Management of Emerging Technologies for Economic Impact

Open innovation strategies and practices

Contents

ManETEI
Management of Emerging Technologies for Economic Impact

For the last four years, the Marie Curie Initial Training Network has brought together a diverse group of leading European business – research institutes and industrial partners to focus on the challenges of managing emergent technologies, with an emphasis on the growth of open innovation ecosystems.

Throughout the four year project, the emphasis has been on developing economic impact by targeting industry-relevant questions. This brochure highlights 5 cases inspired by important questions emerging from the Bayer Industry Event, which brought together early and experienced researchers, academics and industry practitioners to analyse
and discuss the topic of open innovation from an industry perspective. In the following pages, we look to provide some insight into the following questions:

- How do companies interact with external people and organisations (government, universities, and other companies) to innovate?
- How do companies keep track of and integrate emerging technologies into existing business units/groups?
- What are the models and best practices for open innovation systems?
- What are the benefits and challenges of having an open innovation system within a company?

What is ManETEI?

Research

The ManETEI network is a research-led training programme designed to create a rigorous collaborative research agenda centred on the multifaceted phenomenon of managing emergent technologies for maximum economic and social impact. It has advanced capacity building and career development to benefit the early-career and experienced researchers needed to ensure Europe becomes a leading knowledge economy.

Training

ManETEI has brought together leading European business schools and research institutes, and a diverse group of industrial partners from different sectors, technologies and countries. The network has provided a stimulating and active learning environment where researchers were given the opportunity to develop skills by undertaking secondments, paying short visits to network partners, and participating in training events and network meetings. Researchers were temporarily 'adopted' by industry partners to get a real feel for the dynamics of technological innovation in practice.

Managing emergent technologies in an open innovation ecosystem

Innovation resists stabilisation and continuously develops in directions that challenge established theories and the very practice of innovation professionals. It is already recognised that innovation frequently depends on the interplay between many organisations across different industries. Such ecosystems of interdependent organisations are characterized by the wide dispersion of knowledge that organisations need to integrate and coordinate. This focus on collaborative and the open nature of innovation has exposed questions of how organisations organise internally to search for adequate knowledge dispersed throughout an ecosystem, and which strategies are required for capturing value in open innovation contexts.

The open nature of innovation in complex ecosystems radically shifts the understanding of firms' innovation strategy and organisation of innovation processes. Innovation research suggests a number of activities: separating exploitation from exploration activities, searching globally, participating in innovation networks, collaborating in research and development (R&D), acting in markets for technology intellectual property (IP) and fostering corporate venturing, to name just a few. However, the avowed openness of the innovation processes and the ever-increasing role of wider society requires a major shift in understanding the behaviour of an innovative firm.

New organisational structures are emerging that enable coordination across organisational borders, yet those that support open innovation processes are not sufficiently studied. The search for highly distributed knowledge is additionally complicated, because firms are not only searching for external knowledge that supports developments of their products or services. Many technology-enabled new products or services are themselves complex knowledge architectures (e.g. cloud computing), with numerous firms contributing their competency only at a component level.

Bayer MaterialScience

The company

Bayer MaterialScience (BMS) is a high-tech materials company working across a wide range of industries, including automotive/transport, electrical and electronics, construction, and sports and leisure. Situated within the Bayer organisation, alongside Bayer Healthcare (BHC) and Bayer CropScience, BMS develops new high-tech polymer solutions in polyurethanes, polycarbonates and coatings, adhesives and special applications.

Innovation at Bayer

BMS innovation is supported by internal R&D, which is complemented by a broad network of partnerships with the academic, private and public sectors. The company operates a decentralised approach to R&D; with three innovation centres in Europe, the USA and Asia, as well as several smaller R&D hubs around the world in regions across Brazil, Japan, Thailand, South Korea, Taiwan, Singapore and India.

Within the R&D operation, BMS deploys a new-business unit exclusively dedicated to discovering innovation opportunities and anticipating new trends. The new-business group comprises both teams of innovators focusing on basic technical innovations, and scouts working to identify potential business opportunities and threats. The innovators work closely with universities, research institutes, other companies and customers around the world. The scouts collaborate with external experts to develop scenarios and draw conclusions. Being open to external competencies and ideas is crucial.

- In 2011, the company invested approximately €237 million in R&D.
- Around 1,000 of the total employees worldwide are directly involved in innovation.
- In 2010 alone, approximately 240 patents were submitted.
- Bayer MaterialScience cooperates with more than 50 universities and institutes worldwide and many partners from industry, for example, in Germany the Federal Ministry of Education and Research and the energy supplier RWE, and in China the Chinese Academy of Science and the manufacturer Chery.

Open innovation at BMS

The BMS strategy for organising for innovation has varied, dependent on the levels of 'openness' required for the problem or challenge faced. The strategy has included the development of joint ventures, public–private partnerships and the use of 'crowdsourcing'.

Joint ventures, public-private partnerships, idea incubation and crowdsourcing are part of Bayer´s open innovation strategy. These are some additional examples:

- **INVITE:** a research joint venture between TU Dortmund University and Bayer Technology Services.
- **The Innovative Medicines Initiative:** Europe's largest public–private partnership. BHC is involved in several projects.
- **Grant4Targets:** an idea-incubation initiative started by BHC in 2009. It provides financial support for innovators (from academy and industry) to test their ideas, and access to advanced tools and technologies and complementary expertise, while the IP rights remain with the applicant.

The challenge – crowdsourcing at BMS

Crowdsourcing is one part of the open innovation toolkit that has proved a particularly useful strategy for BMS. Bringing together external ideas and knowledge will help the company develop new solutions to global challenges around climate change and energy shortage. BMS's first crowdsourcing initiative started in 2011 to promote solutions to prevent desertification in Africa. The implementation was carried out in four stages over 36 weeks (see *Figure 1*).

1st stage: the first phase was aimed at developing the project proposal ('Help to Avoid Desertification') and then selecting a suitable open innovation platform. A number of platform solutions were evaluated and compared in their abilities to provide openness to the public, fulfil German legislation (IP, data privacy, and terms and conditions), give freedom to design websites, support multiple languages, and offer experience and support. The selected platform was the Innovationskraftwerk or 'Innovation Power House'. This open innovation platform was created by the Germany – Land of Ideas initiative and inno-focus businessconsulting.

2nd stage: the second stage focused on preparing the online phase. The project team developed the guidelines for the on-line community and the assembled decision-making jury. The formation of the jury was an important part of the process, and consisted of five people from different countries and organisations (United Nations to Combat Desertification, Deutscher-Afrika-Verein, BMS, African Development Bank, and Bayer International Fribourg)

The guiding questions were designed to assist the idea-givers to understand how best to connect and contribute to the initiative. The questions were rooted in three areas: water, infrastructure and energy.

- **Water:** how can we conserve this crucial resource most effectively? What approaches optimise its treatment, preservation and availability worldwide?
- **Infrastructure:** how can we make solutions for buildings and transportation more energy-efficient, more affordable and safer while reducing emissions and conserving fertile land?
- **Energy:** how can we increase our use of renewable energies, such as hydroelectric, wind and solar?

Source: Graefenstedt, Michael, 'Open Innovation: Opportunities and Challenges', ManETEI Industry Event

3rd stage: the third phase was the online phase, which lasted approximately ten weeks. During this time, 47 idea-givers submitted 85 ideas. There were more than 15,000 page views and over 1,500 people visited the website, mostly from Germany, Israel, Saudi Arabia and India. The level of professionalism shown by all concerned was impressive.

