MoonLab

A European Laboratory to prepare MOON BASE (and beyond)

Walter Pecorella

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Solidarietà e sviluppo

The ground for Moon Base: MoonLab

- To meet the challenges included in the US President "Vision for Space Exploration Program", the NASA Director Mike Griffin has confirmed the agency's commitment to pursuing the first objective:

  "Returning to the Moon, and this time to stay"

- Moon Base can be seen as the most ambitious human challenge, which includes all the technical and scientific items, even some not directly related to the space area.
- It will be necessary to act quickly to secure a strong position in these activities. This is the rationale of the Moon Base initiative promoted by Solidarietà e Sviluppo.
- These activities have been approved by the US Central Authorities, that financed the NASA with a first portion (more than 100 B$) of the necessary funds.
- NASA, in any case, must guarantee the access to the space for USA: the first task in the Moon Base Programme is the development of the new space transportation system.
- During the Moon Base Workshop in Washington, Mr. Griffin claimed clearly that NASA is open to collaborate with Italy in this enterprise.

Moon Base: goals

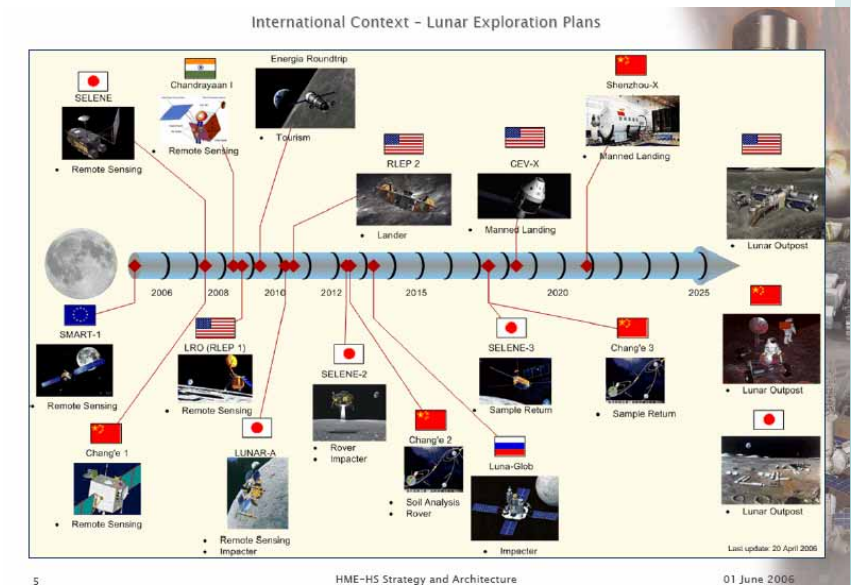
- Moon Base permanent inhabited for:
  - Scientific Issue (Astroparticles, astrophysics, biology, medicine, meteorology, etc.)
  - Energy Production: by sun (thermodynamic and photovoltaic), by nuclear plants
  - Logistic for space activities (propellant in situ production, satellite and rocket final assembly, etc.) and launch site for interplanetary missions
  - Mining on Moon (to use the in situ resources - ISRU)
  - .....
  - Preserve a technological leadership of ISS community countries in the high tech sector, particularly respect the emerging countries.

Moon Base - Impacts

- As a consequence of the US decisions, the other national or international Solar System exploration programmes (starting from Mars) are close to be outdated.
- Moon Base Programme has also to face some negative impacts, such as
  - costs
  - duration of the Programme, exceeding the normal political and economical cycles.
  - The willingness-to-pay must be maintained across the entire programme, i.e. across different offices of the legislatures/governments.
- In order to avoid the above negative impacts, it is necessary to have interim short and medium period results, that can be offered to the governments and the opinion makers to have a continuous support to the initiative.

