OPEN CITIES

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D1.1.1 State of the Art - Open Innovation in Smart Cities

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D1.1.1 State of the Art – Open Innovation in Smart Cities

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1. OPEN INNOVATION

Innovation has been subject of enquiry among academicians since nineteenth century, and it has been deeply investigated and accepted its necessity to sustain growth and profitability for companies. Thus there is no inquiry left about why innovation is crucial for the future of the companies. However, in a moment when classical innovation itself becomes more costly and riskier for the companies to run by them, Open Innovation as a new breed of innovation appears as an attractive alternative and has captured the attention of the academics. Indeed today companies are opening up their knowledge-intensive innovation processes and collaborating for innovation with external partners such as suppliers, customers, universities, end-users etc.

1.1 CLOSED INNOVATION

Traditionally, the innovation model of 1950s was a classical technology push model. Today it is described as closed model of innovation (closed funnel of innovation) in which ideas come from science and technology base and then eliminated and selected down to the market. The internal knowledge base of a company's researchers led the research programs. All the research was developed from being a scratch to a developed product within the boundaries of a firm. This raised the fact that only big companies such as, Eli Lilly, IBM, etc could afford to do R&D as innovation and R&D requires a lot of infrastructure. Of those research programs, those that were successful led to development projects with a few making reaching commercialization. Projects unsuccessful at one of these steps were quite simply dropped.

Accordingly a basic definition of closed innovation is that a company discovers, develops, builds, delivers, finances and provides services of product within itself, by itself as Chesbrough (2003) described. (See figure 1) As time pass, internal R&D gets insufficient so the existing closed innovation strategy and business model too. (Chesbrough, 2003; Dittrich & Duysters, 2007; Coombs & Richards, 1993) Studies of Chesbrough (2003; 2006) and academic reports of OECD (2008) and ATW (2006) emphasized the reasons for erosion of closed innovation. These are as follows:

- Government established a grant program that supporting science and technology in state universities. This led to an increase in the number of graduates in these fields so the employees as well and eventually expanded the role of universities in the innovation system.
- Venture capital market was developed to finance new enterprises.

- External starts ups exploited with the new funds and mobility of the educated workers.
- In mean time external suppliers developed significantly and provided higher capacities and efficiencies. Ultimately, they gained a critical role in the innovation process since they can provide for the larger firms and their competitors too.
- Globalization and global competition forces changed the market conditions.
- Internal R&D could not be sufficient enough to support rapid innovation.

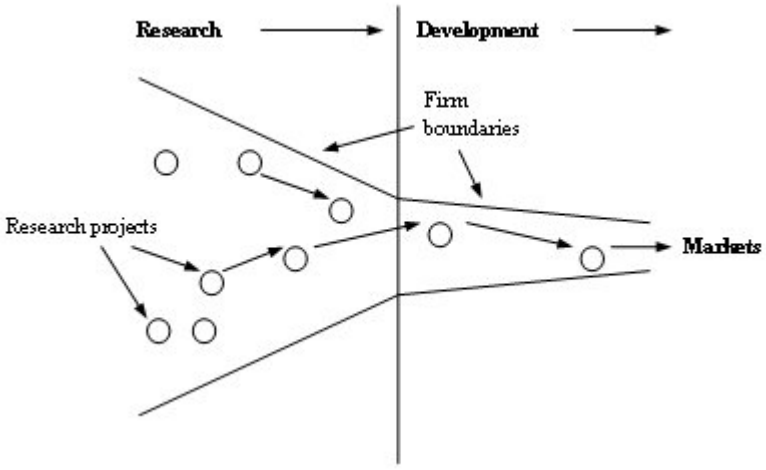

Figure 1: Closed Innovation Model *(Derived from Chesbrough, 2003)*

As a result of the erosion of closed innovation, link between research and development have loosened. This was at the same time when companies have started to look for an alternative to increase the efficiency and effectiveness of their innovation processes. Thus firms need to alter their structure and business model to benefit from these external sources. (Chesbrough, 2003; Dittrich & Duysters, 2007)

In the last few years the number of academics and researchers who see traditional logic of innovation insufficient for the survival of companies in today's world has increased. However the traditional model of innovation, closed innovation, was not sufficient enough for today's business environment. This is why they are instead supporting and researching on a new approach: Open Innovation. The rise of this phenomenon triggered further researches on this field. Today OI is an opportunity for every enterprise due to its intensive knowledge dissemination, ubiquity, increased connectivity, accelerated market cycles, lower costs and higher productivity.

Open innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively (Chesbrough et. al., 2006).

A search of "Open Innovation" in Google Scholar yields around 1.490.000 academic results and a search in the ISI Web of Knowledge approximately provides 190 published articles. This shows that OI concept has been highly popular amongst both academics and practitioners. This is why we start with a description of it and see how they analyzed Open Innovation (OI) so far.

As a simple definition of OI is a process of opening the boundaries of the firm to share and exchange knowledge and information. This also includes using external knowledge to improve, speed, efficiency and effectiveness of firm's focal innovation process as well as selling internally generated un-used knowledge to increase revenues from internal innovation (Chesbrough, 2004; 2006; West & Gallagher, 2006; Gassmann, 2006). Even though Chesbrough (2003) coined the notion of open innovation as a new concept in 2003, open innovation does not totally a new phenomenon. The previous studies on absorptive capacity, user-driven innovation, open systems, open paradigm and customer or user driven innovation topics dates back 1970s (Von Hippel, 2005; Selden & MacMillan, 2006; Esposite & Raffa, 2001).

As the main initiator of the rapidly growing body of literature, Chesbrough (2003) also visualized the definition of the open innovation as follows in figure 2 below. This model involves the cooperation of a firm with multiple channels such as other firms in its sector, suppliers, universities, and of course end-users when developing new products and technologies. This figure clearly shows that previously solid boundaries of the company in closed innovation transformed into a semi-permeable membrane to enable external innovation to get in. Leadbeater (2007) also similarly described the open innovation as IN where ideas flow and narrows down into companies' funnel of corporate development from different sources and OUT is where a company creates a platform to allow a process of evolutionary innovation so that each person can add their ideas and contributions with some tools.

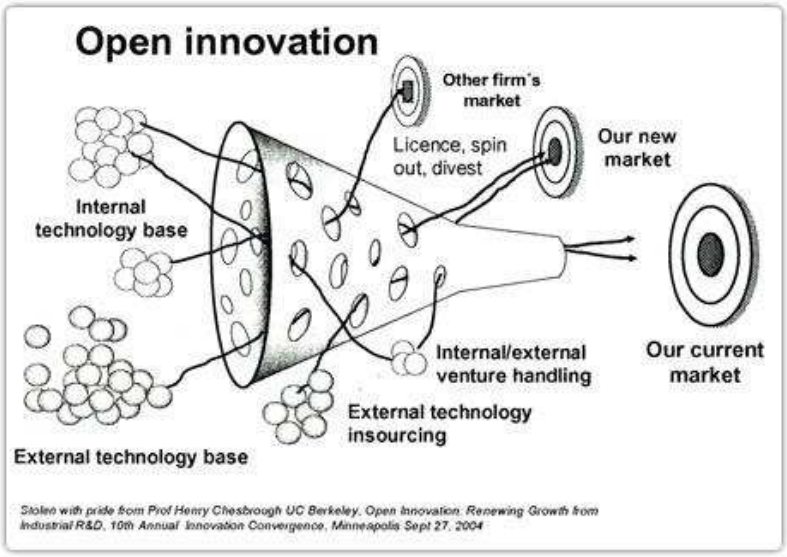

Figure 2: Open Innovation Process (Chesbrough, 2006)

Since open innovation has a definite relationship with all aspects of the innovation process it does as well as with the business model. To maximize their benefit from the open innovation system, companies must open their business models. To do that companies need to build a model which lets the inflow and outflow information and technologies; this contradicts with the traditional business models (Chesbrough, 2007; Backer et al., 2008)