4th stage: in the last phase, the ideas were evaluated. Out of the 85 submitted ideas, 41 were assessed by the jury. Four final winners were selected.
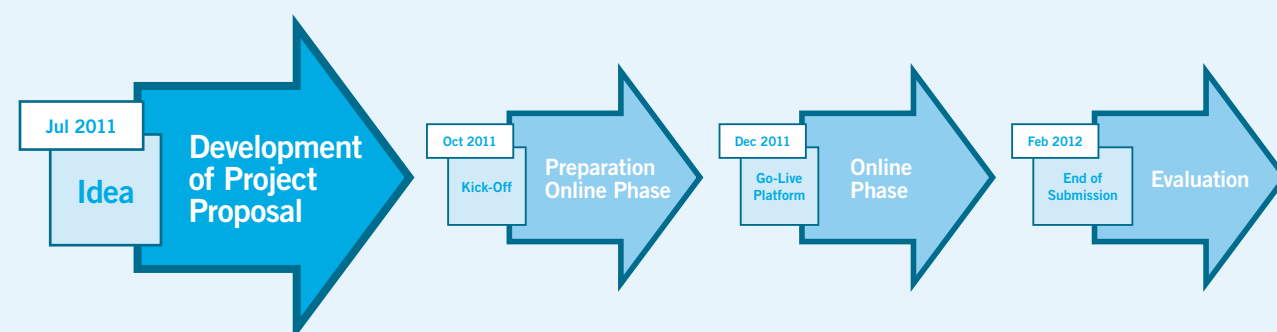
Lessons learned...

Crowdsourcing raised a number of challenges for BMS:

- **The first lesson is one of leadership.** It was important from the start to obtain the support from senior management, and to promote and grow the idea contest into a high-profile project within the company. Not surprisingly, there was initial scepticism towards the idea of addressing external participants for idea generation and outsourcing the contest to an external company. However, internal leadership's positive commitment to pushing the idea forward turned scepticism into acceptance, and fostered an important mindset change.
- **Framing the pathways and routes for connection needs to be clear.** Finding the right questions proved tricky and required time and effort. The questions needed to be specific enough to narrow down the scope of the contest, but generic enough not to restrict the creativity of idea-givers. This challenge was overcome by defining the guiding questions in key areas and sanctioning the help of strategic experts.
- **Getting people excited and motivated matters.** Like other organisations, BMS found that crowdsourcing requires the right incentives for people to feel motivated and to participate, and the project team put much effort and thought into their selection. BMS promoted extrinsic incentives such as money, a visit to Bayer, media recognition, networking opportunities and, importantly, the possibility to change the world.
- **Access needs careful consideration.** Inevitably in an initiative that spans the globe, language barriers affected participation. The limitation of language choice to either English or German may have limited participation by idea-givers from North Africa, for example.
- **Idea generation is just the beginning.** The implementation of the winning ideas has probably been the most challenging part for BMS. Once the ideas are selected, the partners must be engaged to implement them. BMS discovered it is most effective to involve these partners from the very beginning. If partners can be involved early, then the crowdsourcing approach can go beyond idea generation and begin to open up the whole of the new product-development process.

...and benefits gained

The contest provided vital strategic benefits to BMS: (a) the open flow of new external ideas provided BMS with promising innovative ideas to help avoid desertification; (b) it helped the company to understand the views and perspectives on desertification across different countries and communities; and (c) it provided important organisational learning on how to manage ideas and use external knowledge. This is now helping BMS to face the challenge of opening up the innovation process even further for its next exciting crowdsourcing project, focusing on shape memory plastics!

Figure 1: Implementation phases of the BMS crowdsourcing initiative

Jul 2011 | Idea | Development of Project Proposal | Oct 2011 | Kick-Off | Preparation Online Phase | Dec 2011 | Go-Live Platform | Online Phase | Feb 2012 | End of Submission | Evaluation

Open innovation
Crowdsourcing

For companies, deciding how to engage 'the crowd' to focus on innovating is an increasingly important question. It represents a fundamental shift from centrally controlled organisational R&D to a decentralised model made up of a diverse and dispersed network of individuals and/or groups. Occurring now, as it does, across a wide array of industrial activity – including engineering, genomics, pharmaceuticals, software and video games – crowdsourcing presents a host of opportunities and potential pitfalls.

To get started, understanding which problems can be addressed by crowdsourcing will depend on the organisational context, and the problems or opportunities it seeks to solve or realise. However, common organisational challenges in implementation often arise[1]. These tend to be around: (a) recruitment and retention of members; (b) task definition; (c) aggregating a wide number of different inputs; and (d) the challenge of evaluation. BMS was faced with and had to overcome each of these obstacles.

The realisation of successful crowdsourcing projects is highly reliant on identifying the correct form of crowd engagement. The four main crowdsourcing approaches coalesce around four designs: contests, collaborative communities, complementors and labour markets.

Contests are best suited to complex, novel, creative problems where the wider and more diverse the perspectives, the better. This approach requires an 'arm's length' distance from the community and is less sensitive to exposing company details or knowledge. Contests are perceived as easier to manage but can be large in scale.

Learning example: Connect + Develop (a Procter & Gamble programme connecting external partners around important R&D initiatives).

Collaborating communities revolve around organising a spectrum of collaborations into a collective valuable whole. An important challenge here is that the company culture and principles are not necessarily shared across the communities, and IP management may become problematic. Communities provide a way to engage with customers and users, and may involve the use of wikis or similar technology. Communities are used widely in open-source software development.

Learning example: Linux is a freely available open-source software platform developed by a large community of co-developers.

Complementors: this design enables users to access company systems and solve problems directly. This is a more technically challenging approach, and opening up core functions raises the issue of the protection of assets to a higher level.

Learning example: iTunes enables a disparate developer community to create a wide array of complimentary innovations e.g. apps.

Labour markets: focus on specifically matching tasks to resources to improve control. Here, the challenge lies in the matching process and in managing the pool of labour. Labour markets are better aligned with clear work and task boundaries, and are more easily evaluated.

Learning example: Mechanical Turk is an online platform enabling workers to connect with micro tasks for paid work.

[1]Adapted from: Boudreau, K. J. & Lakhani, Karim R. (2013) Using the Crowd as an Innovation Partner. Harvard Business Review. Vol. 91 Issue 4, pp. 60-69.

Intel

The company

Intel has developed a continuous innovation strategy to maximise opportunities, minimise waste and seize big opportunities by solving big problems. The company has achieved consistent profitability, driven by large-scale sustainable innovation that is delivered through intense global research development, positioning Intel in the global top ten for R&D investment. Continuous innovation at Intel is driven by Moore's Law, which states that the number of transistors on a chip will double approximately every two years for less or equal cost. This increased processing speed is leading directly to accelerated technology development. Intel understands that this rate of change can be sustained only by collaborating widely with external partners, and is committed to establishing a global innovation ecosystem. This innovation ecosystem is manifest in Intel Labs Europe (ILE).

The approach – building a complex innovation ecosystem

Intel Labs Europe

Intel R&D and innovation in Europe is driven by a network of research labs, development centres and open innovation collaborations spanning the European region (see *Figure 2*), as well as a variety of Intel business units. ILE was formally established in early 2009 as the central means of coordinating activities across this diverse and extensive network, and to strengthen and improve Intel's alignment with European R&D. Today, ILE consists of more than 50 locations employing more than 4,000 R&D professionals. The mission of ILE is to advance Intel research, development and innovation and to partner with European stakeholders to help improve European competitiveness. Areas of focus include next-generation Intel architecture, visual computing, software service development, enterprise solutions, sustainability, embedded computing and high-performance computing. The central aim of the majority of labs within ILE is to support the manufacturing process and architecture design innovation to sustain Moore's Law: all of these labs are engaged in wide-scale collaboration. However, there are two recent initiatives within the network, which Intel has developed to engage more explicitly in 'open' collaboration activity: the Intel Innovation Open Lab and the Innovation Value Institute (IVI).

Figure 2. ILE Network

The Intel Innovation Open Lab

The Open Lab resides on the campus in Leixlip, Ireland, and is designed to foster cooperation between Intel, industry and academia through joint research and innovation programmes. It focusses on working in new market domains and exploring applications for how Intel products feed into the grand challenges of cloud computing, IT management, and energy and sustainability. The Lab's mission is to facilitate and engage in open research and innovation opportunities in Europe that can ultimately lead to value-driven technology solutions.

