SYSTEM ARCHITECTURE DEVELOPMENT
for a
SELF-SUSTAINING LUNAR COLONY

Progress Briefing
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NIAC

Agenda

- Introduction
- Production Examples
- Required Elements for a Lunar Colony
- Purpose of Phase I Preliminary System Architecture Study
- Requirement Breakdown for Human Survival
- Second Level Requirement Breakdown: Agriculture
- Areas of Consideration
- Illustration of the Resources Available in the Lunar Regolith
- Key Objectives
- Work Schedule
- Tasks
  - Develop Basic Requirements
  - Define Minimum Earth Supply Requirements
  - Develop Examples of Lunar ISRU Production Activities and Products
  - Define the Preliminary System Architecture
  - Create Multidisciplinary Consortium
- Progress to Date

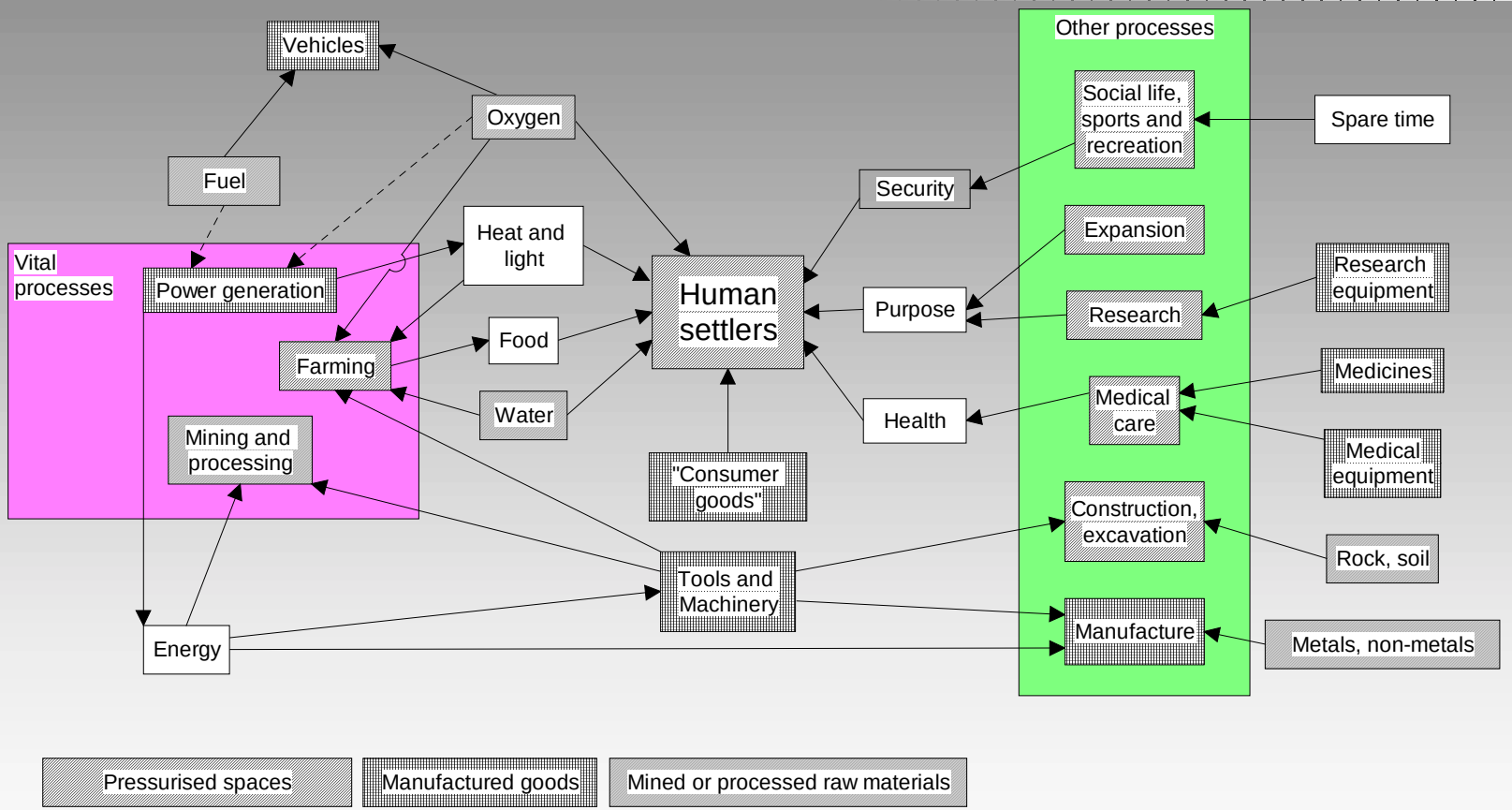
Introduction

- ORBITEC proposes to develop an overall system architecture for the goal of establishing a truly self-supporting lunar colony, independent of sustained Earth resources and supplies
- By deliberate design, we will define a self-supporting lunar colony that would be able to survive and grow, with only initial supplies from Earth
- We intend to show that a design of a self-sufficient architecture is not only feasible, but is an attractive alternative to what might be considered a regular Earth-supported lunar colony
- The establishment of such a colony would indeed be a grand step into space and would absolutely drive new innovative approaches/developments for self-sufficiency that would ultimately support a much lower cost and highly-survivable human colonisation of Mars and other planetary bodies
- Once established, the lunar colony will implement many innovative applications for the production of needed structures and commodities from lunar materials

Production Examples

- Production of oxygen, nitrogen, carbon dioxide, water and food for life support
- Manufacture of raw materials and structures for use on the surface for habitats, production facilities and transportation infrastructure
- Production of hydrogen and oxygen propellants/fuels from the lunar water ice-bearing lunar regolith at the poles for use in ground and flight vehicles operating on the surface, in Lunar orbit, Earth orbit, libration points, and deep space
- Production of chemical, solar and nuclear energy production systems.

