InnovationManagement
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HOW TO MAKE CROSS-INDUSTRY, CROSS-SCIENCE INNOVATION WORK

Many companies have already discovered that breakthrough innovation needs openness to for cross-industry and cross-science approaches, and especially for new industries. The big question, the answer to which is worth millions of Euros, is how to do it.

In the middle of Germany, in the Rhine-Neckar Metropolitan region, InnovationLab GmbH is attempting to find an answer. InnovationLab is an innovation consortium of six companies and two universities, working on the emerging Organic Electronics industry. What is remarkable about InnovationLab is its approach to innovation which focuses on the whole industry value chain.

InnovationLab's story can provide innovation management practitioners with valuable insights into how leading German companies are conducting cross-industry and cross-science innovation and how critical issues, such as collaboration and intellectual property (IP), can be handled most constructively.

EXECUTIVE SUMMARY

This article features an interesting case study of a German cross-industry / cross-science innovation hub – how it was designed and how it works.

The case is InnovationLab GmbH, a joint R&D and incubator enterprise of the universities of Heidelberg and Mannheim and its industry partners BASF SE, Freudenberg & Co. Kommanditgesellschaft, Heidelberger Druckmaschinen AG, Merck KGaA, Roche Diagnostics GmbH and SAP AG. InnovationLab focuses on the emerging industry of Organic Electronics – an industry expected to grow by a factor of 300 by the year 2030.

Based on case evidence the article describes how to get cross-industry / cross-science innovation started and then how it should be structured. Good take off requires the support of top management, vital for getting people to work together, and appropriate ways to deal with trust and IP issues. A value-chain-driven approach, complemented by lateral competence centres helps to structure cross-industry / cross-science innovation.

ABOUT THE AUTHORS

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Bernhard Schweizer studied physics and began his professional career as a software developer at SAP AG. He was Product Manager, Manager for Business Development and Assistant to a Member of the Executive Board before being appointed to Vice President for Regional Affairs. In this position, he was responsible for SAP's activities in the Rhine-Neckar region, which were the origins of InnovationLab. Bernhard is a member of the board of the Heinrich-Vetter-Forschungsinstitut e.V., and coordinator of the 'Wissenschaftsbeirat' (Scientific Counsel) of the Rhine-Neckar Metropolitan region.

Frank Mattes, Innovation expert

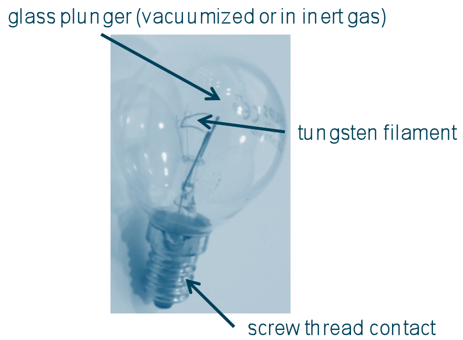
Frank Mattes has more than 15 years' experience of managing projects and innovation gained from working in medium-sized national consulting companies as well as The Boston Consulting Group. He worked at C-level for an IT and a professional services company. Frank's blog and contact information can be found at www.open-innovators.com

THE KNOWLEDGE IN DETAIL

One of the hottest topics in innovation management is Open Innovation, i.e. the paradigm shift towards permeable boundaries between the firm and its ecosystem that allow innovations to transfer easily inwards and outwards. One of the key drivers of this megatrend in innovation management is the increasing complexity of new products.

Take the example of the light bulb and compare it to modern cousin, the Organic LED (OLED) in terms of product structure and the skills required for its manufacture (see graphic 1).

