, 2003; will close to proposals on April 16, 2003.
- **SBIR solicitation 2003.2** -- will be posted on the Web on May 1, 2002; will begin accepting proposals on July 1, 2002; will close to proposals on August 13, 2002.
- **SBIR solicitation 2004.1** -- will be posted on the Web on October 1, 2003; will begin accepting proposals on December 1, 2003; will close to proposals on January 14, 2004.

All solicitations are available electronically. If you want to be notified when a solicitation becomes available, please sign up for the listserv by sending an e-mail to listserv@listserv.dodsbir.net with “SUBSCRIBE SBIRLIST” in the body of the e-mail.

SECOND, TO RESOLVE ANY QUESTIONS YOU MAY HAVE –

If you have a general question about the SBIR or STTR programs, please contact the DoD SBIR/STTR Help Desk by telephone at 866-SBIRHLP (866-724-7457). There is also an online set of prepared answers to commonly-asked questions about proposal preparation, contracting with the government, and getting paid in a timely manner.

If you have a technical question about a specific research topic listed in the solicitation, you may ask it in two ways:

- Talk by telephone with the Topic Author, whose name and phone number will be listed in the solicitation topic. **Important:** The Topic Authors will only be listed, and telephone questions will only be accepted, during the two months following public release of the solicitation on the Web Site and before DoD begins accepting proposals (i.e, between October 1 and December 1 for SBIR solicitation 2004.1).

- Submit a written question through the online SBIR/STTR Interactive Topic Information System (SITIS), in which the questioner and respondent remain

anonymous and all questions and answers are posted electronically for general viewing until the solicitation closes.

DoD SBIR/STTR "Fast Track"

Since October 1995, the Department's SBIR and STTR programs have featured a "Fast Track" process for SBIR/STTR projects that attract outside investors who will match phase II funding, in cash, contingent on the project's selection for phase II award. The matching rates are described online. Projects that obtain such outside investments and thereby qualify for the Fast Track will (subject to qualifications described in the solicitation):

- Receive interim funding of $30,000 to $50,000 between phases I and II;
- Be evaluated for phase II award under a separate, expedited process; and
- Be selected for phase II award provided they meet or exceed a threshold of "technically sufficient" and have substantially met their phase I technical goals.

Consistent with DoD policy, this process should prevent any significant gaps in funding between phases I and II for Fast Track projects.

Many small companies have found the Fast Track policy to be an effective tool for leveraging their SBIR (or STTR) funds to obtain additional funds from outside investors. This is because, under the Fast Track, a small company can offer an investor the opportunity to obtain a match of between $1 and $4 in DoD SBIR (or STTR) funds for every $1 the investor puts in (see matching rates online).

Please send any comments on, or suggestions for improving, the Fast Track policy to the DoD SBIR/STTR Program Manager at fisherij@acq.osd.mil

How to Participate in the SBIR/STTR "Fast Track"

To qualify for the Fast Track –

To qualify for the Fast Track, small companies and their outside investors must follow the procedures detailed in section 4.5 of the SBIR solicitation. The most important of these procedures are summarized as follows.

First, toward the end of a small company's phase I SBIR (or STTR) project, the company and its investor submit a Fast Track application. In the Fast Track application, the company and investor:

- State that the investor will match both interim and phase II SBIR (or STTR) funding, in cash, contingent on the company's selection for phase II award. The matching rates needed to qualify for the Fast Track are as follows:

- **For small companies that have never before received a phase II SBIR or STTR award** from DoD or any other federal agency, the matching rate is 25 cents for every SBIR (or STTR) dollar. (For example, if such a company receives interim and phase II SBIR funding that totals $750,000, it must obtain matching funds from the investor of $187,500.)

- **For all other companies**, the matching rate is 1 dollar for every SBIR (or STTR) dollar. (For example, if such a company receives interim and phase II SBIR funding that totals $750,000, it must obtain matching funds from the investor of $750,000.)

The matching funds may pay for additional R&D on the company's SBIR (or STTR) project or, alternatively, they may pay for other activities (e.g., marketing) that further the development and/or commercialization of the technology.

- Certify that the outside funding qualifies as a "Fast Track investment," and the investor qualifies as an "outside investor," as defined in the DoD Fast Track Guidance posted online. Outside investors may include such entities as another company, a venture capital firm, an individual "angel" investor, a non-SBIR, non-STTR government program; they do not include the owners of the small business, their family members, and/or affiliates of the small business.

Second, DoD will notify each Fast Track company, no later than 10 weeks after the end of phase I, whether it has been selected for phase II award. Once notified, the company and investor must certify, within 45 days, that the entire amount of the matching funds from the outside investor has been transferred to the company.

TIPS FOR PROSPECTIVE INVESTORS –

The Fast Track policy offers prospective investors a major new opportunity to leverage their investments in small technology companies working on R&D projects with defense and commercial applications. What follows are suggestions to such investors for taking full advantage of the new policy.

If you, as a prospective investor, are aware of promising small technology companies that are not yet participating in the SBIR or STTR programs:

- encourage them to apply for a phase I award (your interest in a small company will lend credibility to its phase I proposal); and

- during phase I, qualify them for the Fast Track with your commitment of matching funds.

If you are looking for small technology companies in which to invest, search the list of ongoing phase I SBIR and STTR projects online and, where you find promising opportunities, invest in the company, thereby qualifying it for the Fast Track.

