Samuel Neaman Institute
FOR ADVANCED STUDIES IN SCIENCE AND TECHNOLOGY

HOW USERS BUILD THE INNOVATION PARTNERSHIPS THEY NEED

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This paper was presented at the EFMD conference in Sophia Antipolis and won first prize

September 2002

This project was carried out within the framework of the Neaman Institute for Advanced Studies in Science and Technology, at the Technion, and it was partially supported through a European Community Marie Curie Fellowship (http://www.cordis.lu/improving) to Bernard Kahane

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Introduction

Innovation is unlikely to be successful if it is founded on the supposition that the innovative process is essentially simple, linear and sequential. It is not. The innovative process is complex, intricate and irregular and basically, it can be considered as an information and learning process (Macdonald, 1986). Successful innovation is the product of a total information package to which R&D makes only a partial contribution. There are additional contributions from other participants in the process, including the users of the new technology, whose inputs are just as vital as the information derived from R&D. Most of the time, users involvement is mainly addressed from the firm's or policy maker's perspective. That is, how can firms come in contact and develop a fruitful relation with the users they need to guarantee the success of the innovation they wish to market. We here report of a different perspective where users in order to achieve their goals a) position themselves and act as the driving force in the innovation process, b) mobilize the academic sector as well as the industry, c) create and handle innovation networks. Acting in this manner, they play a catalytic role to mobilize others in an innovation process that would have not happened without them. This situation is described in two different national settings, which allow us to explore the various ways through which users set the pace and the form of innovation. These two situations reveal common features and priorities that have implications at the micro level (actors directly engaged in the innovation process) and meso level (operators designing mechanisms to help generate and foster the innovation process).

Theoretical background

OECD (OECD, 1999) acknowledges that innovation is "an iterative creative process in which both business and non business oriented institutions take part". This points to two different things. First, both business and non-business oriented institutions take part in the innovation process. Second, innovation is an iterative creative process. We thus draw on literature to show a) the recognition that besides academy and industry, users are important players in the innovation process, b) the various models of innovation and their implications for users involvement, c) the new forms of users involvement that have recently emerged where users position themselves as a crucial catalytic and driving force in the innovation process. We then explain why from our point of view, studies on forms of users participation in innovation networks are needed, particularly when users act as the driving force in the innovation process.

Users are key players in the innovation process

Gibbons (Gibbons & al, 1994) have shown that in the new knowledge economy, various actors participate in order to bring science to the market. Not only, present scientific production most of the time combine various scientific fields, but also various types of actors take part in it (academic laboratories, industrial laboratories, hospitals, etc.) both at national and international levels. Further, in the knowledge-based-economy, innovation is considered, first of all, as information and learning process. Thus, diversity of actors' participation allows various stakeholders to bring their own part of information and knowledge to the innovation process. This has implications on the nature and on the number of those who participate in the innovation process, as well as on the density and number of links through which they exchange and on the rules that govern these exchanges.

Academic-industry linkage in the innovation process has already received considerable attention. Academic and industry that were for a time considered as living in two parallel distinct worlds have progressively evolved to become increasing partners and sometime competitors.

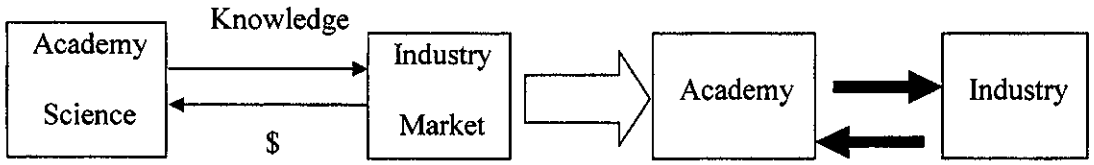

FIG 1: Academy and Industry interplay

Academic-industry interaction has been extended to incorporate governments in the picture in what is called the Triple Helix model (Etkowitz and Leydesdorff, 1997). This system's representation argues that institutional differentiation and links between university-industry-government are crucial in fostering the innovation process and reshaping institutions that take part in it. Integration and diversification forces that provide its dynamism and expansion and allow its endless progress, as long as the interaction and communication among the helices are organized properly, pull the system. On the one side, each stakeholder has his own interests, values and culture. On the other, integration of different stakes holders around a mutual aim happens and is needed. In their first study, they identified three main institutional spheres or sub-dynamics namely; university, industry and government (Etkowitz and Leydesdorff, 1995) and each of them considered being one of the helices. In their more recent studies, they added the emergence of network organizers and coordinators as "knowledge brokers and academic research centers". These are considered to be integral parts of the network system in bridging the helices and translating the different values between them. The model has been further extended when it was shown that not only producers of innovation (academy-industry-government), but also its users were essential part of the innovation process. By what is called "learning by using" (Rosenberg, 1982), users reinterpret new technologies, products and services that are proposed and reshape them, sometime surprisingly, to fit their needs.

