"Science Cities" : Science Campuses and Clusters in 21st Century Metropolises
> Helsinki: Nature City and Living Lab

Nokia and Kone's headquarters in Keilaniemi : © DR

The national and regional ecosystem of Finnish innovation

The Finnish society has intrinsic advantages for fostering an innovative milieu: it is extremely open to technologies; it has a simple and pragmatic approach to problem-solving; phased teamwork is used, with an effort to reach a consensus and a capacity for self-criticism; there is an atmosphere of trust linked to the limited market size and to informal and non-hierarchical working methods; and it is also open to the West (Europe) and to the East (Russian and the Baltic countries).

The "Helsinki region"[i] has indeed the same advantages, which are magnified by the airport and harbor infrastructure and its importance as a capital city—and therefore with government functions and a greater openness to the world at large.

The networking between R&D and innovation professionals is genuine and encourages synergies. One result is the new Aalto University, created from the merger of the Helsinki University of Technology (TKK) with the School of Economics (HSE) and the School of Art and Design (TaiK); this project combined a number of themes, and parallels the "T3" innovation promotion strategy[ii] for Greater Helsinki. Many facilitators, both public (including the Technical Research Center of Finland - VTT[iii] and Tekes[iv]) and private (such as the Technopolis incubator and the many Knowledge Intensive Business Services, or KIBS), promote the creation of businesses and accompany them throughout their growth cycle.

Yet several factors impede the development of R&D activities in Finland: insufficient foreign direct investment (FDI); a relatively undiversified production system; low mobility of students and researchers; the multiple and overlapping skills of innovative institutions; a lack of specialization in the Finnish private sector in fields requiring extremely qualified labor, which results in an under-utilization of Finnish human capital; and a muted (yet ferocious) competition among towns in the metropolitan area to house advanced metropolitan functions.

Otaniemi, TKK University campus and hub of a world-class cluster

- **Characteristics and amenities at the university campus**

The TKK campus is located in the municipality of Espoo, 10 kilometers west of downtown Helsinki. It covers approximately 105 hectares of the Otaniemi peninsula on the coast of Maarinlahti Bay, near the garden-city of Tapiola, and is separated from it by the first beltway (Kehä 1) of Greater Helsinki. Its low ground coverage ratio, added to the abundant vegetation, creates a very lush and spacious environment. The relatively low buildings (four floors high, on average) account for a total floor area of 400,000 square meters.

The first buildings constructed on the northern tip of the Otaniemi estate were student dormitories, initially used to house Olympic athletes during the 1952' Games, as well as an Olympic gymnasium later retroceded to the university. The TKK and the VTT began to move to the site in 1955, during construction of Tapiola.

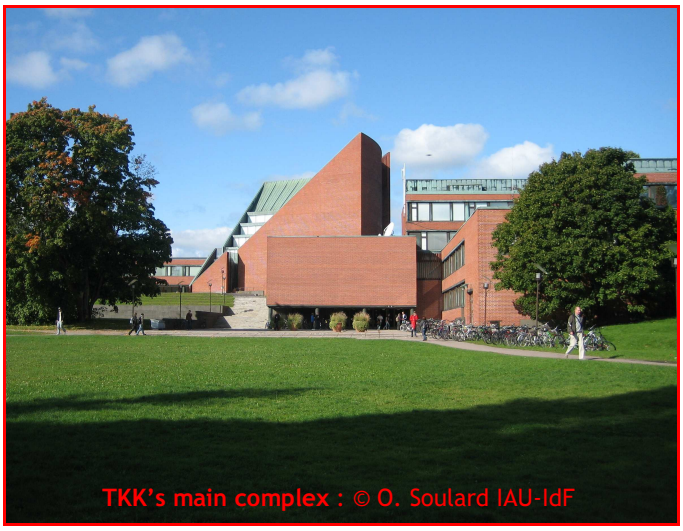
Construction of TKK's primary complex, including the iconic amphitheater designed by Aalto, began in the early 1960s and was completed ten years later, at the same time as Dipoli, the hub of the campus, which houses the Student center, a conference center and an adult learning center. By the early 1970s, most of TKK's departments had relocated to new buildings in Otaniemi.

