



The Future of Open Innovation



The Future of Open Innovation

SCOPE OF THIS REPORT

Open Innovation has been a growing topic of both practice and research for over a decade. The term originated from the USA but has spread globally into many industrial sectors. This paper has a number of purposes:

- To define Open Innovation, OI.
- Outline the history of Open Innovation and the evidence for its success or otherwise in promoting innovation and contributing to new industries.
- Discuss the connection with Forward Looking Activities (FLAs), Open Access and Open Source software.
- Discuss possible policy options for the EC in relation to OI.

About the Author

Chris Yapp is an independent consultant with a 30 year background in the Information Technology Sector. In various roles he has had a 25 year interest in the theory and practice of Innovation. He has also 20 years interest in Scenarios and other Forward Looking activities. He has in this time worked on projects in the Public, Private and Social enterprise sectors.

The information and views set out in this paper are those of the author and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this study. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

OVERVIEW

Innovation is a complex and multi-factorial challenge. It is widely accepted that innovation is central to economic growth, the creation of new industries and the tackling of societal challenges. An increased understanding of the factors that support innovation, be it at the level of the firm, a region or a state is the focus of much research, policy and practice. There are many groups who have created indices that attempt to compare innovation in products and services in regional and national economies including the OECD, Boston Consulting Group and INSEAD.

In 2003, Prof. Henry Chesbrough published his book "Open Innovation". Over the last 10 years, it has become widely debated in academic circles. Many organisations in the private sector have set up "Open Innovation" projects. The initial book focussed on large High Technology Corporations. Today, the Open Innovation model can be found to have spread to debate and practice in pharmaceuticals, Food Industry, Social Enterprises, Start-ups and Small and Medium Enterprises, SMEs, and Higher Education for example. Again the initial book looked at the USA, but now OI is a global undertaking.

As with much of the literature on Innovation, it has its critics. There are many disputes over cause and effects. Evidence for its effectiveness can only be considered provisional in a topic that has evolved so rapidly.

There are other evolving topics that overlap with the field that share the "Open" label. "Open Source" started in Computer Software but has now spread to hardware, including cars, and to medicine for example. Open Access in Publishing is challenging traditional business models and approaches to Intellectual Property rights, IPR. Many governments are now publishing their official statistics online in "Open Data" formats to support the development of novel applications based on public data.

The Future of Open Innovation

The rise of the internet and the World-Wide Web, WWW has brought with it "novel" approaches to problem solving such as the "crowdsourcing" of ideas. This has in turn spread to new approaches to funding, "crowdfunding". Some overlap with these approaches and OI are clear.

There are also other approaches to innovation which show similar characteristics to the OI model. For instance, the evolution of design thinking as an approach to innovation has led to terms such as co-design and co-delivery which have been applied in public, private and third sector organisations. Some design advocates acknowledge OI, others do not. Interest in collaborative innovation can also be seen in the public sector where the notion of public value (22) is adopted.

For strategic decision takers and policy makers the real challenge is to understand how the ideas of OI may evolve and to apply OI principles where appropriate and to differentiate between the aspirations and evidence of the potential of OI.

The aim of this short paper is to provide a narrative to explain where OI came from and how it relates to similar concepts. The goal is to point to areas within the OI literature and outside that can build an evidence base to support visioning, thought leadership and strategic decision making.

Further, if the potential of OI is to be fully realised, there are areas of policy options and research outlined which can deepen and extend the evidence base for future work.

WHAT IS OPEN INNOVATION?

Henry Chesbrough(1) initially defined Open Innovation as follows:

"Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology".

This is contrasted with "Closed Innovation", CI, where companies invest in their own R&D, protect their Intellectual Property Rights, IPR, and maintain exclusivity over their products and services.

The term has evolved since its initial description. In particular, the extension beyond technology, and the private sector should be noted.

One current definition is "Innovating with partners by sharing risk and reward". The boundary of the term is in practice quite porous, but all activities tend strongly to feature common principles, as follows:

1. Connecting external and internal ideas and resources to enhance innovation.
2. Flexible approaches to partnership and business models
3. Trading in IPR where appropriate
4. A focus on frequent incremental innovations

The difference between the mindsets of CI and OI organisations is captured by the description of Innovation as Inside to Outside (CI) and Outside to Inside (OI).

Alternatively, the focus of CI is on the innovating organisation, where in OI the focus is on the innovating supply-chain, economic cluster or ecosystem.

Open Innovation from the Perspective of Forward Looking Activities

When starting a project on Forward Looking Activities, FLAs, it is common practice to start by "back casting". If the purpose of your project is to look forward "X" years, then it is generally considered effective to look back at least "X" years. This can assist in understanding the dynamics and drivers of change and the events that have shaped today in the field of interest.

The value of the OI model from an FLA stance can be seen in the contrast between the OI and CI "mindsets". From 1945 to around 1970, many large Corporations in the USA had large in-house Laboratories. Among the most famous of these is Bell Labs, which made many contributions including the transistor, the UNIX operating

The Future of Open Innovation

system and the development of Lasers. General Electric Labs were established as long ago as 1900. Companies in other fields, notably Pharmaceuticals also created in-house R&D Capabilities. In Europe Siemens was one of the major pioneers in this model.