IVI

Driven by Moore's Law, the speed at which technology change is felt within both public and private organisations, is outstripping the ability of management to make best use of the technology as it emerges. Focusing on this need, Intel recognised a responsibility towards stakeholders to develop knowledge on how to organise for innovation and how to create value through the use of computing technology. Intel also sensed a significant market opportunity to help organisations and policy makers address this challenge. To bridge this gap, Intel co-founded the IVI with the National University of Ireland, Maynooth. The IVI is a business-model innovation in its own right; focusing outside the core business, it is aimed towards issues of strategic and business management of IT rather than the engineering side of technology management. IVI brings together researchers, educators and industry practitioners in real time to research and develop frameworks and methods to assist the delivery of value through IT.

The IVI network is unique in that much of the research within the centre is done by working executives. Today, this initiative, and its open innovation collaboration network, have grown to 90+ organisations (see *Figure 3*.) worldwide. Together, they have developed and continue to maintain a management innovation or 'strategic satnav' and benchmarking management framework called IT Capability Maturity Framework™ (IT-CMF™).

A framework for continuous innovation and value – The IT-CMF™

In a sense, IT-CMF™ acts as a design pattern for the chief information officer to respond to persistent challenges, offering general and reusable organisational improvement solutions for commonly recurring issues. This strategic framework enables individual organisations to ensure IT resources and capabilities are deployed in support of the organisational goals. It provides a comprehensive IT management toolset across more than 30 areas (see *Figure 4*), each composed of maturity roadmaps, organisational assessment tools, and a library of organisational improvement actions.

Figure 3. IVI's global membership, supporting the open innovation collaboration network

Figure 4. IT-CMF™

IVI use of design science to deliver management innovations

IT-CMF™ has developed using a design-science approach in order to create strategic capabilities for enabling the wider organisation to deliver business value from IT. Design science is a method of developing usable knowledge with and for professionals, which they in turn can use in their own specific fields to solve problems and provide solutions to complex problems. The design-science approach here to create IT-CMF™ required the input of researchers and practitioners. From a research perspective, it represents a shift away from approaches that provide some form of prescriptive or historical analysis to practitioners, towards a collaborative approach that leads to the creation of useful artifacts that can be used, in this case, by IT and business executives. This approach, if successful, leads to tools based on the best-available knowledge and a level of repeatability, with the flexibility to be applied across what Intel recognises are different complex contexts.

The artifact (IT-CMF™) in this case is for use by the management teams within the partner organisations, and the knowledge is deployed in the form of the framework and associated management methods, which provides a way of considering the potential of using alternative solutions. IT-CMF enables a flexible but consistent approach to a variety of complex business environments. Providing such a framework allows individual management teams to employ a set of supported and validated processes, meaning they do not have to develop an approach to obtaining value from IT from scratch.

Design-science checklist[2]

A design-science approach will:

- accept each situation as unique and try to learn from it
- focus on action, purpose and utility, and seek ideal solutions and desired futures
- be embedded in systems thinking
- avoid over-emphasis on current data, and stress need for future orientation
- involve solution providers as early as possible to produce knowledge in the context of application
- emphasise participation and pragmatic experimentation and adaptability
- involve intense dialogue, emphasising the definition and assessment of change, and thinking outside the original problem definition.

[2]Adapted from: Romme, A.Georges.L. (2003) Making a Difference: Organization as Design. Organization Science. Vol. 14, No. 5, pp. 558–573.

GlaxoSmithKline

The company

GSK is a global healthcare company with over 100,000 employees, of which around 12,500 are employed directly in R&D. Annual R&D investment is currently around $4billion (2012 figure) in total. The company's global operation includes 87 manufacturing sites and large R&D facilities in the UK, the USA, Spain, Belgium and China. GSK's core areas of R&D are vaccines, new medicines and consumer healthcare, and it is one of the few healthcare companies researching both new vaccines and new medicines for all three of the World Health Organisation's priority diseases: HIV/AIDS, malaria and tuberculosis. The organisation has faced the challenge of how to develop new profitable opportunities by evolving innovation strategy to open up the innovation pipeline and to focus on R&D efficiency with increased externalisation to increase opportunities and minimise risk.

The challenge
Developing entrepreneurial and efficient R&D in discovery research

The discovery process in the pharmaceutical industry is long and complex. In the R&D science discovery model, this complexity is increased not just by the obvious technical barriers and the myriad partnerships involved but also by the range and scale of projects that compete for attention and funding, and the resources required to support each candidate. Early-stage research involves identifying the biological targets related to specific diseases and then creating molecules and biopharmaceuticals to interact with these targets. The vast number of scientific discoveries means the selection and resourcing of those areas most likely to lead to medical advance is a complex undertaking. GSK had already made a number of changes from the traditional R&D structures in 2001, and further evolved its Centre of Excellence in Drug Discovery model during the mid-2000s. In 2007, GSK started a review of its R&D strategy to further increase efficiency and productivity. Part of this activity was a review to identify the most promising areas for drug discovery and to move the organisational culture from one that was predisposed to investing in existing research to one that retains focus on where the scientific opportunity is the greatest. One result of this rebalancing was the development of a new R&D organisational structure and a move to smaller, more agile, focused Discovery Performance Units (DPUs). GSK created 38 DPUs (2012 figure) and also supports the principle with external partners, where it currently has an additional 50 units operating outside the organisation but to the same principles as the internal DPUs.

The approach
DPUs

This GSK approach to innovation involves breaking up the traditional hierarchical approach of R&D to how new projects are created, managed and resourced. Each DPU, consisting of between five and 70 scientists, is allocated a budget and sets clear targets to achieve specific goals in discovering of new medicines for a designated disease or in establishing a pathway into early-stage clinical trials. Every DPU has to develop a business plan, which includes strategies for external collaboration with universities and business. To ensure the clarity, accountability and strength of each R&D development programme, the head of each unit has to pitch a business proposal and strategic plan for the next three years 'Dragons Den' style, to the Discovery Investment Board (DIB). The DIB is a team of committee executives and venture capitalists headed by the President of R&D. For GSK, this approach brings focus and rigour to project selection and resourcing, and also breaks down the traditional process of small numbers of people influencing key decisions by widening participation. To ensure long-term plans are robust enough to meet the challenges set, this approach also encourages the heads of each DPU to foster increased entrepreneurialism and collaboration across disciplines, providing greater use of external expertise. Drug development is a high-risk activity, and the DPU approach increases competition for resources, improves productivity and efficiency in resource allocation, and provides a powerful check on the ultimate chances of success. The overall aim of this strategy supports and underpins GSK's four key principles: focus on the best science, repersonalise R&D, externalise R&D, and focus on R&D efficiency. GSK is improving R&D efficiency through competition between units for funding and resources, and through management towards important milestones. The internal entrepreneurial venturing approach is one of the core components of the GSK model of open innovation. Other aspects include crowdsourcing, licensing and partnerships, open-source IP and more traditional methods of corporate venturing.

Recasting corporate venturing for efficient R&D

The GSK approach to supporting R&D by applying principles of entrepreneurial venturing can be seen as an innovative twist on traditional corporate venturing (CV) behaviour and the organisation of internal R&D. In the traditional model of CV, firms either collaborate with external investors or spin-out new ventures in order to support new innovation. In the GSK model, leaders have applied core venturing principles internally rather than creating or supporting external or new start-up ventures. Importing the competitive components of CV to increase corporate entrepreneurship internally has the effect of freeing teams within the existing organisation to develop new ideas and to launch new business that leverages the assets and capabilities of the core company.

Some of the core principles[3] around CV suggest that it: (a) enables organisations to react quickly to market demands by short-cutting many of the inherent bureaucratic structures of larger organisations; (b) positions new ventures closer to market than traditional R&D, and can therefore locate competitive threats more effectively; (c) fosters fast failure, as ventures that are more remote from the core organisation can be disengaged more readily; (d) combines internal resources with venture-capital resources, which can magnify the impact of investments; (e) increases the chances investment in new ventures can leverage the demand for the core products; and (f) creates ventures that bring with them a high degree of value in people and resources from the source firm, which should find it easier to attract external support and further high-quality investment. By leveraging these strengths internally, GSK is effectively using venture-capital principles for organising medical discovery R&D.