Moon Base – Evolutionary Scenario

- Present applicable scenario sees:
  - USA fully committed in the Moon Base Programme,
  - China, Japan and Italy too,
  - the other players (EU, Russia, India, etc.) are now developing their policy.
- There is a window of 1-2 years in which Italy (and Europe) can act as a bridge and a “catalyser”:
  - Create a bilateral cooperation with USA
  - Invite the other players to join us in a preparatory programme
  - the negotiations of the rules for the exploitation of the Lunar resources



MoonLab Basic Assumptions

- Currently, none is able to offer a consolidated project, aimed to a permanent human presence on another planet.
- Space Technologies cannot meet all the requirements.
- The participation in the Moon Base Programme will face new technological challenges: a lot of new research and development activities are required, and need to be joined to the existing ones.
- We have to prepare ourselves to share resources and using the already gained experiences, coming from industries and research centres, public and private initiatives, different countries and international bodies.
- We need to link all the existing experiences, competencies, facilities in an unique network.
- We need a common place, a common lab, a new model of cooperation in which we can implement this approach: the MoonLab.

Why MoonLab

For these reasons, the development of a co-operative project leading us to the acquisition of qualifying technologies is of primary importance

MoonLab Mission

One way to acquire these technologies is based on the set-up of a network of Laboratories (MoonLab) where the definition of requirements, studies of the technical hypotheses, implementation of mathematical as well as experimental models, testing and developing experiments to be performed in orbit or on the Moon, will be realized.

MoonLab's mission is to help the industries and public/private research centres to respond the issues raised by the Moon Base Programme.

MoonLab Mission (cont'd)

We expect that MoonLab will lead to:

- Support Industries, Universities and Research Centres, by offering an equipped environment for their Research and Development activities;
- Involve the stakeholders
- Acquire the qualifying technologies necessaries for the Moon Base Programme;
- Allow companies and interested Public Institutions to add competences and abilities, to evolve into a single integrated system;
- Bind the Moon Base activities to the territory, where the acquired experiences could be redirected to new Moon Base applications;
- Manage the spin-off of this Programme and maximising the advantage in the competitiveness of the national industrial system;
- Forward the development of new companies linked to Moon Base, both spin-in or spin-off of the Programme.

Requirement/Needs: Development of Enabling Technologies

- The participation in the Moon Base Programme will face new technological challenges: a lot of R&D activities are required.
- To guarantee a significant role in the Moon Base Programme it is of utmost importance the investment in new resources to study the Lunar problems.

For these reasons, it is of primary importance to develop a project that allows for the acquisition of qualifying technologies.

Requirement/Needs: Internationalisation

- The exploration of the Solar System, first of all the Moon, must be realised in an international contest, both for the dimension of the initiative and for avoiding conflicts about the “property of the moon”.
  - We need to realize the Moon Base Program in the frame of a ***soft competition***.
- *We define as **soft** that kind of competition which is not a self reliance social strategy, but a means to pursue efficiency and efficacy in a dynamic and social context.*

Generally speaking, we want to refer to the “etymologic” sense of the word “cum-petere”, which means “to research together”, being competition, in this view, an instrument for societal wellbeing and not a scope/value for the society.

Requirement/Needs: Critical Mass

- Put together all the resources, both public or private existing in order to create a solid basis for a manned exploration programme.
- Allowing companies and interested Public Institutions to merge competences and abilities, to evolve into a single integrated system;
- Supporting the Industries, Universities and Research Centres, by offering an equipped environment for their Research and Development activities;
- Allowing the consolidation of the knowledge in a real European stock, by means the development of common standards, tools and infrastructure as ISS lesson learned.

Requirement/Needs: Sustainability vs Stakeholders

- For the entire Europe, it is necessary to recover the efforts realized for the previous organization of the Solar System exploration programme.
- All the above statements set a base requirement: prudence in the development of the (already started!) International Moon Base Programme.
- Therefore flexibility for a real efficency:
  - clear and effective sustainability of the programme
  - well defined and just in time actions and enlargements
  - joint and shared aims
- In any case, the creation of the willingness-to-pay must guide the entire effort. Only under this condition, Italy (and Europe) can participate, and gain a leading role in the design and development of the Moon Base Programme.

Requirement/Needs: Politics

- The International cooperation has to grow “Step by Step”, according to the main rules:
  - “First come first served”: we have to guarantee some privileges to the beginners, being the first.
  - “The Moon smiles to everyone”: we have to guarantee to every country the opportunity to take part at the programme, even in future.
- MoonLab has to dialogue with local authorities, offering them the link of Moon Base activities with the territory, both:
  - Redirecting the acquired local experiences to new applications for Moon Base;
  - Introducing local companies/research institutes into the network, and consequently into the Moon Base Programme.