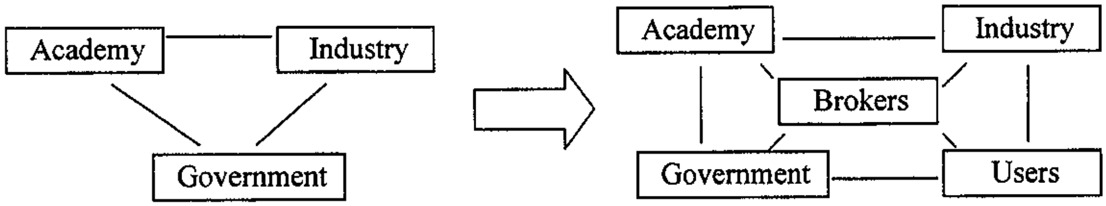

Fig 2: New players in the innovation process

Following this approach, increased involvement from users in the innovation process has been emphasized and various ways to achieve it proposed (Thomke & Von Hippel, 2002). Nevertheless, this incorporation of users is not an easy process that could be taken for granted and key questions still need to be solved in order to achieve it: Who is legitimate and relevant to represent users? How could and should users come into the picture? At what stage should they be there? Until now, these questions seem to be mostly unanswered.

The various models of innovation

Users participation in the innovation process is seen as a key success factor in the innovation process. Nevertheless, time and forms of implications are dependent of how the innovation process is perceived, represented and put into action. Innovation is described mainly through two types of models: Sequential models on the one side, iterative models on the other.

i) **Sequential Models of innovation**

Sequential models are dominant at least in the mind of most practitioners and have helped in the development of various operational tools (Perth and Gantt charts for example) commonly used in project management processes. Different steps arranged in an orderly linear manner where achievements in one of the steps, allow engaging in the next, characterize these models.

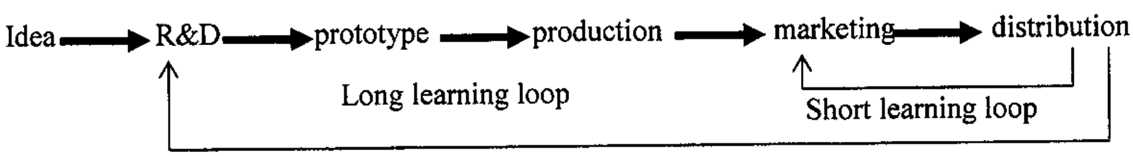

Fig 3: Sequential Models of Innovation

These models identify the various actors needed along the innovation process and determine at what stage they should intervene. In this perspective, improving efficiency lies mostly in reducing the number and duration of each step, in their overlapping and in softening the transfer of information from one step to the next. Retroactive learning loops are possible, whether short from one step to the previous one, or longer as the innovation process progress down the road. One of the implications of these models is that users involvement happens at the end, once the idea has materialized in a product, process and/or service. If for any reason, innovation do not meet users needs, retroactive loops are activated that can go all the way back to the idea itself in order to modify it, before going again through the whole process. This can mean extensive delays and consumption of resources. A second implication of these models is that those in charge of the innovation process should have from the beginning a clear picture of what users need if they want to propose something that could achieve success on the market. These models rapidly face their limits when they have to deal with radical and breakthrough innovation.

b) **Iterative models of innovation**

Due to the limitation and limited relevance of linear models, iterative models have been identified as a possible and credible alternative to describe and interpret the innovation process.

Fig 4: Iterative Models of Innovation

The socio-economy of innovation offers an accurate description and interpretation of the innovation process as an iterative connective process. The network theories (Callon, 1991; Law, 1987; Latour, 1987) and evolutionary theories (Dosi & al, 1988) have identified as a main feature of the new innovation process, the continuous and numerous interactions and feedbacks between heterogeneous actors. This interactive model of innovation emphasizes on mutual interests and definition of actors. One of the implications of these models is that, involvement of users is needed from the beginning of the innovation process since they should take part in the definition of the innovation content all along the innovation process.