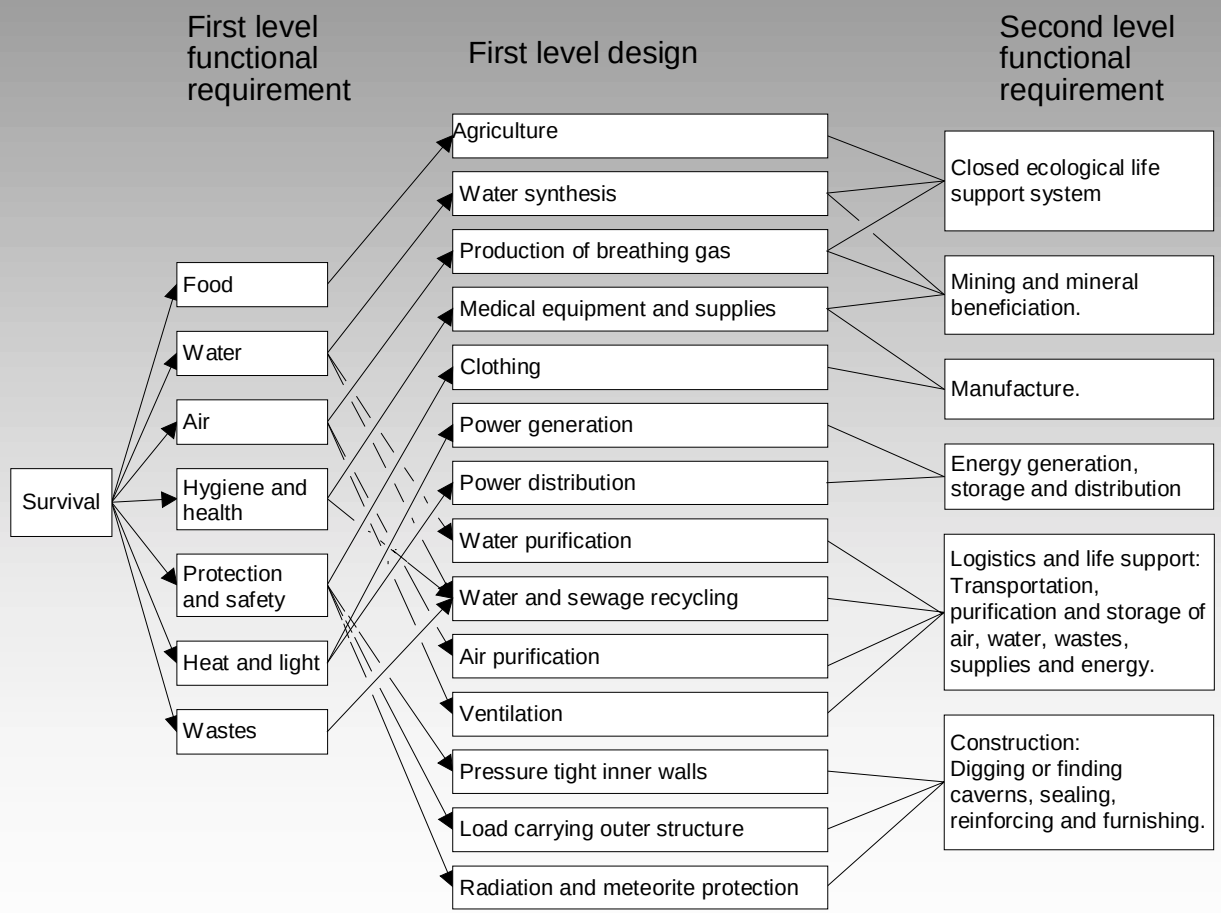
Required Elements for Lunar Colony



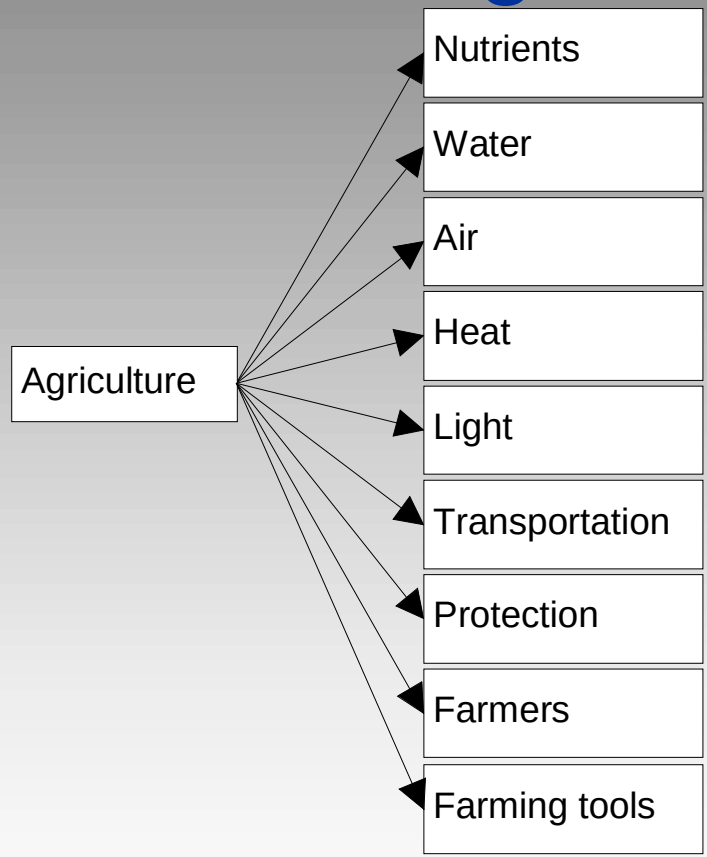
Purpose of the Phase I Preliminary System Architecture Study

- Develop a structured breakdown of the basic requirements for survival of an isolated group of humans on the lunar surface over an definite period of time ~ 1 year
- Define what would be the minimum initial requirements provided from Earth and what absolute minimum on-going supplies, data and communications from Earth would be necessary
- Develop an initial new mindset of how to produce what is needed from in situ lunar resources
- Create a multidisciplinary network or consortium of willing contributing experts, by compiling a directory of technical and business contacts at companies, universities, government agencies, and institutes willing to participate in lunar self-sufficiency colonisation studies in the NIAC Phase II effort and beyond

Requirement Breakdown for Human Survival



Second Level Requirement Breakdown: Agriculture



Areas of Consideration

- **Biology:** Effects of 1/6th gravity and radiation on humans, plants and animals, as well as closed system ecology, food production and processing, plant and animal transport, etc
- **Human Behavioural Sciences:** including psychology and sociology, especially with respect to isolated groups and confined spaces, family structure, social activities, etc
- **Ground Transportation/Propulsion:** personal rocket back packs and rocket-based platforms, small and large rovers, maglev transport systems, heavy haulers, power plants, rocket systems, etc
- **Space Transportation/Propulsion:** Hoppers, orbital vehicles, emergency transport vehicles, rocket systems, etc
- **Automation and Robotics:** Robots, automatic processing and manufacturing technology, self-replicating systems, control systems for safety and comfort, etc
- **Mining and Processing of Resources:** Mining of raw materials and mechanical and chemical processing of the lunar regolith to extract gases, liquids and solids needed for support and extension of the lunar colony, concrete and basalt processing, etc