Hence open innovation is employed as a business model for creating and developing these practices and collaborations while creating spin-off and outsourcing of unused intellectual property. Thus Open innovation is not about outsourced R&D but it is about strategic R&D to improve it and provide commercial innovation while strategically managing intellectual property rights (IPR). (West et al., 2006; West &Gallagher, 2006; Henkel, 2006; Docherty, 2006; Chesbrough, 2004; Gassmann, 2006)

1.2 CONTRASTING CLOSED INNOVATION AND OPEN INNOVATION PRINCIPLES

Chesbrough (2003) and Forrester (2004) defined the main divergences between closed and Open Innovation which are summarized as follows:

	Closed innovation	Open Innovation
Corporate Ethos	"Not invented here" We can do it, we will do it Creation of the best idea internally	Best from anywhere Choosing the best idea among internal and external ideas
Role of Customers	Passive recipients	Active co-innovators
Core Competency	Vertically integrated product and service design	Core competitive differentiation and collaborative partner management
Innovation Success Metrics	Increased margins/revenues, reduced time to market, market share within existing market	R&D ROI, breakthrough product or business models
Attitude Towards IP	Own and protect Do not share internal IP	Sharing internal IP can be profitable Buy, sell the corporation is a knowledge broker using both licensing and commercial development to monetize IPR
Role of R&D and Operations	Internal R&D is the only way to create profit Discover, design, develop and market in-house inventions	External R&D can also create profit and value Use the third partners for discovery, development and delivery of products Optimize performance of owned assets through both in house and external development; do enough R&D internally to recognize significant external R&D
Advantages	First movers advantage	Having better business model is more important than being a first mover
Employees	Professional employees inside the company	Working with professionals within inside and outside the company.

Table 1: Comparison between Open and Closed Innovation (*Derived from Chesbrough, 2003; Forrester, 2004*)

There are many incentives for the companies to apply Open Innovation model. OI provides the advantage of a delayed financial commitment and an early exit. It also offers financial gains through licensing, selling technologies or spin-off ventures that are not used or do not fit with the business model (Vanhaverbeke, 2009; Chesbrough, 2003).

2. OPEN INNOVATION IN PUBLIC SECTOR

Current public policies already enclose some of the necessary elements for OI model so it does not require a modification in traditional policymaking. Still policies should be adapted to motivate organizations to practice Open Innovation. Thus certain areas of policies require changes to adapt to OI. De Jong, Vanhaverbeke, Kalvet and Chesbrough (2008) defined 7 policy areas polices which are most relevant for Open Innovation as follows; 1) RTD policies, 2) Interaction-oriented policies, 3) Entrepreneurship policies, 4) Science policies, 5) Education policies 6) Labour market policies, 7) Competition policies.

In order to justify policies for Open Innovation, De Jong, Vanhaverbeke, Kalvet and Chesbrough (2008) also prepared an overview of the similarities between systems of innovation literature and open innovation as shown in Table 2.

Open Innovation literature	Systems of innovation literature
• Enterprises obtain better results if they open up their innovation processes, i.e. involve the world outside.	• Innovation is the result of complex and intensive interactions between various actors.
• Innovation is no longer the domain of the internal R&D department; traditional stage-gate models provide an incomplete picture of how innovation should be organized.	• The linear model in which knowledge-related activities are divided in supply and demand does not hold any longer.
• Enterprises can benefit from purposive inflows and outflows of knowledge. Knowledge spillovers offer opportunities and are not just a threat.	• Knowledge spillovers are essential for the functioning of the innovation system, and are very much desirable.
• Enterprises need both internal innovation competences (other than R&D) and competences to connect with external parties in order to be successful.	• The functioning of innovation systems can be hampered by capability and network failures.
• As enterprises increasingly depend on external sources, infrastructural arrangements (e.g. IPR) and other framework conditions become more important.	• The functioning of innovation systems can be hampered by institutional and framework failures.
• Increased mobility of labor and presence of a trained labor force are important trends that eroded the closed innovation model.	• Human and social capital provide the oil necessary for lubricating the innovation system.
• If the innovating enterprise cannot internally benefit from its innovations, maybe others can.	• The social benefits of innovation exceed those of the individual innovating actors.

Table 2: Similarities between the Open Innovation and systems of innovation models (*De Jong, et al, 2008*)

Nurturing open and collaborative innovation at the national level may require both a top-down and bottom-up approach. Nations who include an overarching framework that defines shared visions, create clear direction, and identify priorities for open and collaborative innovation provide its business community with clear signal on where progress should be made, and that is reflective of the needs of the nation. Japan is one

example that has given direction allowing business to drive from the bottom-up and organically. Much of the national level guidance must go into nurturing a process that is hard to manage. However, this guidance must nurture and accelerate the natural process for open and collaborative innovation to grow allowing seamless flow of knowledge, ideas, and people.

Countries that have adapted open approaches in innovation have focused on government needs for software. National efforts such as in Germany, Spain, Italy, and Vietnam have looked into alternatives to proprietary software by their governments. Research into Peru (Chan, 2006) showed how governments can directly invest in open source software that addresses the limitations of the state and global markets but further evaluation to the consequences of governments' actions in adoption is required. Other investigation (Chae & McHaney, 2006) on countries such as China, Japan, and South Korea promoted on national level of analysis on open innovation.

Further delineating at a national level, Suk Lee (2006) found that free and open source software (FOSS) is an engine for technological innovation and for market competition. Lee (2006) suggested FOSS provides an opportunity to free the country from its technological dependence on software vendors using the Korean government in a case study. However, he emphasized that governments must consider the long-term interest of society. Far from complete comparing between political dynamics and an open source adoption was introduced by Simon (2005) and Seiferth (1999). The study of Berry and Moss (2006) discussed how the discourse considering open source software may contribute to adopting a more open and democratized e-government as a result.

Open Innovation practices rely upon the availability of external knowledge and other innovation resources (venture capital and human capital) and the availability of these resources depends on public policies towards science, technology, intellectual property (IP), competition, entrepreneurship and education. Specifically Europe has been developing its IP system for almost fifty years but still the current system fails to be simple, transparent, cheap and predictable for organizations (Veugelers, 2009, Van Pottelsbergde de la Potterie, 2010). Therefore, Open innovation requires a reliable and cost efficient IP system and European public policy makers can play a crucial role in the effectiveness of open innovation.

As another major policy issue is related to the workforce in Europe. Developing a mobile, well-educated labour force is primarily a matter of education and labour market policies but also for innovation. Simplified

immigration rules and incentives such as preferential income taxes Migration of highly skilled and temporary workers can be promoted (OECD 2008; O'Doherty and Arnold 2003).

Similarly open government and open data are fundamental approaches for cities to generate more value for their citizens. Since government data is important for both government and citizens, a clear policy on how governments should open up and distribute their data is required. Certain guidelines for open data across Europe can be created to ensure disclosure while considering national security and citizen's privacy (Swartz, 2010; Fung & Weil, 2010).

3. OPEN INNOVATION METHODOLOGIES

3.1 OPEN SENSORS NETWORK

Over the past decade, there has been rapid progress in the communication and sensor technologies that results in the growth of a new research field, open sensor network. Open sensor network have become a highly active research area due to its diverse applications such as energy, health care, traffic, environment, etc. and so its potential impact on the quality of all people' life and the health of the planet. Sensor networks are composed of small, power-efficient, wireless sensor nodes that communicate among each other in environmental fields to sense and monitor. The nodes can perceive various physical parameters such as, light, vibration, etc. about the condition of environment and also in different environment conditions such as underground or underwater.

By definition wireless sensor network consists of a large number of distributed autonomous nodes (sensors) which are installed in environment to monitor and collect data about environmental conditions, such as temperature, humidity, light or motion (Akyildiz et al, 2002; Kalochristianakis, et al. 2009). Each of these sensors jointly sends their data through the network to a main site.