Two important areas where GSK strategy has focused on the internal venturing of the DPUs are changes to ownership and resource authority. For GSK, this has meant divesting ownership and accountability to the DPUs and providing resources that can leverage the core business, through the competitive ('Dragons Den', style), 'enabler' strategy. The strategy at GSK creates an entrepreneurial environment in each unit, encouraging a 'prospector' approach to finding and developing new opportunities. This structural flexibility enables GSK to keep a focus on the most promising pharmaceutical targets. At an organisational level, GSK's entrepreneurial approach has led to strategic renewal of the company as new structures are formed that are designed to embed more business-orientated entrepreneurial behaviour in the DPU.

[3]Adapted from: Lerner, J. (2013) Corporate Venturing. Harvard Business Review. Vol. 91, Issue 10, p86-148.
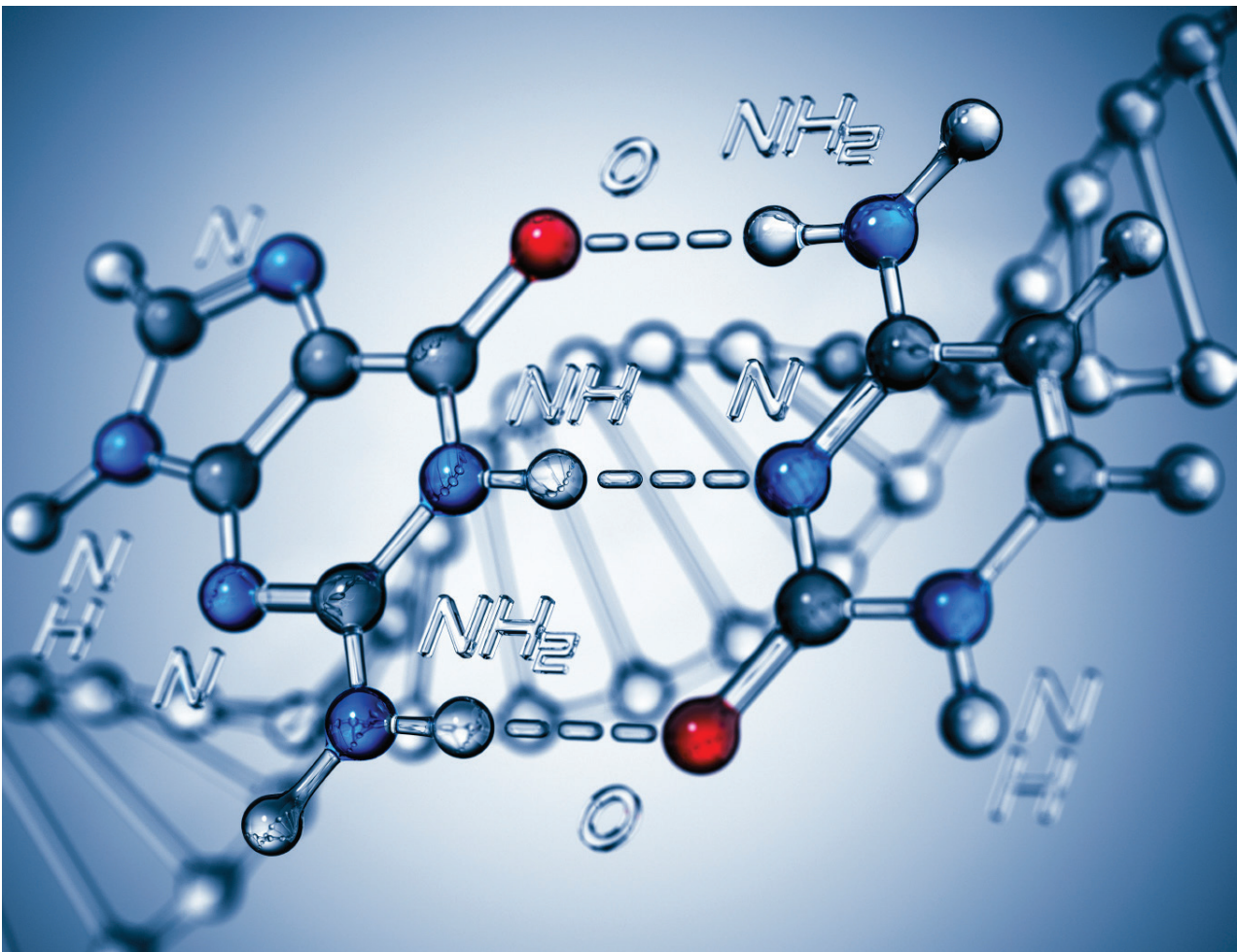
This entrepreneurial behaviour is assisted and driven as the new structures encourage the creation of new forms of connectivity and a level of openness that exemplifies the open innovation imperative to look outside the organisation for knowledge. The GSK approach to venturing not only enables the organisation to balance out the risk though engagement with partners but is also fostering the possibility of recombination opportunities that occur when knowledge partnerships are formed. For the internal venturing approach to work, a model is emerging to ensure the principles can become embedded alongside other open innovation approaches within the GSK innovation ecosystem. The core principles of this are categorised in terms of strategy, structure, culture, attitudes and knowledge and are supported by capabilities.

A change to the organisational structure alone would not be considered sufficient to effect the change required. The model depicted in *Figure 5*, represents an 'ecosystem' supporting the entrepreneurial R&D activities.

GSK has a clearly articulated strategy focused on growth, new products and diversity. This strategy is realised through capabilities at individual and organisational level. GSK's internal R&D capabilities also support their external and CV activities, ensuring that the skills to assess, acquire and exploit internal and external opportunities are maintained. Dynamic capabilities provide the vehicle to effect changes – and adapt to the evolving environment.

GSK is able to tap into external capabilities, not just through traditional in-licensing, but by disseminating its own work, making some IP public domain, providing support services to partners, and offering its facilities to others to work in partnership.

Whilst there are defined development processes, early-stage activities operate in more of a framework than a well-defined process, recognising the iterative and creative nature of this phase. Governance is light-touch but robust, with a strong focus on science and on risk management – a key objective being to eliminate risk early and at low cost, by focusing on the right experiments.

There is a supporting culture encouraging experimentation at project and individual level. DPUs and project teams (after obtaining funding) are empowered to make decisions and progress the project with minimal management intervention other than the main governance and milestone reviews. Teams are actively encouraged to share knowledge and undertake learning reviews to improve capability.

The combination of these activities and attitudes enables an ecosystem that fosters innovation.