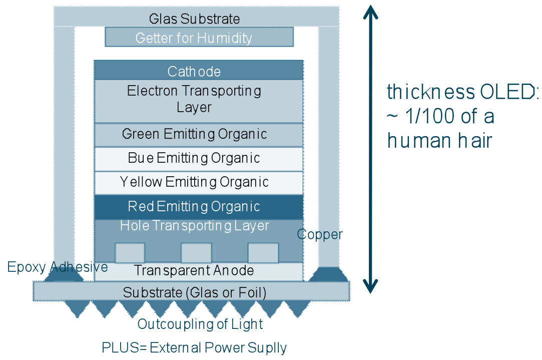
Functioning Light Bulb



Required Skills

- Glass production
- Metal processing
- Engineering

Functioning OLED



Required Skills

- Fine Organic Chemistry
- Production of Substrates
- Production of Glues
- Engineering (processing)
- Getter production
- Printing technologies for feed lines
- Electrotechnology
- Light release

Graphic 1: Comparison of light bulb and OLED

The skills mix makes it clear that no single company, regardless of its size, could innovate the entire product, end-to-end: co-innovation is required.

Why is an OLED such a great innovation and what are its benefits? First, it reduces energy consumption by more than 50% compared to energy-saving light bulbs. Second, its flexibility offers new areas of applications.

OLEDs are one example of the so-called Organic Electronics. Organic Electronics – sometimes also called plastic or polymer electronics – is a new technology based on electrically semiconductive polymers, or small molecules. Its description as 'organic' is because these materials are carbon-based, similar to the molecules of living things – whereas traditional electronics rely on anorganic semiconductors such as silicon.

Organic Electronics is a new emerging industry with projected exponential growth rates for the next 20 years based on its huge number of potential applications, and including printed inorganics along with many devices combining. These include:

- Organic photovoltaics: printing solar panels reduces the price per Watt quite dramatically, while at the same time improving recyclability of the system. New properties, such as transparent solar cells, offer new areas of application, e.g. semitransparent windows for high-rise office buildings in major downtown areas, where the energy generated by the windows can be used to keep the building cool.
- Smart labels: Take vaccines that need to be stored at specific temperatures as an example. Smart labelling allows the temperature conditions to be tracked along the supply chain, from the factory to the consumer, and feeds the information back to an IT system. This increases drug safety as well as allowing the manufacturer to track supply chain performance.
- Organic light emitting diodes (OLEDs) for displays: OLEDs enable transparent displays that e.g. can be put on a window letting light into the room when switched off or delivering a very bright picture when in use. Applications include augmented reality solutions such as displays supporting surgeons through visual data 'projected' onto the glasses worn during surgical procedures.

These examples are sufficient to justify the exponential growth rates expected for this technology. The current market size for printed and potentially printed electronics including organic, inorganic and composites, is US$ 1.99 bn; according to the widely accepted forecasts from IDTechEx this will grow to over US$55 bn in 2020 and to US$340 bn in 2030.

Why open innovation is unavoidable in this industry

Exploiting this market value will require skills, technologies and innovations not currently available. Most of today's Organic Electronics are produced by non-printing techniques such as vacuum deposition or by combinations of printing and non-printing techniques on a small scale. No printing-only processing is in large-scale industrial production. However, in the long run, Organic Electronics will most likely be printed which implies huge innovative disruptions and technology innovations in this market.

Since the 1990s and in particular since 2000 when the Nobel Prize for Chemistry went to three scientists for 'the discovery and development of electrically conductive polymers', Organic Electronics has been on the innovation radar of many companies, from various industries.

Current cutting-edge players include companies from the glass industry (e.g. Asahi Glass), chemical companies (e.g. BASF and Merck), companies with printing / ink expertise (e.g. DaiNippon Printing- and InkTec), plastics companies (Plastic E Print and Konarka), IT companies (e.g. Fujitsu and Hewlett Packard) and universities / research institutes (e.g. University of Cambridge, UK)

The three driving forces of huge market opportunity, an exciting but not yet clear innovation race and a true melting pot of organizations taking part in this race, make Organic Electronics a perfect candidate for open innovation. One might say that Open Innovation in Organic Electronics is similar to the book category for Amazon.com: the natural and obvious way to go.

The need for an open innovation catalyst

In this emerging industry, most yet-to-be-developed applications and products require more technology, skills and experience in materials, devices, production, marketing and sales than any single company could accomplish.