The development of wireless sensor networks was initiated for military applications, DARPA still continues to fund a number of prominent research projects (Römer and Mattern 2004). However today these are used in various applications and industries. It can be installed on a very large scale in both indoors and outdoors. Each sensor/node consists of a processor, a radio transceiver, memory and a battery (Yick, et al 2008). Depending on the complexity of the sensor nodes, the size and price varies which also allows the various applications. Yick, Mukherjee and Ghosal (2008) classified sensor networks into two types: structured and

unstructured based on the weather nodes are deployed in an ad hoc or random manner. With structured sensor networks, management and maintenance of the network is enhanced.

For the design of a sensor network, it is important to have particular characteristics. The network should be accessible, fault tolerance, low-cost, scalability, rapid deployment and self-organizing capabilities Sensors should also be heterogeneous, mobile and be able to bear cruel environmental conditions (Poblete, 2010). It is also important to notice the difference between wireless sensor networks and ad-hoc wireless networks. In terms of resource capacity and redundancy of traffic sensor networks are lacking but they provide more specialized communication pattern.

Today various types of sensors exist, for measuring different parameters such as thermal, visual, infrared, acoustic, etc. These allow them to monitor different conditions so that the applications of sensor networks expanded. Wireless sensor networks are attracting increased interest for applications; among those most common one is environmental monitoring. It is used for deploying over a region where some phenomenon is monitored (Werner-Allen, et al. 2005; Römer and Mattern 2004). A military example is the use of sensors to detect enemy intrusion; a civilian example is the homeland security. The other applications involve security surveillance, intelligent agriculture, asset tracking, traffic, pollution and industrial monitoring, etc (Gupta, et al 2010). All these applications entail facilities for gathering, sharing and analyzing the data of sensors.

Extensive research effort has been invested in recent years to optimize communications in wireless sensor networks (WSNs). Most of the studies in the literature are devoted to connectivity in sensor networks (Bollobàs, 2001; Meester & Roy, 1996; Penrose, 1999) and to carrier-sense multiple access (CSMA)-based MAC protocols (Takagi & Kleinrock, 1985; Kim & Lee 1999; Bianchi, 2000). Specially, wireless ad hoc and sensor networks have recently attracted a growing attention (Bettstetter, 2002; Pishro-Nik et al., 2004).

The literature on sensor networks mainly lacks research on an integrated view of all the factors driving the design of sensor networks and a presentation of architecture and design factors as a guideline and a tool. Thus the future research can involve topics such as fault tolerance, scalability, production costs, hardware constraints, power consumption and sensor network topology (Akyildiz et al, 2002).

As in any new technology, sensor networks initially had certain challenges mainly due to the limitations of resources of sensor nodes in terms of limited memory, computational ability, communication bandwidth, communication range, processing capabilities, coverage problem and energy source (Poblete, 2010; Locher, et al. 2008). However the new smart wireless sensor network can overcome these issues.

As the application of sensor networks broaden, requirements and characteristics of the systems vastly varied. Thus there cannot any typical requirements about hardware and software support since it varies depending on each application. This creates a challenge for the collaborations between users, experts, hardware and software developers to create new systems (Römer and Mattern, 2004). Triantafyllidis et al. (2008) also defined further sensor challenges such as difficulties in achieving interoperability for different sensor nodes and services, or sensors usually are not intelligent enough to do processing tasks.

However the main challenge in sensor networks is the energy. Sensors nodes are severely energy constrained and expected to last until their energy drains out. Thus the challenge is to maximize the lifetime of sensor nodes since it is not convenient to replace the batteries of each sensor nodes. This requires all protocols to be made as energy efficient as possible. Another key issue in wireless sensor networks is to have secure communication between nodes and base. A very few research has been reported in the literature so far on sensor network security (Poblete, 2010).

3.1.1 Case Studies

There are various European researches going on currently on wireless sensor networks such as ZebraNet for wildlife tracking, MyHeart for medical smart wireless sensors and Mimosa for Microsystems platform for mobile services and applications. Below these selected cases will to illustrate the different applications of sensor networks.

Mimosa

The Microsystems platform for Mobile Services and Applications (MiMOSA) is a broad project involved a creation of an open system platform for context-aware mobile services and applications, especially wireless sensors exploiting the RFID technology, highly integrated readers/writers for RFID tags and sensors and novel MEMS sensors for context sensitivity and user-friendly interfaces. The personal mobile phone is used as a gateway between the sensors, the network of sensors, the public network and the Internet. MIMOSA (2011) aimed to develop a generic physical sensor that enables inertial navigation as well as measurements of user activity and gestures. During the project, end users and developers collaborated about the design and evaluate its utilities. It involves applications like health monitoring or intelligent housing.

MyHeart

MyHeart is a European IP Project initiated in 2003 is developing a Body Area Network using smart-clothes referring closes with sensors and electronic systems. These smart-clothes, also defined as biomedical clothes, would allow monitoring of vital signs of people. This helps the doctors to make diagnosis and detect the sicknesses quicker and easily, especially it is more effective on diseases like Cardio-vascular diseases. It is increasingly becoming common disease with high costs. It works as follows, first knowledge on the patient's health status is collected, then textile sensors are installed into smart clothes with other system solutions and finally sensors and systems will make diagnoses and detect early symptoms (MyHeart project, 2010). Thus through these sensors early diagnosis would be possible, healthcare costs will reduce and more prominently it would save millions of lives.

ZebraNet

Sensors networks are also used in order to track animals. One good example is the ZebraNet which aims to observe the behaviour of wild animals, zebras in this case, within their natural habitat in Kenya. It is initiated with demands biologist to track zebras in long term and over long distance. So their objective is to observe their behaviour, their interactions with other species and human impact on them. However the traditional tracking technology is not sufficient for this. Biologist's needed for a way which is light in terms of weight, energy-efficient and wireless and last long. To achieve these intentions all zebras in that habitat were equipped with sensor nodes, light sensors and GPS receiver is also used to locate them. The observation is planned to be done with a mobile base station for a year or more that covers thousands of square kilometres (Martonosi, 2003). Through ZebraNet, biologists have an opportunity to make research on migration and inter-species interactions. For future observations, other various sensors are planned to be used.

As the cases illustrates that wireless sensor networks have found their way into a wide variety of applications and systems with vastly varying requirements and characteristics, and hence it was very difficult to discuss specific application requirements, research directions, and challenges. In the field of sensor networks, there are new trends and developments such as new protocols, increases in speed and memory and miniaturization.

3.2 FIBER TO THE HOME PLATFORMS

Interactive TVs, laptops, e-readers and smart phones that all connected to the web point to ever increasing demand of gigabit society for higher speeds and more bandwidth. Only in 2010, 20 billion videos were watched on YouTube every day, uploaded 3 billion photos every month to Facebook (Sankaran, 2011). To support this increasing demand, not only companies but also many countries realize the potential of Fibre to the home (FTTH) as a significant yet relatively expensive option.

The installation of cutting edge communication technology, fibre to the home, is beginning to make a clear advance across Europe. It is partly due to respond to the increasing demand regard to FTTH. FTTH Councils (2009) defines "Fibre to the Home" as architecture of communications in which fibre extends from the service provider's network to the subscriber's premises directly as Optical Fibre. Referring to that instead of the metal local loop, optical fibres will be used till the door steps of subscribers. FTTH services are extremely high bandwidth data services that transmit data through light signals sent through hair-thin strands of pure glass with an exceptional error performance. It delivers simultaneous various data services such as telephone, video, audio, television with larger capacities at higher speeds. For instance, it would take only one minute to download an 800Mb movie or one second to download a 5Mb mp3 file (Pangilinan, 2009). FTTH can be delivered with a number of installation methods such as Rod and Rope, Open Cut, Mole Ploughing, Radar Directional Drilling, Trenching, etc. and for that providers do work closely with their clients.