Figure 5: The innovation framework
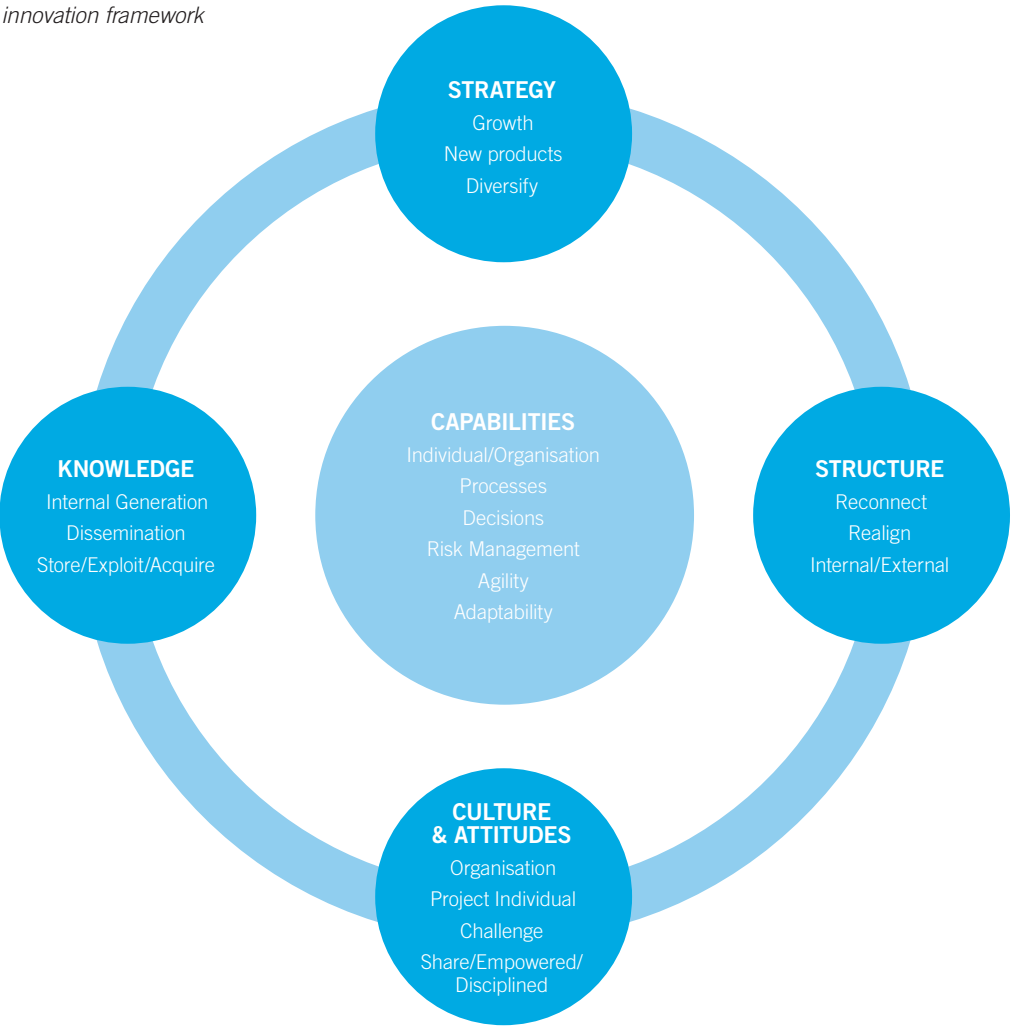
Deutsche Telekom

The company

Deutsche Telekom is an integrated telecommunications company, which provides fixed-network/broadband, mobile communications, Internet, and Internet Protocol Television (IPTV) products and services, for the consumer market. The company also provides information and communication technology solutions for business and corporate customers, through T-Systems, the Deutsche Telekom's IT service division.

Innovation at Deutsche Telekom

Innovation at Deutsche Telekom is based on three core strategies: in-house development, partnerships and equity investments.

In-house R&D

Deutsche Telekom's innovative know-how has been consolidated in Telekom Innovation Laboratories (T-Labs) since April 2005. The unit drives R&D across the group, thereby giving it a key role to play. T-Labs is connecting university researchers and Deutsche Telekom employees to co-develop technology and customer-driven innovation projects (see *Figure 6*). The innovations are transferred to business units or transformed into spin-out companies. Deutsche Telekom has established a global network of internal and external technology scouts to embed monitoring and scanning capabilities to support these innovation activities.

Partnerships

Deutsche Telekom business is primarily focused on the final stage in the telecommunications value chain, making the innovation input of suppliers vital. R&D at Deutsche Telekom has decentralised to reflect this, by combining knowledge from both business units and suppliers. Developing partnerships with both small start-ups and larger global companies is of high strategic importance to Deutsche Telekom, even leading to collaborations with competitors ('coopetition') such as Apple. In a collaborative joint research project with Daimler, Siemens, the Technical University of Berlin (TU Berlin) and three Fraunhofer Institutes, Deutsche Telekom has founded the European Center for Information and Communication Technology (EICT).

Equity investment

T-Venture is Deutsche Telekom's venture-capital company, providing significant equity support for new innovation. Based in Germany and globally active, since its inception in 1997, T-Venture has invested in more than 190 companies and engineered 20 highly successful exits. T-Venture's strategy is based on developing long-term investment relationships that develop innovations to complement and be integrated with Deutsche Telekoms core products and services. Deustche Telekom's and T-Venture's large innovation networks provide exceptional leverage for new start-ups.

Customer integration at Deutsche Telekom is a vital component of its innovation process:

- **Ethnographic methods:** the customer is observed in their own environment in order to gain a deep, empathic understanding of unarticulated user needs.
- **User clinics:** the customer is confronted with prototypes and later asked for preferred sets of features. With conjoint analysis, a preferred product design can be combined from all respondents. An additional benefit is the interactive process that allows collecting further rich data on customer preferences.
- **Ideabird:** people can propose ideas and concepts for future uses of machine-to-machine communication. This ideas contest takes a co-creation and crowdsourcing approach.

The challenge[4] – developing a flexible open innovation strategy

Deutsche Telekom is developing an ecosystem to support its three core strategies. *Figure 6* shows the tools implemented from idea generation to commercialisation.

[4]Source: Rohrbeck, R., Hölzle K. and H.G. Gemünden (2009): Opening up for competitive advantage – How Deutsche Telekom creates an open innovation ecosystem, R&D Management, Vol.39, S. 420–430.
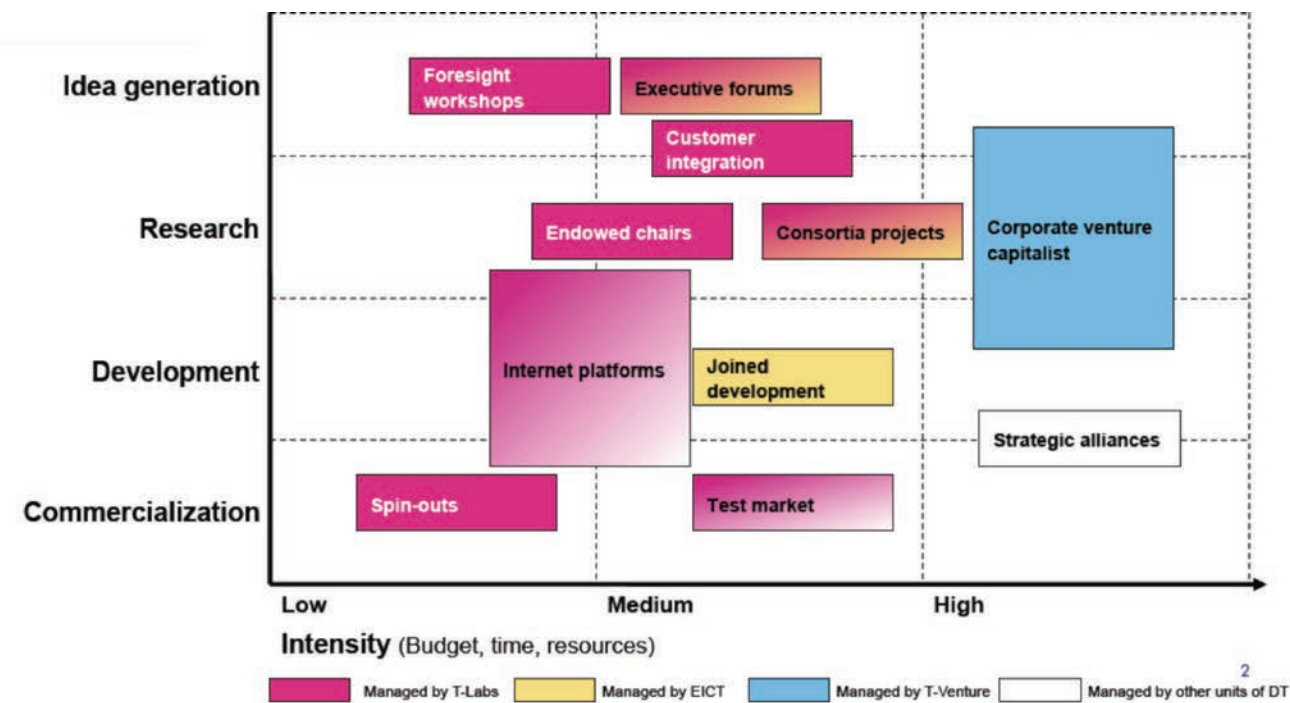
Figure 6. Open innovation ecosystem at Deutsche Telekom

Figure 6 indicates the effort that needs to be made to make an open innovation ecosystem work, particularly in the R&D phase to share costs and risks, and to capture new innovation knowledge. These open innovation mechanisms are managed in three ways:

Executive forums

Deutsche Telekom participates in executive forums (such as Münchner Kreis and Feldafinger Kreis) and government-sponsored activities, bringing together executives and academics to discuss innovation topics and kick-start activities. Foresight workshops with partners are used to share views about the future direction of technologies.