Nearly 3,000 students are housed in one of the nineteen dormitories located on the northeast part of the campus. Students can also find housing in the center of Tapiola, which is just one mile away and all the necessary services. Nevertheless, a hotel, a small supermarket and sports facilities are built on the east side of the campus, rounding out the campus facilities and services. Given its scale and layout based around the main complex and the central library (also designed by Aalto), it is easy to get nearly everywhere on foot. Green modes of transport are also encouraged, with a dense network of footpaths and bike paths linking all the buildings independently of roads.

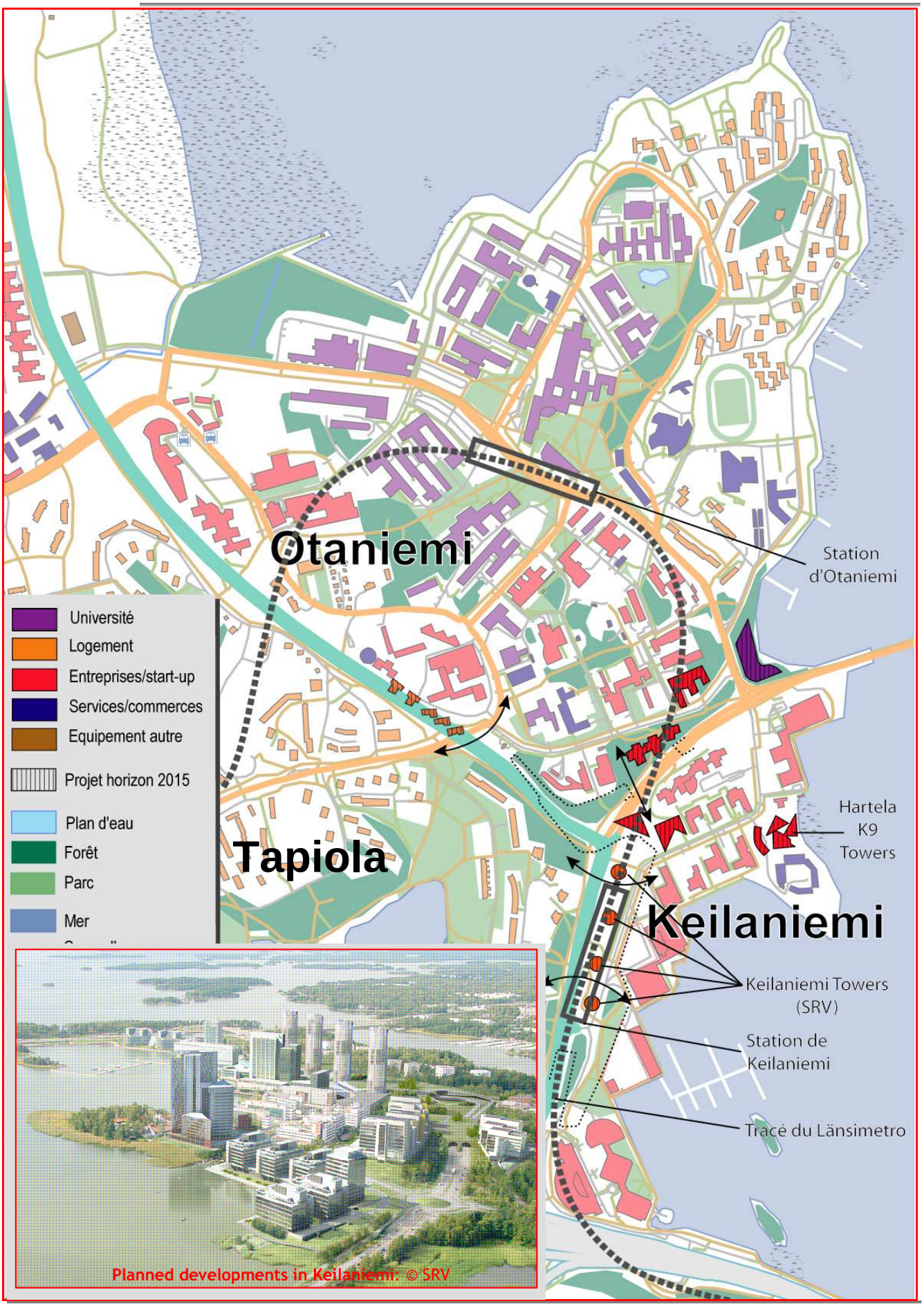
Otaniemi is linked to downtown Helsinki by five bus routes and to Tapiola by nine routes. Furthermore, it is also linked to the main university campuses in Helsinki via the "science bus route." It takes 15 minutes by bus or taxi to get to Otaniemi from Helsinki's central railway station, and 30 to 45 minutes from Vantaa airport.