IF YOU HAVE QUESTIONS OR SEEK ASSISTANCE REGARDING THE FAST TRACK –

- See DoD's Fast Track Guidance posted online, which discusses what types of relationships between a small company and an outside investor qualify as a "Fast Track investment."
- See the list of private-sector sources of early-stage technology financing posted online.
- If you have other questions regarding Fast Track, please contact the SBIR/STTR Help Desk online or by telephone at 866-SBIRHLP (866-724-7457).

APPENDIX F

ADVANCED CONCEPT TECHNOLOGY DEMONSTRATION (ACTD) DESCRIPTION AND POINTS OF CONTACT

ADVANCED CONCEPT TECHNOLOGY DEMONSTRATIONS (ACTDs)

ACTDs exploit mature and maturing technologies to solve important military problems. A declining budget, significant changes in threats, and an accelerated pace of technology development have challenged our ability to adequately respond to rapidly evolving military needs. In addition, the global proliferation of military technologies, resulting in relatively easy access to these technologies by potential adversaries, has further increased the need to rapidly transition new capabilities from the developer to the user.

This ACTD Master Plan describes the rationale and objectives of the ACTD program. It also provides detailed guidance regarding the processes for proposing, selecting, managing and transitioning ACTDs. In addition, comprehensive summaries are included for each of the individual ACTDs that have been approved to date.

In early 1994, the DoD initiated a new program designed to help expedite the transition of maturing technologies from the developers to the users. The Advanced Concept Technology Demonstration (ACTD) program was to help the DoD acquisition process adapt to today's economic and threat environments. ACTDs emphasize technology assessment and integration rather than technology development. The goal is to provide a prototype capability to the warfighter and to support him in the evaluation of that capability. The warfighters evaluate the capabilities in real military exercises and at a scale sufficient to fully assess military utility.

ACTDs are designed to allow users to gain an understanding of proposed new capabilities for which there is no user experience base. Specifically, they provide the warfighter an opportunity: to develop and refine his concept of operations to fully exploit the capability under evaluation, to evolve his operational requirements as he gains experience and understanding of the capability, and to operate militarily useful quantities of prototype systems in realistic military demonstrations, and on that basis, make an assessment of the military utility of the proposed capability.

At the conclusion of the ACTD operational demonstration, there are three potential outcomes. The user sponsor may recommend acquisition of the technology and fielding of the residual capability that remains at the completion of the demonstration phase of the ACTD to provide an interim and limited operational capability. If the capability or system does not demonstrate military utility, the project is terminated or returned to the technology base. A third possibility is that the user's need is fully satisfied by fielding the residual capability that remains at the conclusion of the ACTD, and there is no need to acquire additional units.

For further information, contact the Office of the Deputy Under Secretary of Defense for Advanced Systems & Concepts (DUSD(AS&C)), at (703) 697-6446 or atl.actd@osd.mil.

APPENDIX G

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA) DESCRIPTION AND POINTS OF CONTACT

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY (DARPA)

OVERVIEW

The DARPA mission is to develop imaginative, innovative and often high-risk research ideas offering a significant technological impact that will go well beyond the normal evolutionary developmental approaches; and, to pursue these ideas from the demonstration of technical feasibility through the development of prototype systems.

DARPA OVER THE YEARS

The Defense Advanced Research Projects Agency was established in 1958 as the first U.S. response to the Soviet launching of Sputnik. Since that time DARPA's mission has been to assure that the U.S. maintains a lead in applying state-of-the-art technology for military capabilities and to prevent technological surprise from her adversaries. The DARPA organization was as unique as its role, reporting directly to the Secretary of Defense and operating in coordination with, but completely independent of, the military research and development (R&D) establishment. Strong support from the senior DoD management has always been essential since DARPA was designed to be an anathema to the conventional military and R&D structure and, in fact, to be a deliberate counterpoint to traditional thinking and approaches.

Some of the more important founding characteristics are listed below. Over the years, DARPA has continued to adhere to these founding principles:

- Small and flexible;
- Flat organization;
- Substantial autonomy and freedom from bureaucratic impediments;
- Technical staff drawn from world-class scientists and engineers with representation from industry, universities, government laboratories and Federally Funded Research and Development Centers;
- Technical staff assigned for 3-5 years and rotated to assure fresh thinking and perspectives;
- Project based – all efforts typically 3-5 years long with strong focus on end-goals. Major technological challenges may be addressed over much longer times but only as a series of focused steps. The end of each project is the end. It may be that another project is started in the same technical area, perhaps with the same program manager, and, to the outside world, this may be seen as a simple extension. For DARPA, though, it is a conscious weighing of the current opportunity and a completely fresh decision. The fact of prior investment is irrelevant;
- Necessary supporting personnel (technical, contracting, administrative) are "hired" on a temporary basis to provide complete flexibility to get into and out of

an area without the problems of sustaining the staff. This is by agreement with Defense or other governmental organizations (military R&D groups, National Aeronautics and Space Administration, National Science Foundation, etc.) and from System Engineering and Technical Assistance (SETA) contractors;

- Program Managers (the heart of DARPA) are selected to be technically outstanding and entrepreneurial. The best DARPA Program Managers have always been freewheeling zealots in pursuit of their goals;
- Management is focused on good stewardship of taxpayer funds but imposes little else in terms of rules. Management's job is to enable the Program Managers;
- A complete acceptance of failure if the payoff of success was high enough.