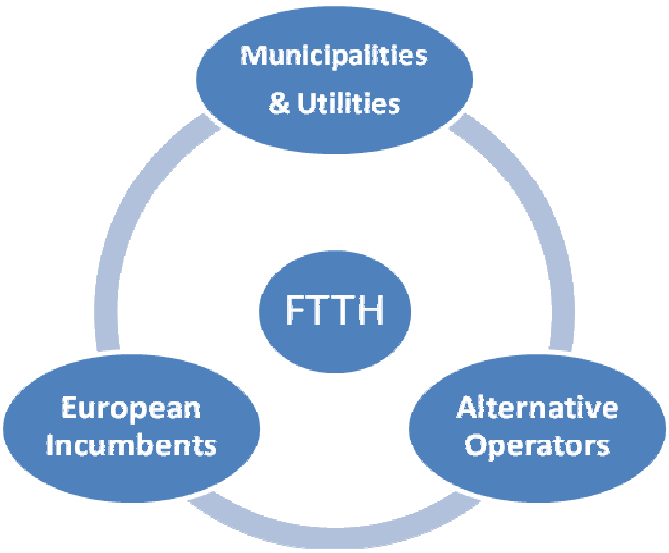

Figure 3: Key players of FTTH deployments (*Derived from Holden et al., 2011*)

For the deployments of FTTH, there are 3 main players that are involved in the process as figure 3 demonstrates (Holden et al. 2011). At the national level, European incumbents are concerned with national deployments. They perform the 19% of total FTTH deployments by the end of 2010. Municipalities and Utilities is the least (8%) involved ones and engage in only with local deployments. Most of the FTTH deployments, 73 %, is covered by alternative operators which are engaged both national and local deployments.

Nevertheless, there is a lot of work to be done. It is now of great importance to stimulate the players involved to make progress with the installation of FTTH. To support that FTTH Council of Europe is founded as an industry organization to accelerate the availability of fibre-based, high-speed access networks to consumers and businesses. The council consists of more than 150 member companies from various industries (FTTH Council Europe).

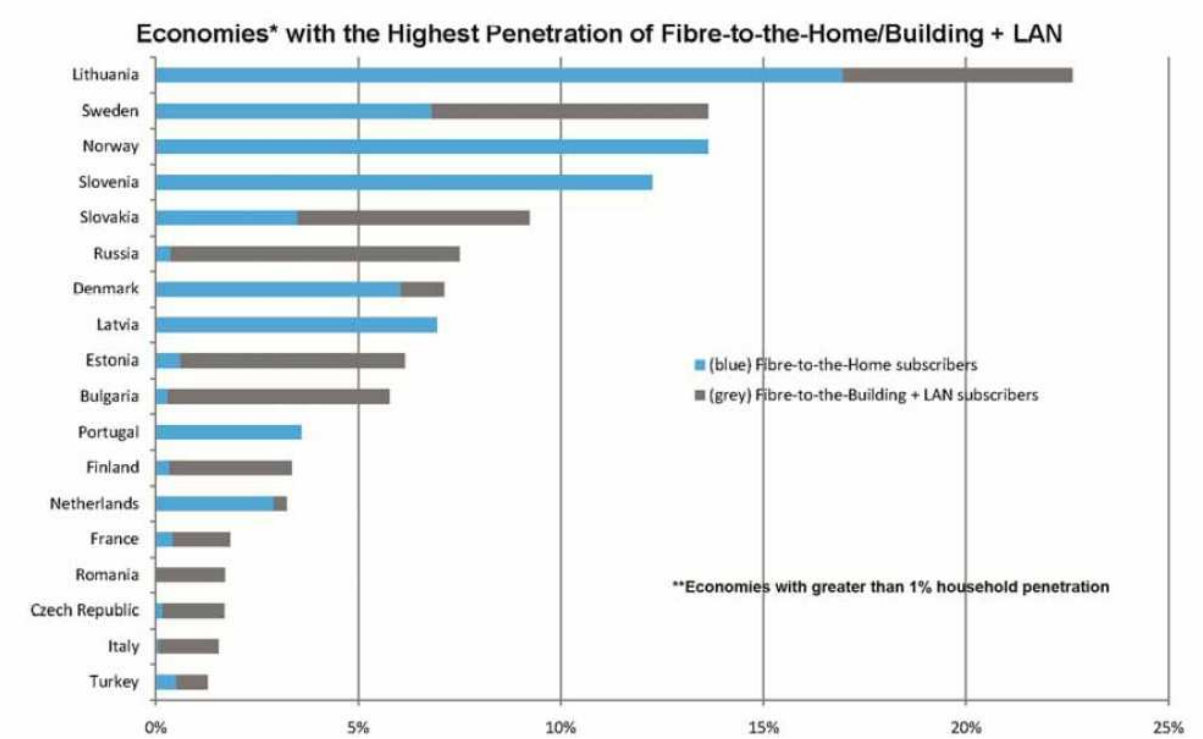

Figure 4: FTTH European Ranking by the end of 2010 (*Derived from Fibre to the Home Council, February, 2011*)

In Europe currently 3.9 million FTTH has been deployed, still quite behind the rest of the world regions. The figure 4 demonstrates the European Ranking of FTTH deployments by the end of 2010. It clearly shows that

projects are mainly getting aggregated in Northern European countries. The current agenda of the European Commission concerning FTTH deployment and consequent regulation is stated by Neelie Kroes (2011), Vice-President of the European Commission responsible for the Digital Agenda. Kroes (2011) declared that since the BEREC (Body of European Regulators of Electronic Communications) is operational from now on, the European Commission will be particularly attentive to the complete cooperation of historical operators concerning the possibility given to alternative operators to be part of this FTTH rollout process, in a fair and open market.

However, bottlenecks regarding financing, regulations and collaboration with various authorities are also significant themes that influence the actual roll-out of FTTH. Holden et al. (2011) summarized the main challenges for FTTH as follows; 1) low dissemination rate in Europe as its benefits are not perceived by users, 2) as a business it can be complex to run for municipalities, 3) requires co-investment for nationwide large scale implementation, and finally 4) increased interest of property managers. To overcome these challenges, European Commission aim to create a single common approach for challenges and similar regulatory challenges should be met with similar tough rules and remedies across Europe (Kroes, 2011).

3.2.1 Case Studies

Many countries have been taken initiatives to establish national FTTH platforms. These platforms would focus on legal, political and communicative activities which stimulate the installation and use of FTTH and remove possible bottlenecks. It involves companies from infrastructure, technology, government (municipalities, provinces), research and consulting, media and housing construction.

Amsterdam Citynet:

Today Amsterdam is the leading city in Netherlands in optic fibre use, with its finished fibre network of 43,000 homes with a project called Citynet (Amsterdam Citynet, 2010). The investigation to build a network was initiated in 2001 and followed with a public-private partnership to invest in the passive fibre infrastructure only. The physical network was to be constructed by a consortium of local Dutch companies. Mean time substantial private investment was also permitted. Also the Dutch FTTH regulatory policy was well established to support the new entrants wanting to build fibre networks. It was discovered that customers favored competitive services in a multi-operator market.

Citynet project faced with several challenges such as construction of the network in a densely populated old city, a co-ordination challenge since for half of Amsterdam housing individual agreements must be negotiated with owners and the biggest challenge was bringing together the right partners under the right conditions for investment of the project (Amsterdam Citynet, 2010). Despite all these challenges, the project has been a success and end-users appreciated the services that it provides.

Fastweb

Fastweb Company in Italy was founded with few entrepreneurs in late 90s with a plan to create a single end to end fibre network to transport every other service such as internet, television or voice. Together with partnering with the local electricity company, AEM, in early 2000, they started offering service to homes and businesses in Milan (Fastweb, 2010). Fastweb merged with other companies and expanded into other cities.