Requirement/Needs: Spin-off Management

- We define ***technological shift*** any technological improvement or advancement, in different productive sectors, as characterized by a *"fuzzy-type" overlapping* between basic, intermediate and product technology. We expect from Moon Base Project the production of a technological shift.
- This allows to realize a number of on earth application developed at marginal cost. It represents an opportunity to gain a competitive advantage for the countries involved in Moon Base project.
- This means managing the spin-off of this Programme and maximising the advantage in the competitiveness of the national industrial system.

Requirement/Needs: Operative Structure

- NASA includes many operative centres (Goddard, JPL, AMES RC, NIAC, etc.) having a partial autonomy. For the definition of the Moon Base Programme, NASA has heavily used the results of the activities, already embedded in these centres.
- The US industries work in the same centres, facing directly, in this way, the problems related to the exploration programme, and thus acquiring a competitive advantage.
- ESA, and the major part of the European national space agencies (ASI too), doesn't operate in the framework of US model.
- Thus, as Europe:
  - we cannot exploit the competitive advantages associated to this model.
  - most of all, we cannot present a proper counterpart to the US players which are preparing the Moon Base Programme.

Requirement/Needs: EU/ESA Rules

- In Europe, EU and ESA represent two different international bodies, with different treaties, members, rules (internal and external), methodologies, and, sometimes, overlapping objectives.
- Moon Base needs a common action in Europe: MoonLab is the operative instrument to realize such a common strategy, taking into account both EU and ESA positions.
- MoonLab government rules, can be identified in the fully compliance of the ESA, UE, and national regulations and standards.
- The same situation will occur with respect to the local authorities and national agencies and/or space institutions.
- MoonLab has to apply the management rules in accordance with ESA standards.

Requirement/Needs: Financing Rules

- It is hard to believe that the programme for the exploration (of the Moon, at first, and then for the Solar System) will be financed only by the space agencies.
- Other financing subjects could be:
  - European Union
  - Local authorities
  - Private investors
- Currently ESA and the national space agencies don't have an institutional instrument that can negotiate financing for the exploration programme, with such subjects
- Consequently, ESA needs to verify the possibility to establish a proper instrument.

Requirements/Needs: Legal Aspects

- Private investments require possibility of economic return with acceptable levels of risk.
- This implies the negotiations of the rules for the exploitation of the Lunar resources in the framework of the existing international treaties.
- Identified Structures for Private Investment on the Moon are essentially based on the following considerations:
  - No specific legal arrangements in place
  - Initial need for joint undertaking with regard to key infrastructure to avoid prohibitive expense

MoonLab – a CERN-like approach

- CERN represents one of the successful experience for Europe about the international competition. The CERN model, a network of national institutes and labs, with a physical centre hosting the largest and the most important facilities, allows:
  - The development of a common and shared knowledge, methods, standards, tools;
  - The development of enabling technologies and technological transfer.
  - The development of a common sense of ownership both to the project and to the network;
  - The integration among different industries in order to realize larger industrial co-operations.
- Warnings:
  - Moon Base, and the Solar System exploration programme in general, implies many technologies and production chains.
  - CERN was grounded 50 years ago.
  - CERN is leaded by scientists.

MoonLab architecture

- MoonLab has been thought as a physical network of laboratories, research centres, and industries operating (or possibly interested in operating) in the aerospace sector. Each one represents a point of the network.
- Such points share their own facilities, expertises and proficiencies with the others.
- MoonLab is organized in different thematic sub-networks (for instance Mission Support, Life Support, Applications, etc.).
- Each sub-network include a main centre, primary node of the sub-network, where the most important facilities are (the existent ones) or will be (the new ones) located.
- Each primary node act as manager and collection point of knowledge for the relative sub-network.