- **Technology and business parks of Otaniemi and Keilaniemi**

Work on the 55-hectare Otaniemi science park began in 1986, initiated by the city of Espoo. In twenty years, more than 220 M€ have been invested in its development. It houses about fifteen public research laboratories and centers (with the VTT national technology research center topping the list), as well as several business centers such as Innopoli 1 and 2 (with shared facilities such as reception, catering services, meeting rooms, auditoriums, gyms and saunas), and private incubators and activity parks, housing a total of more than 600 technology start-ups and firms. Approximately 16,000 people work there. Even though the Otaniemi master plan adheres to a fairly strict functional zoning, the university campus and business zones overlap to a significant degree, much alike many academic sites in North America. The sense of unity is reinforced by the coherent overall design of the buildings and landscaping.



TKK's main complex : © O. Soulard IAU-IdF



Planned developments in Keilaniemi © SRV

The Keilaniemi site extends over 30 hectares south of Otaniemi. This office sector, which is an outgrowth of Otaniemi, is home to the headquarters of many major Finnish firms, such as Nokia, Koné and Fortum, as well as many small and medium companies, most of which work in the IT and nanotechnology industries and the forestry industry. With two 100-meter-high buildings and several others in planning stages (offices and housing), Keilaniemi is considered by some as the (small) Finnish version of Paris's La Défense district. Private developers there recently built rental offices that share services, modeled after Innopoli, which is a sign of growth for the Otaniemi-Keilaniemi cluster.

- **Major development projects**

The development and innovation strategy pursued by the metropolitan area of Helsinki can be summed up by "T3", which symbolizes the alliance of science (*Tiede*), art (*Taide*) and the economy (*Talous*), a concept strongly promoted by the Aalto University. The town of Espoo intends to play a major role in this strategy by further developing the assets it has in the Otaniemi-Tapiola sector, and taking advantage of the extension of the Helsinki metro to the west, scheduled to begin service in 2015 (at a cost of 714 M€). All these building projects underway, or for which permits have been granted, represent a net floor area of 1 million square meters: 40% for housing, 40% for offices and 20% for commercial or public facilities.

The potential growth for this sector is therefore now around 10,000 residents and 16,000 jobs (as many as Otaniemi has today). In conjunction with the metro construction, Espoo is planning to cover certain sections of the Kehä 1 beltway, first to reduce noise levels, and second, to create a coherent spatial unity for Tapiola, Otaniemi and Keilaniemi.

