

# TWO PATHS TO THE MOON

NEEP 533 LECTURE 39

Harrison H. Schmitt

A photograph of astronaut Harrison H. Schmitt on the Moon. He is wearing a white spacesuit with a large life-support backpack and is using a shovel to dig in the lunar soil. The background shows the dark, rocky lunar surface under a black sky.

SPACE POLICY 2004

**PRESIDENT GEORGE W. BUSH  
HUMAN EXPLORATION INITIATIVE  
JANUARY 14, 2004**



# **“RENEWED SPIRIT OF DISCOVERY”**

- **NASA COMMITTED TO LONG TERM HUMAN AND ROBOTIC SPACE EXPLORATION**
  - **ENABLE EXPLORATION OF MARS AND OTHER DESTINATIONS**
    - **RETURN TO THE MOON TO FACILITATE THIS**
  - **NEW FOCUS FOR NASA**
  - **AFFORDABLE, SUSTAINABLE, HIGH LEVELS OF SAFETY**
  - **TECHNOLOGICAL BENEFITS ON EARTH**

# **NASA'S NEW AGENDA - 1**

- **COMPLETE ISS BY 2010**
  - **RETURN SPACE SHUTTLE TO FLIGHT 2005**
  - **RETIRE SPACE SHUTTLE BY 2010**
  - **FOCUS ISS RESEARCH ON BIOMEDICINE**
- **DEVELOP CEV BY 2014**
  - **FERRY TO ISS**
  - **MISSIONS BEYOND EARTH ORBIT**
  - **OTHER?**

# **NASA'S NEW AGENDA - 2**

- **RETURN TO MOON BY 2015-2020**
  - **INCREASINGLY LONG STAY-TIMES**
  - **DEVELOP NEW EXPLORATION TECHNOLOGIES**
  - **HARNESS LUNAR RESOURCES**
    - **MISSIONS TO MARS AND BEYOND**
  - **ROBOTIC LUNAR MISSIONS BY 2008**
  - **INCREASED ROBOTIC EXPLORATION OF SOLAR SYSTEM**

# **FY 2005-2010 NASA BUDGETS (REQUESTED)**

- **CURRENT FY 2004 BUDGET = \$15.4 B**
- **FY 2005: ADD \$800 M**
- **FY 2006-2010: ADD \$200 M PER YEAR**
  - **RE-ALLOCATE \$11 B FROM WITHIN 5 YEAR BASE PLAN OF \$86 B**
    - **NASA ADMINISTRATOR WILL REVIEW ALL CURRENT PROGRAMS**
      - **REDIRECT TOWARD PRESIDENT'S NEW GOALS**
- **CONGRESSIONAL RELUCTANCE**

# **PRESIDENTIAL COMMISSION ON IMPLEMENTATION OF US SPACE EXPLORATION POLICY**

- **PETE ALDRICH - CHAIRMAN**
- **REPORT IN FOUR MONTHS**
- **INDEFINITE LIFE ?**

**ARE THERE TWO PATHS  
TO THE MOON?**

**NASA'S NEW VISION**

**AND A**

**PRIVATE ENTREPRENEURIAL  
INITIATIVE**



# WHY TWO PATHS FOR PRIVATE AND GOVERNMENT SECTORS?

- **PROGRESS SOMETIMES REQUIRES A CATALYST**
  - **THRESHOLD FOR PRIVATE INVESTMENT MAY BE TOO HIGH**
  - **STILL NEEDED ADVANCEMENT FOR PUBLIC GOOD**
  - **MUST AVOID GOVERNMENT'S MISDIRECTION OF TECHNOLOGY**
    - **SPACE SHUTTLE DEVELOPMENT IN 1970s**
      - **SATURN SYSTEM ALTERNATIVE**
    - **SOLAR ENERGY EMPHASIS IN 1970s**
      - **TECHNOLOGY NOT READY**
      - **NET COSTS NOT COMPETITIVE**
    - **SYNFUELS / OIL SHALE EMPHASIS IN 1980s**
      - **WASTE DISPOSAL INTRACTABLE**
      - **NON-COMPETITIVE COSTS**
    - **ELECTRIC AUTOMOBILES IN THE 1990s**
      - **ENERGY STORAGE TECHNOLOGY NOT READY**
      - **INCREASED USE OF FOSSIL FUELS ABSENT COMMITMENT TO FISSION**
    - **D/T MAGNETIC FUSION IN THE 2000s**
      - **INHERENTLY NON-COMMERCIAL**