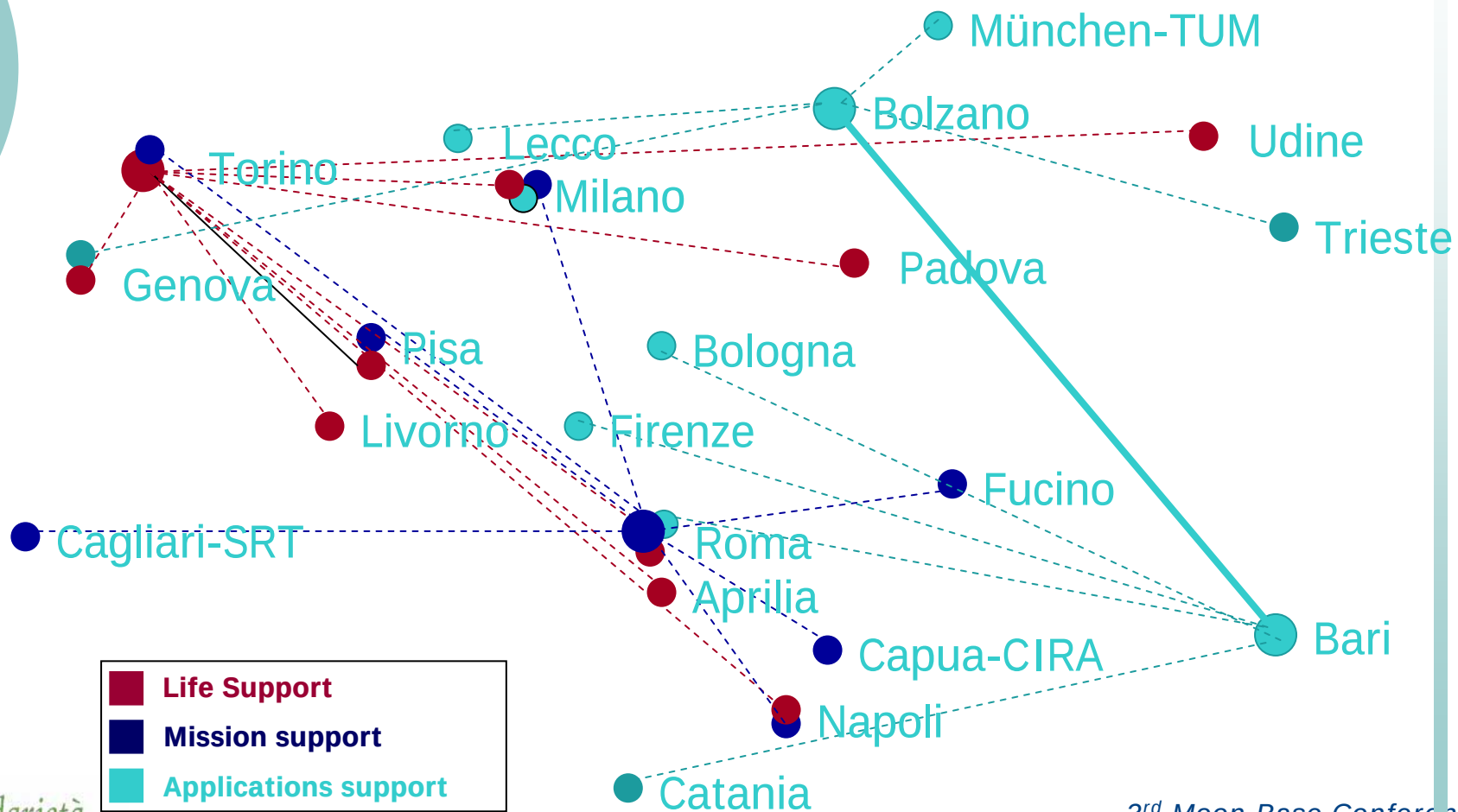
MoonLab: enlargement rules

- A new network can be generated when an item included in an existing network assumes a relevant role;
- The node in charge for the item inside the upper level network will be the centre of the new thematic sub-network.
- When the item is well known and its relevance is decreased, the sub-network is closed but the knowledge still remains at level of node of the upper level network, just like the beginning.

