Putting University Research Results to Work

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Abstract

The report argues that transferring technology from academia to industry is a daunting task. As a consequence, the report proposes an alternative approach to facilitate technology transfer based on a web-based communication platform. The concept leverages many findings addressed in a series of academic publications. Furthermore, it has been tested in a sequence of interviews performed with Technology Transfer Officers working for internationally renowned universities in North America and proven effective. The report provides a list of critical success factors for such a platform and concludes with a conceptual design for the web-based communication platform.

1. Introduction

Universities are increasingly interested in commercializing their existing and growing body of research results and technologies. This increased interest is triggered for once by success stories of universities, which created substantial revenues by licensing patents, where the employed researchers have made the corresponding invention. After all, this kind of income can be a substantial source of additional funds for a university successful in technology transfer. For public universities there is also political pressure to demonstrate that their research work delivers a tangible contribution to the economic welfare of a region or a country, as the operational cost for running a university is covered by taxpayers' money. Furthermore, success in technology transfer represents a means to assess the productivity of a university, a factor that has an impact on various rankings.

In the past years many universities have established various forms of technology transfer offices (TTO) to commercialize their research results. The ultimate vision for technology transfer looks like a running sushi place, where industry representatives drop, taking out technology as they find it, as is illustrated in "Running TUMshi" shown in Figure 1. However, this vision is closer to diving down a rabbit hole to reach Wonderland then to reality.

The TTOs spend much effort on increasing the patent portfolio of its university, intending to create revenues by subsequently licensing the patents to industry. However, all this effort has generated commercialization

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successes, which fall short to expectations. This is true for North American as much as for European universities, with only very few exceptions.