However, there were challenges to the success of this approach, especially in the late 1960s and 70s. Xerox Parc was responsible for many breakthroughs in a wide variety of fields. However, some of the inventions in the Computing field had to be spun out to become successful. It has been argued that Xerox invented the Personal Computer but failed to capitalize on it. Chesbrough argues that the CI mindset can create blind spots, which he describes as the dominant logic of the innovating firm. This means that in-house inventions are made to fit the existing business model, which may not be appropriate for the new invention. He argues that the full value of the innovation can only be realized by a combination of the technology and the optimum business model.

The success, at that time, of the US Economy and the Corporate Labs, however provides only one part of the historical picture. Eric von Hippel (2) developed the notion of the "lead-user" in the mid-1980s and then generalised the model in his 1988 book on the "Sources of Innovation". He was able to show that over a long period of time that innovation had come from various sources and not just manufacturers. He described various examples where an innovation had been developed by partnership working with a company and a user. He also illustrated that suppliers of materials and components had also contributed to the wider innovation landscape. The notion of the lead-user of an innovation can be described as a user who has a need which will in time spread across the market, but has specific needs and can benefit from being part of the innovation process and contributing to its development.

The idea of user-led innovation can be clearly evidenced by the creation of the World-Wide Web, WWW, at CERN at Geneva in 1990. It is difficult to conceive how it could have reached its current scale and impact if after its invention it had been owned and controlled within the Particle Physics Research Centre.

As with Xerox Parc, the WWW demonstrates that the innovating organisation may not be the most suitable long-term home for a breakthrough innovation.

The Innovation Funnel

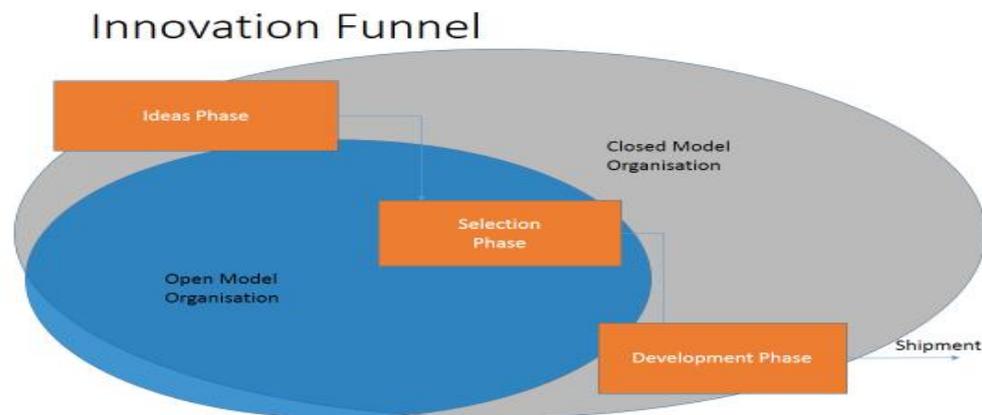
There are many different models of innovation. Here I wish to concentrate on the core innovation process, rather than the subsequent diffusion of the innovation. One of the most frequent visualisations of the innovation process is known as the Innovation Funnel. This is frequently drawn with a wide opening at the top narrowing to a small hole at the bottom. The illustration is adapted here to highlight the difference between the open and closed models.

The Innovation funnel is essentially a series of three steps. In the closed model all three steps are wholly or largely contained within the boundary of an organisation. The three steps are briefly:

- The ideas phase
- The selection phase
- The Development phase

Rather than treating the OI and CI models as opposites, they can be considered as the ends of a dimension. The extent to which one or more of the steps is executed beyond the boundary of the innovating organisation is then a degree of openness rather than an absolute.

The Future of Open Innovation



The ideas phase is similar to the notion of Horizon Scanning in FLAs. Horizon scanning is a process for an organisation to systematically search outside the organisation for trends, technologies, market changes to identify possible future problems or opportunities and to create a robust evidence base of decision making.

The second step is to narrow down the possibilities and make a few choices from all the possibilities available. This has some similarities to the notion of "Sense making" in FLAs. A key tool in FLAs are scenarios. Scenarios are not predictions about the future, but qualitatively different possible "stories" about the future.

The third step is the development phase where the investments are made in the development of the products and services.

One organisation might choose to develop the first step largely outside the organisation but keep the other steps in house. Another might choose to export the first and last steps beyond the organisational boundaries, but keep the selection process in house.

The Innovation Funnel model has been recently challenged by Wim Vanhaverbeke (3). He argues that the model tends to reinforce the notion that R&D is the same as innovation. So, much of the literature of the last 10 years has focussed on the application of OI to existing businesses. The rethinking that Vanhaverbeke suggests would apply to a much wider group of organisations, including start-ups in both products and services. In this case it could be argued that all three steps are outside the boundaries of the organisation.