- **A world-class cluster on a 4 km2 area**

The Otaniemi cluster achieved international recognition in the 2000s in the IT sector due to the success of the major national firm, Nokia. It is a high-tech cluster even though there are other types of activities on the site, notably business services, along with research facilities linked to metrology and the forestry industries. Most of the Finnish high-tech patents are generated within this 4-square-kilometer area that formed around the TKK campus. The critical mass of accumulated capital and skills in the cluster means that today, it can add new activities with strong growth potential, such as mobility, microelectronics/electromechanics, nanotechnologies, and technologies linked to well-being and health that combine IT and biotechnologies.

Otaniemi is an excellent example of the way physical proximity and interconnectedness among people foster collaborative work and innovation between public and private institutions. Companies (large and small, national and foreign), cutting-edge research institutes and universities conduct world-class research within a tight-knit community that encourages collaborative and multidisciplinary R&D along with commercial cooperation. The presence of investors, infrastructure and services—technological or not—that fulfill the needs of companies at various stages in their growth cycle, augments the cluster's efficiency.

Hundreds of network activities and events are organized to facilitate transactions between the leading academic, economic and financial actors, and potential partners. The joint actions involving Nokia's industrial leadership, which was able to attract many nearby small and medium businesses, along with the strong presence of the government and the town of Espoo, via such emblematic institutions as the VTT, the TKK, the Culminatum Center of Expertise, the Otaniemi Marketing development agency, the Innopoli incubators, the Tekel expertise centers, all contribute to the vitality of the cluster.

The dynamics of development at the Otaniemi cluster is based on a bottom-up process that brings together all the various participants on the site on a complementary value chain, in symbiosis with the multinationals—a process that generates highly productive results in terms of innovation (products, start-ups, patents, etc). Yet, as in many major cities, the existing structures present a certain complexity, or they even overlap over time,

which creates a layering effect that sometimes interferes with the overall legibility of the site. The governance of the Otaniemi cluster is certainly complex, but is based on the three main driving forces which are TKK, VTT and Nokia.

The success of the Otaniemi cluster rests on several key elements: externality-rich urban centers (Helsinki and Tapiola); the presence of largely government-sponsored national research centers; high-quality education; and the spontaneous development of companies that have become leaders in their fields, with spin-offs scattered around Helsinki. "Co-opetition" among companies, with the aim of optimizing benefits, is a driving force in the cluster's dynamic. Recent initiatives, like Nokia's Innovation Mill or Otaniemi Microclusters, illustrate that the multiple actors are working together to find solutions to the challenges raised by the Otaniemi ecosystem (international appeal, start-up growth), to create increased added value and jobs.

From spin-off to start-up: Enfucell

The Enfucell start-up was created in June 2002 by a Chinese researcher and four PhD candidates after ten years of research in the TKK Automation Laboratory in Otaniemi. Its chief product is the SoftBattery™, a thin, flexible 1.5 V battery used in disposable, short-lifetime products. It has several applications: RFID (Radio Frequency Identification), micro-sensors, intelligent packaging, and cosmetic and pharmaceutical applications such as transdermal drug delivery. The company employs 25 people; its investors include the founders, private investors, a government pension fund and the largest private pension fund in Finland. Enfucell was also supported by Tekes (Finnish Funding Agency for Technology and Innovation. In late 2008, it raised 5.5 M Euros, including financing for the technological development provided by Tekes. Initially, Enfucell set up its head office and technical production site in the Innopoli building in Otaniemi, opposite the TKK; it later moved to the Petikko industrial park in the town of Vantaa, north of Helsinki. The firm constructed a modern installation for the SoftBattery R&D activities and production. Enfucell now occupies the same building as Auraprint Oy, a Finnish leader in RFID and plastic labels for printers, and the two companies have been partners since 2007.

