PART I

Chapter 3

Principal Actors in the Space Economy

The space economy includes many different types of public and private actors. This chapter answers the following questions: Who are the key actors involved in space activities and how to obtain information on them? What are the value chains in the space economy?

Actors by organisational structure

There are many different types of actors involved in the space economy and it is often challenging to assess their size and activities. They include: public actors, higher education actors, large industrial groups, but also small and medium enterprises.

Public actors

Governmental bodies play a key role in the space economy as developers, investors, owners, operators, regulators and customers for much of the space infrastructure. As in the case of terrestrial large infrastructure systems (*e.g.* water, energy), government involvement is key to sustaining the overall space economy and to dealing with strategic implications of such complex systems (OECD, 2009).

Space research and development (R&D) in particular is conducted by a myriad of different public actors (*e.g.* space agency, technology centre) and they are not always easily identifiable. The international classification of actors involved in R&D, as described in the *Frascati Manual*, is often used to gather comparable data concerning the R&D activities of governments.

According to the *Frascati Manual* (OECD, 2002), government actors involved in R&D include:

- "All departments, offices and other bodies which furnish, but normally do not sell to the community, those common services, other than higher education, which cannot otherwise be conveniently and economically provided, as well as those that administer the state and the economic and social policy of the community.
- Non-profit institutions (NPIs) controlled and mainly financed by government, but not administered by the higher education sector."
- Public enterprises or partially public enterprises, which are often quite active in the space sector, are included in the "business enterprise" categories.

When looking at other governmental actors involved, particularly as customers for products and services (*e.g.* municipality buying products based on satellite imagery), a classification of these bodies can be used. The government sector's legal entities are usually classified into three categories according to the level of government involved: central and federal government

units; provincial and state government units; and local and municipal government units.

Higher education actors (research institutes)

Many universities, laboratories, and research institutions play a key role in space research and development in both OECD and non-OECD countries. They may act as contractors to space agencies and industries, but they constitute a particular source of innovation for the sector (*e.g.* basic research, patenting).

Again according to the *Frascati Manual* definitions, higher education actors include:

- All universities, colleges of technology and other institutions of post-secondary education, whatever their source of finance or legal status.
- It also includes all research institutes, experimental stations and clinics operating under the direct control of or administered by or associated with higher education institutions. The private units of the higher education sector, such as private universities, are included if they are officially recognised by the state.

Business enterprises

Most countries have national statistical business registers, built on administrative and statistical sources (*e.g.* surveys, tax registers). These registers serve as the primary and preferred source of information for business demography statistics (OECD, 2007). One challenge is that the comprehensiveness of these registers varies across countries and time, and the level of detailed information on companies' activities may be limited.

The industrial statistical classifications issue is one major stumbling block when looking for data on enterprises involved in space activities. The industry codes used nationally (as mentioned in Chapter 2) usually give indications about actors involved in the aerospace sector, but even this type of information may be limited. National statistical offices (NSOs) also conduct census on specific sectors from time to time to have a better idea of the businesses involved, but the cost of running a regular census makes this approach unrealistic for most countries with a small aerospace sector.

One other issue relates to the definition of a "space company". Very often enterprises involved in the manufacturing of satellites, launchers or subsystems, and even in space-related services are involved in other economic sectors, and may derive only a small part of their revenues from space activities. An open issue is to decide which revenue threshold a company should reach to be considered a mainly space company. Many industry associations struggle with this problem, and Eurospace has found an

elegant methodology when compiling data from its annual survey of the European space industry (Eurospace, 2011). It measures consolidated sales at company level, but also takes into account intermediate sales throughout the value-chain when possible, thus avoiding some possible double-counting. The Canadian Space Agency's survey questionnaire asks companies to report their revenues on two levels, company-wide and space sector's revenues, so it is possible to identify trends over time in growth and downturns directly related to the space sector's activities (CSA, 2011). Concerning NSOs, a few, like the French INSEE for example, integrate specific questions in their aerospace-sector industrial surveys to try and track specifically space-related revenues, so that companies provide a level of detail on their would-be aeronautics, defense and space activities (INSEE, 2009).

As the space economy increasingly includes players that may be included in the ICT sector rather than the aerospace or defense sectors, correctly scoping all the actors is a key issue. Industry mapping could be an important avenue for progress, which would have the objective of better tracking current developers and users of space-related products and services.

Concerning businesses involved in space activities, large aerospace and defense groups tend to be the main actors, many of them being active along entire value chains in space manufacturing and services. Smaller actors are active in specific segments (*e.g.* components, subsystems, equipment, services). Notwithstanding the main mergers of the 1990s and 2000s, an interesting ongoing trend is the emergence of small actors competing in the same market segments as the large groups (*e.g.* OHB in Germany). The small and medium-sized enterprise sector accounts for 99% of firms in the OECD area, and 50%-75% of value added across these countries (OECD, 2010). Although SMEs are quite numerous in services, it is thought that they play a rather small role in space manufacturing. For example in Europe, 77% of space manufacturing employment is thought to be in large groups (Eurospace, 2011). The *Eurostat-OECD Manual on Business Demography Statistics* provides guidelines for the compilation of business demography indicators (OECD, 2007).