Internet platforms

The Developer Garden is Deutsche Telekom's developer ecosystem, built on a network of strong global alliances. The platform enables software developers to create applications by offering easy access to technologies and services. Partners and developers are able to distribute and monetise software, whilst new businesses are discovered and the time to market is reduced.

Corporate venture capitalist

T-Venture secures access to new business concepts and technologies through equity investments. It has a budget of €750 million and 20 investments per year. It currently manages a portfolio of around 80 companies.

Lessons learned…

- **'Opening up' improves innovation capability.** Deutsche Telekom has successfully enhanced its innovation capacity by going from a traditional in-house R&D to an open innovation approach. This has allowed Deutsche Telekom not only to access external creativity and knowledge but also to understand and lead the future direction of the telecommunications industry. Innovation pathways enable: a) direct access to talented students (T-Labs being based directly on the campus of TU Berlin); b) direct access to knowledge by funding academia; c) direct access to IP; and d) freedom to research any topic of interest for the university in the communication field.

- **It is a case of 'horses for courses'.** Deutsche Telekom has implemented a variety of strategic and measured pathways and tools to open the R&D process to the outside world.

- **Balancing objectives is vital.** When implementing more open approaches to R&D, companies often face conflicting interests, for example, the need to appropriate value from IP whilst sharing enough information to allow others to connect meaningfully. Deutsche Telekom's strategy is to provide a number of entry points and to combine different cooperation models ensuring Deutsche Telekom benefits from better access to new ideas and development, and its partners get access to the company's communications and Internet services, as well as its sales channels and distribution capacity.

Siemens

The company

Siemens is a multinational engineering and electronics organisation working in the fields of industry, energy, transportation and healthcare. The company seeks to develop and manufacture products, and to design and install complex systems and bespoke projects and services.

> **Siemens key facts**
> - **Number 1 in patent applications at the European Patent Office** (in 2011)
> - **370,000+ employees**
> - **€4.2 billion investment in R&D** (in 2012)

Innovation strategy at Siemens

Siemens, innovation strategy is based on developing internal R&D capabilities, identifying and supporting wider partnerships, and explicitly using open innovation and crowdsourcing tools to connect both external and internal expertise.

The main Siemens research department is the Corporate Technology (CT) unit, which employs more than 7,000 globally collaborating industry experts. The main research areas of CT are Automation & Drives, IT & Software, Materials and Image & Knowledge Processing. The CT unit plays a major role in Siemens long-term innovation strategy, in the development of cooperative projects with research institutes and industrial partners. The CT unit acts as an interface between Siemens, R&D and its academic partners, coordinating the work and identifying new collaboration opportunities, supporting over 1,000 projects annually.

Siemens has also created eight Centers of Knowledge Interchange (CKIs), situated on the campuses of a number of universities. The CKIs exist to develop collaborative research, encourage talent and establish networks. The CKIs are located in Munich Technical University, TU Berlin, and RWTH Aachen in Germany; at the Technical University of Denmark in Copenhagen; at Tsinghua University in Beijing and Tongji University in Shanghai; and in the USA at the Massachusetts Institute of Technology in Boston, and the University of California, Berkeley.

Siemens suggest that many problems are now being successfully addressed using an open innovation approach by using different crowdsourcing tools to tap into the creativity of larger more disparate groups of people. For example, Siemens' approach to open innovation includes deploying service providers such as NineSigma or yet2.com. Other more direct crowdsourcing tools include idea contests and intelligent-technology search platforms, which facilitate the identification of new/emerging technologies and experts.

The challenge – managing knowledge networks using crowdsourcing tools

Siemens is a complex organisation comprising many autonomous business units. This complexity gives rise to the danger that potential synergies between units are not always exploited. Thus, the challenge arises of how to become an integrated organisation and build meaningful knowledge-sharing connectivity between employees dealing with similar organisational issues. With this purpose in mind, Siemens has developed TechnoWeb 2.0 (see *Figure 7*). This is an internal platform for knowledge networking that enables everyone, from developers to office workers, to post complex technical questions or obtain simple operational assistance. It currently has over 9,000 registered users, who discuss a variety of issues organised into 850 theme groups.

Figure 7. Live example of TechnoWeb 2.0
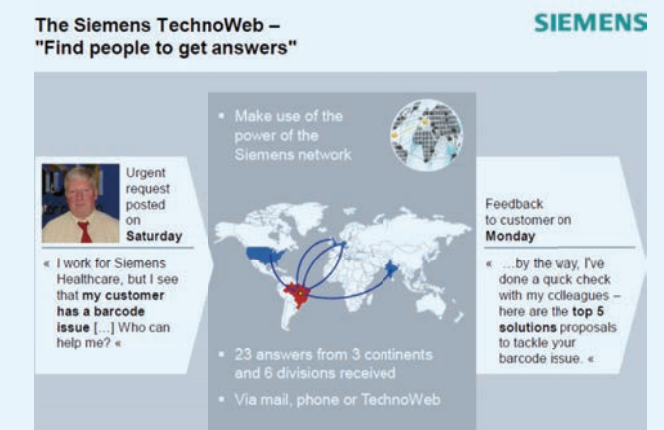
TechnoWeb 2.0 exists to increase the efficiency of daily work and to leverage collective intelligence and content generation by facilitating internal exchange of contacts and information at zero cost. The main characteristics of TechnoWeb 2.0 are the very low entrance barrier to creating an individual technology network, producing an experience similar to existing social networks. It provides dynamic structure of content and know-how, and cross-links to existing contents and tools (e.g. blogs, wikis and SharePoint). There is no need to create any new database for technologies or measurement of participants' performance or activity. TechnoWeb 2.0's main functions are organised around networks, news, profile pages, urgent requests and search for networks or individuals. The system includes permission management and the option to rate contents and networks.

Unlike other person-centred tools like LinkedIn, Xing or Facebook, or object-centred tools like Flickr, YouTube or wikis, TechnoWeb 2.0 is network-centred. As such, it is built around networks, which are focused on knowledge areas. *Figure 8* shows the current number of networks active across themes.

Figure 8. Number of TechnoWeb networks
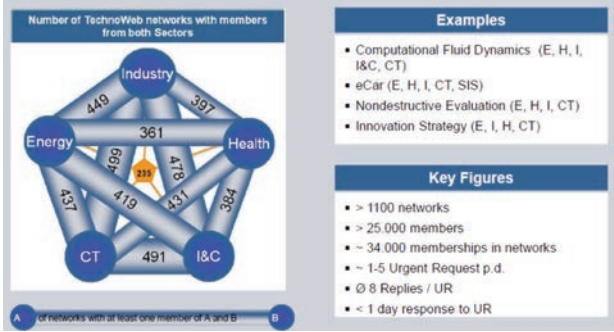
Benefits and challenges

The adoption of TechnoWeb 2.0 has brought benefits at both organisational and individual levels. The interaction of divisions has improved and the employees are empowered to do their work faster and more efficiently. Siemens has restricted access to employees to ensure free information exchange. Challenges have arisen, such as the importance of keeping up employee motivation to contribute, establishing high connectivity, and managing potential tensions that may arise within the networks between two constituent groups. These two groups can be characterised as specialist and generalist.

Tension may arise between specialists and generalist users in platforms such as TechnoWeb 2.0.