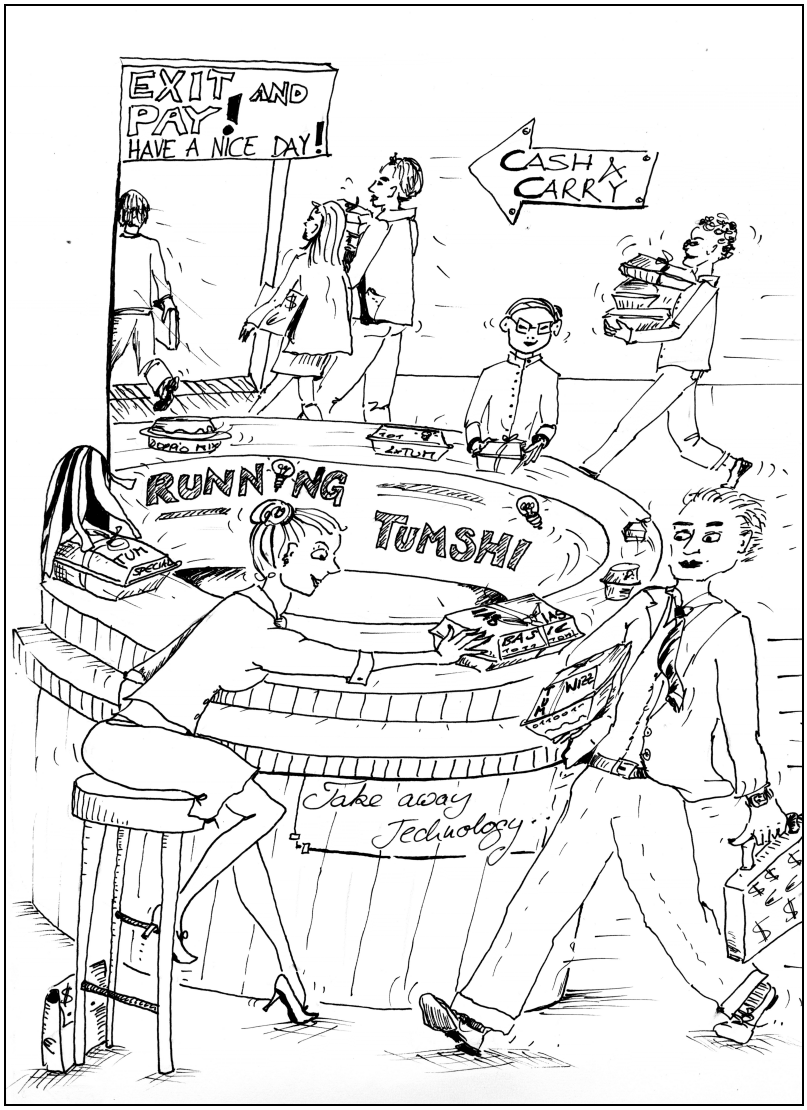

Figure 1: Running TUMshi - Illustration by Carola Diem©

This report provides some thoughts on this issue along with a proposal for an alternative approach to technology transfer by leveraging Internet technology.

2. Prior Work

Conti and Gaule [7] performed a study where they compare the effectiveness of technology transfer in Europe and the US. They find that European TTOs do not execute less licenses than US TTOs. However, they earn significantly less revenue from licenses. They relate the difference in licensing income to differences in the organization and staffing of TTOs. Specifically, US TTOs employ more experienced staff and appear to have greater flexibility in managing their budget.

3. The Challenge Of Technology Transfer

University Technology Transfer Offices (TTO) work hard to get innovations to industry, but in reality, they transfer only a small proportion of university patents. After all, patents cover only a small fraction of university research results and potential innovations. Most innovations have no known applications and this presents a barrier to the TTO. This marketing gap is summed up in the simple question, “What is it good for?”

Answering this question can be surprisingly difficult, time consuming and expensive. Based on the years of experience of Shadow Labs, a single innovation may require 6 months to 1 year’s effort by an experienced and dedicated professional, involving substantial travel and industry meetings. In the end, when all ideas are explored, the result is often that no economically practical application is found.

Considering this in the context of a typical TTO staff with less than 10 people, and a limited budget, they cannot pursue more than a few inventions per year. In fact most TTOs are unable to pursue any inventions in this active way – they can do little more than post short descriptions and wait for industry “customers” to contact them.

The typical TTO office is organized with specialists assigned to follow and license technology coming from specific departments of the University. If the TTO specialist can manage to keep track of the many diverse projects within their university domain, they will have the impossible task of keeping up with the inner working of all the industries of the world.

Everyone is aware of the exponential growth of technology, but there also is less-famous mirror-image exponential growth of complexity in the industrial world. The TTO is in the very difficult position of trying to bridge these two.

For example, imagine a simple example of the TTO officer assigned to the lab which developed the laser. With hindsight, we know that lasers have applications in almost every industry, including giants like communications, construction, manufacturing, medical, military and transportation as shown in Figure 3.