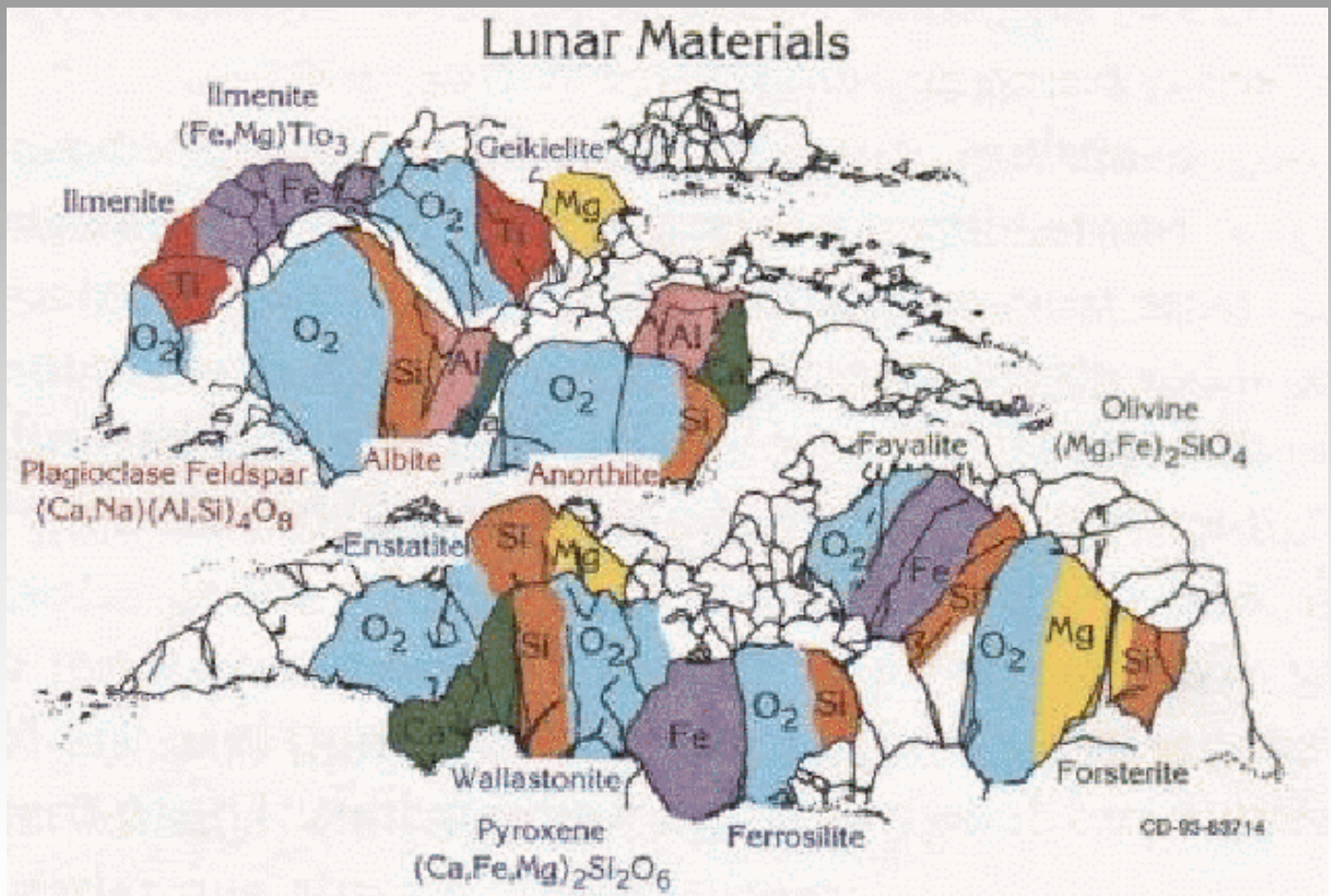
Areas of Consideration
(Continued)