Generalists (people who cover a broad range of topics, in this case) draw upon a broad knowledge base, and are able to connect different communities inside the system, acting like brokers. Often, overtime they become central in networks, performing an important role of enabling connectivity in the network. Thus, they are able to connect different parts of the system and facilitate the knowledge flow in the network. However, they struggle to reconcile different identities, roles and demands that membership of these multiple professional communities brings along.

Specialists (people who specialise in the particular area) have in-depth expertise and can provide profound feedback on a particular issue. However, over time, without challenges to the status quo, this group could potentially be prone to groupthink.

Social network tools

Siemens has shown how network tools can be applied in large organisations to help connect diverse and disparate groups to create an 'internal' open innovation system. Network theory and tools are increasingly being used by organisations to help increase the open flow of information through and between organisations. Much of the theory and practical application of network tools have evolved through cross-disciplinary research in sociology, mathematics, physics and anthropology. Perhaps the biggest development in the proliferation of the network metaphor has been that of accessible computerised visualisation tools, which are increasingly being used by firms that want to understand the role of networks. Most of us today are familiar with social networking sites such as Facebook, Twitter and LinkedIn. These sites have introduced people to the potential of making and maintaining connections with a much wider group of people than was possible even a very short time ago. When captured and used in organisations, network data and visualisations can reveal clear patterns of communication that are not possible with conventional graphical depictions. These visualisations can really help people to shed light on identifying potential organisational shortcomings. Network structures seem to lend themselves to our natural proclivity towards pattern recognition.

Two key theories that have been vital in the development of social networks are structural holes and closure. Both ideas provide insight into how network structure can play a part in the flow of information. Structural holes are connections out of a closed network to a more remote person or group; such people are very good at providing certain skills and resources related to introducing novelty into existing groups. The competing idea is cohesion or closure. This is important in the consideration of communicating within an internal group. Understanding and working with these ideas is important in innovation. For example, people have been shown to rely more heavily on gathering novel information from people with whom they are loosely or remotely connected (strength of weak ties)[5]. This is partly because those people close to you often know and exchange the same (redundant) information; we get more novel information from remote connections or those people less connected to the others in your closer group. However, for an idea to be developed and to take hold within a group, a high degree of cohesion is required to build trust, through development of norms. This is stronger and more likely in relatively 'closed' cohesive groups. Understanding and managing this tension is viewed today as a vital element for coordinating successful innovation.

[5]Granovetter, M.S (1973) The strength of Weak Ties. American Journal of Sociology. Vol 78, Issue 6, pp1360-1380.
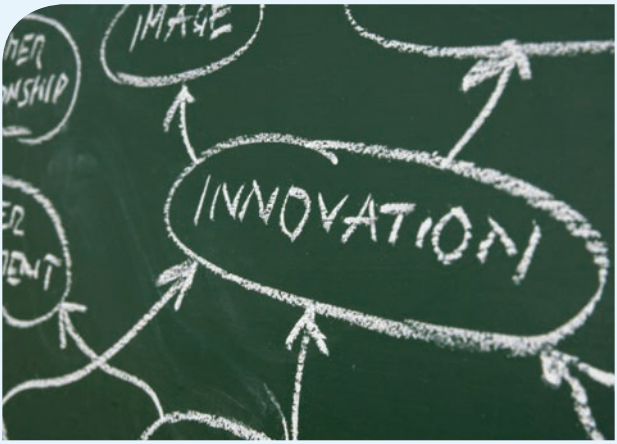
Insights from the ManETEI Open Innovation Event

In 2003, Henry Chesbrough[6] published the expressively titled book *Open Innovation*. The featured open innovation concept highlights, with equal importance, knowledge generated outside an organisation and knowledge produced within organisational borders. Chesbrough advises tapping into the rich pool of externally available knowledge and, at the same time, paying serious attention to internally generated knowledge that resists commercialisation through existing business models or current market channels. The cornerstone of the original open innovation idea lies in capturing value from both adequate external and under-commercialised internal knowledge. The notion of open innovation certainly created an impact on academic researchers but, more importantly, caught the attention of practising managers. Managers embraced the idea of innovation as a complex process where a myriad of different organisations and individuals interact to absorb and share knowledge. The introduction of a concept like open innovation, with the potential for wide-ranging impact, inevitably creates a life of its own, with managers ascribing different meanings and creatively stretching the original propositions.

Insights gained from a dedicated workshop with five complex and technology-intensive companies offer a glimpse of how managers perceive the importance of open innovation and how they utilise prescription from the original idea to develop organisation-specific innovation strategies.

Strategic importance and ambiguous meaning

The concept of open innovation unquestionably resonates with managers from technology-driven companies. It is regularly used as a label that motivates strategic decisions related to innovation. It is, however, also often used beyond the original idea of effectively managing internal and successfully acquiring external IP. Undoubtedly considered as strategically important, the concept of open innovation remains ambiguous across organisations or even within an organisation. For some, open innovation is an umbrella term for all collaboration activities, including partnering with other companies, engaging with universities, interacting with governments, corporate venturing and crowdsourcing. For others, open innovation is limited to just a few of the above approaches, especially those where any IP protection is considered less of a strategic issue. Open innovation is certainly a concept that can mobilise strategic action, yet companies significantly differ not only in open innovation practices, but also in perceptions of what constitutes an open innovation initiative.

[6]Chesbrough, H. (2003) Open innovation: the new imperative for creating and profiting from technology. McGraw-Hill, Harvard Business School, Mass, Boston.

Open innovation for radical exploration

The notion that companies have to explore internally generated knowledge that does not directly support core products is a cornerstone of the open innovation concept. Additionally, some companies are reluctant to label collaboration with external partners as 'open' if new knowledge supports the existing core products. Regardless of whom they engage with or how uncertain or radically different the relevant technology is, collaboration is rarely described as 'open' if it directly contributes to improvements of core products or technological competency. It is indicative, however, that companies use open innovation strategies when exploring integration of their products into radically new product or service architectures. Here, technological advances in products are of secondary importance to how a product fits into emerging product or service architectures. This is even more pronounced if the emerging innovation ecosystem lacks a central firm to orchestrate integration efforts or when collaboration is needed between companies from different sectors as well as governments, to create a complex new product or service architecture. Companies have to develop new open innovation capabilities and skills to navigate ecosystems that aspire to create complex architectural innovation from a variety of innovative products.

