

***Applications of Robotics for Moon missions:
ILE WG/ICEUM4 Recommendations for
Exploration and Utilisation of the Moon***

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ILEWG

INTERNATIONAL LUNAR EXPLORATION
WORKING GROUP

The Next Steps...

Apollo

SELENE

SMART-1

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ILEWG

- ILEWG International Lunar Exploration Working Group
- ILEWG History
 - Beatenberg International Conference 1994
 - Hamburg 1995 (ILEWG Charter)
 - Kyoto 1996
 - Moscow 1998
 - ESTEC July 2000 (ICEUM4)
- COSPAR Symposia
 - Washington 92, Hamburg 94, Nagoya 98, Warsaw July 2000
- EGS sessions on lunar exploration
 - Vienna 97, Nice 98, The Hague 99, Nice 25-29 April 2000

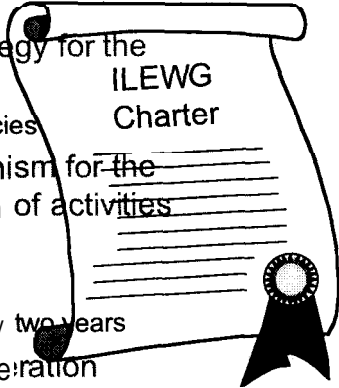
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Hamburg 1995

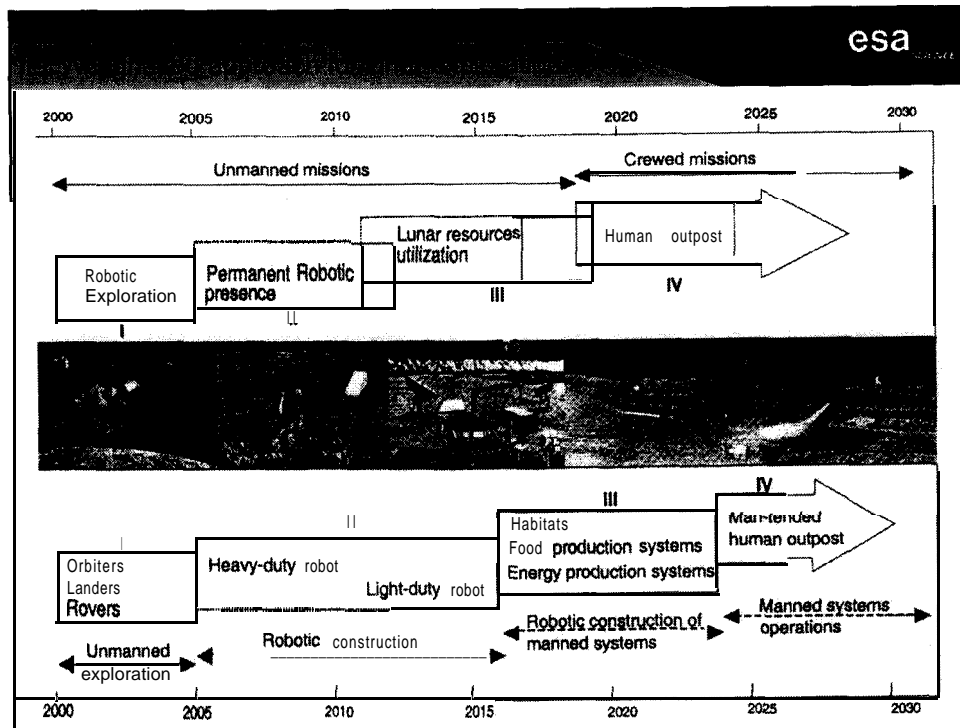
- To develop an International Strategy for the Exploration of the Moon
 - members appointed by space agencies
- To establish a forum and mechanism for the communication and co-ordination of activities
 - <http://ilewg.jsc.nasa.gov>
 - <http://www.estec.esa.nl/ilewg>
 - large lunar ILEWG conference every two years
- To implement international co-operation
 - yearly co-ordination and co-operation meetings
 - reports to COSPAR