Today, DARPA is an organization of 240 personnel (approximately 140 of which are technical) directly managing a budget of about $2 billion. A typical technical project might be structured as follows:

- $10-40 million over 4 years;
- Single DARPA Program Manager with direct control of the efforts and the funding;
- A SETA contractor or contractors to support the Program Manager in his or her primary roles of managing the efforts and representing the program with Congress, the Office of the Secretary of Defense, the military Services and/or involved Unified Commander;
- An Agent (furnishing from a fraction of a person to several people) in a military R&D laboratory to provide technical and contracting support (paid from program funds to provide this support);
- Five to 10 contractor organizations and two universities executing tasks focused on a specific aggregate goal.

Obviously, there are wide variations to this "typical" case. Some projects are under $1 million and a few are in the hundreds of millions of dollars. However, the management paradigm is the same; the variation is in the amount and type of "hired" assistance. Even in larger programs, the emphasis is on small teams of the highest quality people. Regardless of size, a single DARPA Program Manager is in charge and must manage and represent the project internally and externally.

DARPA's original operating philosophy has changed over the years in only three ways – its relationships with the commercial marketplace, its business practices, and its emphasis on joint systems.

First, the DoD has gone from dominating the market in such areas as microelectronics, computing and network communications, each of which was driven by DARPA in past years, to the current situation where the DoD is able to somewhat influence the directions of a much-larger-than-DoD market. DARPA has played one of the key roles in assuring that DoD's long-term interests are served in this new

situation.

Second, in the past decade, DARPA has pioneered revolutionary R&D business practices reform. With the support of the Congress and DoD senior management, DARPA has led the way in adopting commercial practices and innovative contracting arrangements. Congress provided the authority for "Other Transactions" and "Section 845" agreements to DARPA on an experimental basis, and, because of DARPA's success, has now conveyed the same authorities to the rest of DoD.

Third, since the Goldwater-Nichols Act, DARPA has focused considerable attention on solutions to joint-Service systems and problems.

In summary, DARPA's ability to adapt rapidly to changing environments and to seek and embrace opportunities in both technology and in processes, while maintaining the historically proven principles of the Agency, makes DARPA the crown jewel in Defense R&D and a unique R&D organization in the world.

SEEKING DARPA SUPPORT

DARPA's strategy to accomplish its mission is to provide a forum for the evaluation of competing scientific and technological ideas. Entities seeking R&D support from DARPA should explore the Agency's interests in research by reviewing sources such as the Federal Business Opportunities (FedBizOps) web site, public literature, published testimony before Congressional committees, and The Department of Defense Small Business Innovation Research (SBIR) Program Solicitation. DARPA welcomes new technical ideas at any time from all public and private entities. If you have a great idea, DARPA wants to hear about it.

Additional information on doing business with DARPA is available upon request from the DARPA General Information Line, at (703) 526-6630.

INDUSTRY BRIEFINGS

DARPA uses industry briefings whenever possible to outline problems within specific technology areas and to request submission of technical solutions to these problems. During these briefings, all potential offerors are provided with identical information and therefore have equal opportunity to respond. DARPA advertises its industry briefings through the Commerce Business Daily.

Offices sometimes also include information on industry briefings on their office web site home page at www.darpa.mil.

DARPA holds a Systems and Technology Symposium approximately every 18 months to communicate to industry priorities for future programs. The 23rd Symposium, DARPATech 2002, concluded in August 2002.

APPENDIX H

SUMMARY OF PHASE I STUDY AND PREVIOUS STUDIES

Defense Industry Report List and Summaries

DEFENSE INDUSTRY REPORT LIST

LESS TRADITIONAL SUPPLIERS FOR TRANSFORMATIONAL WARFARE

- **Author:** Office of the Deputy Under Secretary of Defense (Industrial Policy)
- **Publisher:** Office of the Deputy Under Secretary of Defense (Industrial Policy)
- **Date:** June 2002 (Unpublished Draft)

MILITARY TRANSFORMATION AND THE DEFENSE INDUSTRY AFTER NEXT: THE DEFENSE INDUSTRIAL IMPLICATIONS OF NETWORK-CENTRIC WARFARE

- **Author:** Peter J. Dombrowski, Eugene Gholz and Andrew L. Ross
- **Publisher:** Center for Naval Warfare Studies, US Naval War College
- **Date:** September 2002

ASSESSING THE USE OF "OTHER TRANSACTIONS" AUTHORITY FOR PROTOTYPE PROJECTS

- **Author:** Giles Smith, Jeffrey Drezner, and Irving Lachow
- **Publisher:** RAND
- **Date:** 2002

U.S. DEFENSE INDUSTRY UNDER SIEGE – AN AGENDA FOR CHANGE

- **Author:** John R. Harbiston, et. al
- **Publisher:** Booz-Allen & Hamilton
- **Date:** March 2002

CONTRACT MANAGEMENT: DOD'S PROFIT POLICY PROVISION TO STIMULATE INNOVATION NEEDS CLARIFICATION

- **Author:** GAO
- **Publisher:** GAO-01-801
- **Date:** July 2001

PRESERVING A HEALTHY AND COMPETITIVE U.S. DEFENSE INDUSTRY TO ENSURE OUR FUTURE NATIONAL SECURITY

- **Author:** Philip Odeen, et al.
- **Publisher:** Defense Science Board Task Force
- **Date:** November 2000