# WHY TWO PATHS FOR PRIVATE AND GOVERNMENT SECTORS?

- **DUAL ROLES TRADITIONAL IN U.S. HISTORY**
  - **TRANSPORTATION: ARMY AND NACA**
    - **TURNPIKES, CANALS, RAILROADS, LOCKS AND DAMS, AERONAUTICS**
  - **AGRICULTURE: LAND GRANT COLLEGES**
    - **RESEARCH AND DEVELOPMENT OF CROPS AND TECHNOLOGY**
  - **COMMUNICATIONS: REGULATORY AGENCIES, NIST, AND NASA**
    - **STANDARDS AND SATELLITES**
  - **MEDICINE: NATIONAL INSTITUTES OF HEALTH AND ARMY**
    - **BASIC MEDICAL RESEARCH AND LARGE SCALE TRIALS**

# COMPARISON OF TWO PATHS - 1

## GOVERNMENT

- HUMAN TENDED BASE
- POLICY DRIVEN IMPLEMENTATION
- OVERSIGHT BY PRESIDENTIAL COMMISSION ?
- HEADQUARTERS PROGRAM & PROJECT MANAGEMENT
- HIGH OVERHEAD, DIVERSE FUNCTION POLITICAL “CENTERS”
- MID-CAREER TO RETIREMENT WORKFORCE
- **CURRENT STABLE OF ELVs**
  - 25-30 TONNES TO LEO
  - 5-6 TONNES TO MOON

## PRIVATE

- PERMANENT SETTLEMENT
- RETURN ON INVESTMENT DRIVEN IMPLEMENTATION
- OVERSIGHT BY INDEPENDENT BOARD OF DIRECTORS
- CENTRALIZED PROGRAM / DELEGATED PROJECT MGT.
- FOCUSED CENTERS OF EXCELLENCE
- YOUNG WORKFORCE / MID-CAREER MANAGERS
- **NEW HEAVY LIFT ROCKET**
  - 250-500 TONNES TO LEO
  - 50-100 TONNES TO MOON

# COMPARISON OF TWO PATHS - 2

## GOVERNMENT

- **SHUTTLE & ISS TO 2010**
  - FUNDING LIMITATION/  
MANAGEMENT DISTRACTION
  - \$800M FY 2005 THRESHOLD
- **RETURN TO MOON BY 2015**
- **INTERNATIONAL PARTNERS ?**
- **MULTIPLE PURPOSE CEV**
- **MULTIPURPOSE ROBOTIC MISSIONS**
- **INTERNALLY SPONSORED MEDICAL RESEARCH**
- **GOVERNMENT SPONSORED**

## PRIVATE

- **BRIDGING BUSINESSES TO 2014**
  - TECHNOLOGY/MATURATION/  
RETURN ON INVESTMENT
  - \$15 M CAPITAL THRESHOLD
- **RETURN TO MOON BY 2015**
- **INTERNATIONAL INVESTORS & WORKFORCE**
- **SPECIAL PURPOSE SPACECRAFT**
- **SPECIAL PURPOSE ROBOTIC MISSIONS, IF ANY**
- **NIH / UNIVERSITY PARTNERS IN MEDICAL RESEARCH**
- **GOVERNMENT REGULATED**

# **MUTUAL BENEFIT FROM TWO PATHS -1**

- **MAJOR PUBLIC BENEFITS FROM PRIVATE INITIATIVE**
  - **LOW COST, LARGE ROCKETS**
    - **PLANETARY EXPLORATION**
    - **NATIONAL DEFENSE**
    - **ASTEROID IMPACT PROTECTION**
    - **LUNAR TOURISM**
  - **ACCESS TO LUNAR RESOURCES**
    - **PLANETARY EXPLORATION CONSUMABLES**
    - **EARTH ORBIT CONSUMABLES**
  - **DEVELOPMENT OF COMMERCIAL HELIUM-3 FUSION POWER**
    - **CONTINUED ECONOMIC GROWTH AND COMPETITIVENESS**
    - **CLEAN ENERGY FOR TERRESTRIAL DEVELOPMENT**
    - **MEDICAL APPLICATIONS OF FUSION TECHNOLOGY**
    - **EXPLOSIVES DETECTION, INCLUDING LAND MINES**
    - **CLEAN-UP OF FISSION RADIOACTIVE WASTE**
    - **PLANETARY EXPLORATION PROPULSION**