Innovations networks

Networks can be viewed as inter organizational relationship in which firms maintain their autonomy but are involved in mutual dependency (Williamson, 1991). Networks allow members to coordinate their activities and to receive individual advantages from the cooperation (Vonortas, 1994). It is well recognized that externally generated knowledge can not be efficiently identified, assimilated and exploited, without engaging one self in R&D activities in order to develop in house absorptive capacity and competency (Cohen and Levinthal, 1989, 1990). Further, engaging in a network not only allow participants to gain access to resources that are difficult to transfer but it also enables them to create common resources and value that they try to capture for their own benefit.

User involvement in innovation networks

Networks can take various forms depending on their objects (that we will here restrict to innovation), on the nature and heterogeneity of participants as well as on the kind of agreements that links them. Nevertheless, the emphasis of network schemes is most of the time on R&D producers, not so much on users. User participation at an early point in the innovation network, often looked for but most of the time seen as a complementary asset in networks that are created by R&D producers, whether academic or industrials (Kahane, 1992).

We here show that networks can and are sometimes initiated and managed not only by R&D producers but also by users that mobilized other actors in order to achieve their goals. This is reported through two case studies in two different national settings, which explore different ways of users intervention as catalysts, and driving force in the innovation process. The first case study located in France shows how a patient's association managed to put together and align interests of its constituents (the patients and their families it represents) and those of others. Not only the interests of academic and clinical research as it is often the case, but also of an industrial, which in turn incorporates patients demands in order to shape its own strategy. The second case study is located in Israel and describes how doctors managed to activate a national innovation network support scheme in order to induce various R&D producers to cooperate in the development, production and commercialization of needed system of surgical imagery

Case A: Patients as end users and no government involvement

Patients' associations have taken an important place in research linked to hereditary genetic diseases. These illnesses are often called "orphans" since the number of patients is too small to be considered as primary targets by health policy makers or as valuable targets by pharmaceutical companies. One of the main specificity of these associations, besides the fact that they are directly driven by patients and their families, is that they have recently, heavily engaged themselves in research and what lies behind: not only taking care of patients but also curing them.

AFLM goals and interventions

We here report, how in France, one of these patients association named AFLM (Association Francaise de Lutte contre la Mucoviscidose)[1] has taken the lead in building a strategic partnership with a private business company in order to advance its goals. Thus, a non-profit organization engages itself in a strategic interaction with a profit seeking company for the mutual benefit of the two partners. This is a clear example where users not only build network with academic laboratories, something that has been largely documented (Callon, 1991) but where these networks extend to other kind of partners needed for the success of innovation. We here show how this interaction put together the various stakeholders needed for gene therapy to occur.

AFLM decided to engage in research in the middle of the eighties, but real momentum came in 1989 with the discovery of the CFTR gene linked to cystic fibrosis and the involvement in Gene Therapy[2]. Cystic fibrosis appeared then as a good model for this therapeutic approach since this illness was monogenetic (one gene drives the sickness) and since the most frequent form of this sickness was pulmonary (thus at a precise and limited location which could be reached through aerial delivery). The involvement of the association reached then a new level, first because local events were organized all over France to explain and promote research for this illness, second because at the same time another patients association (AFM= Association Francaise des myopathes[3]) started simultaneously to use TV shows (Telethon) as a way to convey its message. Telethon, through the presence and expression of people experiencing these illnesses, allowed them to promote their interests, to emphasize the potential and necessity for more research and to ask for funding in order to reach the "Gene Therapy goal" for the benefit of all. The sums they raised from the public were such that the association found it could not keep all for itself and needed to redistribute part of it to other actors with shared interests. Since cystic fibrosis was considered as a first simple model to experience gene therapy before addressing more complex genetic hereditary diseases such as muscular dystrophy, AFM decided to channel part of the money obtained to AFLM in order to advance the gene therapy track. From 1989 to 1995, AFM funded 10MF of

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[1] *The national equivalent of the US cystic fibrosis association. Cystic fibrosis is a disease where children bearing two copies of the defective gene are sick and can many time progressively die from their sickness while their parents who bear only one copy are in good health. Thus, parents see their children dying in front of their eyes after a long period of invalidating and painful sickness.*

[2] *Gene Therapy is a new therapeutic approach that aims to cure general and hereditary diseases through intervention replacement at the gene level*

[3] *Muscular dystrophy patients association*

the 100MF devoted to research (research accounting for half of all AFLM expenses during that period[4]).