There has been a trend in innovation literature from a focus on innovation of a product or service, to innovation as a process. This shift in emphasis can also be found in the design approach (4) to innovation. The role of the designer is described as changing from the focus on the "product design" to the facilitator of the design process from concept to delivery. The descriptions of these design methodologies has clear overlaps with the innovation funnel approach.

Exporting the ideas phase beyond the organisation raises the idea of crowdsourcing(5). The increasing availability of broadband communications is making it possible to create online communities and engage with many more people than has traditionally been possible. A number of technology platforms have been created which offer crowdsourcing services. For instance, Procter and Gamble provide web access for individuals and companies to share their ideas about new products but also packaging, design and technologies. P&G now claim that 50% of their innovations are externally sourced. The same mechanism also allows outbound transfer of P&G assets to new channels or markets.

However, crowdsourcing predates the internet and WWW by many years. In creating the first Oxford English Dictionary, Professor James Murray advertised for individuals to send in words and examples of their usage. By 1884, over 3.5 million examples had been sent in by people in a number of countries.

The Future of Open Innovation

It is useful to see the rise of the WWW as facilitating the growth of new capacity for innovation, rather than inventing new models for innovation that have no precedent.

James Surowieki (6), for instance develops the concept of the "wisdom of crowds". Under certain circumstances and with particular types of problem, it can be shown that diverse groups can outperform expert groups in a number of tasks. Feedback from some of the crowdsourcing platform users demonstrates this approach can be beneficial. Surowieki points out that not all crowds are wise, and defines the criteria under which high performance can be demonstrated. Again, one of the challenges with Crowdsourcing of ideas is that framing the question is key to the quality of the answer. Critics argue that if the question suffers from the "dominant logic" problem of CI, then small incremental innovations are likely to arise, rather than significant innovations. Two authors also describe a shift towards greater collaboration. Charles Leadbeater (7) describes the shift in logic from "mass production" to "mass innovation". Similarly, Clay Shirky (8) outlines the impact of mass online collaboration.

One interesting field lies in "citizen science". Galaxy Zoo (23), now in its 6th year is a website that allows people interested in astronomy to help professional scientists classify galaxies. As the principles of classification of galaxies are well understood by scientists it is possible to share images with non-professionals, who can assist in the endeavour which would take many years for the professionals to do alone. In its first year 50 million classifications were done by 170,000 individuals. It has grown and expanded year on year.

It can be argued that both OI and CI models have co-existed for a hundred years or more, rather than OI being a recent phenomenon. It could be argued that the CI model is the anomaly, becoming dominant for a generation in the late 40s, but since declining.

From the perspective of FLAs, this does not mean that the OI model lacks substance or novelty. On the contrary, the value of the OI mind-set is that there are a series of trends which are all pointing towards a trend away from closed to open innovation models. Different firms, sectors and countries may move at different speeds and along different paths, but the growth and development of OI for the foreseeable future seems highly probable.

DRIVERS OF CHANGE FOR OPEN INNOVATION

The emergence of the concept of OI can be seen in the context of a series of economic drivers which are well established and feature in many Futures studies.

Drivers of Change supporting	Open Innovation
The move from vertically integrated organisations to supply-chains, locally and globally.	Increasing availability of low-cost high speed communications networks The growth of digital products
The increased number of educated people	The need to personalise and localise products and services
Reduction in Product Life cycles	Increased complexity of products and services
Mature international standards bodies	Increased interdisciplinary skillsets needed
Increased number of Research Centres Globally	New models of IPR
Long research timescales	Resource constraints
Globalisation of Finance	The rise of Brazil, Russia, India, China

The Future of Open Innovation

	and India (BRICS)

These factors are not independent of each other. The factors in the table combine to create an economic environment which make the closed innovation model of the vertically integrated corporation increasingly difficult to sustain.

These factors have affected different sectors of the economy on different timescales and with varying effects.

The computer industry is an example where this change has been underway for many years. Up to the 1980s, the industry was dominated by companies globally who made their own hardware, software and communications and supported their customers with in-house support, training and services. These companies were largely proprietary and different machines from different suppliers were hard to connect together.

Today, individual companies create complex partnerships and supply chains to meet market needs. Each of the separate components of the industry has large niches. For instance, within software there are large segments in operating systems, applications and development tools and many other niches.

The long gestation times of Research in pharmaceuticals and the high costs and risks involved have led to Pharmaceutical companies developing strategic research collaborations with Universities to develop both the ideas and skilled people they need while reducing the need for in-house Laboratories.

The increasing drive for openness

The set of drivers outlined above do not mean that openness is an inevitable outcome. The ability of dominant players to create proprietary niches or exercise quasi-monopoly powers can still happen. In the online digital world there are competing tendencies between those who aspire to openness and those who seek what are known as "walled garden" environments where they can exert market power.

The protection of IPR, such as patents and copyright in the globalising world is a constant challenge and this affects different sectors in different ways.

Digital distribution of film and music for instance can be challenged by piracy undermining business models. Protecting firms' patents and business models may however make products unaffordable in the developing world, itself creating tensions. This has been most contested so far in the availability of drugs to the developing world.