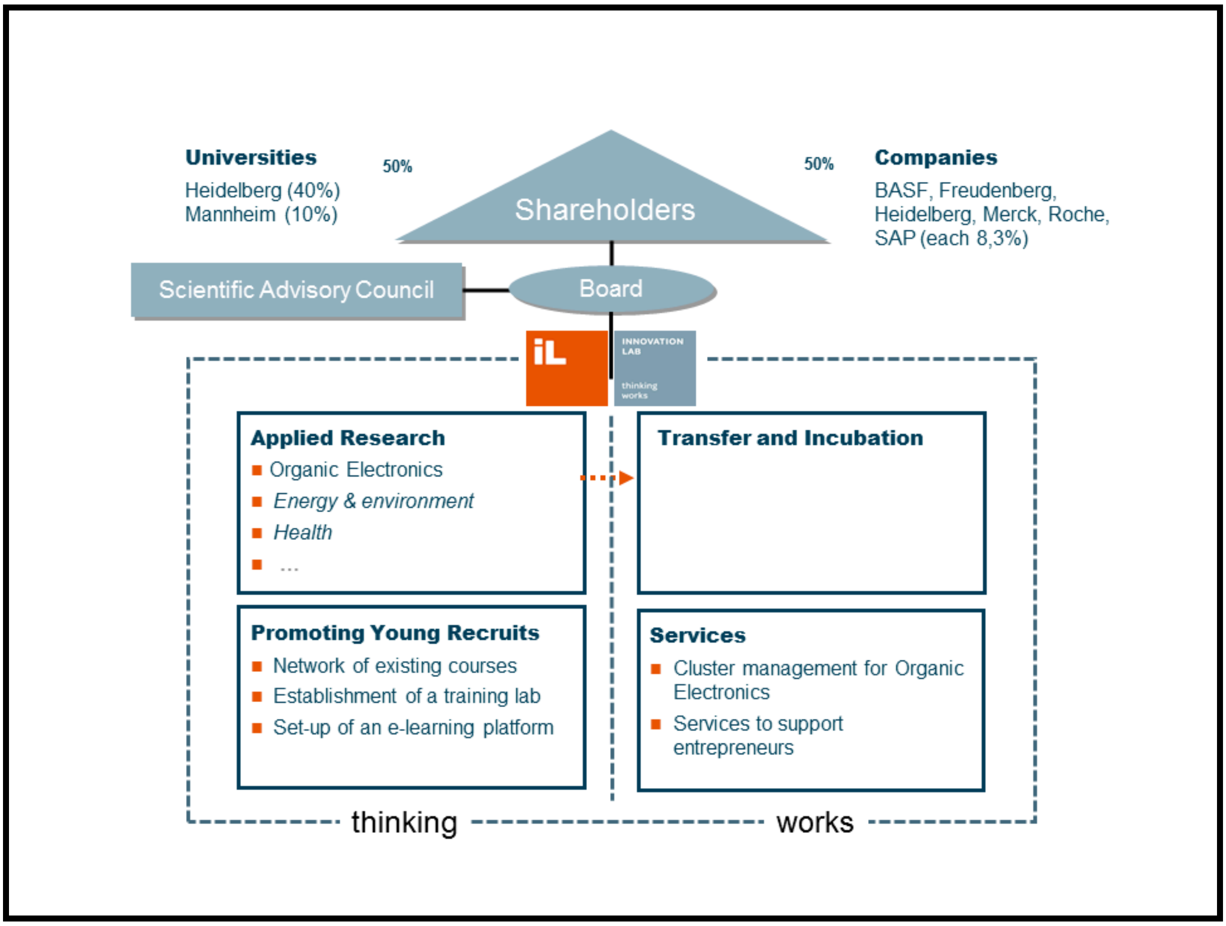
The Wissenschaftsbeirat (Scientific Counsel) of the German Rhine-Neckar Metropolitan region recognized this. The group comprised members of the boards of several leading companies, and the deans of two of the most prestigious universities and politicians in the region. The questions they faced was how could this huge market opportunity be captured and what would be a clever way to do, parallel to creating an infrastructure that would enhance the region's competitive position?