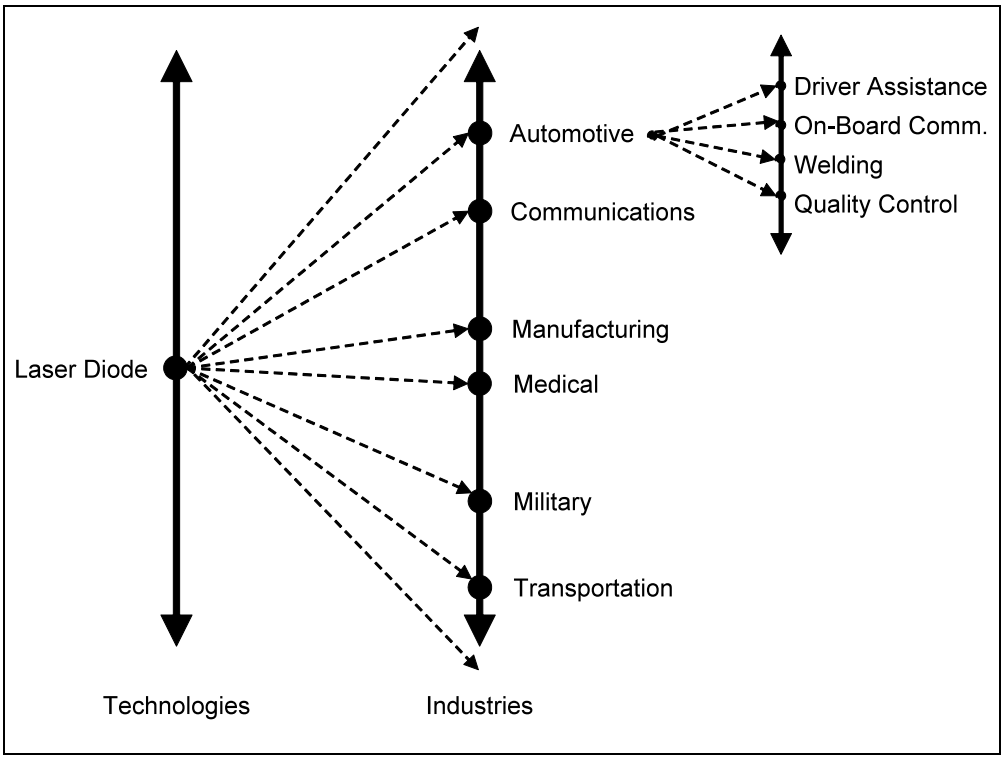

Figure 3: A single technology may be valuable in many industries in multiple ways around the world.

Of course, it is impossible for an individual to be expert in the inner workings of all of these industries, so the most complete TTO offices try to augment technology experts with experienced veterans from specific target industries. However, this leads to an equally daunting mirror-image task.

As another example, imagine the TTO officer assigned to the transportation industry. Perhaps it is too much to ask one person to cover air, rail, sea and land, so the TTO may narrow the field to only the automobile industry. This is still a daunting assignment as the automobile industry has needs that span a huge number of disciplines including manufacturing techniques, information technology (e.g. supply-chain management, logistics, inventory), chemistry (e.g. plastics, lubrication, rust-proofing and painting), metallurgy (e.g. alloys, hardening, plating), metal fabrication (e.g. forming, laser welding, abrasives), navigation, passenger safety, glass, fabrication, textiles, design tools (functional and aesthetic), automation (e.g. robotics, cognitive systems), ergonomics human factors engineering, tires/rubber, suspension dynamics, entertainment, acoustics, environmental and more as shown in Figure 4.