The key challenge to policy makers in seeking to stimulate and support innovation is to distinguish breakthrough innovations from incremental innovations.

When a breakthrough innovation occurs then the knowledge and understanding will be in a small group of people, probably in a few locations. At this stage a temporary monopoly is quite likely. Balancing the rewards to the innovator with the wider social and economic benefits requires flexibility in regulatory frameworks and public policy. The danger with breakthrough innovations is that over regulation may stifle innovation. Weak regulation however may unintentionally confer undesirable monopoly market power.

Increasing numbers of governments around the world and some Research-intensive Universities are adopting a policy that all publicly-funded research should be available to industry and the wider public without additional charge. This is known as Open Access (9). Efforts to create more flexible models of intellectual rights to support openness have been championed by Lawrence Lessig (10), under the Creative Commons license regime for instance. It should also be noted that some companies who are proprietorial over their products also publish in-house research

The Future of Open Innovation

under open licensing regimes. This has two main purposes. First, the ability to attract high quality researchers is impaired if they are unable to publish their work. Secondly, it is a defensive mechanism in that it can prevent subsequent lock out of a market by another organisation attempting to patent in the same area.

In technology arenas, there are frequent battles over technology standards. The full market potential is often held-back in consumer markets until one standard becomes dominant. For instance, in the 1970s, the competition between VHS and Betamax in video recording has been well documented. In the last decade, Blu-ray took off in the DVD market once victory over the competing HDD standard was confirmed.

An alternative approach to standardisation can be found in Europe with the rise of digital mobile telephony in the late 1980s. A European collaboration on the GSM standard facilitated the rapid growth of mobile communications. Competing companies were then able to focus on incremental innovations built on the underlying technology platform.

Policy makers can contribute valuably to promoting innovation by identifying and supporting the development of key standards and platforms which will support the growth of new competitive industries and companies, facilitating investment in incremental innovations.

As mentioned earlier, the opening up of the WWW standards by CERN has facilitated the rapid growth of new sectors, such as e-commerce, e-learning and social media.

The rapid diffusion of innovations once the underlying platform has been established is a key feature of digital industries. The seminal work on the Diffusion of Innovations was that of Everett Rogers (11). In preparing this report, a gap in the evidence base appears to exist here. It is evident in much of the literature that the diffusion of innovations is changing facilitated by global communications. However the models that describe this important process and how it is evolving in different economic sectors and any consequential policy implications are hard to find.

An Openness Narrative

Scenarios are an important element of FLAs. Scenarios are descriptions or stories of plausible futures, not predictions. The creation of different but equally plausible scenarios creates a framework for strategic decision making in which thought leadership and policy directions can be tested to reveal underlying assumptions and risks.

The earlier table describes a set of drivers which support the creation of an environment or context within which OI may flourish.

What is outlined here is a narrative for an Openness Scenario and some possible challenges to it, based on the table of drivers above.

The growth of global communications networks based on common standards, has facilitated the globalisation of financial transactions and the growth of integrated supply chains in many sectors of the economy at a state, bloc and global level.

Growth in the developing world, especially the BRICS, which account for 40% of global population has brought with it an increasingly high number of educated people. As the developing world moves beyond being seen as a source of cheap labour, it increasingly seeks to invest in its own science and technology base to create research hubs to promote further prosperity. Cooperation on research, especially in areas such as health, between countries is developing as the number of high quality Research hubs increases.

While research is long term, product life-cycles in many sectors are diminishing. Also, there are increasing demands for the localisation and personalisation of products and services. Add to this the increasing complexity of products and

The Future of Open Innovation

services and the risk for companies who endeavour to develop everything in house becomes increasingly unacceptable. Rapid developments in technologies also increase the number of multi-disciplinary requirements for skills within an innovating firm. For instance telemedicine requires both medical and computing expertise. Regulatory demands also have impacts on innovation requiring multidisciplinary approaches: Energy companies face new requirements on climate change and Pharmaceutical companies are required not only to demonstrate the effectiveness of new medicines, but also their cost-effectiveness in improving health outcomes.

As the global economy expands, the need to avoid resource constraints is a growing challenge in many sectors requiring new materials and processes. Greater concerns over food security, climate change and energy security for instance lead to a drive for higher levels of innovation. These global challenges are best addressed through international collaborations.

Within ICT, concerns over Cybersecurity again require international collaboration on both standards and practice. The development of the digital economy has brought with it disruption to sectors which required physical production such as books, music and films. The ability to trade internationally in digital-only media and tackle issues such as piracy needs international harmonisation.

The next phase for the development of the Internet, known as the "Internet of Things", IoT, envisages 50 billion sensors around the world by 2020.

Standardisation efforts are underway around the world to underpin the IoT.

Within the above scenario the model of Open Innovation as it is developing should be secure as a dominant approach for tackling social and economic problems and the creation of new innovative possibilities.

Challenges to the Openness Scenario

As with all scenarios, there is no inevitability. For policy makers pursuing this scenario as a desirable outcome what are the risks and alternative futures that need to be prepared for?

Some of the major challenges to this view are outlined here to stimulate debate on policy options.