The group's vision was a 'MIT-like Organic Electronics' cluster, i.e. a world-class cluster of leading companies focused around a core of internationally renowned units from business and science, which would attract smaller companies and increase the overall commercial attractiveness of the region.

Based on this vision InnovationLab was founded in June 2008 with the mission to become

- a world-leading, integrated place for research and production in Organic Electronics;
- a world-leading centre of innovation for knowledge transfer and start-ups in Organic Electronics;
- the most attractive location for young recruits and students interested in organic electronics.

Although the shareholder structure comprises only the core partners, at project level InnovationLab is an open system. Within the scope of individual projects other companies can join if it makes sense and is conducive to all the partners.



Graphic 2: Ownership structure of InnovationLab

InnovationLab is not primarily profit-driven. Its main objective is to add value for its partners and to achieve the best results, better than any of the partners could achieve on their own.

An industry player's perspective: Merck

One of InnovationLab's founders and shareholders is Merck, which is based in Darmstadt. (This company is not affiliated to Merck & Co., Whitehouse Station (NJ), USA, although their respective corporate histories have some common roots.) Merck is a global pharmaceuticals and chemicals enterprise with around 40,000 employees in 64 countries. The acquisition of Millipore in July 2010 made it a global leader in the life science tools market, with pro forma revenues of around €8.9 bn in 2009.

Merck is the world-market leader in liquid crystals, mostly used in liquid crystal display (LCD), currently a multi-billion dollar industry. In 2000, Merck recognized that technological advances in the area of OLEDs (one of the most prominent applications of Organic Electronics) would eventually lead to substitution of the currently used liquid crystals.

Merck decided to establish a research platform in the field of printable electronics and currently is active in various areas of printable and Organic Electronics: OLEDs used in displays and OFET (Organic Field-effect Transistors) used to realize logical functions in the electronic displays of RFID (Radio Frequency Identification).

To boost the technological innovation pipeline, Merck set up two concept labs in Germany with the mission to prove the technical feasibility and scalability of technological ideas with the potential to establish the next S-curve with respect to technological performance and cost/performance.

In liquid crystals, Merck has a long tradition of co-innovation with its (predominantly Asian) customers and cross-science collaboration, mainly involving chemists and physicists. However, it soon became clear to Merck's innovation managers that to advance in printable electronics these established patterns of co-innovation did not work. The reasons were that first, from the point of view of the customer co-development processes, the feed-back cycles relating to technological results would be too long to achieve rapid progress of technological knowledge; second, co-developing customers would be unwilling to provide Merck with in-depth insight into later-stage processes which would make Merck's learning curve too shallow.

Merck decided on an approach building on a successful cross-science innovation model developed earlier which offered higher chances of success in advancing a new technology. This decision materialised in the investment in InnovationLab.

Merck views InnovationLab as a platform for cross-industry/cross-science open Innovation in the pre-competitive research stage of its innovation funnel. The borderline between closed and Open Innovation is represented by Merck's key decision criterion for closeness to commercialization. The closer the technological concept is to the market the greater the number of R&D activities that require to be in a closed innovation model, and the closer to a long-term breakthrough basic innovation, the more suited is the project to Open Innovation. Currently a smaller, but more visible part of Merck's overall R&D budget is invested in Open innovation activities, mainly focused in InnovationLab.

The IP of the projects channelled to InnovationLab is secured through patents establishing a clear basis for joint research with the partners in InnovationLab. There is the incentive to obtain patents in application areas not covered by the materials and applications patents held by Merck. Since this industry is in a nascent stage, in Merck's view there is enough room all the partners involved to obtain patents.

Since Merck's work in InnovationLab is at a very early stage in the innovation process the key performance indicators (KPIs) are rather 'soft'. The yardstick for measuring success is the contribution to the pipeline, i.e. the number of ideas that pass the Stage Gate and are developed into concepts. This KPI however is anchored firmly in the overall objective system of Merck's innovation management.