# MUTUAL BENEFIT FROM TWO PATHS -2

- **MAJOR PRIVATE INITIATIVE BENEFITS FROM GOVERNMENT EFFORT**
  - **CREDIBILITY WITH INVESTORS: “MOON IS IN PLAY”**
  - **DICHOTOMY OF APPROACHES TO RETURN TO THE MOON**
    - **MORE CONCEPTUAL APPROACHES CONSIDERED**
    - **ENGINEERING AT COMPONENT, SUBSYSTEM AND SYSTEMS LEVEL**
      - **MORE OPTIONS FOR BENEFICIAL OUTCOMES**
  - **COLLECTION OF LUNAR DATA SETS RELATED TO RESOURCES**
    - **2008 LUNAR ORBITER**
  - **POSSIBLE LUNAR NAVIGATION SYSTEM**
  - **SPACE BIOMEDICAL RESEARCH AT ISS ?**
  - **CHAMPION IN INTERNATIONAL FORUMS**

# **UNIQUE REQUIREMENTS: GOVERNMENT**

- **USE EXISTING LAUNCH VEHICLES**
- **MULTI-PURPOSE SPACECRAFT - ISS AND MOON AND ?**
- **EARTH ORBIT RENDEZVOUS IMPLEMENTATION  
MODE**
- **MULTI-PURPOSE LUNAR VEHICLES AND FACILITIES**
- **MULTI-PURPOSE ROBOTIC LUNAR MISSIONS**

# **UNIQUE REQUIREMENTS: PRIVATE LUNAR INITIATIVE**

- **HEAVY LIFT, LOW COST LAUNCH VEHICLE**
- **LOWEST COST, GREATEST PAYLOAD LANDING MODULE**
- **LUNAR ORBIT RENDEZVOUS IMPLEMENTATION MODE ?**
- **LUNAR VEHICLES / FACILITIES FOCUSED ON RESOURCE RECOVERY**
- **HIGHLY MOBILE / LOW MAINTENANCE SPACE SUITS**
- **GLOVE DEXTERITY OF THE HUMAN HAND**
- **DESIGN FOR INDEFINITE OPERATIONAL LIFE**
  - **IMBEDDED DIAGNOSTICS**
  - **ANTICIPATORY MAINTENANCE BASED ON LIFE CYCLE TESTING**
  - **MODULAR REPLACEMENT AND REPAIR**
- **REQUIRED PRECURSOR ROBOTIC MISSIONS WILL BE LOW COST AND DATA SPECIFIC**

**ALL CAN BE BENEFICIAL TO NASA**



# **POTENTIAL SYNERGISM BETWEEN NASA AND PRIVATE PATH**

- **ROBOTIC EXPLORATION**
- **SPACECRAFT SUB-SYSTEMS**
- **HABITATS**
- **ROVER SUB-SYSTEMS**
- **SPACE SUIT SUB-SYSTEMS**
- **LUNAR NAVIGATION SYSTEM**
- **MEDICAL RESEARCH**

# **GOVERNMENT: MANAGEMENT SYSTEM**

- **SENIOR MANAGEMENT RESPONSIVE TO POLITICAL INTERESTS**
  - **DECISION MAKING TOP DOWN**
  - **INEFFICIENT REPORTING STRUCTURE THE NORM**
- **SUSTAINABILITY OF FUNDING UNCERTAIN YEAR TO YEAR**
  - **WHITE HOUSE SUPPORT**
  - **OMB SUPPORT**
  - **CONGRESSIONAL SUPPORT**
  - **MEDIA SUPPORT**
  - **PUBLIC SUPPORT**
- **HIRING / FIRING BASED ON CIVIL SERVICE CONSTRAINTS**
  - **DIFFICULT TO KEEP AGENCY “YOUNG”**
- **INFRASTRUCTURE INHERITED AND POLITICALLY FIXED**
  - **RESEARCH AND OPERATIONAL CENTERS FIXED**
  - **LAUNCH LOCATION FIXED**
  - **CONTRACTOR BASE LIMITED TO THREE MAJORS**
- **COORDINATION WITH DOD AND REGULATORY AGENCIES**