There are many challenges to globalisation. These include civil unrest and security of supply. For instance, the floods in Thailand disrupted component supply in automobiles and computers. Some industries, notably mobile phones require materials whose principle sources are in unstable regions.

Models of open corporate ownership in the developed world are being challenged by large sovereign wealth funds, private equity and governance models from the BRIC countries.

The ownership of proprietary standards can be a source of economic leverage in new markets.

Attitudes to the protection of IPR vary around the world and in different economic sectors. Where product lifecycles are very short, the cost and value of patents may not be properly aligned.

Concerns over data security and privacy internationally have been rising in the recent past as have concerns over internet censorship.

What these factors illustrate is that there is likely to be a balance between Open and Closed models of innovation in any realistic future scenario. The goal for policy makers in promoting innovation should be to define areas where openness is required to foster new industries and companies and to maintain the competitiveness of existing industries where there are desirable public policy outcomes, such as security in its widest sense, inclusion and job creation.

RELATED CONCEPTS

The Future of Open Innovation

With Open Innovation as a concept arising from studies of Technology firms, it is inevitable that there is an overlap with the concept of open source software. There are other terms that are also sometimes seen as part of the OI umbrella. Some of these ideas will be explored here in the context of the evolving OI model.

The open source software, OSS, movement has a long history and examples can be found before the rise of the internet. However, the internet has enabled the rapid growth and spreading of the Open Source principles and practice. Two approaches to OSS developments have been documented in a famous essay by Eric Raymond (12). He calls these approaches the Cathedral and the Bazaar. In the Cathedral approach a group of software programmers work on a product. Once they have a defined set of features they make the software available to the wider public along with the source code. This is similar to the methods used in proprietary software developments and can be considered top-down developments.

The Bazaar model is a bottom-up approach in that software is developed openly over the internet by collaborators and is visible at all time. The best practice in this approach is to make frequent releases of capability with an initial version for those who want to take advantages of new features and are prepared to accept that it may contain errors with a second stable and tested version. The responsiveness to feedback on errors and missing features is often noted as key to keeping people engaged and motivated by the project.

Open Source Software

The funding and the business models for OSS are very diverse. Also, the terms under which the software is made available is similarly diverse. There are over 1000 different licensing regimes within the OSS movement.

Some OSS approaches have become dominant within their niches. Well-known examples include Linux, Apache, Java, Moodle, Mozilla and MySQL. When OSS projects become successful, the development processes, testing regimes and documentation tend to evolve to assure quality, documentation and deal with cyber security issues and bug fixing.

It is important to distinguish Free Software from Open Source. The difference is that in OSS the authors may claim retention of the ownership of the software but grant a user a free license to use, modify and develop the software without charge so long as they do not violate the terms of the license, that is to say that they retain rights over the software. However, the complexity of the licensing regimes makes a firm division between the camps difficult to call.

Often the OSS developers will release software development toolkits, SDKs, also under OSS licenses or provide documentation of software interfaces to enable the further developments of the software.

Many OSS projects have been initiated within Universities, often with Public Funding.

The OSS movement has expanded to cover many application areas including project management, office software and content management systems. It has also spread to digital media and user-created content. It is in this content sphere that a more permissive licensing regime, Creative Commons, has evolved. Wikipedia is the most successful example of the open content initiatives.

It is clear from this brief outline that OSS shares much in common with OI. There is an emphasis on collaboration and flexibility in business models. In the early phases there is a lot of experimentation and freedom in the processes. For large scale projects once successful, there is more rigour put into the processes and frequently the ownership of the project and its strategic direction placed into an institutional arrangement.

The Future of Open Innovation

If there is a key lesson from OSS for the OI movement it must be in the complexity of the licensing regimes. Combining different OSS projects under different licensing regimes, especially when embedded in commercial offerings, has probably been a brake on the success of OSS because of the uncertainties over commercial liabilities.

It can be argued that the relationship between OI and OSS is asymmetric. While OSS implies OI, the reverse need not be the case. The availability of SDKs and published interfaces for proprietary platforms can enable users to develop their own innovations, thus fulfilling at least some of the aspects of the OI model.

OSS is also an example of crowdsourcing as described earlier. Raising funding for OSS projects using the open collaborative principles, crowdfunding, has also developed over the past few years. Here again the legal frameworks can be a barrier to success. Threats by patent holders, lack of IPR protection for innovators and fear of scams are all barriers to the sustainability of these open approaches.

Application of OI to start ups

It is in the application of OI principles to start-ups and spin outs from HE research that an important approach, hackathons, could improve the rate of formation of growth-orientated Small and Medium sized-enterprises, SMEs which may enhance the competitive environment of the EU member states.

A key challenge for many entrepreneurs is that investors want to see something before they will invest in the project or business. The problem is that the innovator often needs skills and funding to build the prototype which the investor wants.

In a hackathon, a group of experts in a field meet for a short period with potential innovators. The best practice appears to be to define a loose field or domain for the event, such as a field in computing, health, or transport. The innovators get the chance to work on their own ideas but also to get feedback from innovators in the same field to identify potential collaborators and sharpen their concept. Variations on this model can be found under names such as Bootcamps, Sandpits and Meetups. The latter is, for instance, growing for start-ups working on the IoT. This can enable knowledge sharing and the developments of clusters and skills.