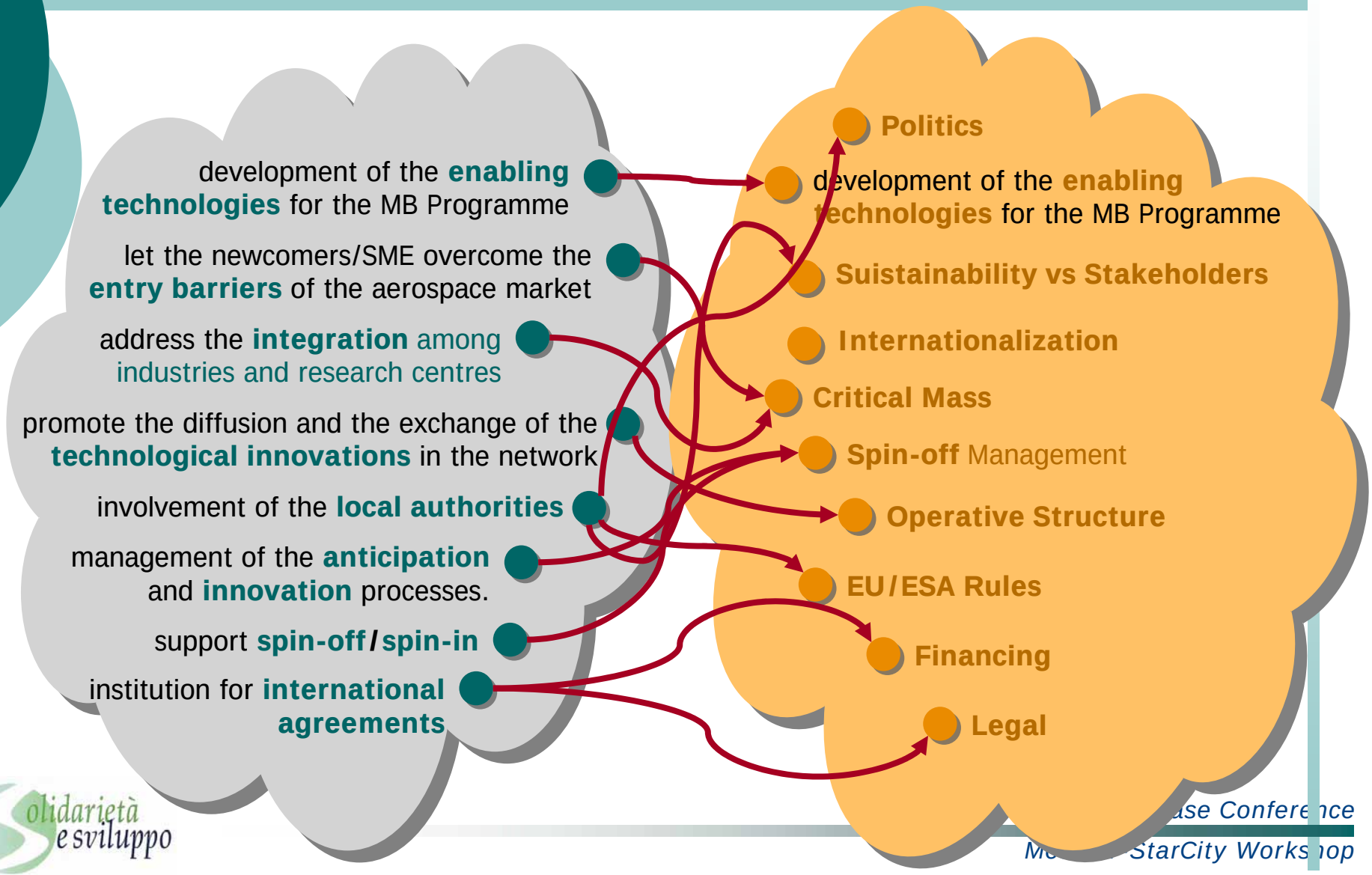
We call this rule as “blossoming” mechanism.

- In this way, MoonLab offers always an opportunity to everyone to join the Moon Base Program, but, at the same time, guarantees the rights of who has started first.

Italian MoonLab: Network



Italian MoonLab vs Requirements



Italian MoonLab: Internationalisation