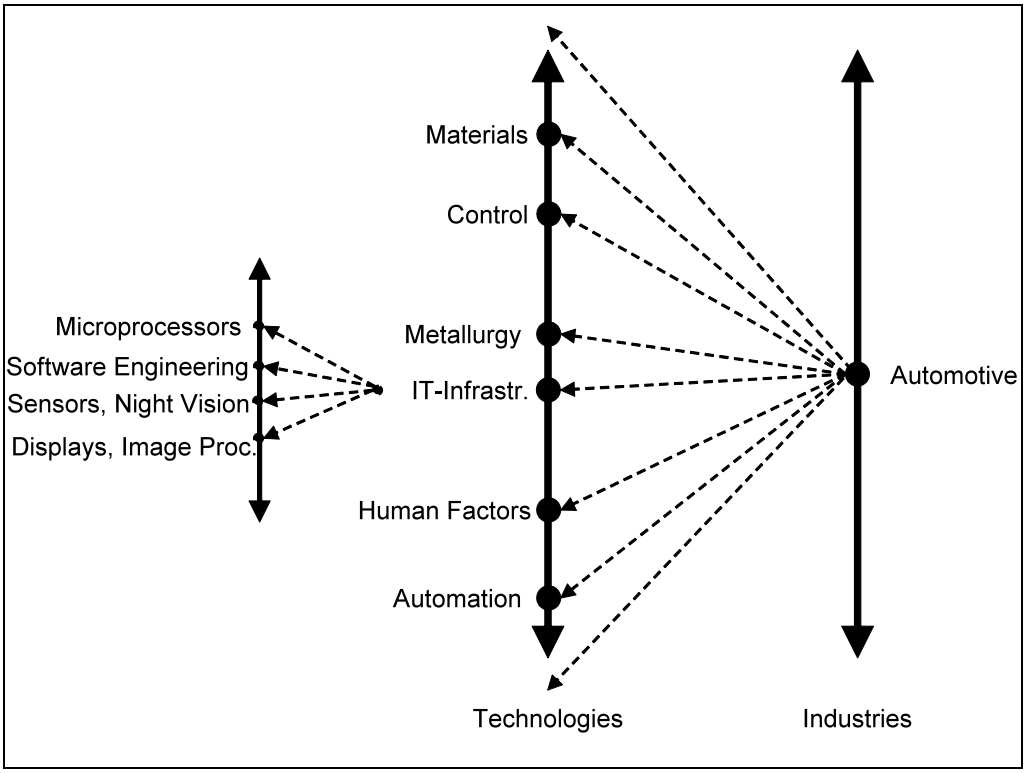

Figure 4: A single industry requires many technologies from multiple disciplines.

Such a list can go on forever, but the point is that it may be as impractical for an individual to know every need within an industry as it is to know all the technology within a given scientific discipline.

Because of this, it is clear that adding more people to the TTO will not solve this complexity problem – even if incredibly knowledgeable industry and academic people are recruited. The problem calls for new tools to help the human find matches.

If a system can find and sort the possible applications of technology, this would allow the TTO staff to pursue applications that have the highest probability of success. This would greatly increase the options of the TTO as well as increasing the value of the technology in the portfolio.

It is the mission of this study to explore one promising possibility to help the TTO officer using the Internet and the established techniques of social networking and broadsourcing to solve this problem.

4. An Alternative Approach To Technology Transfer

4.1. A Web-based Communication Platform

The goal is to craft an open web-based site where visitors can help inventors and TTOs find and evaluate applications for University technologies.

There are already many sites where visitors answer questions, give advice and build knowledge-bases (e.g. user-groups, Wikipedia). If properly structured, a new Internet site could harness this same voluntary help energy to gather and refine application suggestions from people all over the world.

These visitors who write about applications don't need to be in positions to purchase or use the innovation – their role is only to identify and discuss a good application. We can use the tools of the Internet to provide forums to collect the ideas as well as Internet social and sharing features to let visitors collaborate to develop ideas as well as correct or reject off-target suggestions.

Armed with vetted application ideas, a TTO is empowered to contact appropriate industry people or work with local venture capital firms to form a startup.

Further, if the site showcases ongoing research areas as well as patented property, the visitors can give valuable real-world feedback to guide researchers for future work. This can also serve as a powerful sales tool to help the University get new industry-sponsored research projects.

4.2. Conceptual Design

The base concept is to use Internet methods to build a site where world-wide visitors can suggest, describe and refine potential uses for the innovations, harvesting their diverse knowledge.

- Member universities describe their innovations on an online site. Innovations may be patented or not. In fact, it is not necessary for the innovation to be "for sale" in order to gather feedback and suggestions.
- A successful forum conversation would result in vetted ideas to guide the TTO and innovator. These include ideas for using the innovation as well as ideas for future R&D.
- The description can contain multimedia, links and tutorials to help describe the innovation.
- The innovation description can be supported by a collaborative mechanism like that of Wikipedia. To keep the description section from being corrupted, access can be limited to a community approved by the owning innovator – for example, the members of the inventing laboratory.
- For each innovation on the site, a refereed open-forum gathers suggestions and encourages comments. The goal is to have the general public suggest applications for the technology. Suggestions and comments are visible in the public forum where others can validate or contradict the idea.
- This allows visitors to build on previous entries as well as correct and fill gaps. As the innovator get suggestions, the online description can be updated and expanded to incorporate the best suggestions and comments.
- The site will be drawing on web visitors from all corners of the globe with widely varying life-experiences. This provides vision into every corner of every industry.
- Ongoing monitoring and participation by the innovator is encouraged so they can answer questions and benefit directly from the flow of ideas.