Actors by value chain

As noted in OECD (2005), countries with space programmes have generally adopted a broad institutional model for conducting their space-related activities. This generic model involves three general sets of actors: *i)* public agencies that focus on space R&D and science, typically space agencies providing contracts to industry, universities and laboratories; *ii)* public and/or private organisations responsible for the upstream segment of the space industry (*i.e.* spacecraft and launcher manufacturers, providers of launching services); and *iii)* public agencies and/or private actors responsible

for the operations of space systems and the development of downstream applications. As noted by the UK Department for Business Innovation and Skills (2010), those actors are part of a long and complex value-added chain comprising two main inter-related sectors:

- The upstream sector includes manufacturers of space hardware and providers of services that enable the launch of systems into space. This comprises prime companies and systems integrators for space and ground equipment, which in turn build on the contributions of subsystem and component suppliers.
- The downstream sector includes operators of satellites and providers of space-enabled products and services. These range from products and services which can only be delivered through space to those which compete with or complement other forms of enabling infrastructures and/or services. Space-related services use a specific satellite capacity, such as bandwidth or imagery, as inputs to provide a more global service to business, government or retail consumers.

Downstream services are as diverse as there are space applications. The services are traditionally divided into three large application domains: telecommunications, Earth observation (also called remote sensing) and navigation. Value chains often involve public agencies as investors and final users. As such, public authorities remain significant customers even in well-established commercial markets, such as telecommunications. In the following example for telecommunications, many companies are active in different segments of the value chain (see Table 3.1).

The value chain starts with the initial R&D, followed by the satellite and launcher systems manufacturing, the actual launch, ensuing satellite management and operations, with the provision of the actual services to the end-customer (*e.g.* broadcast, communications signals). Orders of magnitude in terms of revenues for the diverse actors of the value chain are provided in Table 3.2. The costs of an end-to-end satellite system, based on a commercial geostationary satellite built in North America or Europe (around USD 450 million in total) can be divided as follows between the different main segments:

- Satellite in orbit: 56%.
- Satellite system: 28% (around USD 80-100 million, divided between the system integration tasks 20%, the platform 45%, the payload 35%).
- Launch services: 22%.
- Insurance: 6%.
- Ground segment: 44% (around USD 200 million – user ground segment, mission control centre, satellite control centre) (ITU, 2010).

The same general format (from R&D to service provisioning) applies to other sectors (satellite imagery, navigation and positioning), although with important

Table 3.1. **Actors in satellite telecommunications**

Activity	Description	Selected actors
Satellite operators	A satellite operator finances a satellite's construction and its launch. Each satellite has transponders designed to cover a specific geographic region, or "footprint", thus helping the operator address specific customer markets. The operator then leases transponder capacity to customers, such as service providers, television broadcasters, corporations and governments.	SES, Eutelsat, Intelsat, Inmarsat, Orbcomm, Chinasat Globalstar, Telespazio, Telesat
Ground station equipment providers	The ground equipment, including hubs and Very Small Aperture Terminals (VSATs), is manufactured and supplied by the equipment providers.	MDA, Gilat network Systems, Hugues, iDirect, Thales Alenia Space, AAE Systems Inc., ViaSat, Advantech Satellite Networks, Cerona Networks, Comtech EF Data, NanoTronix, PolarSat, Newtec, ND SatCom, SatPath, Shiron Satellite Communications, STM Group, TSAT, EMS Aviation, International Datacasting Corporation (IDC), SED Systems
Service providers	These are typically either telephony or broadband internet companies who lease capacity from satellite operators, buy equipment from the ground station equipment providers, install and maintain the resulting network and sell full package communication services to the end user.	Spacenet Inc., Spacenet Rural Communications, Stratos Global, Barrett (rural broadband)
Customers	Customers are the organisations and individuals utilising the equipment and satellite communication services. Very large customers, primarily governmental agencies and international companies, sometimes act as their own Service Providers, operating their own ground station equipment. Smaller organizations, including Small & Medium size Enterprises (SME) and Small Offices/Home Offices (SOHOs) work with service providers rather than managing their own infrastructures. Consumers, whether using a telephone, ATM or computer in a rural area might not even know that satellites are providing the network connection.	Governmental agencies, companies active in diverse economic sectors, individual consumers

Source: Adapted from Comsys (2010), Annual VSAT Report, 11th edition, Report prepared by Simon Bull, Comsys, London, January and Gilat (2011), Satellites' Basics, www.gilat.com [Accessed January].

differences in the prevalence of actors involved and in the revenue streams (*e.g.* more governmental agencies as initial R&D funders and final customers).