The ability to bring different domains of expertise together in this way in such areas as telecare can also facilitate innovation across different disciplines such as IT and health.

These approaches are used in both the support of for-profit enterprises and social enterprises.

So, within the broad scope of Open Innovation there is a wide variety of activity and terminology and practises which build up an evolving picture of both the goals of OI as a movement and the means to achieve an improvement in the innovative potential of the EU.

CRITICISMS OF OPEN INNOVATION

The first focus of criticism of the OI model is that it is not a new phenomenon and that it predates CI. As argued above, what is now identified as OI has a long history before 2003, but there are many trends in the economy and society that arguably favour a general context of openness. This line of criticism is unhelpful from a policy perspective. In tackling global issues, in fostering international collaboration and trade, there is a balance to be struck between the CI and OI models to ensure desirable outcomes. Advocates of OI would argue that the starting point should be "open by default". Acknowledging the co-existence of both the OI and CI models enables us to draw on evidence of the efficacy of both approaches rather than restrict ourselves to evidence gathered in the last few years.

The Future of Open Innovation

Probably the most significant challenge to the OI model is suggested that evidence to date points towards its use in incremental innovations, but that it is weak in areas of breakthrough innovations. With long-term pressures on state budgets, the funding of long-term research without clear payback timescales that led to the development of the Arpanet and the Internet in the USA, and the development of the WWW in Europe is contested. The evidence that the private sector will fund this type of research is limited. Perhaps the greatest policy challenge is to determine those areas of public intervention and the supporting tax and IPR regimes that will ensure European Competitiveness and social cohesion.

A further line of criticism is on notions of mass collaboration. There is clear evidence in cases such as Wikipedia of success in building a global platform. Corporate examples such as Lego or Procter and Gamble illustrate how established brands can benefit from OI. Open source software, notably Linux, has spread to Open Hardware and to projects such as OSCAR, a project to build a car to Open Source principles. However, in fields that are less "glamorous" will these types of community be sustainable? Claims of mass innovation need to be treated with caution. One study for instance on OSS(16) showed that the median size of an OSS project was 2 programmers with an average of just over 5.

It is also argued that there are hidden costs in OI approaches and that if too many OI projects are undertaken simultaneously that the organisational complexity for the innovating firm can be as challenging as the CI model. Gianluigi Giustiziero (17) provides such evidence in a Pharmaceutical context.

WHERE NEXT FOR OPEN INNOVATION?

Clayton Christensen has made two highly significant contributions to the innovation field. In the Innovators dilemma (13) he highlights the challenges to existing successful firms when their existing products and services are challenged by new technologies and disruption to their business models. Advocates of OI would argue that the OI mind-set is more suited to an era of disruptive change.

Importantly, Christensen (14) argues that theories of innovation can be used to enhance our understanding of and prediction of industry change.

As argued earlier there are some similarities between the innovation funnel model and some of the FLA processes.

While a lot of emphasis is placed on innovative products and services, the literature on innovation constantly stresses the importance of leadership and organisational culture in fostering innovative potential.

Lindgard (15) has drawn together the key themes of the Essentials, roadblocks and the Leadership skills needed to optimise the success of OI-committed organisations. Vareska van der Vrande (18) provides a complementary coverage looking at OI in the context of SMEs.

The rise of OI as a concept and its increasing expansion of scope brings with it the need for more robust frameworks for evaluation of both the opportunity and the limits and risks. Gassmann et al. (19) have outlined a framework for research in OI and evaluation of the OI model.

There is also an emerging field within Innovation under the name of "Responsible Innovation" (20). In this field, the goal is to develop frameworks to help the transition from scientific breakthrough to technology products and services meet wider social goals such as sustainability and social equity. It notes that many areas such as nanotechnology and GMOs have ethical challenges which need to be addressed to ensure acceptability. This field also stresses future-looking responsibility. It should be noted here that both OSS and OI advocates make claims that "Open" is an ethical choice.

The Future of Open Innovation

The theme of democratizing innovation is also described by Eric von Hippel (21).

Principles of the OI model

There appear to be a set of principles and themes within the OI model and the related concepts that are evolving in a common direction and may give some sense of direction about how these concepts may merge, integrate or co-exist.

1. Openness as a mind-set for leadership.
2. Focus on developing the open innovation processes
3. Co-design and co-delivery of outcomes with partners
4. Organisational agility for incremental innovation
5. Flexible approach to IPR and business models
6. Innovation as a Forward looking activity
7. An ethical basis for "Open" innovation

The challenge for policy makers is to identify the levers which will enable the benefits of the OI approach to be maximised in support of economic competitiveness and social equity within the EU and member states.

INTEGRATING OPEN INNOVATION AND FORWARD LOOKING ACTIVITIES

It can be argued that the greatest strength of OI is also potentially its weakness. The ability to collaborate globally from start-up phase and to iterate products and flex business models can be of great benefit to the rapid development of innovative ideas. However, with that comes great complexity when trying to make combinations of open innovations. These can lie in areas such as licensing regimes, but also in unintended consequences or unforeseen problems.