(Source: www.enfucell.com)

"Innovation Mill" : a partnership in R&D

Industry-research partnerships, and collaborative research projects form the core of Otaniemi's mode of operation. With the aim of going beyond closed chains of innovation in which local actors cooperate only during the early stages of the R&D process and internalize the development phase, recent initiatives have been developed to better integrate a more open chain of innovation, which should establish a more efficient link with market demand. Nokia, working with Tekes and Technopolis, launched an open innovation program, by which it makes patents available to Otaniemi start-ups. Launched in early 2009, this three-year program should create new products from the thousands of unused ideas and patented ideas developed by Nokia, by transforming them into product and services. This program receives financial and technological support to improve the competitiveness of innovative firms in Finland. Participating firms can use the Technopolis resources and its networks transform their innovations into products. Innovation Mill is coordinated by Technopolis; financing comes from Tekes and the cities in Finland hosting Technopolis parks.

Strengths

An exceptional density of researchers in complementary technologies: 5,000 researchers/km2 (including PhDs and teachers). This large concentration, in a site that is spacious but where nearly everything can be reached on foot, encourages serendipitous encounters and exchanges with colleagues from other disciplines and with other interests, with whom they do not usually work.

A high-ranking applied-science campus combined with a high-tech multinational: the combined presence of both TKK and Nokia contribute to the cluster's specialization, encourages the emergence of a pool of talent that spins off, thus contributing to the international image of the cluster.

The critical mass of scientific and technological expertise and accumulated capital increases Otaniemi cluster's abilities to regenerate and move toward other industrial sectors. Examples include the shift at Otaniemi from traditional IT to mobility, nanotechnologies, technologies linked to well-being and health that combine IT and biotechnologies.

Innovative practices available to all cluster participants are an undeniable factor of success for future collaborative projects. Their success rests on such "major players" as Nokia and Philip, which bring their expertise to highly sophisticated cooperative practices. This is possible because they maintain strong internal R&D skills, based on partnerships and skills from around the world, notably for radical innovative projects.

Weaknesses

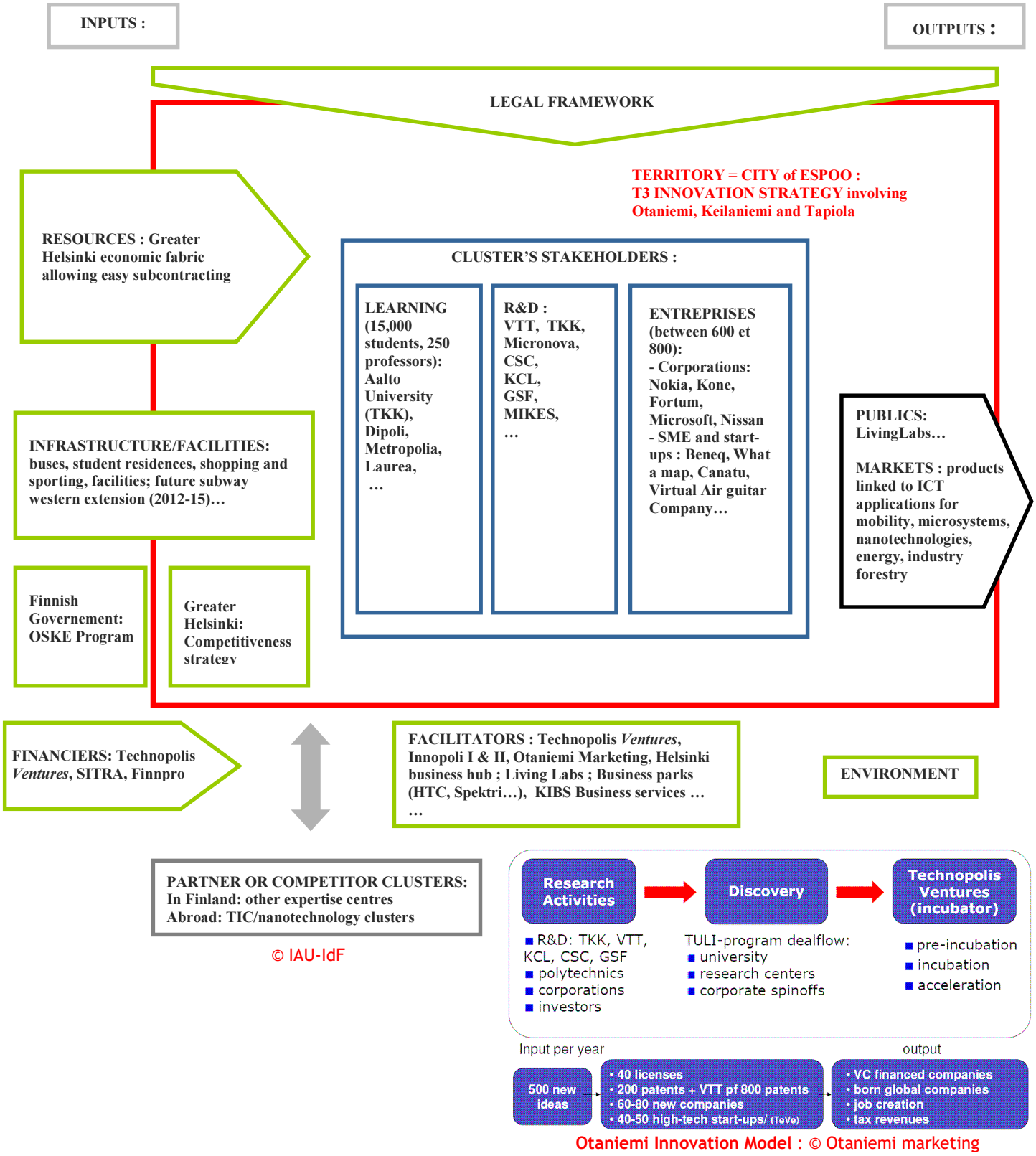
Insufficient foreign talent, due to multiple factors: remote location in Europe, harsh climate, language barrier…