An industry player's perspective: SAP

SAP AG, the world's leading provider of business software (ERP and related applications e.g. Supply Chain Management and Supplier / Customer Relationship Management), is an investor and, through its SAP Research unit, an active partner in InnovationLab. This is based on a well thought-out strategy.

SAP believes that one of the next big waves in the computing industry will be the 'Internet of Things', i.e. an extension to the existing Internet infrastructure (ERP systems, Web applications, current Internet devices and existing Internet connection infrastructure) to encompass countless semi-intelligent everyday objects.

When the wave hits, everyday life and day-to-day business operations will be profoundly transformed. For instance, the chances of a company running out of stock will be minimized because all involved parties will know what products are being consumed at any given point in time, which goods via which channels are reaching the end of their consumption period, and which orders have to be placed to keep the supply chain working. Items will never be lost; they will be able to be located on a continuous basis.

SAP Research is convinced that organic electronic components will be key enablers of the Internet of Things; they will be like the 'nerve endings' in a global digital nervous system. Although their life cycles may not be as long and their reliability less solid compared to inorganic components (e.g. computer chips made from silicon), their cost position and disposability will allow for ubiquity and therefore radically different business scenarios.

In house discussion in SAP has focused on the need to be involved at the basic research stage of InnovationLab projects. The decision was made for three main reasons:

- The safest way to manage risk in a long-term radical innovation such as the Internet of Things is to be close to the basic research done by partners in the ecosystem.
  At presence, the time horizon for the Internet of Things is unknown. For instance, RFID, an early manifestation of the Internet of Things is proliferating more slowly than originally expected. But no one knows what the killer applications in the Internet of Things might be or how rapidly they will be adopted;
- In a basic research field, involving iterative trial-and-error processes direct involvement is key to reducing research risk and time to market.
  In the Internet of Things, defining the characteristics of future devices and applications needs to be a collaborative effort. Ecosystem partners such as Merck (see above) do not have expertise in software design and SAP does not have the expertise required to design the components of the Internet of Things. Both perspectives are required and are complementary;
- Radical innovations usually generate challenges to companies' core business areas – early involvement is crucial for acquiring insights into and developing solutions to these challenges.
  When the Internet of Things materializes, the huge amounts of data traffic from the billions of devices connected to mission-critical applications, such as Supply Chain Management, will require new solutions for data storage and distributed computing.

Within InnovationLab, SAP Research is contributing to several projects. One is POLYTOS, a project aimed at researching and developing materials, concepts, components, production processes and software for applications in the packaging industry. Apart from SAP and InnovationLab's founding partners Merck and BASF, this project has input from industry partners such as Pepperl+Fuchs (sensing technology), PolyIC (printed electronics), Robert Bosch, Copaco (packaging industry) and VARTA Microbatteries.

SAP's work in InnovationLab, like Merck's, is at the very early stage in the innovation process and the KPI are soft. SAP is applying four KPIs:

- Transfer into products within a 3-year perspective; the notion of product is broad and includes consulting;
- Number of patents generated;
- Contribution to thought leadership i.e. being recognized by customers and analysts as having the deepest insight into future developments;

- Secondary benefits such as algorithms for decentralizing decision control while managing torrents of data.

Choosing the right strategy

In a dynamic market and technology environment such as Organic Electronics, the choice of strategy is crucial. The challenge for InnovationLab was to identify and formulate a strategy that ensured cross-fertilization between industries (and industry partners) and scientific fields, and to ensure evolution of a high-tech cluster of leading companies.

InnovationLab chose a strategy that rests on three pillars.

Co-innovation for advancing mainstream technologies. Industry partners and universities should be aligned along the value chain of specific application fields. So-called competence fields, targeted at well-defined know-how-intensive, cross-value chains and cross-application fields of expertise were identified to ensure know-how transfer.