ACQUISITION REFORM: DOD'S GUIDANCE ON USING SECTION 845 AGREEMENTS COULD BE IMPROVED

- **Author:** GAO
- **Publisher:** GAO/NSIAD-00-33
- **Date:** April 2000

DEFENSE TRADE: WEAKNESSES EXIST IN DOD FOREIGN SUBCONTRACT DATA

- **Author:** GAO
- **Publisher:** GAO/NSIAD-99-8
- **Date:** November 1998

DEFENSE RESTRUCTURING AND THE FUTURE OF THE U.S. DEFENSE INDUSTRIAL BASE: A REPORT THE CSIS SENIOR POLICY PANEL ON THE DEFENSE INDUSTRIAL BASE

- **Author:** James R. Schlesinger, Murray Weidenbaum, Daniel Goure & Joseph Cyrulik
- **Publisher:** The Center for Strategic and International Studies
- **Date:** March 1998

DEFENSE INDUSTRY CONSOLIDATION: COMPETITIVE EFFECTS OF MERGERS AND ACQUISITIONS

- **Author:** GAO
- **Publisher:** GAO/T-NSIAD-98-112
- **Date:** March 1998

DEFENSE INDUSTRY: TRENDS IN DOD SPENDING, INDUSTRIAL PRODUCTIVITY, AND COMPETITION

- **Author:** GAO
- **Publisher:** GAO/PEMD 97-3
- **Date:** January 1997

FEDERAL RESEARCH: DOD'S SMALL BUSINESS INNOVATION RESEARCH PROGRAM

- **Author:** GAO
- **Publisher:** GAO/RCED-97-122
- **Date:** April 1997

In From the Cold: Prospects for Conversion of the Defense Industrial Base

- **Author:** Maryellen R. Kelley & Todd A. Watkins
- **Publisher:** Science – Vol. 268
- **Date:** April 1995

Industrial Base: Assessing the Risk of DoD's Foreign Dependence

- **Author:** GAO
- **Publisher:**GAO/NSIAD-94-104
- **Date:** April 1994

Department of Defense Profit Policy and Capital Investment in the Military Aircraft Industry

- **Author:** Thomas P. Frazier, Matthew S. Goldberg, and Thomas R. Gulledge, Jr.
- **Publisher:** Review of Economics and Statistics, pp. 394-403
- **Date:** August 1992

Profit Regulation of Defense Contractors and Prizes for Innovation

- **Author:** William P. Rogerson
- **Publisher:** Journal of Political Economy – Vol. 97, #6
- **Date:** 1989

LESS TRADITIONAL SUPPLIERS FOR TRANSFORMATIONAL WARFARE

Author: Office of the Deputy Under Secretary of Defense (Industrial Policy)
Publisher: Office of the Deputy Under Secretary of Defense (Industrial Policy)
Date: June 2002 (Unpublished Draft)

Issues:

- What does transformation imply about the types of contractors DoD will require to meet its needs?
- What impediments does the DoD acquisition system place in the way of non-traditional suppliers?

Findings:

- Military transformation will require less-traditional suppliers in many areas, including:
  - Unmanned Systems
  - Space Systems
  - Communications
  - Special purpose weapons, sensors and countermeasures
  - Information assurance/warfare
  - Data fusion/interpretation/distribution/display
  - Unconventional warfare techniques
  - Medical
- Impediments to participation of less-traditional suppliers include:
  - Burdensome acquisition and contracting policies
  - Decentralized multiple-layer decision processes
  - Risk aversion within DoD
  - Difficult relationships between prime contractors and sub-tier suppliers
  - Limited contact between sub-tier suppliers and DoD leadership and customers
  - Low production quantities
  - Lack of financial incentives
  - Gaps in transition from research to production
  - Intellectual property rights issues
  - Export control restrictions

MILITARY TRANSFORMATION AND THE DEFENSE INDUSTRY AFTER NEXT: THE DEFENSE INDUSTRIAL IMPLICATIONS OF NETWORK-CENTRIC WARFARE

Author: Peter J. Dombrowski, Eugne Gholz, Andrew L. Ross
Publisher: U.S. Naval War College
Date: September 2002

Issues:

- What are the defense industrial base implications of military transformation?
- Will military transformation lead to major changes in the composition of the defense industrial base?
- Three sectors were evaluated from perspective of naval net-centric warfare: shipbuilding, unmanned vehicles and systems integration

Findings:

- Transformation will require both sustaining and disruptive innovation
- The changes that transformation causes in a given industrial sector will depend on what type of innovation dominates future requirements
- At the highest level of generality, military transformation will not require wholesale defense industrial transformation
- Innovation will proceed apace with or without commercial sector participation if the military can decide on goals for transformation innovation
- Consolidation has been largely a financial story, and will have little impact on industry's role in transformation.
- Commercial information technology firms will not displace defense sector primes as the major suppliers of equipment in the future
- Globalization has been, and will be, limited in defense, and will have little affect on transformation
- Commercial-military integration has been, and will continue to be a factor mostly in the lower tiers, and should not be a major concern when examining the industrial base and transformation
- The ability to reform acquisition practices to mirror commercial practices is limited, so expertise working with the government will continue to be important.
- The advantages of the current shipbuilders' close relationship with the Navy will largely preclude large-scale entry by commercial firms. Where entry of new firms does occur, it will likely be in partnership with existing defense firms.
- The current UAV firms are unlikely to be surprised and overtaken by new entrants. However, the possibility for disruptive innovation and new entrants does exist.