# **PRIVATE INITIATIVE: MANAGEMENT SYSTEM**

- **SENIOR MANAGEMENT RESPONSIVE TO SHAREHOLDER INTERESTS**
  - **DECISION MAKING DELEGATED**
  - **EFFICIENT REPORTING STRUCTURE THE NORM**
- **SUSTAINABILITY OF FUNDING BASED ON PERFORMANCE**
  - **BOARD OF DIRECTORS SUPPORT**
  - **SHAREHOLDER SUPPORT**
- **HIRING / FIRING BASED ON OPERATIONAL REQUIREMENTS**
  - **COMPANY CAN STAY “YOUNG”**
- **INFRASTRUCTURE NEW AND CAN CHANGE**
  - **LOCATION OF RESEARCH AND OPERATIONAL CENTERS OPTIMIZED**
  - **LAUNCH LOCATION OPTIMIZED**
  - **CONTRACTOR BASE CAN BE BROAD AND RECREATED**
- **COORDINATION WITH REGULATORY AGENCIES**

# **PRIVATE INITIATIVE: BOARD OF DIRECTORS**

- **LEGAL RESPONSIBILITY TO REPRESENT SHAREHOLDERS**
- **HIRE AND FIRE CHIEF EXECUTIVE OFFICER**
- **OVERSEE INDEPENDENT FINANCIAL AUDIT PROCESS**
- **OVERSEE COMPENSATION PLANS**
- **PLAN MANAGEMENT SUCCESSION**
- **CREATE AND REVISE STRATEGIC / CONCEPTUAL PLAN**
- **ASSIST IN GOVERNMENTAL AND CONTRACTOR INTERFACES**
- **APPROVE ACQUISITIONS AND SPIN-OFFS OF SUPPORT FUNCTIONS OR ANCILLARY BUSINESSES**

**NOTE: NO COMPARABLE FOCUS OF  
RESPONSIBILITY FOR A GOVERNMENT AGENCY**

# PRIVATE INITIATIVE: CORPORATE HEADQUARTERS

- **CENTER DIRECTOR SELECTION**
- **PROGRAM AND OVERALL RISK MANAGEMENT**
  - **LEVEL ONE SCHEDULES INTEGRATION AND OVERSIGHT**
- **FINANCIAL PLANNING, MANAGEMENT, AND REPORTING**
  - **LEVEL ONE INTEGRATION AND OVERSIGHT**
- **INTEGRATED INFORMATION PROCESSING SYSTEM**
- **DEFINITION AND OVERSIGHT OF CENTER INTERFACES**
- **PERSONNEL AND BULK PURCHASING SYSTEMS**
- **PREVENTION OF DECISION CREEP**
- **REGULATORY INTERFACES AND GOVERNMENT RELATIONS**
- **INTELLECTUAL PROPERTY COM**
- **GENERAL COUNSEL**
  - **LAWS AND TREATIES**
- **CENTER ADMINISTRATIVE SUPPORT AS REQUIRED**
- **FUSION POWER AND ENVIRONMENT FOUNDATION**

**NOTE: THESE ARE ALL FUNCTIONS  
REQUIRED OF NASA HEADQUARTERS  
IN A VERY MUCH MORE COMPLEX  
ADMINISTRATIVE ENVIRONMENT.**

# **PRIVATE INITIATIVE: OPERATIONAL CENTERS**

- **EISENHOWER (?) LAUNCH CENTER (VLC)**
  - **LAUNCH SYSTEMS DEVELOPMENT AND OPERATIONS**
  - **LAUNCH SYSTEMS MARKETING, SALES AND SUPPORT**
- **LOW (?) SPACECRAFT AND FLIGHT CENTER (LSC)**
  - **SPACECRAFT DEVELOPMENT AND FLIGHT OPERATIONS**
  - **SPACECRAFT SYSTEMS MARKETING, SALES AND SUPPORT**
- **SANTARIUS (?) LUNAR RESOURCE CENTER (SLC)**
  - **RESOURCE EXTRACTION AND REFINING DEVELOPMENT AND SETTLEMENT SUPPORT**
  - **LUNAR RESOURCES MARKETING, SALES AND SUPPORT**
  - **LUNAR ANCILLARY BUSINESS MARKETING, SALES AND SUPPORT**
- **KULCINSKI (?) FUSION CENTER (KFC)**
  - **FUSION TECHNOLOGY DEVELOPMENT AND BRIDGING BUSINESS INCUBATION**
  - **POWER PLANT MARKETING, SALES AND SUPPORT**