In order to enhance exchange of expertise, InnovationLab and its partners have invested several million Euros in joint labs and pilot production facilities. In terms of cluster management, the networking and matching between internal / external projects and existing / new partners is a key value-added of InnovationLab.

Corporate entrepreneurship for seeding secondary IP. It has always been clear that not all the IP generated at InnovationLab would be absorbed fully by the industry partners, mainly because the relevant world markets would be too small.

InnovationLab could provide incubators where ideas and concepts could be developed into prototypes; marketing and sales channels could be built up to generate value (spin-offs, joint ventures, trade sales). In other words, InnovationLab should become an active inside-out open innovator.

Support for entrepreneurs. It is hoped that the level of innovation achieved by InnovationLab's industry partners and university partners will attract numerous entrepreneurs in Organic Electronics.

To increase its value proposition, InnovationLab will provide a technical and business infrastructure for these new companies. Start-up companies will profit from e.g. scientific discussions, access to industry partners and their business networks in this areas, and research facilities.

Trust and IP

A key issue in setting up InnovationLab as a cross-industry / cross-science innovation hub is trust among co-innovators to allow experts from the various organizations to cooperate in an open and constructive way. University researchers are often reluctant to collaborate with corporate researchers, who in their turn may be hesitant about co-operating with their peers in other companies and especially competing firms.

To overcome these problems it is necessary:

- First, for the experts at the working level to have the strong and explicit support of their top management. In the first InnovationLab projects, the industry experts were all at the 3rd and 4th levels in their respective corporate hierarchies, rather than middle management, probably because any conflicting goals would be beyond the power of middle managers to resolve;
- Second, InnovationLab realized the need for a strong and clear challenge to motivate people to work together, represented by competition in an economic development scheme of the German federal authorities (see below).

Finding clever ways to deal with IP issues was also important for getting InnovationLab off the ground. Fortunately, competition among InnovationLab's industry partners was low level and all shared a conviction that in the emerging industry of Organic Electronics the priority was to develop a market – in other words to make the pie bigger. In mature industries, growth rates are low and joint innovation is a zero-sum game.

The IP foundation of InnovationLab is that each party that contributes to a specific advance in expertise and technology should have IP exploitation rights. In specific projects, IP agreements have to be negotiated on a case-by-case basis.

How to embark on cross-industry, cross-science Open innovation

Aligning the experts from the various organizations with a common goal is vital to the success of cross-industry / cross-scientific innovation.

Before InnovationLab was founded the competitive economic development scheme 'Leading-edge cluster competition' had been launched by the German Federal Ministry of Education and Research.

The winner stood to receive major public funding to be complemented with its own funds. InnovationLab and its partners decided to compete for this funding.

In preparing its bid, the team made up of representatives from the various organizations learned to work together and to compromise. InnovationLab was disadvantaged by having decided to join the competition at a rather late stage, but this resulted in stronger collaboration and trust among team members.

InnovationLab won the competition and was keen to cash in on the collaborative energy created, to keep up the spirit and move into working mode. The InnovationLab partners focused on four areas:

- Refining how innovation should be directed within the cross-industry / cross-science environment of InnovationLab;
- Investing in state-of-the-art infrastructure such as labs and pilot production facilities – world class research facilities are a major motivator for top researchers, for personal input, and open collaboration;
- Establishing focal points where people would meet and chat e.g. the water cooler or the coffee machine;
- Setting up a Web 2.0 communication platform to facilitate the exchange of codified knowledge.

Co-Innovation: The value-chain approach

InnovationLab aims at being a premier innovation hub for the emerging Organic Electronics industry. It quickly became clear that innovative applications and products needed a value chain-driven innovation approach.

Take for example smart labelling. Smart labels are tags (labels) with a RFID device consisting of at least an integrated circuit for storing and processing information and an antenna for receiving and transmitting the signal. They have many applications such as in enterprise supply chain management to improve the efficiency of inventory tracking and management. To achieve a truly innovative solution of printed RFID tags requires a holistic view encompassing materials plus printing technology plus software applications.

