INNOVATION AND ITS DIFFUSION AMONG REGIONS: THE AERONAUTICAL SECTOR

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Economic pressure on industrial activity leads firms to face two economic problems: Uncertainty and Cost. Cost is endogenous and partially controllable. Uncertainty is exogenous and highly uncontrollable. The response of the economic system has been the creation of knowledge, both for society, by creating institutions, and for individuals and firms, by creating innovation.

Specifically, the entrepreneurial universe (large firms and SMEs) will respond to uncertainty and cost in two distinct ways. Large, mainly oligopolistic, firms performing in high technology sectors respond by routinizing innovation. SMEs, mainly price takers, by spontaneously creating clusters which facilitate access to available standard technology. Hence, the production of innovation arises from competing agents within the system and is key to large firms and SMEs.

Due to the high costs involved in routine innovation, recurring year after year, firms must charge a p>mc if they want to recuperate the investment in R&D. The need to charge a p>mc is essential for this firms since the appropriability rate of income

generated by innovation is temporary. That is, innovation is largely a public good in that the exclusion of third parties is difficult and the retention of income is fleeting.

Cluster technology guarantees that no firm will be excluded from existing technology. The reason is that the appropriability rate is maximal in the interior of the Cluster, so any innovation flow will be shared by all the firms.

If the diffusion of innovation is maximal in the Cluster the incentive to innovate should be minimal. If everybody will have access to innovation, why make the effort?. Clusters made up of price taker SMEs operating in very competitive markets cannot generate routine R&D processes. If p= mc, the price will only cover the variable costs of the last unit produced and, therefore, it can not recoup any sunk costs such as investment in R+D.

All the same, Cluster technology reduces total costs of participating firms in several ways: First, Industrial specialization, i.e. reducing the manufacturing process of a complex good to homogeneous subprocesses, provides opportunities to obtain scale and scope economies. Second, since Clusters are composed of many SMEs, the persistent problems of management (information and control), that are the main source of increasing variable costs in large firms, are avoided.

Third, mutual knowledge existing among firms provides fast, true, transparent and very useful information thus reducing transaction cost and generating collaboration (whether desired or not). Fourth, the multitude of participating firms results in decreased entrepreneurial risk and reduced probability of failure.

¿How can Clusters have access to innovation? In general, Clusters adopt and adapt ideas created elsewhere. As explained, SMEs do not have the capability of investing in permanent innovation departments. They may take on discreet innovation projects - and many do so - but not routinely nor continually. Therefore, the technological transfer rate between the large innovation-producing firms and the innovation-receiving SMEs should be determined.

Aeronautical Sector

The aeronautical sector is characterized by three main aspects: 1) a trajectory lying very close to the state, although recently somewhat closer to the market, although oligopolistic; 2) high technological and organizational complexity of participating firms; and 3) a dual local - global geographic projection. This is the profile of the Spanish sector and, most likely, of the European sector as well.

Industrial organization has been transformed in the sector from production units with an arsenal mentality, where in-house production prevailed, to increasing processes of externalization (outsourcing, spin offs, internationalization) over the last 25 years. This process is attributable to increasing financial needs involved in the launching of a new aircraft, greater technical complexity required by external technological partners and the need to control costs.

The oligopolistic nature of the sector is obvious, and so is competition in innovation. Finance, technology, size, security and quality levels in production processes are barriers to entry and explains why economic literature considers the aeronautical sector a canon of industrial complexity.

Financial needs have motivated explicit state support, usually in the form of reimbursable credits for R&D investment, as well as well as the need to share risk in future industrial products through alliances with other large technological firms either in the same geographical area or in the international scenario.

The process of internationalization is presently consolidated as shown in an analysis of the EADs/Airbus case which has assembly plants in at least four countries and collaborating firms in many other geographical locations. Moreover, competition among the various factories and plants for work load is ferocious; a structural factor of the industrial strategy of the firm. Increasing outsourcing has the disadvantage of a significant increase in governance problems and transaction costs.

The model of innovation and diffusion in the aeronautical sector shows a hybrid structure made up, on the one hand, of those firms of an oligopolistic nature that produce innovation and those that use (adopt and adapt) it. The entire model forms an industrial ensemble of a pyramidal nature at the service of the final product. The architecture is closed within the model, but can be opened to foreign markets through internationalization of the final producer and its network of global collaboration.

Innovation in the sector flows horizontally among the final producers (EADS/Airbus' innovation centers and those of the eight or ten large multinational firms) who jointly create innovation with the ultimate goal of building a new aircraft or improving an existing model. The interaction among Airbus, the large firms in the sector and, to a lesser degree, the SMEs has brought about the figure of "innovation nodes" in the regions where AEDS/Airbus production units are located.

Innovation Nodes interact among themselves from one R&D department to another through the Centers of Concurrent Engineering (C.E.C.s), the Research Centers created by the firm in Hamburg, Toulouse and Getafe, with joint participation of innovation departments in first level firms. Of course, the creation and transmission of information through the nodes would have been impossible without Information Technology (I. T.).

At the same time, innovation in the sector flows vertically from the innovation nodes of the final producer and first level firms, toward the multitude of firms articulated in Clusters. For SMEs, there are entry barriers that can only be surpassed with the compliance of large firms which predetermine an asymmetrical contractual relationship.

The lower the technological capability of the SME, the greater the sacrifice it must make in the industrial margins of its products and the greater the organic and technological dependence. Contrarily, the higher the level on the quality ladder, the greater the possibility that the SME may receive, and eventually generate, tasks of greater technological content and, therefore, the greater the possibility of escaping from the p= mc norm.

This hybrid model, with its innovation nodes, is based on two spatial realities. On the one hand, the final producers, many of the large multinational firms and the SMEs in grouped clusters tend to locate in a given territory near other agents active in the sector (professional associations, research centers, public authorities, etc.) forming the **local** component of the sector. On the other hand, the search for financial and technological support, clients and better production costs have opened an inevitable process of internationalization which profiles the **global** nature of the sector.

The most appropriate policies will guarantee a continual flow of new innovations toward the SMEs in the sector. That is, given the existence of innovation gaps among the various groups of firms in the sector, policy should focus on minimizing the time involved in adopting and adapting innovation on the part of SMEs. At the least, policies should try to avoid the innovation gap becoming wider. We must run to stay in the same place, as occurred in Lewis Carroll's famous book.