Fastweb has a key role in the "Italia Digitale" project ("Digital Italy") which aims the development of a next generation fibre network for Italy. This initiative of operators and government has agreed that there will be one single passive network infrastructure that provides FTTH to half of the Italian population by 2020. Currently it has been successfully tested as a pilot network in the Collina Fleming area of Rome (Fastweb, 2010).

Andorra Telecom:

As FTTH world leader, the Principality of Andorra is a perfect illustration of deployment of FTTH for the rest of Europe. The country's incumbent Telco Andorra Telecom decided to improve its services through providing Internet access over optical fibre as a universal service, to every end-user in 2006.

In terms of challenges they faced with landscape issues during deployment. Andorra is very mountainous and consists of mainly from small towns. After overcoming these challenges, they ripped the benefits with higher consumer satisfaction and attracting investments to Andorra. Currently it is concentrating on developing services for the new broadband network such as Internet TV (Andorra Telecom, 2011).

Utah, USA: A Perfect Fibre World

Some local FTTH projects in the US are already seeing some success; the state of Utah is one of them. A consortium of 14 Utah cities aimed to deploy a wholesale fibre optic network for any service provider to run their services within its member cities (Dux, S. 2005). Since 2008 it has been deploying various cities. It

allows end users to choose their own service providers and continues to increase its capacity and scalability. It aims to accelerate growth of the network, stimulate innovation and create business opportunity and developments. Even though this project faced with quite some legislation challenges, they managed to successfully deploy (Brotherton, 2010). For future, they invest and aim to support new technologies such as telemedicine, distance education, interactive gaming etc.

Optic fibre is an important provision for the realization of a sustainable future in Europe. Currently there is a steady growth of European FTTH deployment. Local initiatives such as in Italy are taken over by national projects. However accelerating the deployment of FTTH is a necessary and fundamental attempt which will help to increase the quality of life, competition, and provide new level of services across Europe. European countries therefore should see it as their mission to increase the acceptance and use of FTTH in all the interested stakeholders. To achieve this, networks should be expanded and involvement of different parties from both supply and demand side should be encouraged.

3.3 LIVING LABS

The traditional projects are mainly initiated and executed in a closed laboratory environment without any interaction or collaboration. This has changed with a new research and development infrastructure called "Living Labs". Simply it is community-driven innovation, knowledge sharing, collaboration and experimenting, in real-life situations. It involves collaboration and cooperation of academia, industry and public administrations. With this approach technical developments and innovations will be accelerated.

"Living Labs" as a term introduced by William Mitchell, defined as a user centred innovation platform to search human interaction with new technologies, products and services in real-life environments through a public-private-people partnership (Niitamo, et al. 2006; Stahlbröst, 2008; Eriksson et al, 2005). Esteve Almirall and Jonathan Wareham (2008) stated that there are two main motives for Living Labs applications; allowing user participation in the innovation process and performing experimentation in real world settings.

Most of the Living Labs focus on service based industries such as telecom, information, media, or entertainment industries. Living Lab has been introduced first in 2006 and followed with a creation of the network of European Living Labs and the European Network of Living Labs (ENoLL). Today after the 4th wave living labs, there are over 250 accepted Living Labs in Europe (See figure 5).

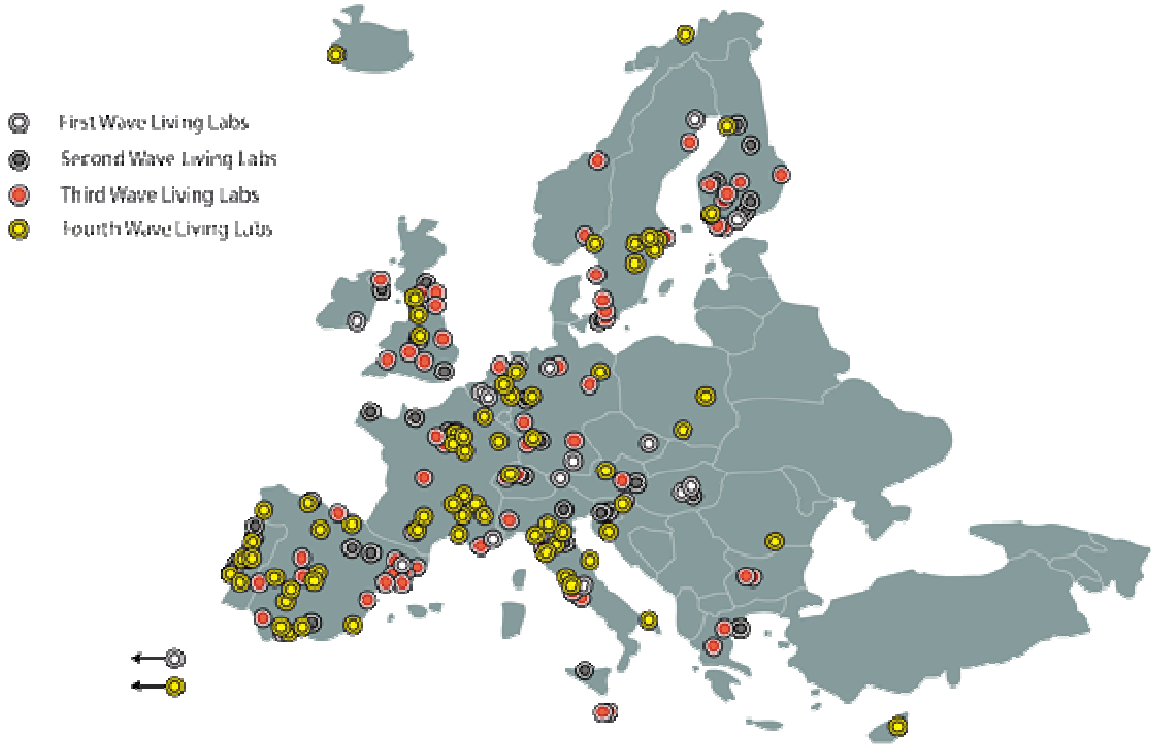

Figure 5: European Living Labs (*Derived from Living lab project, 2008*)

Living Labs have mainly three components involved in its structure; 1) data, information and knowledge that gathered from end users, expert and organizations, 2) environment that involves culture, negotiation protocol, meta knowledge, 3) resources that entails customers, facilitators and computing platforms (See figure 5). Depending on the resources and the environment, the products or services get ready for real implementation. Thus each Living Lab is associated with local universities, government, institutes and companies. It is mainly finance its costs and investments through public and private sponsors and contract research for clients. The interaction between all the stakeholders is described as a merger between market, technology and society in a collaborative fashion by Eriksson, Niitamo and Kulkki (2005). Thus the main characteristics of a living lab involve an examination of users in their environments throughout a combination of quantitative and qualitative research methods.