To allow scaling to a large collection of innovation and many visitors, use social networking and modern tools:

- Wikipedia-style updating of descriptions
- Enable people to pass on innovations (or links) to friends – via email, text, social site posting, tweets.
- Use ranking and status of contributors to encourage participation – people can rise in rankings with good ideas.
- Hot trends – this is a ranking for innovations. List the most popular and the recent posts so frequent visitors can quickly get to them.
- Startup Ideas – allow users to suggest ideas for a startup based on innovations they find. “Computer Dating” inspired features can assist the process of gathering up a team for a new startup (e.g. marketing people meet interested technical and finance people).
- Cross-linking – Readers may cross-link multiple innovations recognizing similarities or synergies into a “super-innovation.” In some cases, the combination might be a better vehicle for a viable startup product than any one innovation by itself
- People who read these also read “…..” Like Amazon book recommendations, this site can point people to entries that seem to cluster in popularity.
- “See other items by this inventor” or by this laboratory – maybe one entry gives a clue that a lab is in a good area and the user will want to see more.
- Volunteers – allowing volunteers to monitor and control the individual forums will let the site scale with growth. Sites such as Wikipedia and Answers.com work this way.
- Rating of innovations similar to EBay or Amazon
- Subscriptions to newsletters

Posting types: As the site grows a user base, it can offer relevant suggestions on more than just innovations. In addition to patented inventions, the same mechanism can support:

- Research projects and results
- Materials (new materials or even industrial waste products which are available)
- Product ideas
- Defensive publishing – get the idea into the public domain so other cannot patent

Although it may, optionally, include incentives of cash, status or merchandise, the preferred embodiment will use non-monetary incentives (such as recognition) to tap into the same volunteer spirit that encourages people to contribute to Wikipedia as well as the multitude of helpful sites and forums powered by the knowledge of users. In addition some guidelines for design include:

- Age diversity is desirable – elders can draw on more life experiences.
- It should have mechanisms to encourage scale and expansion of the net of people.
- It should have mechanisms to give out information and collect suggestions.
- It should have mechanisms for feedback and tuning of suggestions

5. Initial Validation of Concept

In order to verify the validity of the conceptual design, a search of academic papers was performed along with a real-world practicality test via interviews with leading University TTOs. Five North American Universities, Caltech, MIT, University of Alberta, Carnegie Mellon and Harvard were contacted in addition to TUM.

Although the Universities are of different scale and specialties, the discussions showed that the Conceptual Design was on track and it was clear that TTOs were willing to participate by putting their innovations on-line if such a system were implemented.

5.1. Success Factors

As a result of these discussions, we identified 3 critical success factors to guide the design:

1. **Get a large volume of quality content on the site**. Both the number of entries and the quality of entries will be important. We want people to return so a steady stream of new innovations will keep the site fresh. Also, the entries must be readable and engaging as the readers are volunteers coming for entertainment. If it seems like tedious work, they will not come back. Patents and technical papers are not appropriate formats. Although most current TTO sites just dump patents on the site as a way to save work, this will not work and will just chase away readers.
2. **Get many visitors to come to the site**. The concept depends on the combined wisdom and vision of large numbers of active visitors. The readers don't need to be customers who can use or buy the innovation; they just need to be people with knowledge of the world of industry and applications. Both the number of visitors and the diversity of visitors will influence the results.
3. **Get participation and relevant suggestions from the visitors**. The goal is to get ideas from visitors. If they visit and do not interact, then the site will not achieve the goal of finding applications.

5.2. Quality content for the site

TUM has plenty of innovative research and patents to go onto the site, and initial discussions with other school TTOs have shown that there is no shortage of content readily available. Universities would love to show their stuff.

The difficult part is getting the innovations into a form that is engaging to a reader and also exposes the relevant aspects of the innovation.

Patents are currently the most common form posted online by TTOs, but in their native form, patents are not suitable. Most patents are written in a terse form designed to get legal protection, not as a sales tool. They are not easy to read and usually do not lay out a relevant picture of potential applications. Most scientific papers suffer from the same problem.