- **Facility Construction:** Buildings, underground facilities (tunnelled), inflatables, roads, launch pads, maglev tracks, etc
- **Communications:** Satellite communications, direct broadcast (lunar orbit, from Earth), local communications, cable, etc
- **Manufacture of Tools, Equipment, Commodities:** Manufacture of tools, parts and repair of existing equipment, production of needed products for survival and living, etc
- **Solar and Nuclear Power Generation and Energy Storage:** Solar power system manufacture, solar cell production, nuclear power systems construction, nuclear fuel production, electrical, chemical, and thermal energy storage for night and emergencies/breakdowns/eclipses, etc
- **Recreation and Entertainment:** Colonists require recreation and entertainment, which would include modifications to Earth-based activities; Entertainment could be from Earth-based activities (movies, news, shows, sports, etc.), etc
- **Political Science/Government:** Colonists will require a governmental/lawful system to guide, manage and control the events and processes, etc
- **Commercial Activities:** Both internal and external commercial activities include production of required products for the colony and the export of valuable recovered resources that Earth-based or other space-based systems require for exploration and space commerce, etc

Work Schedule

WORK TASK	Project Month 1	2	3	4	5	6
Task 1. Requirements Definition						
Task 2. Earth Supply Requirements						
Task 3. Develop Supply Requirements						
Task 4. Preliminary System Architecture						
Task 5. Develop Consortium/Network						
Task 6. Reporting						

Illustration of Resources Available in the Lunar Regolith



Key Objectives

- Develop a structured breakdown of the basic requirements for survival of an isolated group of humans on the lunar surface over an infinite period of time that fully utilise lunar in situ resources and minimize the use of Earth-supplied materials/products
- Define what would be the minimum initial requirements provided from Earth and what absolute minimum on-going supplies, data and communications from Earth would be necessary
- Develop an initial new mindset of how to produce everything that is needed from in situ lunar resources
- Create a multidisciplinary consortium of willing contributing experts, by compiling a directory of technical and business contacts at companies, universities, government agencies, and institutes that are willing to participate/contribute to lunar self-sufficiency colonization studies in the NIAC Phase II effort and beyond

Task 1. Develop Basic Requirements

- Purpose to develop the basic architecture design requirements for the survival of an isolated group of humans on the lunar surface over an indefinite period of time that fully utilise lunar in situ resources and minimise the use of Earth-supplied materials/products.
- The study team, comprised of a broad range of experts, will meet at a requirements workshop June 22-23 in Madison.
- The requirements relating to implementation time frame, colony initial size and growth rate, basic groundrules, self-sufficiency categories and needs will all be defined by the Workshop.
- The Requirements Committee will be made up of: O'Handley, Rice, Duke, Järvstråt, Teeter, Gustafson, Lin, and Jordan.

Task 2. Define Minimum Earth Supply Requirements

- The purpose of this task is to estimate, based upon the data available on Lunar resources and the requirements for survival of the colony, the minimum Earth supply requirements for the initial and growing lunar colony

Task 3. Develop Examples of Lunar ISRU Production Activities and Products

- This task will involve the development of subsystem concepts that relate to required ISRU production and products needed by the colony (as defined by Task 1)
- Inputs from members of the project team will be obtained

Task 4. Define the Preliminary System Architecture

- This task will task the input from Tasks 1 through 3 and draft an initial system architecture concept for the lunar colony as a Phase I product

Task 5. Create Multidisciplinary Consortium

- Task will create a multi-disciplinary consortium or network of experts for developing a self-sufficient lunar colony
- Consortium or network will be created by compiling a directory of technical and business contacts at companies, universities, government agencies, and institutes from around the world that are willing to participate/contribute to lunar self-sufficiency colonization studies in the NIAC Phase II effort and beyond
- Compile a database of ongoing world-wide projects/activities that are relevant for lunar colonization
- Develop a contact data base that involves contacting various aerospace organizations, including: SSI, AIAA, NSI, AAS, Artemis Society International, and the Lunar Institute of Technology
- ORBITEC web page will be modified to capture electronic mail responses
- The organisation's members will be encouraged to donate their time and knowledge to the project

Progress to Date

- Developed an Agenda for the Requirements Workshop
- Contacted Potential Workshop Participants Over Phone
- Set Date and Organized Requirements Workshop for June 22-23, 2000, Madison WI
- Sent Out Workshop Invitations
- Communicated Project Goals to the Study Team
- Began Building a Contact Data Base
- Began Assessing Basic Requirements