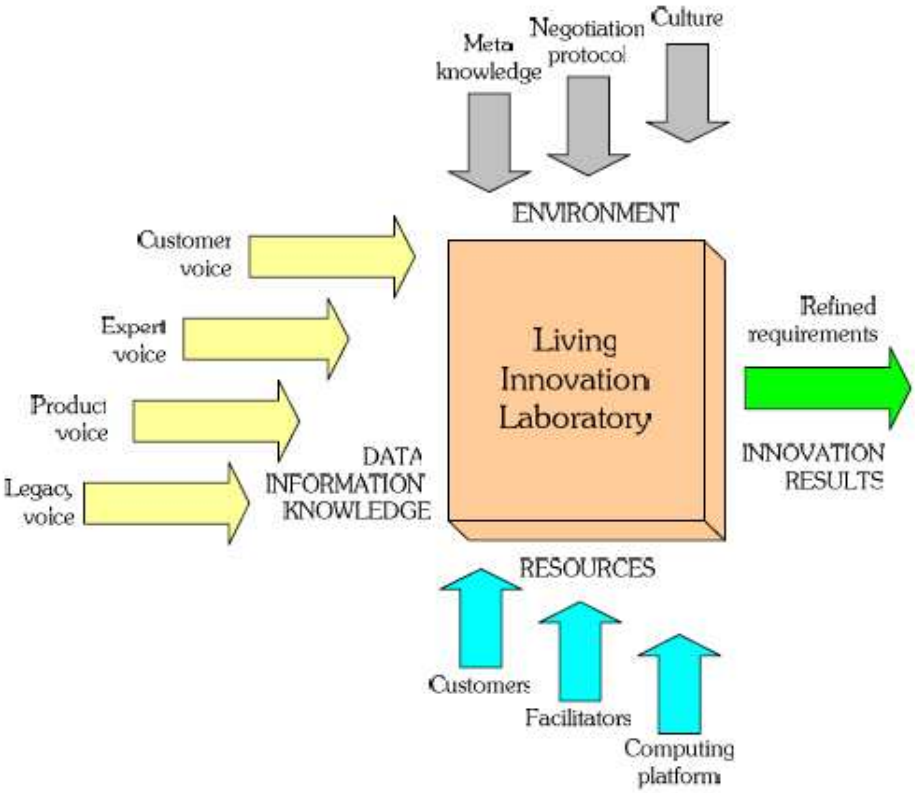

Figure 6: The concept of the Living Innovation Laboratory (*Derived from Kusiak, 2007*)

Living Labs have received a great deal of interest in the past few years. Among the research community it is also gaining a growing acceptance especially for acquiring insight into the innovation process. There are various advantages of living labs. However the major advantage for organizations to gain a more accurate market evaluation so the development of successful sustainable products and services through using living labs methodology. Also it shows how their products and services will be adapted in the real context through the generated insights from the functional prototypes. It also provides insights about future markets. Living labs are also getting momentum especially in for small and medium enterprises that look for a lower risks in their businesses and their investments (Lama and Origin, 2006; Schaffers and Kulkki, 2007). Thus there is a growing need for living labs which also explains their growth in number.

Even though living labs have various challenges still there are certain challenges that projects and organizations face. First of all, while the laboratory is a controlled environment, the Living Lab is not. Besides it can be time and budget consuming. It is also difficult to sustain cooperation of multi-disciplinary research teams (Schuurman & De Marez, 2009). Finally it requires further research as a concept and method.

Due to the various definitions, two different streams of thoughts generated about living labs; a pure "testbed" for innovative solutions or a means to conduct context research and co-creation with other users. Følstad (2008) classified three different kinds of Living Labs: a testbed enabling developers to test software, environments where you can experience and experiment with ubiquitous computing and services outside a production environment and finally an open innovation platform. Whereas Pallot (2006) argued that a living lab is neither a testbed nor a research lab, but rather an innovation platform. Additionally, Ballon, Pierson and Delaere (2005) reviewed 18 cases and according to technological maturity and focus, they classified six platforms: prototype platforms, testbeds, field trials, living labs, market pilots and societal pilots. The European Network of Living Labs (2006) defined living labs as a system and environment for building a future economy in which real-life user-centric innovation will be the normal co-creation technique for new products, services and societal infrastructures. Niitamo, Kulkki, Eriksson, and Hribernik (2006) mapped Living Labs based on a related approach. However, the current body of Living Lab research signifies that there is not a common agreement on general matters yet. Also there is a lack of common understanding of how Living Labs can be used for innovation and development. Moreover, there appears to be little agreement regarding needed future research.

3.3.1 Cases Studies

Frascati Living Lab

The Frascati County in Italy is famed with its archaeological heritage and wine but more importantly it is the most populated technological and research region. This is why a Living Lab is built to create a dynamic platform for institutions such as Nuclear Physics Laboratory, University of RomeTor Vergata and Banca d'Italia etc. Through this platform they aim to serve not only to traditional applications in sectors such as environment and agriculture but also transfer space technologies to non-space sectors. Moreover here they provide services to support the interaction of SME's networks with human centric organizations. With this living lab they provide services such as GeoNetwork repository, an application to manage spatially indicated resources through the web, GeoVine is a farming services based on satellite data and Sensor Web server data communication (ESA, 2008). These applications within the living lab intend to foster innovation and collaboration in various sectors.

CO-LLABS

Across Europe there is a CO-LLABS (Community-Based Living Labs to Enhance SMEs Innovation in Europe) project with the aim to achieve a European-wide adoption of ICT-based Living lab applications to support SMEs. These applications will foster the innovation for SMEs and provide an access to "open innovation" environments. The project initiated in 2008 and followed with various pilot applications for Living labs based SME innovation in domains such as e-health, and e-inclusion, e-business. These applications involve such pilots; mobile services for business (e.g. RFID and sensors within logistics) Telemedicine, Energy efficiency, e-tourism, etc (AMI@Work Communities, 2010). These pilots aim to provide superior insights for future SMEs. Since the CO-LLABS network will lead the interaction of policy makers at regional, national and European levels, it will also support the formation of a consensus on the Living Lab approach as a European Policy.

Helsinki Living Lab

The Living Lab initiative is scattered all around Finland and among them Helsinki Living Lab initiative in the Helsinki Metropolitan area is a major one. It encompasses and coordinates Living Labs and their activities in three cities: Helsinki, Espoo and Vantaa since 2007. It aims to provide a common branding and act as a hub for companies and the public sector that is willing to collaborate with Living Labs. The aim of this living lab is to develop living services that improves living comfort as well as provides the development of companies' operating conditions. For instance in the Arabianranta district University for Art and Design (UIAH) operates the Living Lab and Forum Virium, public agency, tests various projects such as intelligent traffic management, digital solutions for grocery stores, etc. Similarly Helsinki Living Lab completed a social media pilot called Fillarikanavais, RFID in gas logistics, Mobile TV and so on (Helsinki Living Lab,2007).

22@Urban Lab

In certain districts Barcelona pushes its limits toward an effective and sustainable city by transforming from industrial area into a home of new innovative companies. This, specifically, is the 22@Barcelona district project, but that is just one of many projects within the Barcelona Smart City plan, which includes a series of projects that will add value to companies and cities. 22@Barcelona district is a true living lab for new infrastructures and services with a collection of about 14 pilots in various domains such as Environment, Mobility, and Telecom (Leon, 2008). 22@Urban Lab project set up in the 22@Barcelona district as a testing ground for innovative solutions for companies seeking to implement tests in any field: urban planning, education, mobility, etc. Project along the neighbourhood began in 2001 and has run for over 10 years on

the district. It involves projects aim to create a sustainable living, working and mobility with advanced infrastructures. Some pilots include the implementation of 12 outdoor public street lighting points Eco Digital with LED technology that includes sensors of vibration, temperature, humidity, sound and pollution as well as GSM aerials, Wi-Fi Mesh access point and webcam for video surveillance functions. Another pilot was the implementation of 2 charging points for electric cars and management and analysis of the system from a centralized control point in Barcelona City Council. This district embraces clusters of ICT, Media, Energy, Design and Biomedical with a triple helix case (Batlle, 2011). With this living lab, new business culture is promoted based on collaboration between companies, universities and the public sector for innovation.

Living Labs are used as tools and processes for the creation of user innovation cooperatively in real life environments. It is employed for learning, conducting tests and research for the implementation of new technologies and services of organizations in large scale real life environments. As a promising method, Living labs not only provide benefits like product improvements but also foster innovation and give insights for future markets while lowering risks. This is why living lab applications have been accelerated tremendously in the recent years across Europe.

3.4 CROWDSOURCING

Crowdsourcing has gradually become more of a recognized mechanism for problem-solving for organizations through outsourcing the problem to the “wisdom” of a large “crowd’ of non-experts. Crowdsourcing has been defined as “the act of a company or institution taking a function once performed by employees and outsourcing it to an undefined (and generally large) network of people in the form of an open call. This can take the form of peer-production or by sole individuals (Howe, 2006). This “open call” often takes the form of a challenge/competition that attracts participants to submit their proposals/ideas and in return the best solution is awarded with monetary rewards. Thus the principle of “collective intelligence” is the underlying assumption of this idea.