ILEWG
Charter

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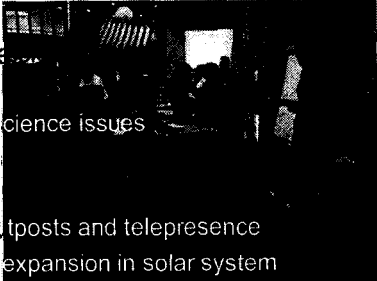
Exploration Missions

- Clementine US- BMDO **1994**
~ Multi-band Imaging, technology demonstration
- Lunar Prospector (NASA Discovery) **1998**
~ neutron, gamma ray low res mapping
- SMART-I ESA Technology Mission **2002**
~ Instrument technology, high res., geochemistry
- Lunar A J-ISAS Science **2003**
~ 2 Penetrators with seismometers + equator cameras
- SELENE-A **2004**
~ ambitious orbiter instruments for science

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ICEUM4 ESTEC 2000, July 10-14

- Young Lunar Explorers Special Session
- Science of, from and on the Moon
 - Clementine, Prospector, key science issues
- Technology activities /Future Missions
 - SMART-I, Lunar-A, SELENE
 - Moon as **testbed** for robotic outposts and telepresence
 - infrastructure, resources and expansion in solar system
- **Recommendations** and Space agencies plans
 - synergies with Mars and solar system exploration
 - new approaches and long term perspectives
- http://solarsystem.estec.esa.nl/Moon2000/ilewg.4_frame.htm
- <http://lunarexplorers.org/>



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ESA Lunar Exploration Studies

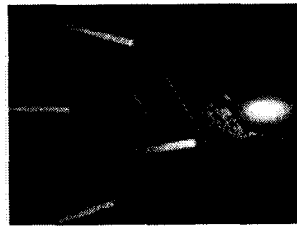
- ESA Lunar Study 1990-I 992
 - Report Mission to the Moon
- MORO Lunar Orbiter Study (science) 1994-I 996
- LEDA Lander Study (technology) 1992-1996
- ESA EUROMOON Study 1997-I 998
- LUNARSAT Educational study 1997-I 999
- SMART-I Technology mission 1998-2005
 - Solar Electric Propulsion to the Moon
 - launch end 2002, science opportunity
- Technology (Propulsion, Landing, Robotics, . . .)

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Missions under study

- Ice Breaker Moon Rover 2004
 - commercially sponsored lander/rover
- LUNARSAT 2006
 - educational mission by young lunar explorers
- SELENE B 2006
 - Soft Landing Technology Mission
- SELENE II 2008
 - Lunar Global Net/ Sample Return or Rover



Tools for Lunar Science

- Science of the Moon
 - Remote sensing miniaturised instruments
 - Surface geophysical and geochemistry package
 - Instrument deployment and robotic arm
 - Close mobility, nano-rover, sampling, drilling
 - Regional mobility: rover, navigation
- Science from the Moon
 - Autonomous robotic telescopes
 - Deployment of large telescopes (VLF, sub-mm/IR, vis.)
- Science on the Moon
 - Resource utilisation, outpost installation
 - Life sciences



Exploration

- Benefits from Science exploration
 - Origin and evolution of Earth Moon system
 - Comparative planetology from orbit & surface
 - New instruments
- Human and Social benefits
 - **Promotion of science and technology**
 - **Education**
 - **Commercial initiatives**
 - **Resource utilisation**
 - **Ecosystems on the Moon**
 - **Protection of lunar environment**

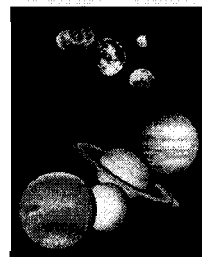


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Moon as step to solar system

- Moon as test bed for solar system exploration
- Moon-Mars science synergies
- Instrument technologies
- Robotic outposts
- Tele-presence, Virtual reality
- Deployment of large infrastructures
- Earth-Moon L1 libration point for transfer
- Coordination humans and robots
- Medical aspects
- Human expansion in solar system



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