If SAP, one of InnovationLab's stakeholders, wants, for instance, to deliver a solution for tracking the temperature of a product along the distribution chain to ensure the good is in good condition at the point of sale, or to pinpoint which partner in the supply chain is not complying with performance standards, then the solution is smart labelling. Ideally, a complete timeline of the temperature of the product is required. Another of InnovationLab's co-innovating companies, PolyIC, might decide that this was not feasible with the current technology and to change the parameters to whether set temperature thresholds were respected or not. BASF, another one of InnovationLab's founding members, might join the discussion and work on which materials should be used in order to provide relevant thresholds.

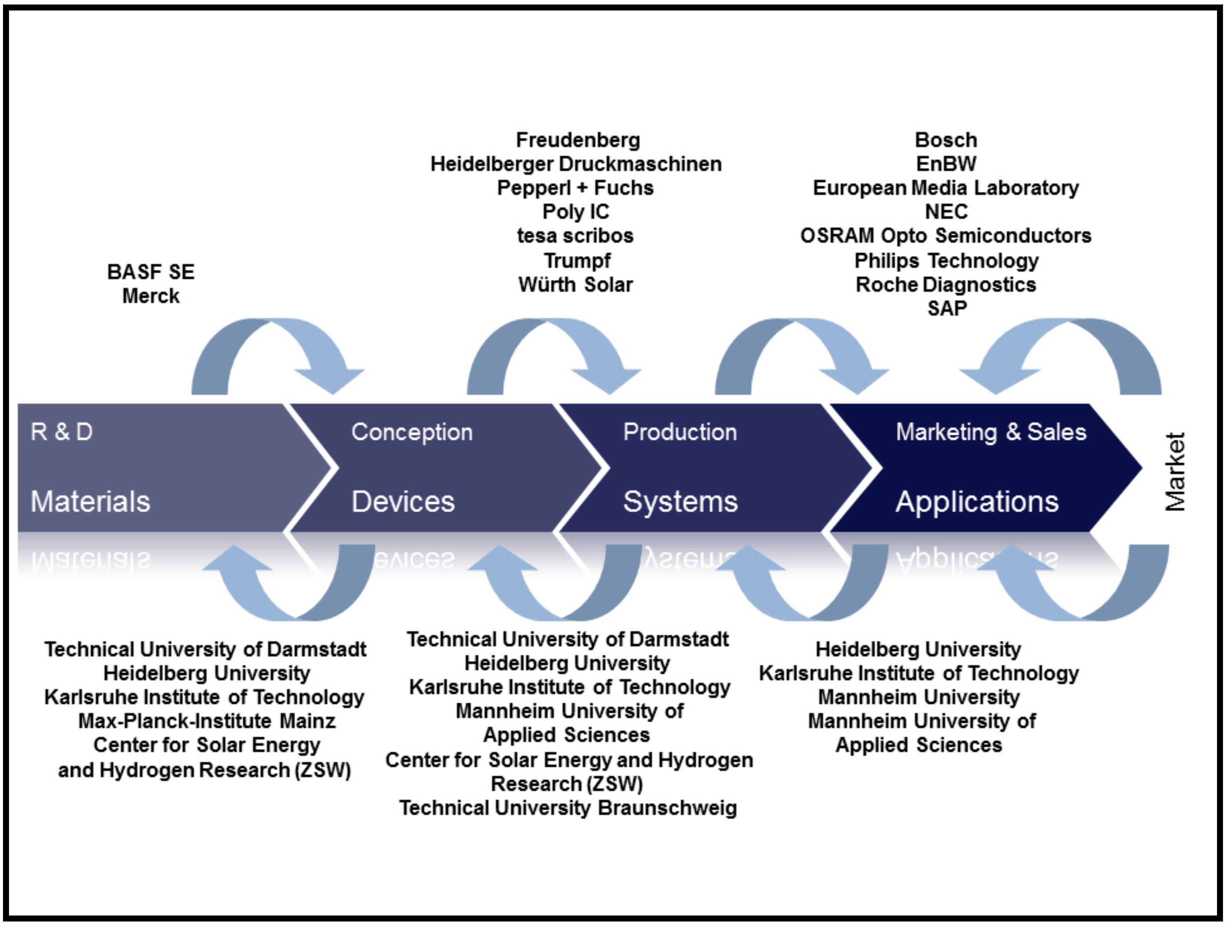
InnovationLab partners have identified four application areas that cover the entire value chain from development of materials to marketing and sales of applications:

- organic photovoltaics
- organic LED for lighting
- organic circuits and storage, e.g. RFID tags
- organic sensor applications e.g. for medical applications.

