Paper Session II-A - Space Transportation At The Turning Of A Century (Ariane Space Experience)

Roger Solari
Director Of Operations Delegate Head Of Arianespace Kourou

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When Europe decided in 1973 to enter a new launch vehicle development on the hot ashes of the fate Europa programme, a few would have bet a penny on the success of this new attempt.

On a 1979 Christmas night, the first flight success was a delightful gift to the teams fully committed to this challenge. Later on the demonstrated qualities of the product, the reactivity of the commercial service and the circumstances enable ARIANE to enter the commercial market and to establish a recognized position.

In this sheet presentation, at the time where things are moving fast in the space transportation area, I would like to emphasize on some topics relevant to the space business with an illustration based upon the ARIANE experience. Let us pass through:

- a quick look to the market evolution which gives the impulse to the operational systems
- the space transport competition in terms of launch systems
- the European answer with the ARIANE 4 and 5 launch systems, their evolution and the way there are produced and operated.

Space transportation covered all the application through Science, Defense and commercial activities.
If the scientific and the Defense programme are directly attached to the will of the Government to assigned dedicated budget to space, human adventure and security, the commercial business is directly attached to the market evolution specifically in the range of the telecommunication and the multimedia services.

There is a direct link in between this market evolution and the system due to deliver the service and it is interesting to pass through some characteristics able to influence the launch systems and their evolutions. In the years to come, (1997 - 2006), our assessment can be translated as follow:

**about mission**
the geostationnary transfer orbit could represent 63% of the turn over with 55% of the mass and 28% of the S/C to be launched.
The requirement in the scientific environment and on the polar orbit should be rather stable.

The constellation are going to be the strong new commercial requirement with
a first generation on the way (i.e IRIDIUM experience...)
a second generation with bigger spacecraft and higher orbits.

About spacecraft evolution:
in the range of the telecom mass is going to increase.
The main projects currently running are a good clue:
HUGHES 601/702 = 5 200/5 600 kg ; LORAL Lafayette 5 000 kg
AEROSPATIALE SB 3 000 : 5 500 kg ; MATRA MARCONI SPACE EUROSTAR 3 000 : 5 500 kg

The sharing in between spacecraft category will be moving: S/C with range of 1 700 kg to
2 700 kg should decrease from 20 to 15 % of the total amount; S/C from 2 700 to 3 700 should
drop down from 60 % to 50 %, 55 % an big platforms should raised from 15 to
30 % of the record.
Electroplasmic propulsion should give more payload capacity even if classic apogee with motor
have still a great future.
S/C production time should be reduced and brought down to less than two years bringing the
launch vehicle production reactivity in the same way in order to be ready at any time to be a
quick request for proposal answer.

Among the main impacts of the market evolution, on the launch vehicles characteristics, we can
point out:
- higher performances in term of mass and flexibility
- complementary launch systems able to cope with a high launch rate, big mass
  spacecraft, a multiple launch capacity for constellation multiple orbital planes
  requirements, constellations orbital maintenance...
- improved maneuverable upper stages in order to face the in orbit injection diversity
- and for sure lower cost to orbit.

In this schematic of the market, what is going to be the launch inventory at the turning of the
century.
We can first give a look to the main launch systems able to cope with all the market aspects. The
picture (here attached) summarize all the main expendable launch system able to face the market.
There are numerous, some are still on the paper or under development but it is sure that
with such an inventory, there could be no place for everybody in the years to come thus giving
way to a strong competition where, quality of the launch service, reliability of the systems,
reactivity, flexibility and cost will be among the main parameters able to determine the customer
choice and the survivability of the systems involved.

The European answers is based right now upon the dual services ARIANE 4 and ARIANE 5 with
an evolution toward a single launch capacity build around the ARIANE 5 launch vehicle and it’s
high evolution capacity with eventually a smaller complementary launch vehicle depending
upon the market evolution.
For the time being, ARIANE 4 and ARIANE 5 are an attractive duo!

The Kourou Range is a strong trump in the European inventory. It has been chosen at the very beginning of the sixties when France withdrew its launch facilities from HAMAGUIR in SAHARA. A lot of advantages were offered by the equatorial French Guiana environment. Geographical, meteorological and operational advantages where attached to this choice: wide azimuth capacity, better equatorial orbit accuracy, better performances in geostationnary transfer orbit.

A quick survey of its history shows the constant increase in capacity. From the first sounding VERONIQUE rockets in 1968 to the ARIANE 5 502 flight end of October 1997, a wide range of experience has been booked.

Technically speaking, a large improvement programme was initiated five years ago. A lot of facilities have been improved:

- a new Control Center,
- a new computation and localization system
- an improved meteorological system
- an enhanced payload preparation complex
- a new transmission system based upon a wide optical fibers network.

The different pictures presented give a rapid survey of this high reliable spaceport.

Let’s now give a look to the launch vehicles themselves.

The different drawings attached, give the main characteristics of the ARIANE launch vehicles, the launch facilities and the way the system are operated.

About the industrial organization, a picture attached shows whom is directly involved in Europe in the ARIANE production line. Beyond the prime contractors more than 500 industrials spread out among Europe provide their skillfulness to those programme. ARIANESPACE manage the production and there is a full continuity in Europe in between the development phase in the hand of the European Space Agency and the exploitation phase entrusted to ARIANESPACE. The picture attached shows the relationship and the responsibilities sharing in between ESA, CNES (French Space Agency) and ARIANESPACE in the field of the launch systems development and exploitation process.

A big effort was produced by the industry those last four years (see picture attached). The figures presented give a good estimating of the results achieved.

Beside the industrial organization, the way the system is operated is also a source of efficiency and cost reduction.

The ARIANE launch production organization is fully within the hand of the ARIANESPACE management. I would emphasized on two topics: the operations and planification management process that keep within the hand of a single manager all the aspect of the operational produc-
tion line (see chart attached) and the low staff involved in the launch vehicle and ground activi-
ties. This has been achieved by the way of an optimized industrial organization on the range
where full synergy of the human resources have been the leading trump toward the low produc-
tion cost permanent objective (see chart attached).

In 1997, twelve launches where achieved, a good year for ARIANE. Among those flight, the
second ARIANE 5 launch was a success full of fruitful teachings. This new launch vehicle
demonstrated a strong capacity and a high potential of evolution. We are now on the way and
decision have been taken in order to improve the performances and the flexibility of the Euro-
pean launch tool for the 21st Century. (see chart attached).

In conclusion, Space Transportation is moving fast at the turning point of the 21st Century. Eu-
rope proceeds with the ARIANE adventure. ARIANE 5 and the Kourou Launch Site are two
trumps to enable ARIANESPACE to face the market and to try to keep it’s recognized position.
We will do our best in a large strong and fair competition. The stake are high and there is still
place for efforts, imagination and audacity to stay among the best ; we will do our best to con-
tinuously improve the launch service.