The crowdsourcing phenomenon is not novel concept as Jeff Howe, the father of the buzzword “crowdsourcing” states. However it has recently gained significant amount of interest from both industry and academia. Especially web 2.0 technologies accelerated the application of this mechanism through online crowdsourcing platforms and contests. Today numerous organizations such as Starbucks, Procter & Gamble, Nike and Dell exploit bottom-up approach either through their own platforms or special marketplaces.

Crowdsourcing is popular in industries such as electronics, fashion, media, computers and sports/outdoors (McConnon, 2006).

James Ssurowiecki (2004) explains in his book The Wisdom of Crowds, that 'under the right circumstances, groups are remarkably intelligent, and are often smarter than the smartest people in them'. Thus crowdsourcing application is habitually superior to collaborative groups or single intellects. While this outsourcing mechanism provide several benefits for both the implementers and the participants, it also poses several challenges such as management of the crowd, quality of ideas, etc and limitations.

The crowdsourcing notion is coined by Jeff Howe, delineated it as "the act of taking a task traditionally performed by an employee or contractor, and outsourcing it to an undefined, generally large group of people, in the form of an open call" (Howe, 2006). Online crowdsourcing contests refer to a form of online competitions in which a firm outsources its problem/ challenge to an open crowd of solvers who compete for a preset reward. Most of these contests often facilitated as a service by online marketplaces such as InnoCentive, NineSigma and TopCoder.

The literature on crowdsourcing platforms and communities has been investigated by various authors from different sides. For instance, some authors focused on their relation with knowledge creation (Lee and Cole, 2003), knowledge sharing (Kuk, 2006) and innovation models (Von Hippel and von Krogh, 2003). Another important block of works are devoted to motivation of people participating in online communities (Hertel et al., 2003; Shang et al., 2006).

Crowds are not just motivated by money but also through other motives. Intrinsic motives such as fun (von Hippel and von Krogh, 2003; Torvalds and Diamond, 2001) recognition (Jeppesen and Frederiksen, 2006; Lerner and Tirole, 2002) self development (Lakhani et al. 2007) the passion for problem solving (Ghosh et al, 2002; Raymond, 1998) and reputation (Bagozzi and Dholakia, 2002; Hargadon and Bechky, 2006; Lakhani and Wolf, 2005) were found to be also the main motives for participators rather than only monetary rewards.

However, crowds are not only employed for solving business challenges but also for the creation of content in the form of news, blogs, videos, music, etc. The applications of crowdsourcing vary from information collection as in Wikipedia to user feedback collection as Starbucks does (Jenkins, 2006). Crowdsourcing platforms are also used to foster innovation, building channels with customers, improve competition and decreasing the risk of product development failure. It is important to notice that crowdsourcing differs from Open source with its model of competition and compensation that rewards its contributors. Whereas in the

case of Open source a product/software gets improved collaboratively with full transparency without any compensation.

Crowdsourcing activities vary in the nature of contributions; time spent and required knowledge for a contribution. These deviations lead in different crowdsourcing types such as knowledge discover approach which involves exploring and assembling knowledge; broadcast search approach for exploring an empirically right answer; peer-vetted creative production approach involves consumer tastes or user preferences; distributed Human Intelligence Tasking in which human intelligence is required to process large sets of data (Brabham, 2008).

Crowdsourcing involves numerous benefits such as extended resources, timesaving and cost savings in labour and production to access innovative resources outside the boundaries organization (Walmsley, 2009; Howe, 2008). With crowdsourcing customers are seen as biggest resource for identifying the innovative ideas (Leimeister et al., 2009). For contributors, sharing their knowledge and skills through crowdsourcing also offers opportunities for them. Simply they increase their exposure and can work on real issues (Drummond and Perkins, 2009), get noticed, improve their creative skills and be part of a community (Bonabeau, 2009; Schmitt, 2009; Winsor, 2009; MacMillan, 2009).

While it has certain benefits, it is also important to notice its potential drawbacks, limitations and challenges. Crowdsourcing encloses some potential limitations; 1) lack of collaboration of contributions, 2) quality of contributors may not be sufficient, 3) IP is available for exploitation by the contributor, 4) variances in the motivations for contributors to participate (compensation mechanisms), 5) management of platforms, challenges, submissions and crowd (Euchner, 2010).

Thus a successful crowdsourcing contest should involve a clearly defined challenge, effective incentive mechanisms, good management of submissions, a significant degree of control on crowd and building trust between the crowd and the organization. Moreover, still the success of crowdsourcing platforms is pretty much unknown. Similarly the ethics of crowdsourcing has been inquired since it benefits from the creativity of the participators for commercial gains (Bruns, 2007).

3.4.1 Case Studies

Currently, companies such as P&G, Starbucks, Google, etc have exploited crowdsourcing platforms with great success. Even governments initiated in crowdsourcing activities, such as Open Questions is a popular

initiative of President Obama to identify public concepts and issues. Some firms use crowdsourcing for new product development, for instance Cambrian (Marshall, 2008).

Brainrack.com

Pepjin de Visscher, CEO of President of Brainrack.com, and two other students intended to create a crowdsourcing platform for creative students like them to provide innovative ideas for organizations. This idea initiated based on a fact that there is not enough collaboration between people and organizations in terms of idea flow. Based on this view, Brainrack.com created a portal for organizations and students to meet and collaborate in 2009. The major challenge was attracting and persuading organizations to participate into this platform. The platform works as follow; first an organization posts a challenge and students submit their solutions on the platform. The organization reviews all the ideas and top proposals are awarded with money range between $3,000 and $9,000 and an opportunity to have an interview for a job position or internship. From their customer organizations, for each challenge they charge $99 and 25% of the prize money (Brainrack.com, 2011).

GoldCorp Inc.

GoldCorp Inc., a Canadian gold mining corporation operated in fifty year old mine in Red Lake, Ontario. Due to its underperforming after fifty years, it did not know where to look for gold in its area (Tischler, 2002). To generate new ideas, the company drastically posted all of the geological data online on its webpage for its land holding in Red Lake and invited participants to use this data for possible ideas in 2001. In total US$575,000 were handed out as rewards to the best of the proposals sent in out of more than 1,000 professionals from 50 countries. Through this crowdsourcing application more than 100 targets were identified on GoldCorp's property but more importantly 50% of them were new to the company. Since the launch of the challenge, 8 million ounces of gold worth roughly US$3 billion have been discovered on the Red Lake property which ensured an extraordinary return on GoldCorp's investment in the crowdsourcing challenge (GoldCorp, 2011).

12designer

12designer is a German based company founded by Eva Missling who had broad experience in the design industry. As an online crowdsourcing platform, 12designer is where customers with design demands such as

naming, slogans, logos, flyers, websites or multimedia clips meet the designers to get their demands. Through this platform, relations are build relations to achieve the desired results. It also provides cost-effectiveness for participator companies, mainly entrepreneurs, SMEs. They offer more than just design projects but also ratings, brainstorm, sound and multimedia creations. They also try to keep a close contact with their creative community. To their customers they offer free 12basic option which limits the number of participants to 12, and another service called 12plus that is paid with unlimited participation and privacy options. It is a platform for creative competition projects. It operates with various languages and has more than 7000 creators (12designer, 2011).

Crowdsourcing is not just another buzzword, but is instead a strategic tool to outsource information and innovation through tapping into a motivated crowd of individuals. Thus crowdsourcing provides a more efficient and innovative way for organizations to engage with the crowd. Crowdsourcing platforms assist to remove barriers for information flow and allow better access to decision-makers who need it. Clearly crowdsourcing has its advantages as well as its limitations and challenges. As its application broadens, we will learn more about it and take advantage of the value it creates.