# **PRIVATE INITIATIVE: LUNAR SETTLEMENT ROLES**

- **SETTLEMENT HAS SAME STATUS AS A “CENTER”**
- **RESOURCE PRODUCTION MANAGEMENT**
- **RESOURCE DISTRIBUTION IMPLEMENTATION**
- **MINE PLANNING**
- **RESOURCE EXPLORATION**
- **SETTLEMENT MANAGEMENT**
  - **PERSONNEL ASSIGNMENTS AND SCHEDULES**
  - **AGRICULTURAL PRODUCTION**
  - **FACILITY AND EQUIPMENT MAINTENANCE**
  - **OCCUPATIONAL AND PREVENTIVE MEDICINE**
  - **INVENTORY MANAGEMENT**
  - **COORDINATION WITH LUNAR RESOURCE CENTER**

# **PRIVATE INITIATIVE**

## **SOME DESIGN PRINCIPLES**

- **FAIL TO OPERATE, FAIL TO MANUAL, FAIL TO SAFE**
- **INDEFINITE LIFE TO ALL MAJOR HARDWARE**
  - **MAINTENANCE DESIGN**
  - **IMBEDDED DIAGNOSTICS / TROUBLE-SHOOTING**
  - **LIFE TESTING AND PREDICTION**
- **PARALLEL DESIGNS FOR SYSTEMS CRITICAL TO SAFETY OR BUSINESS SUCCESS**
- **DESIGN FOR PERIODIC UPGRADES**
  - **HARDWARE**
  - **SOFTWARE**
- **DESIGN FOR MINIMUM DIRECT MONITORING**
  - **YELLOW-LINE ALARMS**
  - **SELF-DIAGNOSIS AND REPAIR (?)**
- **APOLLO CONFIGURATION CONTROL SYSTEM**
  - **ACTIVIVATE AT SYSTEM LEVEL PDR**