One such area has been the challenge of cybersecurity on the internet and WWW. Retrofitting security into a global network of billions of users is a serious challenge to technologists and to law enforcement alike.

With the growth of the next generation internet, the IoT, it is envisaged that cars, domestic appliances, sensors and other artefacts will be networked. It is not yet clear which applications of this technology will turn out to be economically viable. The Smart Cities movement is pioneering many new technologies to meet the challenges of 21st century urbanisation.

What is clear is that retrofitting requirements for privacy, security, resilience sustainability and public value, as examples, is problematic in both cost and capability. While not predicting the future, FLAs can provide insights into the general areas of likely problems.

Within the technical domain, ensuring that the "platform" technologies are designed as "secure by default", for instance, may increase upfront costs, but can address serious downstream problems preventing costly reworking. Especially where a technology becomes part of the city or state critical national infrastructure, ensuring end to end resilience and security requires technical standards and common interfaces.

To integrate FLAs with OI what is envisaged is a 3-layer model, as follows:

- The Social Layer (e.g. policy, economy, culture and values)
- The Domain Layer (e.g. Health, Education, Transport, Sustainability)
- The Technology Layer (e.g. ICT, Pharma, Genomics, Energy)

Much FLA activity starts at the top level and moves downward. Many innovations will start in the bottom two layers and move up. Better communication across these 3 layers can assist in detailing requirements and identifying areas of policy development and standardisation efforts.

The Future of Open Innovation

For instance consider development in electronic health records. The health domain requires that the supporting technologies meet the requirements for patient confidentiality. In turn, changes in the treatment of long-term conditions or societal values may place new demands on the health records system. A feature of the openness narrative is that at each layer, the individual domains have porous boundaries. An ageing society with more long-term conditions creates potential for education and health to work together to empower the patient or citizen to manage their own condition.

An early example of the Internet of Things is the notion of the Smart Grid. Here, the ICT infrastructure integrates with the energy infrastructure. The benefits expected are contributions to a low carbon economy and reduced energy costs for consumers in the long run. However, concerns have already been raised by privacy campaigners about the monitoring or surveillance of individuals and households made possible by this integration at the technology layer.

Mapping the higher level requirements gathered from FLAs onto the lower layers can support the targeting of public investment in innovation and regulation into ensuring innovations at the lower layers are consistent with societal and economic goals. It could also provide a framework for discussion between Universities, Government, Standards bodies and Industry on areas where collaborative standards development is required to facilitate the growth of a new platform which will support incremental innovations built under the OI principles, while ensuring social goals.

The constant tension is that innovators and entrepreneurs want autonomy, so early regulation can impair innovation. However, a lack of regulation and policy direction can create systemic problems when scaled, as in the case of cybersecurity. A simple framework as envisaged here could facilitate improved dialogue between these differing views.

AREAS FOR POTENTIAL POLICY DEVELOPMENT

It is important to realise that there are already many initiatives within the member states and at the EC that are contributing to furthering the OI agenda.

Open data initiatives, Open Source Software initiatives, Open Access Publication of Publicly-funded research, Collaborative R&D, Education mobility, standards activities, High Level Expert Groups are just some of the mechanisms and programmes in place which are facilitating OI within the EU.

Consideration should be given to improving the visibility and co-ordination of these activities within the OI agenda. A review of all these activities at EC level and member states could provide valuable insights into leading practice and gaps or inconsistencies that hamper OI development within the EU.

The key shift in policy focus is from the "innovating firm" to the innovating region, cluster and ecosystem. Again, it is likely that there is much EC activity in this area which might be aligned with promoting OI.

The following suggestions are brief descriptions of the methods and domains associated with OI which may be fruitful for further development and debate.

Applications of Crowdsourcing and mass participation

The development of the Open-mind set and the potential for mass collaboration is a significant challenge across society. Within Education at all levels, what can be done to develop citizens who can contribute to enhancing this?

For instance, are there areas of EC activity where mass participation could be modelled along the lines of Galaxy Zoo? Potential areas may be in Smart Cities and the Internet of Things. For instance could citizens, including children work on

The Future of Open Innovation

modelling impacts of climate change at a local level alongside professional scientists?

We know these techniques can work, but greater understanding of the preconditions for success requires robust research and evidence.

It would be wrong to restrict this to areas of science and technology. With an ageing society, in advances of treatments for Dementia and other conditions of old age, might crowdsourcing of ideas around "living with ageing" work. This is the kind of complex field where health, transport, work and factors such as loneliness interact. If successful, the ability to process what is known as big data could provide a richer, more nuanced picture for policy makers of the challenges at lower costs than traditional consultation mechanisms.

Applications of hackathons

Improving the environment for start-ups, SMEs and entrepreneurship is a key objective of the EC. Are there areas of EC challenges where hackathons might bring together innovators, researchers, subject experts and financiers to shorten the timescale to initiate new company formation?