Crowdsourcing and distributed problem-solving

The recognition that problem-solving and solution-providing capabilities are highly distributed gives a new impetus to the original open innovation idea that has traditionally focused on managing IP in markets for technological knowledge. The ubiquity of Internet and social networking makes innovation managers more confident in integrating and coordinating knowledge exchange amongst a variety of experts globally through the practice of crowdsourcing. It is conventionally assumed that crowdsourcing is effective when identified problems are characterised by modularity – an effective solution can be found for a specific problem without the need to change the entire configuration of a complex product or service. It is indicative, however, that some companies use crowdsourcing approaches for addressing large challenges that, instead of providing ready-made solutions for existing products, offer identification of future opportunities. Such use of crowdsourcing suggests companies are still exploring its very mechanism rather than complementing internal experts with external ones. Moreover, companies are equally enthusiastic about using social-networking techniques to search for solutions amongst internal experts, without opening the search to external contributors.
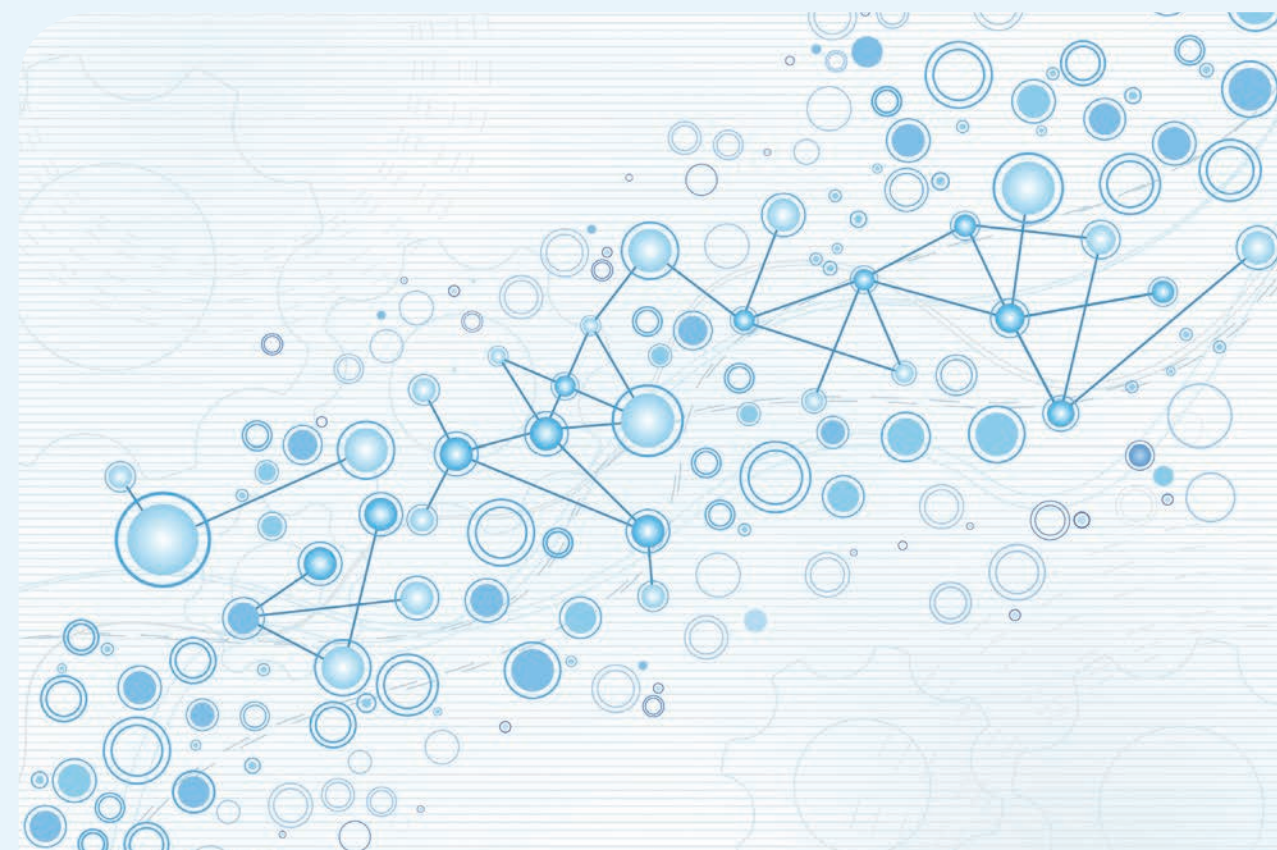
Autonomous practices and professionalisation of innovation management

The collaborative nature of innovation goes hand-in-hand with innovation strategies that aspire to make R&D efforts more efficient. Recognition that partnering with external organisations reduces the risk of exploring distant technological and market domains enables internal R&D to become more focused and targeted. In many ways, extensive collaboration reduces internal production of under-commercialised IP. The drive for innovation efficiency also transforms the centralised R&D department into a highly decentralised and autonomous collection of R&D groups. Technology-driven companies are themselves becoming complex ecosystems of internally distributed innovation initiatives. These decentralised R&D groups are becoming increasingly autonomous in collaborating with external partners such as universities and technology-intensive small and medium-sized companies. These developments have two intriguing and interrelated consequences. Firstly, complex organisation introduces new organisational units that specialise in supporting autonomous innovation initiatives undertaken in collaboration with external partners. Secondly, innovation management becomes a new profession distinctive from R&D activities.

Open innovation for exploring organisational capabilities and responding to societal challanges

The efficiency of internal R&D enabled by collaborating with external partners potentially decreases the internal production of IP that does not directly support core products. This is not to say that companies do not produce internal competency or IP that could be further developed through mechanisms of open innovation. Companies often develop not only technical IP but also the wider organisational capabilities that could lead to future opportunities if developed in collaboration with external partners. Intel's capability in the management of an internal information system is leveraged in open collaboration with other partners with an interest in the effective use of information and communication technology. Companies also increasingly link IP management strategies with the notion of responsible innovation. GSK is a founding member of WIPO Re:Search – a new open innovation platform that aims to help accelerate the development of new and better treatments against neglected tropical diseases, which disproportionately affect the least developed countries.

Partners

University of Leeds Business School
c-TIE

The Centre for Technology, Innovation & Entrepreneurship (c-TIE) is a management research centre that brings together researchers and practitioners interested in understanding complex processes of innovation and entrepreneurship. Research in the centre explores how entrepreneurs and managers at novel and established companies explore and exploit major technological discontinuities, create new capabilities and utilise culturally grounded repertoires to facilitate the comprehension and justification of an innovation in the eyes of stakeholders.

Bayer Technology Services

Bayer Technology Services GmbH, a Bayer AG company, is a capable supplier of technology solutions for the chemical and pharmaceutical industries, with close ties to operators. Its first-class network of experts draws on the decades-long experience of a global corporation and holistic expertise along the entire life cycle to develop, implement and optimise plants and processes. Trust, team spirit, quality and pragmatism characterise the attitude towards customers and the company's work, laying the groundwork for trustful, long-lasting and successful partnerships.

Aalto University School of Business, Helsinki

Aalto University School of Economics is Finland's leading university-level business school and globally acknowledged player in management education. It focuses on high-quality research and teaching. The Department of Business Technology studies and teaches the use of information and technology in management and economic analysis.

Rotterdam School of Management

Despite the increasing relevance of strategy and strategic renewal in the new millennium, there has been relatively little accumulation of theory. Many managers in today's competitive environment engage in strategic experiments without the guidance of appropriate theories, concepts and tools. As one of the leading strategy departments in Europe, Rotterdam School of Management provides new directions in strategy. The research area addressed by the Strategic Management and Business Environment programme focuses on the antecedents and outcomes of strategic renewal of firms and of their external networks and industries.

Grenoble School of Management

The areas of research interest for LINC Lab, are learning and innovation, central themes in the management of technology, innovation and change in ICT. More specifically, LINC Lab focuses on networks and communities as the key units of analysis for theoretical and empirical investigations in Europe, the USA and China, across all sorts of boundaries of firms, business units, regions, nations, and technology sectors.

IE Business School, Madrid

The main aim of the Operations and Technology area of IE Business School is to familiarise students with all the processes employed by firms to commercialise their products or services in the most efficient manner possible.

It introduces students to the latest management tools, providing a global and strategic vision of a business organisation and deep knowledge of consumer demands, the development of new products, optimisation of resources and other factors that influence any product or service.

Fraunhofer ISI
Competence Center Emerging Technologies

The Competence Center Emerging Technologies investigates how innovative technologies evolve, spread and influence each other. It determines the economic, ecological and social impacts of the application of new technologies. The Competence Center analyses the scientific and economic potentials of technologies and assesses their potential uses. Furthermore, it examines the societal and political framework conditions for the development and use of new technologies, as well as possibilities for implementing necessary changes.

University of Ljubljana Faculty of Economics

The team from Ljubljana conducts theoretical and empirical research into how firms' productivity dynamics depend on their innovation activities. The Research Centre posseses valuable research expertise in the economics of innovation, econometrics modelling and economic analysis. Its research centres on factors enhancing firms' productivity growth, including trade participation, foreign direct investment and innovation activities.

Dublin UCD School of Business

UCD School of Business is Ireland's leading business school and research centre. In 2009 we officially celebrated 100 years of business education.

One of the keystones of our reputation as one of the world's leading business schools is the quality and expertise of our Faculty. We are the only business school in Ireland to hold the triple crown of accreditation from AACSB (US), EQUIS (Europe) and AMBA (UK). We are also the only Irish member of CEMS, a global alliance of leading business schools and multinational companies.