- To get the system integration required for transformation, DoD may need to create an organization for integration, much like Strategic Defense was created in the 1980's.

ASSESSING THE USE OF "OTHER TRANSACTIONS" AUTHORITY FOR PROTOTYPE PROJECTS

Author: Giles Smith, Jeffrey Drezner, and Irving Lachow
Publisher: RAND
Date: 2002

Issues:

- In 1994, Congress authorized the use of "Other Transactions" for the development of prototypes directly relevant to weapon systems.
- These projects are not required to comply with procurement specific laws and regulations
- There were 72 prototype projects during the period 1994-1998
- This report assesses the overall effectiveness of Other transactions and addresses the following four topics
    - What were the general characteristics of typical projects
    - What benefits were achieved from the other transactions process
    - What disadvantages were encountered
    - What was the net effect of Other transactions

Findings:

- The Other transactions process has been very beneficial to DoD
- Important new industrial resources are participating in DoD prototype projects due to the freedoms inherit in the process
- The process has resulted in more effort being devoted to product and less to process
- The primary risk to the Government is the lack of company financial data and the ownership of intellectual property.
- RAND concludes that the immediate rewards from the other transactions process substantially outweigh the risks.

U.S. Defense Industry Under Siege – An Agenda for Change

Author: John R. Harbiston, et. al
Publisher: Booz-Allen & Hamilton
Date: March 2002

Issues:

- Does the recent string of bad defense industry news reflect a passing cold or serious pneumonia
- What are the fundamental reasons for the industry's poor performance
- What proactive steps can industry and the DoD customer take to stem the erosion and create a path to a long-term sustainable industrial base

Findings:

- The decline of the defense industrial base is occurring and if left unchecked, will eventually have an effect on national security
- There are increasing challenges to recruiting and retaining top talent
- There is an erosion of the financial health of the industry
- To ensure a healthy industrial base in the future, the contractors must take action in three major areas; Growth, Operational Excellence, and Management/Leadership
- Growth: Pursuing vertical integration, building an innovation engine, commercializing tech outside defense, and forming international alliances
- Operational Excellence: Achieving lean manufacturing and rationalizing capacity, redefining supply chain management, reducing complexity, and restructuring the role of the corporate center/shared services
- Management/Leadership: Building employer of choice into HRM, improving post-merger integration, and using best practices
- To ensure a healthy industrial base in the future, the government must take action in three major areas; Tone of Relationship, Rules, and Processes
- Tone of Relationship: Strengthening the Partnership
- Rules: Stabilizing programs and funding, creating incentives for the industrial base to rationalize capacity, living with selected monopolies, and sustaining a spirit of innovation
- Processes: Considering industrial base issues in the acquisition process, understanding industry's merits, streamlining the export control process, and addressing the human resource issues

CONTRACT MANAGEMENT: DOD'S PROFIT POLICY PROVISION TO STIMULATE INNOVATION NEEDS CLARIFICATION

Author: GAO
Publisher: GAO-01-801
Date: July 2001

Issues:

- Is the new policy to add a technology incentive to profit guidelines on negotiated defense contracts likely to stimulate increased innovation?
- Is it possible that the new policy simply rewards existing innovation without encouraging additional innovation?

Findings:

- Limited effects observed since policy is relatively new. Not expected to have large impact because of:
  - Limited reach during R&D phase when it is necessary
  - No adequate guidelines to DoD contract managers as to when and where to approve added incentive
- The following are GAO's recommendations to DoD:
  - Narrowly define the definition of "innovation." Current definition is too broad and includes contracts that just have enhanced system performance.
  - Determine how long innovation rewards should last for contractors.
  - Reconcile the disconnect that exists between incentive policy and DoD's acquisition process; policy encourages innovation, but acquisition process encourages technological maturity
- DoD's response to recommendations:
  - DoD agreed with the first two recommendations, but determined the improvements would best be made after policy has been in place for over a year.
  - DoD disagreed with the third recommendation stating that ultimately it determines how much technological risk is acceptable. This policy can then be used to reward contractors who undertake technical risk during the development phase or in making substantial technological advances.

PRESERVING A HEALTHY AND COMPETITIVE U.S. DEFENSE INDUSTRY TO ENSURE OUR FUTURE NATIONAL SECURITY

Author: Philip Odeen et al.
Publisher: Defense Science Board Task Force
Date: November 2000

Issues:

- Determine if DoD acquisition policies and regulations have supported or tend to weaken the technological capabilities of the defense industrial base.

Findings:

- Independent, innovative R&D is shrinking.
- In the absence of long, profitable production runs to offset losses, R&D must earn a larger return.
- Find new ways to expand commercial buying and revise profit guidelines so that IR&D is fee bearing.
- Consider not for profit venture capital fund.
- Focus export controls only on the most crucial defense technology.