Fishing for a industrial partner

In the same period, AFLM decided to engage in collaboration with Transgene, a research company created at the start of the 80s and which at that time had already established itself as the biggest biotechnology firm in France. During a first period between 1989 and 1992, Transgene acted as a "contract oriented research company", focusing on the one side on ad hoc development and production of genetic tools and on the other on the production of transgenic mice needed for animal testing (this second line never succeeded). Beside others, AFLM had a contract with Transgene under which Transgene would develop tools related to cystic fibrosis and would deliver them, free of charge, to scientists supported by the association. In 1992, Transgene, faced with limited present and potential performance, decided on a drastic strategic shift in order to focus on gene therapy where prospects seemed better. AFLM, who on its own wanted to emphasize gene therapy, engaged negotiations with Transgene in order to insure that cystic fibrosis, would remain one of Transgene strategic goals. Matching occurred. This translates in how, in 1997, the assistant CEO explains the new strategy of the firm. " First, we wanted and needed to become a full pharmaceutical company, something which implied to invest heavily to develop good manufacturing practices (GMP). Second, we had to concentrate on a few goals, taking into account two contrasted situations:

- Big markets where big pharmaceutical companies lead the game and for which SMEs are not well suited. In these markets, the best we could do was to limit ourselves to pre-development (until phase II of clinical trials needed to obtain access to the market by agency approval such as those given by FDA). Once that done, we would seek a development and marketing deal with an internationalized pharmaceutical company. This is what we have done for cancer treatments we have developed.
- Small markets, mainly linked to hereditary genetic diseases, in which we wanted to become a full industrial player which means developing potential candidates until they reach the market and distribute these drugs worldwide in order to reap the full benefit. Cystic fibrosis became the first target of this second dimension of our strategy".

Thus, as AFLM wanted to engage in gene therapy, it had realized that it needed others to develop and produce the necessary material in order to advance on the path of gene therapy for cystic fibrosis. A first gene therapy clinical trial had been set up in the US in 1993, using an adenovirus vector developed and produced in an artisanal way by a French scientist supported by AFLM. In 1994, AFLM through its strategic partnerships was able to organize the first gene therapy clinical trial to be held in France. All main choices of the association are present in this trial, which considerably increased AFLM visibility and credentials. Research supported by the association had developed the adenovirus vector. Industrial partnering had allowed its production in quality and quantity needed for the clinical trials. Support to a health clinical institution (public hospital) created the condition of trust and confidence to get access to patients and to engage in the long and tedious process of regulatory and administrative authorizations. Although these trials did not give results as positive as expected, they showed that on the path to develop successful treatment for cystic fibrosis, the association had, at least

[4] Other funds went to support health care (through devoted health centers, 17%), quality of life (including individual support to families, 15%), associative life (through regional representatives, 6%), communication (between members and toward others in order to increase the awareness and the knowledge about the illness, 8%), association administration, 5%).

in the French setting, to play an active role in putting academic research, industry and clinical institutions on the same boat and to help them align their specific goals.

Whatever the position on the possible results of gene therapy, it is interesting to understand that allowing treatment is not only a technological issue. Multiple questions appear that are relevant for the association as well as for the industrial and on which they are engaged in a strategic dialogue. How many gene therapy centers will exist at least in France (not to say in Europe and in the World) and what will be their optimal location (for the association, that means how much transportation for a patient to get to these centers and for the industrial, how much training and local distribution networks)? Who will pay for the infrastructure and the treatment? How is it possible to progress along this path in order to accelerate this process or/and give it more credibility? What will be the responsibility of the association, of the industrial, of the public health service, of legal administrative and funding authorities? ? The association is both the representative and the speaker of future users who do not already exist. As such, it bears a heavy responsibility since it is today that condition of tomorrow treatment shape themselves. If AFLM wishes to insure that tomorrow look the way the association wants it to be, non profit organization have no other choice than engaging in strong partnership with partners such as profit seeking companies that will be part of this future.

Thus, associations who want research to deliver a product to the users face many questions, which are not limited to funding aspects. This drives the association to engage in strategic partnerships, which go well beyond the sole academic sector and funding decisions alone are not enough to solve issues that have to be addressed one by one. Researchers, as represented in the AFLM advisory research committee, did not have by themselves the necessary tools to help in this choice. Thus, the association had to develop and incorporate other competencies and expertise.

This first case tells us of a situation where users without government involvement extend their reach and build the innovation partnerships they need to achieve their goal. In this process they also help companies build value for themselves, test the relevance of the products they develop, define and prepare conditions to access the market.

Case B: Medics as end users and government support for the clustering

Case A is a situation of users involvement in France without government support. The following case now reports of a contrasting situation where users in Israel mobilized a government program named Magnet in order to create the innovative network that was necessary to answer their need. Interestingly, it should be noted that in this case, medics and not patients as was the case in the previous situation, were the main driving force in creating and initially managing the innovation network.