The TKK campus is too far from the center of the garden-city of Tapiola for any real porous relationship to exist between them. Furthermore, it is separated by a heavily used regional road. But development projects approved by Espoo should soon unify these two complementary poles.

The limited size of the Finnish market restricts local growth for start-ups created in Otaniemi. Many of them are purchased by foreign firms and continue their industrial growth in other countries, benefiting economies other than that of Finland and the Helsinki region.

Otaniemi cluster mapping and innovation model:

The analysis of the Otaniemi cluster aims to examine its overall "ecosystem". Beyond the triptych of founding firms, R&D structures and educational institutions, an analysis of the elements provided from a territorial standpoint is essential to understanding the logic and benefits of a cluster.



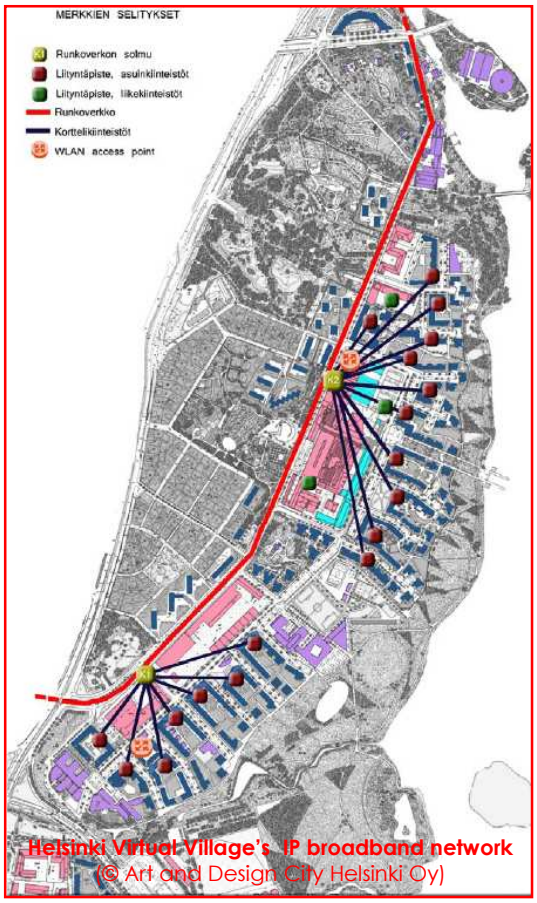
Otaniemi Innovation Model : © Otaniemi marketing