ACQUISITION REFORM: DOD'S GUIDANCE ON USING SECTION 845 AGREEMENTS COULD BE IMPROVED

Author: GAO
Publisher: GAO/NSIAD-00-33
Date: April 2000

Issues:

- What are the benefits of Section 845 agreements
- What are the risks to the government with these agreements and how is this risk managed
- What metrics are tracked to determine the benefits
- How are these contracts used
- How do they differ from standard contracts

Findings:

- Top three reasons to use OT/Sec. 845:
  - Using commercial products or processes
  - Attracting commercial firms
  - Increased negotiating terms and conditions
- Other reasons include: lowering program cost; effecting better partnership between government and contractor; streamlining the acquisition process, and spurring technological innovation
- 97 contracts were analyzed by GAO, representing 82% of $2.1 billion in Sec. 845 contracts between 1996 and 1999. During this time DoD issued $100 billion in R&D contracts.
- 11% of these contracts went to commercial firms, while 87% went to traditional defense firms (the remainder went to universities).
- No good measure of effectiveness of this type of agreement.
- There was little evidence available that Sec. 845 agreements were more effective in attracting commercial companies
- As far as reducing program cost:
  - The main benefit came through lower contract administrating cost to the government.
  - Contractors were usually required to cost share development programs
  - Cost sharing could be used to fill short term funding gaps
- Key points of most of the contracts:
  - Did not rely on certified cost and pricing data to establish price
  - GAAP in lieu of CAS for contractor
  - Limits on government audit rights
  - Paid contractor on basis of agreed technical milestone not incurred costs
  - Streamlined dispute process

- GAO conclusion: DoD needs to update guidance with conditions to use Sec. 845 and a framework to tailor the Terms and Conditions. It should also establish a set of metrics that are measurable and directly related to the agreement's use.

DEFENSE TRADE: WEAKNESSES EXIST IN DOD FOREIGN SUBCONTRACT DATA

Author: GAO
Publisher: GAO/NSIAD-99-8
Date: November 1998

Issues:

- Trends in foreign sourcing and whether contractors are reporting their foreign subcontracts
- The effects this has on decisions made by DoD on matters relating to defense procurement and defense industrial base issues

Findings:

- DoD's prime contract awards outside the U.S. remained about 5.5% of total DoD contract awards
- Weaknesses in the Office of Foreign Contracting's data collection and management processes undermine DoD's ability to use the foreign subcontract data for defense trade and industrial base decision-making
- The Office has no mechanism for ensuring that contractors provide required foreign subcontract information, which contributes to the underrepresentation of foreign subcontract activity
- The Office's poor database management also compromises the credibility and usefulness of its foreign subcontractor data

DEFENSE RESTRUCTURING AND THE FUTURE OF THE U.S. DEFENSE INDUSTRIAL BASE: A REPORT OF THE CSIS SENIOR POLICY PANEL ON THE DEFENSE INDUSTRIAL BASE

Author: James R. Schlesinger, Murray Weidenbaum, Daniel Goure & Joseph Cyrulik
Publisher: The Center for Strategic and International Studies
Date: March 1998

Issues:

- How has the character and structure of the defense industrial base changed over the last ten years
- How has the process of industrial consolidation contributed to meeting the needs of both industry and the nation
- How do broader economic, technological, and policy trends affect the consolidation process
- How is the government's acquisition system responding to changes in industry
- What policy options should the nation's leaders consider in order to increase the nation's access to leading-edge defense products

Findings:

- The most desirable situation would have two, and where possible three, robust competitors in each major military market area
- DoD must continue to encourage experimentation in advanced developments
- Deliberately contract only for limited production of new weapons systems
- Subsidize costs associated with maintaining critical design and production skills during lean times or early stages
- Ensure adequate funding for basic research
- Eliminate unproductive restrictions and requirements on defense contractors and increase access to commercially oriented firms
- Achieve budget savings through outsourcing and privatization and the more efficient use of manpower
- Consider foreign policy consequences of U.S. defense industry consolidation and encourage consolidation within the European defense industrial base

DEFENSE INDUSTRY CONSOLIDATION: COMPETITIVE EFFECTS OF MERGERS AND ACQUISITIONS

Author: GAO
Publisher: GAO/T-NSIAD-98-112
Date: March 1998

Issues:

- Consolidation in the defense industry.
- Sharp decline in defense spending since 1985
- Approaches to preserving competition in a more concentrated industry
- The status of DoD initiatives to improve its monitoring of competition

Findings:

- The defense industry is more consolidated today than at any time in more than 50 years
- Little evidence that the increased consolidation has adversely affected current DoD programs
- Antitrust reviews have identified some problems, and remedies have been implemented
- DoD should take action to improve its ability to identify problem areas and devise alternative ways to maintain competition in defense acquisition programs
- To maintain competition, DoD can, for example, design acquisition strategies to compete missions rather than products and direct R&D funding to develop alternative suppliers and technologies

DEFENSE INDUSTRY: TRENDS IN DOD SPENDING, INDUSTRIAL PRODUCTIVITY, AND COMPETITION

Author: GAO
Publisher: GAO/PEMD 97-3
Date: January 1997

Issues:

- Broad review of productivity and competition in the defense industrial base
- Overall trends in productivity, competition, and other financial indicators in the defense industry over time
- What are the trends in DoD's total, procurement, and RDT&E budgets
- What are the trends in the dollar amount of DoD procurement and RDT&E awards to defense contractors and subcontractors over time
- What are the trends in indicators of employment, productivity, and competition over time
- How are employment, productivity, and competition related to indicators of defense spending
- What are the trends in the financial indicators of major defense contractors over time
- What is the relationship between indicators of defense spending and indicators of the financial status of major defense contractors over time

Findings:

- Although the downward trend in budget outlays and procurement spending is sizable, it is one of four times in post-WWII history that the industrial base has had to adjust
- Recent spending on procurement and RDT&E prime contract awards is similar to spending just prior to the peacetime defense buildup of the early 1980s
- Since WWII, the number of aircraft contractors dropped from 26 to 7 in 1994, missile contractors from 22 to 9, and tank contractors from 16 to 2
- Fewer contractors are operating in an environment where DoD awards more money on weapon procurement contracts using other than full and open competition
- DoD estimates a 39% decrease in defense-related employment between 1989 and 1997
- Actions companies have taken to remain viable include; attempting to gain market share and be more competitive, reorganizing and restructuring, reducing their supplier/subcontractor base, engaging in team concepts and joint ventures, expanding defense markets, and selling non-core businesses

FEDERAL RESEARCH: DOD'S SMALL BUSINESS INNOVATION RESEARCH PROGRAM

Author: GAO
Publisher: GAO/RCED-97-122
Date: April 1997

Issues:

- The DoD and certain other federal agencies are required to set aside a certain percentage of their R&D budgets for the Small Business Innovation Research (SBIR) Program.
- In FY97, DoD funding for SBIR was about $500 million.
- The GAO reviewed DoD policies and procedures to determine if current process ensured that
    - Quality research is performed
    - Competitive procedures are being followed
    - Technologies developed through SBIR are likely to be used in military programs or projects.

Findings:

- Although measuring the quality of research is difficult, the GAO concluded that the current process helps ensure that quality research is being performed in the SBIR program
- DoD conducts three national SBIR conferences each year and widely distributes solicitations for research proposals from small businesses. The GAO concludes that these procedures ensure full and open competition.
- The report cites several factors that ensure that the technologies developed through SBIR have military applications. A linkage is required between the research topic and military planning documents. Additionally, the research topics must address DoD's key technology areas.
- The GAO concludes that the current DoD procedures for managing the SBIR program are adequate.

IN FROM THE COLD: PROSPECTS FOR CONVERSION OF THE DEFENSE INDUSTRIAL BASE

Author: Maryellen R. Kelley & Todd A. Watkins
Publisher: Science – Vol. 268
Date: April 1995

Issues:

- Barriers defense firms see to entering into the commercial world
- Are defense contractors able to function in the commercial economy after the recent draw down in defense purchases?
- Conventional wisdom supports the idea that defense manufacturing is isolated from commercial manufacturing. This is true of both prime manufacturers and subcontractors.
- Paper analyzes the market structure and behaviors that are thought to separate commercial manufacturing from defense manufacturing.

Findings:

- Found few technical and competitive barriers separating the defense and commercial industrial sphere
- The normal practice at the end of the Cold War was for commercial-military integration. In 1990, there was little dependence upon the Pentagon from typical defense contractors.
- On average, large multiplant firms are slightly more dependent upon the Pentagon than subcontractors.
- There is little evidence to support the theory that government contracting has forced a divide between military and commercial contractors.
- Defense contractors actually have an advantage over strictly commercial contractors because of their greater use of productivity enhancing technology
- The technological gap that exists between defense and commercial contractors is largely the result of government policy initiatives geared for the defense side.

INDUSTRIAL BASE: ASSESSING THE RISK OF DOD'S FOREIGN DEPENDENCE

Author: GAO
Publisher: GAO/NSIAD-94-104
Date: April 1994

Issues:

- How critical is the item to various national security needs
- How great is the likelihood that the United States will not have access to the item or technology when needed

Findings:

- Over the long-term, the overall economic and business environment should encourage sustaining innovative domestic industries
- Short-term risk of foreign sourcing interrupted or delayed access to items critical to engaging in conflicts
- Long-term, the concern is the U.S. will not have access to the technologies, including equipment, needed to meet new or existing threats to national security
- Experts agreed that the data on defense suppliers necessary to assess the risk of foreign dependence is not being collected, particularly at the lower tiers of the defense industrial base.

DEPARTMENT OF DEFENSE PROFIT POLICY AND CAPITAL INVESTMENT IN THE MILITARY AIRCRAFT INDUSTRY

Author: Thomas P. Frazier, Matthew S. Goldberg & Thomas R. Gulledge, Jr.
Publisher: Review of Economics and Statistics, pp. 394-403
Date: August 1992

Issues:

- Does the DoD's profit policy have the effect of inducing contractors to invest in capital?
- What effect do progress payments have on the investment behavior of contractors?
- What effect do markups on capital equipment have on the investment behavior of contractors?

Findings:

- The paper examined time series data from four large aerospace contractors.
- There is no evidence that changes in progress payments influenced contractors to substitute labor and materials for capital.
- The Working Capital Adjustment, introduced in 1987, compensates contractors for most of the financing costs associated with partial progress payments.
- However facilities capital markup was a very powerful tool in increasing contractors' investment in new plants and equipment.
- The generous DoD markup policies have had the desired effect of encouraging the defense sector companies to increase their capital/sales ratio to the level found in the commercial manufacturing sector.