If the content is dry and legal, like the typical patent-listing site, then people will be bored and it will drive away all but the most die-hard techno users.

Instead of the patent, a quality description would be much more successful in engaging the reader and inviting ideas. The entries could add instructive background from the professor as well as helpful links and suggested applications to help start the thinking process.

Where patents are limited to ancient black-ink printing, the entries on the site should include color, photos, diagrams, and animations, audio and even videos to better explain and highlight the work.

Often there are valuable aspects hidden within the research work and in the innovation process. For instance, to build a part of a very complex invention, the research team may have had to develop a very valuable high-precision fabrication technique. Or perhaps they developed a new precision instrument to guide their own work. Although not appearing anywhere in the patent or prior publications, these may be of high value – sometimes higher than the invention.

Writing for this wider audience is a time-consuming task requiring skills which are different from the writing skills commonly found in researchers.

A small special writing staff could help get the site started in the right way, but if it is to scale and grow quickly at “Internet growth rates,” a scalable solution must be found. Perhaps, after some experience with a small staff, we may be able to create automated tools or a guide set of rules and templates to help the innovator and TTO. In this way, the writing “staff” grows as new innovators join the system.

Another solution would be to encourage and support a 3rd party network of writers. These agents could be engaged by the TTO to work with the inventors to capture the information and put it in a good form for the site. These could be volunteering students or could be a small industry which springs up to fill the need for services.

Also, a Wikipedia type mechanism for the description part of the site could be a solution. In this way, a professor could assign one or more students to contribute to the description. The description can start small and grow and expand over time as they have more material.

5.3. Get Visitors to Come to the Site

To get a substantial benefit for the many innovations that we will have on the site, there will need to be a substantial number of visitors with varied backgrounds.

For this, we have some advantages with our university heritage. A university has a large community of students and professors which the TTO can tap into and this is a good start.

When a number of professors have their inventions on the site they will have a natural incentive to help it succeed. It will be in the professor's interest to encourage their students and colleagues to go to the site. This can be a good start of a user network.

Further, universities have press offices with regular contact with newspapers and other press. They can get the story out to the general public in their geographic area. Press stories may focus on the innovation website, itself, and can generate follow-on stories over time describing interesting successful technology transfers. In the US, the TTOs were all in contact with the press and promoted their activities and successes in the community.

Also, North American universities have strong alumni offices with ongoing communication with alumni. In the US, the communication can be extensive with contacts reaching back 50 years or more. This is very valuable because alumni, with their years of experience in industry, may be the best resource for application ideas.

Currently, TUM is intensifying contact with alumni. Such an innovation site can serve as a new tool to offer incentives for alumni and hence to increase their bond with TUM.

Each university can seed a geographic area and network of people to help grow a user base. How far and how fast will it grow? This depends, to a large extent on how engaging the site is.

It is to our advantage to have multiple member universities who can each seed their network of people such as alumni as well as their geographic region (through local press).

By seeking universities in diverse regions, we can seed diverse groups, each of which can grow. This gives a good scale as well as some insurance against one or two non-responsive communities. Even if some groups fail to grow, others can flourish and fill the void.

A rational plan would have at least one leading University in each interesting geographical area. More than one will be welcome, but our efforts should focus on signing up at least one in each. Of course, some markets, such as Japan will present a language challenge and others, such as China and Russia may be less than desirable because of their history of lax IP handling.

With this in mind, a quick list might include:

- Europe: Germany, France, Italy, Denmark, Netherlands, Benelux, Norway, Sweden, UK, Spain, Switzerland
- Americas: USA, Canada, Mexico, Brazil
- Asia: Australia, Japan, Taiwan, Singapore, China, India, Russia

In the US and in Europe, there are organizations of TTO officers which make it relatively easy to reach many universities in parallel. Other regions can be prioritized and approached as staffing permits.