# **PRIVATE INITIATIVE: OPERATIONAL PRINCIPLES -1**

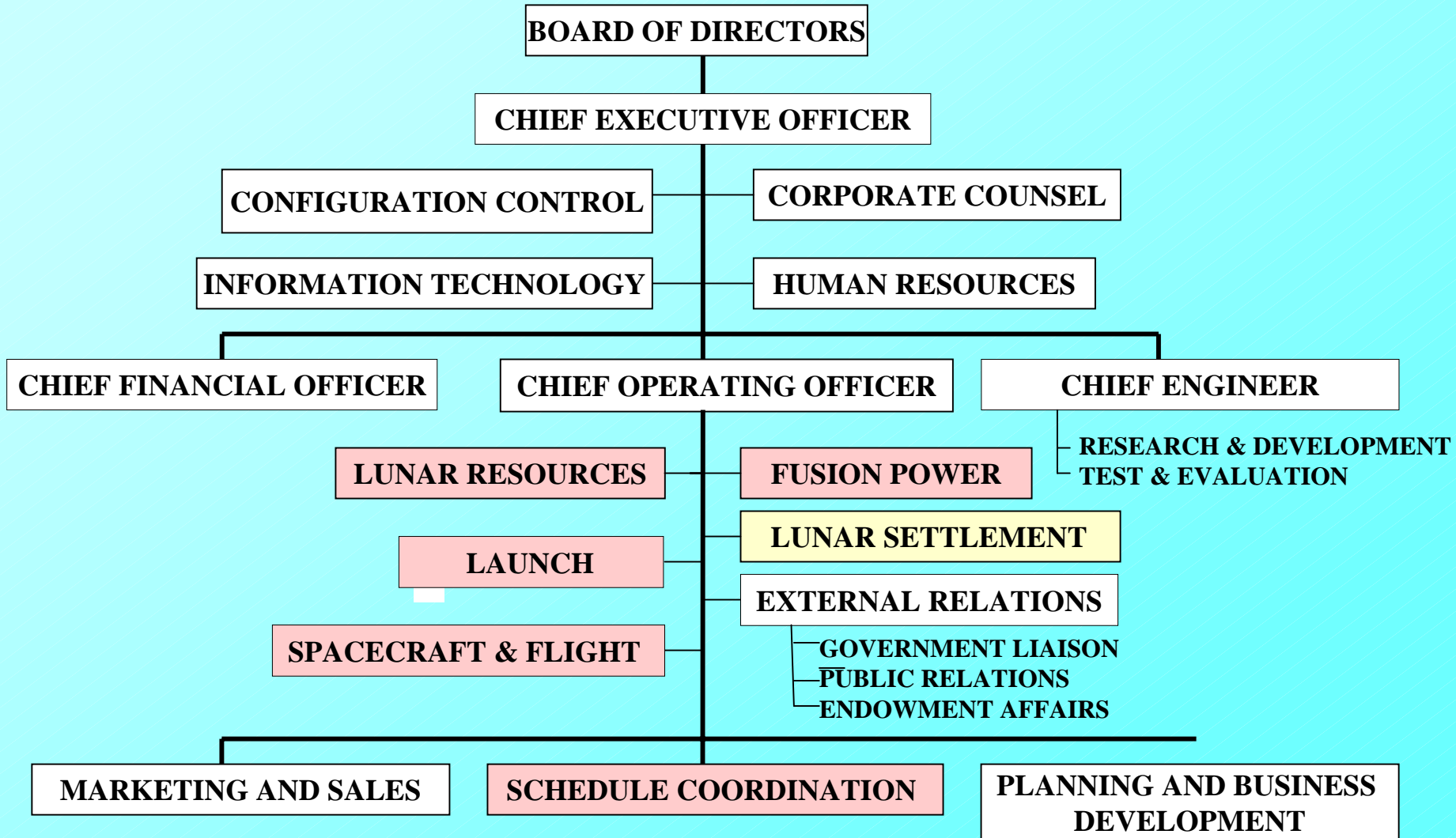
- **NO LAUNCH STAND-DOWN LONGER THAN TWO SCHEDULED LAUNCHES**
- **QUALITY CONTROL IS A HIGH PRIORITY, DISPERSED RESPONSIBILITY OF ALL PERSONNEL**
- **LUNAR WORK CYCLE (FIRST FEW YEARS):**
  - **12 HOUR SHIFTS, TWO HOUR OVERLAP OF SHIFTS**
    - **TWO MINER-PROCESSOR MAINTENANCE HOURS PER 24 HOUR DAY**
  - **6 DAY WORK WEEKS, 24 WORK DAYS PER LUNAR MONTH**
    - **~4 MINER-PROCESSOR MAINTENANCE DAYS PER LUNAR MONTH**
  - **12 WORK MONTHS OUT OF ~13 LUNAR MONTHS PER YEAR**
    - **ONE MINER-PROCESSOR MAINTENANCE MONTH PER LUNAR YEAR**

# **PRIVATE INITIATIVE: OPERATIONAL PRINCIPLES -2 THE 204/CHALLENGER/COLUMBIA PROCESS**

- **EACH CENTER WILL HAVE A SPECIFIC PROCESS FOR IDENTIFYING AND WORKING TEST AND OPERATIONAL ANOMALIES**
  - **NO ANOMALY WILL BE CLEARED BY A CENTER EXCEPT AFTER REVIEW BY AT LEAST TWO LEVELS OF APPROPRIATE MANAGERIAL OVERSIGHT**
  - **CLEARANCE OF ANOMALIES RELATED TO PERSONNEL OR PUBLIC SAFETY ALSO REQUIRE REVIEW BY FLIGHT CREW COMMANDER, SENIOR TEST DIRECTOR, POWER PLANT MANAGER, AND/OR LUNAR SETTLEMENT MANAGER AS APPROPRIATE**
    - **A SENIOR CORPORATE MANAGER AND THE CHAIRMAN OF THE RELEVANT BOARD OF DIRECTORS COMMITTEE WILL BE PROMPTLY NOTIFIED OF THE ANOMALY AND OF SUBSEQUENT CLEARANCE DECISION**

# INTERLUNE INTERMARS INITIATIVE INC.

## PRELIMINARY ORGANIZATION



MAJOR MANPOWER AREAS

# IMPLICATIONS

- **RETURNING TO THE MOON TO STAY**
  - **COMPARABLE TO THE FIRST MOVEMENT OF HUMANS OUT OF AFRICA ~150,000 YEARS AGO**
  - **OR TO THE FIRST MIGRATION OF HUMANS TO NORTH AMERICA IN SEARCH OF FREEDOM ~400 YEARS AGO**