PROFIT REGULATION OF DEFENSE CONTRACTORS AND PRIZES FOR INNOVATION

Author: William P. Rogerson
Publisher: Journal of Political Economy – Vol. 97, #6
Date: 1989

Issues:

- How to encourage innovative R&D when the prizes are in production
- Is it possible to create a structure in which firms earn negative economic profits during the innovation phase and positive profits during the production phase, totaling zero economic profits overall?
- DoD needs to reward successful innovation, but how would this be done objectively?
- What methodology should be used to determine the size of a prize?

Findings:

- Need to offer large prizes in R&D in order to induce technological innovations from DoD contractors.
- Positive economic profits in the production phase will help to encourage firms to successfully follow through on their projects.
- Prizes in the production phase encourage firms to spend their own money in the innovation phase, increasing their chance of receiving the contract.
- Defense firms earning relatively constant profit margins regardless of the value of their innovation.
- Due to constant profit margins, firms lack an incentive to earmark money towards researching programs critical to DoD.
- Necessary to vary pricing rules based upon different sectors of the defense industry. Smaller economic profit for sectors where innovation is not as important.
- Future research is necessary to determine how to create prizes for innovation while also creating an incentive for firms to minimize their costs.

APPENDIX I

RED TEAMS AND CONTRIBUTING INDIVIDUALS

INTERNAL OSD RED TEAM

Dr. Robert Buhrkuhl
Deputy Director, Acquisition Management
Room 3D161

Dr. Stephen Cambone
Director, Program Analysis & Evaluation
Room 3E836

VADM (Ret.) Art Cebrowski
Director, Force Transformation
Room 3D980

Mr. Jaymie Durnan
Special Assistant to the Secretary of Defense
Room 3E944

Capt Jeffrey Gernand
Joint Chiefs of Staff, J8
Room 1D963

Mr. John Jennings
Defense Advanced Research Projects Agency
3701 North Fairfax Drive
Arlington, VA 22203-1714

Mr. Louis Kratz
ADUSD (Logistics Architecture)
Room 2C263

Mr. Kenneth Krieg
Special Assistant to the Secretary of Defense
Room 3E856

Dr. Glenn Lamartin
Director, Defense Systems
Room 3E130

Ms. Deidre Lee
Director, Defense Procurement and Acquisition Policy
Room 3E1044

Col John Long
Office of General Counsel
Room 3D984

Dr. Spiros Pallas
Deputy Director, Defnse Systems
Room 3E130

Ms. Sue Payton
DUSD (Advanced Systems & Concepts)
Room 3E114

Mr. Charles Perkins
ODUSD (Advanced Systems & Concepts)
Room 3E114

Mr. Frank Ramos
Director, Small & Disadvantaged Business Utilization
1777 N. Kent Street, Suite 9100
Arlington, VA 22209

Dr. Nancy Spruill
Director, Acquisition Resources & Analysis
Room 3E1025

Lt Col Chuck Stribula
Acquisition Resources & Analysis
Room 3D756

VADM Stanley Szemborski
Deputy Director, Program Analysis & Evaluation
Room 3E836

RADM Richard Terpstra
Director, Special Programs
Room 3D1064

Hon. Dov Zakheim
USD (Comptroller)
Room 3E822

INDUSTRY/INNOVATIVE PROGRAMS OF TODAY RED TEAM

Lt Gen Michael Hough
Deputy Commandant for Aviation
Headquarters, USMC
2 Navy Annex
Washington, DC 20380-1775
(Former Program Manager, Joint Strike Fighter)

Mr. William Lawler
Vice President and General Manager, Integrated Defense Systems
The Boeing Company
Building 100 Dock, Mail Stop S-100-1015
Berkeley, MO 63134

Mr. Terry Little
Director, Kinetic Energy Interceptors
Missile Defense Agency
Room 30742 (Pentagon)
(Former Program Manager, JDAM)

Mr. Frank Pace
Executive Vice President
General Atomics Aeronautical Systems, Inc.
PO Box 85608
San Diego, CA 92186

Ms. Ann Sauer
Vice President, Policy and Budget
Lockheed Martin Corporation
1725 Jefferson Davis Highway #300
Arlington, VA 22202

Mr. David Thompson
President and CEO
Spectrum Astro, Inc.
1440 N. Fiesta Blvd.
Gilbert, AZ 85233

Mr. Craig Fraser
Fitch Ratings
28th Floor
1 State Street Plaza
New York, New York 10004-1505

Mr. Joseph Nadol
JP Morgan
12th Floor
277 Park Avenue
New York, New York 10172-0003

INTERNATIONAL "DESKTOP" RED TEAM

Brigadier General Jose D'Antin
French Embassy
Minister for Defense Cooperation
4101 Reservoir Road, NW
Washington, DC 20007-2172

Mr. Uwe Fialkowski
German Embassy
Counselor for Defense Cooperation
4645 Reservoir Road, NW
Washington, DC 20007-1998

The Honorable John Hamre
Center for Strategic & International Studies
President & CEO
1800 K Street, NY
Washington, DC 20006

Ms. Shuna Lindsay
British Embassy
Minister for Defense Cooperation
3100 Massachusetts Avenue, NW
Washington, DC 20008