As the space sector has been spurring more commercial activities outside its traditional science and R&D scope over the years, trying to better identify statistically the different space applications and downstream services has become an important theme. Activities include specific information technology products and services, such as GPS receivers, satellite television

Table 3.2. **An example of the space sector's value chain for satellite telecommunications**

Activity	Description	Selected actors[1]	ISIC Codes	Estimates of EBIT margins[2]
Space systems manufacturing	• Study and design of the mission • Satellite, ground and launch manufacturing • Assembling, integration • Testing • End-to-end systems delivery (satellite, ground, launch service and insurance) • Satellite in-orbit testing • Telemetry, tracking, command and monitoring	Thales Alenia Space, Orbital, Northrop Grunman, OHB technology, EADS, Loral Space & Communications, Lockheed Martin, Ball, RKK Energia	3030	2%-8%
Launch	• Launch system manufacturing • Launch system management (and sale when applicable) • System integration (satellites and launchers)	Lockheed Martin, EADS, RKK Energia, Arianespace, ISRO	3030 5120	1%-6%
Fleet management and operations	• Satellite fleet management and control • Uplink and downlink • Capacity provisioning • End-to-end services	SES, Eutelsat, Intelsat, Inmarsat, Orbcomm, Chinasat Globalstar, Telespazio	6130 6190	30%-40%
Service provisioning	• Service packaging and development • Marketing and sales • Distribution and management of retail channels	Spacenet Inc., Embratel	6190	From negative to 15%

1. Many actors can be active on multiple segments.
2. EBIT: Earnings before interest and taxes (when applicable).

Source: Adapted from Thales Alenia Space (2010).

and even investments in new tourism-related activities (*e.g.* space-related amusement parks, suborbital flights).

Satellite communications have reached maturity in terms of user base. As shown in Table 3.3, users of data networks using satellites (Very small aperture terminal – VSATs) for example include various government departments and agencies, but also banks, insurance companies, general stores, supermarkets, car dealerships, lottery systems, healthcare companies, manufacturers, hotel electrical utilities, oil and gas pipelines, energy production and exploration, timber companies, plantations, maritime shipping fleets to name but a few. This allows a first identification of actual users of space applications, and many market studies focus on this aspect (more indicators of the satellite telecommunications sector are provided in Part 2 of the *Handbook*).

Finally, as already mentioned by OECD (2005), the integration of technologies, thanks to advances in computing power as well as miniaturisation, is both an opportunity and a challenge for developers of space applications. This is also a challenge for trying to statistically map the many new downstream applications. As an example, the markets for broadcasting are undergoing

Table 3.3. **Examples of users of VSAT systems, with system vendors and services operators (2008)**

User	Country	Industry sector	Sites in service	User since	System vendor	Operator
Camelot/GTECH	UK	Lottery	27 000	2007	Hughes	HNS Europe
US Postal Service	US	Post Office	10 400	1998	Gilat	Spacenet
BP/Amoco	US	Gas/Convenience	5 800	1994	Hughes	HNS
Venezuelan Govt Elections	Venezuela	Government	5 000	2004	Gilat	Spacenet RC
Enterprise Rent-a-car	US	Car Rental	4 648	1998	Hughes	Dedicated
National Stock Exchange	India	Financial	3 500	1994	Gilat	Dedicated
Best Western	US	Hospitality	2 383	1995	Hughes	HNS
Shenzhen Securities	China	Financial	2 230	1993	ViaSat	Dedicated
Bombay Stock Exchange	India	Financial	2 000	1997	Hughes	Dedicated
Wendy's Restaurants	US	Restaurant	1 870	2001	Hughes	Hughes
Hollywood Video	US	Retail	1 750	1998	Gilat	Spacenet
Central Bank of Iran	Iran	Banking	1 450	1993	Hughes	ISC
Hungarian State Lottery (SRT)	Hungary	Gaming	1 400	1993	Tridom	GTS
FONCOS	Mexico	Rural	1 100	2005	Hughes	Telmex
Spanish Post Office (OACT)	Spain	Post Office	785	1994	NEC	Telefónica
Shoppers Drug Mart	Canada	Retail	745	1995	ViaSat	Dedicated
Safeway/Argyll	UK	Retail	670	1994	ViaSat	BT
DZ Bank	Germany	Banking	630	2001	Gilat	Satlynx
Farmacias Similares	Mexico	Retail	520	2006	iDirect	Elara
Banco do Brasil	Brazil	Banking	500	1993	Gilat	Embratel

Source: Adapted from Comsys (2010), *Annual VSAT Report, 11th edition*, Report prepared by Simon Bull, Comsys, London, January.

constant change (OECD, 2008). In many countries, the switchover from analogue to digital broadcasting has accelerated, and customers are now able to receive audio-visual content through a number of different networks (satellite, cable, terrestrial, UMTS, IPTV, DVB-H) on a variety of devices (including PCs, mobile telephones and other portable devices). "The convergence of telecommunications and broadcasting, made possible by digitalisation, has resulted in a number of commercial offers of which the triple- (or multiple-) play strategies of telecommunications and cable companies are among the most prominent. This has impacts on how to best determine which technologies are involved."

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