Contacting and signing up universities will be a very important task. PR can help us reach the universities, just as it helps us reach visitors, but the job entails more. When a university signs up, there may be a lot of important work to bring them up to speed on how to brief professors, how to write descriptions, how to manage forums, etc.

We can do this ourselves, at first, but to scale, we'll have to get this down to a system that can be delivered to the new member university in a usable form (maybe instruction videos, etc…).

Of course, the member universities will also be a source for new ideas on growing the network and the site. A convenient forum for exchange of ideas among members (e.g. newsletter or user groups) can help spread the ideas to every member's advantage.

5.4. Get Participation and Relevant Suggestions from the Visitors

It is one thing to get visitors to the site, but the goal is to get great applications from the visitors. To this end, it is important that the site be easy to use and encourage participation.

If it is easy to use and the entries are fun to read, people will spend time, return to read more and recommend the site to friends and colleagues. If the site is confusing and the innovations are tedious to read, they are unlikely to recommend the site to friends.

Here, too, the skill of the forum monitors can help. They can work to keep the threads relevant and progressing, trimming and combining where needed. Likewise, if the innovators can stay involved to answer questions and react to suggestions, relevant results can be found sooner.

Another element that can help get responses is to make the site easy to navigate using such techniques as intelligent indexing and clustering of similar items. For instance, we can index by the technology, but also index by suggested application areas. In this way, visitors can look for technologies that others have flagged as relevant to their industry. For example, if a visitor came from the "paint" industry, they might find relevant innovations in chemistry (faster drying), electronics (color matching), or marketing (IPhone apps). Instead of making them search through all of mankind's knowledge it would be great if we had a listing of all innovations that visitors had previously suggested might be good for the paint industry.

Other common Internet techniques can also be used:

- Clustering: "People who read this also liked these entries"
- Email: "Email to a friend"
- Social: "Post to MySpace"
- Organizing: User groups or gathering points for those who want to fund or start a new company around an innovation

6. Conclusions

To read further …

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Profiles

Steven D. Edelson

Mr. Edelson has made a successful career out of developing innovative new strategies for technology companies in new or changing markets. From makers of consumer electronics, to enterprise software developers, to food processors, to manufacturers of highly specialized laser modulators, Mr. Edelson has solved marketing challenges for companies looking to extend relevance or enhance appeal for their products and services. With the creativity of an inventor and the analytical rigor of an Engineer/MBA, Mr. Edelson generates groundbreaking ideas by adapting classic business strategy techniques to include technology prediction, and matching historical scenarios from other markets that have experienced similar challenges and transformations.

An honors graduate of MIT (BSEE, BSCS) and Harvard (MBA), Mr. Edelson began his career developing audio and visual surveillance devices for government agencies. He later founded venture-backed Edsun Labs, to develop and market silicon and software products for personal computers. Over its 8 years, Mr. Edelson oversaw and guided Edsun through various stages as it grew from 1 to 30 employees until it was sold to Analog Devices in 1991. One of his key milestones was the invention of the core Continuous Edge Graphics (CEG) technology, which won industry awards and acclaim from *PC* Magazine, *PC Computing*, *Byte* Magazine, and Comdex. In addition to CEG, Mr. Edelson holds 14 patents in display systems, computer graphics enhancement, medical imaging, and IP telephony. Since 1991, Mr. Edelson has been in high demand as a strategic consultant for major technology organizations around the globe. He has provided creative insights and consulting expertise to global technology leaders such as: IBM, Cisco, QinetiQ, Microsoft, Intel, Lockheed Martin, Sony, Kodak, Broadcom and Polaroid.

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Forschungsschwerpunkte – Videosignalverarbeitung, Videokompession, MPEG Standardisierung, Visual Computing, Computer Vision, Multivariate Datenanalyse; Theorie zeitvarianter linearer Systeme und Computational Modeling; netzwerktheoretische und algebraische Methoden für den Algorithmenentwurf in der Signalverarbeitung, maschinelles Lernen für kognitive Systeme, Differentialgeomtrische Methoden für den Algorithmentwurf.