Intellectual Property

There is already much activity on IPR within the EC. The proliferation of licensing regimes may be a barrier to furthering OI goals. Yet too rigid an IPR regime undermines the flexibility of OI project initiation. If barriers to uptake of OI are being created by this complexity, it would be useful to have evidence of this to inform the ongoing debate in this complex arena.

Public Investment

In respect of IPR, the regimes for public investments in University and other research centres can play a significant part in fostering the OI movement within the EC. As mentioned earlier, there is a lot of activity in this space already. Could an "open by default" approach match and learn from the various "digital by default" initiatives around the world?

It was noted earlier that the WWW, initiated in Europe as with many other breakthroughs, often occurs in an organisation that is not the proper long term home. It is likely that future significant breakthroughs may occur in a similar way. Can FLAs help identify areas where these kinds of step change may arise?

Standards Activities

It is recommended that the EC identify key new industry areas where open collaborative platforms will accelerate the time to market and create environments for incremental innovations under OI principles. As with the success of GSM in mobile telephony, fostering industrial collaboration can enhance competitiveness and prevent proprietary lock out.

Incentives for OI in Industry

It is widely accepted that the USA has a significant lead in the rate of new company formation in high-growth industries. While there are strong cultural reasons for this, small companies cite the tax regimes and access to finance as a significant barrier outside the US. Investments by US corporations through venture capital in start-ups in adjacent industries is also more common, as is investment in University Research. This fosters a climate of clusters and ecosystems as seen in Silicon Valley.

CONCLUSION

The Future of Open Innovation

The term Open Innovation arose in the USA a decade ago. However, the principles behind this evolving concept have a long history. There are many factors which are driving a move towards greater openness, but this should not be seen as an inevitability.

The climate for Innovation and Entrepreneurship in the high tech industries within the USA clearly creates international competitive advantage. Increased investment in innovation by the BRICs also creates new collaborative opportunities.

However, by putting the OI movement in a wider context it is clear that Europe has a track record and some major successes in delivering OI-based activities. There are also many areas of activity which already support the OI agenda. This is not to be complacent however. Better co-ordination of effort and focus in the areas outlined in the earlier section can contribute to enhanced competitiveness and social goals. Importantly both OI and CI models will co-exist. The balance appears to be shifting towards OI, but CI cannot be ignored.

REFERENCES

1. Open Innovation: The New Imperative for Creating and Profiting from Technology(2003), Henry W Chesbrough (Harvard Business School Press)
2. The Sources of Innovation (1995, new Ed.) Eric von Hippel (OUP USA)
3. Rethinking Open Innovation beyond the Innovation Funnel (2013), Wim Vanhaverbeke (Technology Innovation Management Review)
4. The Art Of Innovation: Success Through Innovation the IDEO Way (2002), Thomas Kelley (Profile Books)
5. A Guide to Open Innovation and Crowdsourcing: Advice from Leading Experts in the Field(2011), Paul Sloane (Kogan Page)
6. The Wisdom of Crowds (2005), James Surowieki (Doubleday)
7. We-Think: Mass innovation, not mass production (2009), Charles Leadbeater (Profile Books)
8. Here Comes Everybody: How Change Happens when People Come Together (2009), Clay Shirky (Penguin)
9. Open Access(2012), Peter Suber (MIT Press)
10. Free Culture: The Nature and Future of Creativity (2005), Lawrence Lessig (Penguin)
11. The Diffusion of Innovations (2003) Everett M. Rogers (Simon and Schuster)
12. The Cathedral and the Bazaar (1999), Eric S Raymond (O'Reilly Media)
13. Innovator's Dilemma: When New Technologies Cause Great Firms to Fail (2013, Reprint Ed.) Clayton Christensen (Harvard Business Review Press)
14. Seeing What's Next: Using the Theories of Innovation to Predict Industry Change: Using Theories of Innovation to Predict Industry Change (2004), Christensen, Anthony and Roth (Harvard Business School Press)
15. The Open Innovation Revolution: Essentials, Roadblocks, and Leadership Skills (2010), Stefan Lindegard (John Wiley and Sons)
16. Free/Libre and Open Source Software: Survey and Study Part V (2002) Ghosh, R.A.; Robles, G. and Glott, R. (*Maastricht: International Institute of Infonomics*)
17. Open Innovation in the Pharmaceutical Industry: Does friendship have a price? (2011), Gianluigi Giustizerio (Lambert Academic Publishing)
18. Open Innovation in SMEs: trends, motives and management challenges (2009),Vareska van de Vrande et. al (Technovation, Elsevier)
19. The Future of Open Innovation (2010), Gassmann, Enkel and Chesbrough (R&D Management, Blackwells)
20. Responsible Innovation: Managing the Responsible Emergence of Science and Innovation in Society (2013) Richard Owen (Ed.) et al. (Wiley)

The Future of Open Innovation

21. Democratizing Innovation (2005), Eric von Hippel (MIT Press)
22. Creating Public Value (1997), Mark Moore (Harvard University Press)
23. Galaxy Zoo@ www.galaxyzoo.org