3.5 OPEN DATA

In order to establish a transparent, accountable and innovative administrative management system, governments are transforming their public services in a more open, accessible and collaborative way. Several countries initiated in what is often referred to as “open government”. However, this revolution in the public sector primarily got worldwide attention after President Obama’s Memorandum on Transparency and Open Government in 2009.

An open government initiative is a robust framework for transformation of government agencies. It involves various activities ranging from interactive policymaking with citizens to proactive disclosure of government data. It also improves informational inputs into markets for public services and enables co-production of public services. Thus, open government initiatives redefine the traditional roles of government and citizens.

The focal foundation for this alteration is achieved via initiatives, which promote the exchange of information between the government and the public, otherwise referred to as open data. Open data refers to a practice of making data freely available online in a standard and re-useable format for everyone to use.

City halls collect extensive data about its residents and the city. “Data” in this case means everything from statistics to election results, to the locations of schools or parking lots.

As governments realize the benefits of opening up their data, open data has emerged as an essential movement across the world. Publishing government data to bring more transparency and greater public participation in government is neither purely an American idea, nor new. Many local and national governments have created their own ‘data portals’ to list their data such as “data.gov.uk” in the United Kingdom. These open data portals allow citizens to access all public information obtained during the management of public affairs, in standard and re-useable formats. Thus, open data is the key foundation of open government initiatives.

The social benefits of open government vary from citizen engagement to increased transparency and accountability, or enhanced communication channels. For instance, citizens gain greater insights into how their tax payments are being spent. As governments foster the availability of information towards citizens and help them to become better informed, transparency about government decisions and practices is improved, and much more knowledge can be created in a distributed way by citizens or organization that deliver new or improved services based on the huge database that the government opens up. Real-time availability of information also increases the potential to set up a broader range of services.
Beyond the social aspects of this progress, open data also supports public sector innovation by diminishing bureaucracy and friction in data exchange and demolishing competitive advantage gained by proprietary access to data. Innovation is most likely to occur when data is available online in open, structured, computer-friendly formats for anyone to download. Excellent examples are the USPTO[1] and EPO[2] databases containing patents that were applied for and issued in the US and Europe, respectively. These databases have been used by thousands of researchers and have advanced our understanding of the role in innovation in the creation of competitive advantages at the firm level and welfare creation on the macro-economic level. As a consequence, open government encourages new means of interaction between government and public.

To foster innovation, government entities vastly use “contests” to encourage citizen to collaborate. Among them, commonly occurring apps contests, such as the “Apps for Democracy” events, held worldwide, which aim to build web applications and services with open data. Government agencies also launch challenges such as ‘Challenge.gov’ or the ‘NASA Centennial Challenges Program’ in the United States for citizens to provide

[1] The United States Patent and Trademark Office
[2] The European Patent Office

and share their solutions and innovations with the government. Hence, open data is crucial for innovation as developers use government data to build novel applications.

Nonetheless, feeble implementation of open data initiatives may create high integration costs or security problems for the protection of citizens' data. Fung and Weil (2010) mention that when transparency focuses primarily on accountability of government, it could be problematic. This especially holds true if political opponents or journalists or even citizens use this transparency against government to seek evidence to destroy the liability of government. Then, instead of focusing on the public benefits arising from governments' activities, they will tend to focus on costs and any possible failure or corruption. The authors have also suggested that it can be overcome by creating a full accounting, to achieve complete government transparency.

3.5.1 Case Studies

data.gov.uk

The UK Government is publishing its government data to everyone in the 'data.gov.uk' website. As a result, people are not only informed about how the government operates, but they also will have a chance to reuse the data for new applications. This website provides all the government data, using open standards, open source and open data. They also provide resources and tools for developers and users. The general public can get involved in projects listed on the website by generating ideas on certain subjects, building applications, and providing data visualizations.

There is a discussion forum for developers to discuss and assist each other about ideas, applications and using of the data. Also a wiki was created for developers to share techniques, problems and tools and various other resources. All the datasets, except personal and sensitive information, created by public organizations are accessible for reuse in the 'data.gov.uk' website. In the future, government aims to open the access of these previously inaccessible data (HM Government, 2011). It also allows the access to raw data and its usage in varying ways. Developers use this data to build useful applications for the society and country. Currently, more than 5,400 government datasets are available for broad range of subject matters.

NASA

In the United States, NASA has embraced the White House's Open Government Directive and plans to embed the Open Government Framework through various schemes such as online challenges, open source

code competitions, technology transfer activities and open data. These schemes not only aim higher collaboration and innovation, but also infuse more public participation into NASA. The NASA aims to be transparent and accountable while improving its collaborative activities and innovation together with superior citizen participation. To kick off their efforts, NASA sought to use open innovation service providers (Innocentive and yet2.com) as a collaborative strategy to seek solutions to challenges external to NASA. With this open innovation strategy NASA explores solutions to its problems in the research and technology external to NASA. The solutions for these challenges may also be further developed as commercial products and services by other industries. NASA also developed a pilot project, an open source code competition, for a NASA challenge on the TopCoder community in 2009 as an open innovation initiative.

Currently NASA has various ongoing Open Government Activities mainly in two directions; 1) opening up its data to public and for that it initiated in Freedom of Information Act (FOIA); Declassification Program to review all classified information to assess what can be released to the public, what cannot and these initiatives provide the public access to government information; 2) engaging with public through initiatives such as NASA TV, NASA education activities and web initiatives to provide detailed information on its' activities, missions, and news (NASA Open Government Plan, 2010).

Recently, NASA has established other Open Government Initiatives, such as maintaining transparency on its' financial data and providing NASA's science data available to the public on the 'data.gov' portal to create new applications. Both new and ongoing initiatives aim to enhance Open Government principles in the long term. Out of these initiatives, NASA's technology transfer activities are the most crucial ones to promote economic growth and innovation in commerce since NASA acquires broad spectrum technologies. Given that many of its' technologies are so generic, they can be applied in almost any other industry.

With the National Aeronautics and Space Act of 1958, Federal Agencies such as NASA, are required to have a formal technology transfer program that facilitates the transfer of technology to the private and public sector for businesses and others to generate common benefit for the public (NASA Open Government Plan, 2010). Accordingly, NASA looked for various means to provide the technology transfer. For licensing process, NASA conducts new ways of licensing its patents and terms are negotiated on a case-by-case basis. Still, terms of use for every case are narrowly defined. NASA seeks licensees to transfer its technology to both private and public sectors that include commercial applications in various sectors such as medicine, agriculture, energy, manufacturing, transportation, and computer technology. It uses three main means; public auctions, publications and a technology portal.

QinetiQ

The idea that military research and development could possibly be privatized is not a novel focus. QinetiQ, which was founded from the partition of the UK's National, *Defense Evaluation and Research Agency* (DERA) provides technology-based services and solutions internationally to commercial customers and governments via its extensive IP portfolio. They use their domain knowledge to overcome technical challenges faced by their customers in defense, security, energy, and environment. QinetiQ launched projects like 'Advanced Sensors Innovation Project' to assist companies with their sensing capabilities (QinetiQ, 2011). During this project, a rich number of intellectual properties were generated that are applicable in various markets and industries.

Although it is not yet clear whether Open Government, in general, or different open data initiatives, in particular, will facilitate innovation or not, it is certainly on the agenda, for nearly all of governments, as a future governance model. In other words, open government, if implemented effectively not only could improve accountability of government, but also boost innovation in and beyond the public sector.

4. CONCLUSION

Previous innovation policies originated based on closed innovation and research strategies that were appropriate for until recently. However, with the changes in research strategies these policies cannot satisfy the needs of today's organizations. Eventually, public policies have started to be altered to support open innovation. After a thorough analysis of open innovation in public polices and its five methods, it is observed that today most of the European governments are implementing open innovation. They focus on stimulating innovation through implementing one or more of the following open innovation methods: living labs, sensor networks, open data, FTTH, and crowdsourcing. Overall, the implantation of open innovation in public sector is accelerating despite the challenges and obstacles that are faced.

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