Although cross-industry / cross-science innovation in each of these fields of application is a complex venture but this is not enough for establishing a world-leading innovation hub.

The work streams all involve some common issues such as:

- Synthesis of materials
- Analysis of material and device properties
- Morphology of thin films
- Printing technology
- Numerical simulations



Graphic 3: Value-chain driven innovation within InnovationLab

A mechanism for interconnecting partners across application areas was required to lift the innovation to a new level. InnovationLab calls these cross-application innovation streams competence centres. Every competence centre is led by a world-class academic researcher and represents a research discussion line. InnovationLab has contracts with some of the most senior and best researchers which is attracting young high-potential research fellows to InnovationLab.

Open Innovation inside-out

InnovationLab expects that a significant amount of the IP generated within the cross-industry / cross-science innovation hub will not be exploited by the industry partners because the global market is too small. InnovationLab wants to provide an environment where its projects and technologies can mature and increase in value.

InnovationLab plans to manage these ideas via a virtual company that will provide commercial and technical management up to the point where the value in these technologies increases making it attractive to institutional or corporate venture companies, spin-offs, trade sales or joint ventures.

LESSONS LEARNED

Lessons learned: General

- Innovation in a new industry with not-yet mature technologies works best within a cross-industry / cross-science platform where R&D staff from numerous organizations work at arm's length.
- To fully commercialize a cross-industry/cross-science open innovation approach requires mechanisms to be in place to accommodate what might seem to be unimportant inventions in disruptive technologies, and to turn them into major innovations. InnovationLab provides an infrastructure for start-up companies which it is hoped will lead to an Organic Electronics cluster similar to the Silicon Valley development that evolved on the periphery of Stanford University.
- To build a cross-industry / cross-science innovation hub such as InnovationLab a shared vision among the top executives in the participating organizations is required. A leader must be identified to drive the venture and make the shared vision a reality.

Lessons learned: Merck

- In cross-industry innovations frequent physical contacts are one of the keys to success. Closeness, especially in the start-up phase of a joint project, is necessary to identify a common language, agree IP issues and establish trust.
- IP issues need to be clarified and settled before work begins of there will be lack of trust, and loss of a spirit of collaboration.

Lessons learned: SAP

- Major investment in open innovation requires consistent and continuous support from senior management. There will inevitably be conflicts about resources for closed and open-innovation activities. R&D managers need to be focused on fostering newly established open innovation initiatives.

- A major enabler for breakthrough innovations in a cross-industry / cross-science innovation setting is close physical co-location. Even the most sophisticated Internet-based communication and collaboration tools do not enable bonding, trust and a spirit of adventure engendered by joint research in a state-of-the-art laboratory.

CONCLUDING REMARKS

Cross-industry and cross-science innovation will be at the heart of managing breakthrough innovation in the future. The work of five leading companies and two world renowned universities in InnovationLab is pointing the way for innovation managers.

Among the key factors addressed by InnovationLab's shareholders and managers are:

- consistent and enduring Top Management support
- shared vision
- a value-chain-driven innovation approach
- physical proximity of the innovators involved
- professional management of individual projects and cross-project synergies
- management of IP issues, and agreement before collaboration starts
- building trust and personal relationships
- mechanisms for commercializing secondary innovation results.

FURTHER READING

- Urban, Hauser, 1993: Urban, G. L. and J. R. Hauser, Design and Marketing of New Products, Prentice-Hall, Second Edition 1993.

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