Arabianranta: techno-social laboratory and creative cluster in the making

The Arabianranta urban redevelopment, built around a large, derelict pottery factory northeast of Helsinki, stressed residential development with a strong focus on the arts and design, and an economic center for creative industries. Today, this district is well-known for its high-quality and diverse housing, which displays art work in public and semi-public spaces. Creativity, design and art are therefore integral parts of daily life in Arabianranta.

This district is as innovative in urban design as it is in lifestyles, consumption and work. It is widely acclaimed both in Finland and abroad, because of its creative and manufacturing tradition in the sectors of tableware, design and media, along with its sophistication and respect for nature. Designed as a laboratory of contemporary habitat, it has also become a de facto laboratory for IT creative content, as it is completely integrated into the public and private spaces, and thanks to the many students and researchers from the University of Art and Design (TaiK), the Helsinki Pop and Jazz Conservatory, a branch of the Metropolia University and the Arcada University of Applied Science.[v]

The locations and cultural focus of these establishments in the neighborhood mean that this cannot be viewed as a true campus, but more as a "university district," which should, in time, stimulate the economic development of the site with the emergence of a specialized cluster based on the arts, design and the media. Its hub, in terms of economic development, is the "Helsinki Living Lab".



Helsinki Virtual Village's IP broadband network
(© Art and Design City Helsinki Oy)

Strengths
A concept that intelligently recycles a widely recognized piece of industrial heritage with many urban functions, including universities, as well as a strong environmental and artistic focus (characteristic traits of Finnish society).
A significant constructible reserve (900 housing units, 60,000 m2 of office space) which allows for necessary modifications to the project.
A comprehensive integration of information and communication infrastructure in the district, making it possible to develop and test new applications before industrializing them, through the participation of a society dedicated to this function.
Weaknesses
A location that is too out-of-the-way to be attractive for certain creative firms and professionals, despite all the advantages of the site and the urban quality, Arabianranta suffers from.
The media sector development at Arabianranta could suffer from the competition of Central Pasila, a partially competitive development project promoted by the city of Helsinki.

The "Living Lab" concept refers to a process that connects an *in vivo* observation, in a real-life, user-driven context, to an *in vitro* observation using specific methods and installations. A living lab offers many advantages: it speeds up the innovation process, reduces the risks of failure, improves the return on investment per project, results in innovations that are better suited to the end-user, and re-empowers the citizen and a socially responsible player.

With the development of the Helsinki Virtual Village, Arabianranta became the first Finnish cyber-community, thanks to the creation of a very high-speed fiber-optic network and Wi-Fi terminals, and the experimentation of new "tele-services," as part of a pilot project initiated in 1999 by Sonera (Finland's leading telecommunications operator), in partnership with Nokia, Ericsson, Motorola and Psion.

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[i]-One quarter of Finland's population (1.3 million inhabitants) and 30 percent of the jobs (638,000 jobs) are concentrated in the 14 towns forming this area. The Helsinki region invests 4.4 percent of its GDP in R&D (the equivalent of Sweden's investment) and its average productivity is twice that of other European regions.
[ii]-T3=*Tiede+Taide+Talous* (in other words, a strategy aimed at bringing together the science/technology sectors with art/design and business/finance).
[iii]-Public research organization administered by the Ministry of Employment and Economy. With 2,700 jobs, it is the largest organization of applied research in Northern Europe.
[iv]-Tekes is Finland's funding agency for the development of technology and innovation.
[v]-Representing more than a total of 5,000 people working in the media and creative fields.