The Magnet program

The conventional wisdom of economic theory today is that investment in R&D positively influences the economy above and beyond the benefits enjoyed by an individual company. Therefore, as many others, the Israeli Government has engaged in supporting and encouraging R&D through various schemes. Israel's innovation policy is considered as effective since it has succeeded in the last twenty years in turning Israel into a technology-rich export oriented economy. High-tech industries have developed and contributed to the mobilization of funds from venture capitalists and other sources of international investment, while significantly increasing the country's exports.

The Office of the Chief Scientist (OCS) is the operational branch of the Ministry of Industry and Trade, dedicated to encouraging investments in industrial R&D. It pursues this objective through risk sharing and by establishing a framework of international funds and agreements, supporting the creation and initiation of relationships involving industrials inside and outside Israel. These activities are carried out through a number of special assistant programs and channels. One of the OCS support programs is the MAGNET program. The MAGNET program was created in 1992 and is dedicated to the establishment of a technological infrastructure for the next generation, and to the creation of a cooperative technological reservoir - containing a combination of knowledge from the industrial sector and the academic world. The MAGNET program supports the industrial R&D of generic pre-competitive technologies. Generic pre-competitive technologies refer to a broad spectrum of common technologies, components, materials, design and manufacturing methods and processes, standards and protocols - which have wide-ranging applications in numerous industries. The MAGNET rationale is based on two factors:

- Critical mass - in a country with about 6 million people, cooperation is the key to creating critical mass for building common technologies. Through the pooling of resources, the process of technological development is accelerated, bringing innovation to industry more rapidly, and - ultimately - shortening the time-to-market cycle of new generation products.
- Efficient exploitation of national resources - to harness the know-how of Israel's world-renown academic research institutes and encourage the country's high-tech industries to exploit this advanced scientific know-how, through mutually beneficial cooperative programs.

The MAGNET program has several channels. Its Technology R&D Channel is based on technology teaming, developers and researchers from industrial companies and academic research institutes work cooperatively in the development of the basic technologies they need for the next generation of their line of products. The program offers several incentives in order to help members make the decision to join and find the route that fits best their needs: A 66% grant of the approved budget is offered; this is a straightforward grant - there are no royalty fees; full recognition of expenses for dedicated equipment. But, the real emphasis is on cooperation. These alliances are aimed at cutting costs, saving manpower, and developing and fostering the synergistic relationships in order to focus, strengthen and expand technological activity, to the mutual benefit of everyone involved. Since its creation, Magnet, through several consortia addressing different technologies and markets, has helped industrials built technological capabilities and expand commercial and export potential that should benefit the future development and growth of the Israeli economy.

The IZMEL consortium

In the establishment of the IZMEL consortium, Medics took the lead. IZMEL is one of the biggest consortia of the Magnet program. The original idea for the consortium, named IZMEL — scalpel in Hebrew — began in the Rambam Medical Center in Haifa. Surgeons, familiar with the limitations and problems in their routine work in the Operating Room, aspired to bring surgery and imaging together, both in time and space. Thus, they were operational in creating inside the hospital an Image Guidance Surgical Oncology Center (IGSO). This center is aimed at developing new strategies for integrating imaging into surgical procedures, so that images are seen in "real time," enabling better control and evaluation as well as providing better guidance to the surgeon. As it was looking for resources, the IGSO discovered the option of presenting their projects for R&D funding to the Ministry of Trade and Commerce through the Magnet program. Thus, a consortium was set up in accordance with the program's stipulations, consisting of a number of clinical centers, academic centers and Israeli industrial companies, all willing to work together toward a shared objective. The projects taken by the consortium are dedicated to develop and integrate the various technologies and products in order to prepare the future operating room (OR) in which surgeons will work tomorrow.

The actual "Cut and see approach"

The rationale and motivation for establishing IZMEL as told by the initiator and first head of the consortium is the following. In spite of tremendous advances in diagnostic technology, primary therapeutic procedures such as surgery are still performed today essentially the same way as half a century ago. In conventional surgery visibility is limited and incomplete. The surgeon cannot see beyond the exposed surfaces. Within the constraint of the surgical opening the exposed visible field lacks additional clues needed to comprehend the entire anatomy. These limitations are accentuated by the even greater restrictions of minimally invasive surgery (e.g. endoscopy and laparoscopy) where surgical tools are inserted into the body through a small number of holes. Visibility through these "key holes" during endoscopic procedure is limited and therefore increases the need for supplemental guidance.

The limitations of conventional therapy are affecting its effectiveness to a great extent. In many cases the surgeon does not know his accurate location. Therefore, the task of navigating through the anatomy to the exact desired target location becomes a formidable task. As a result, the usual surgical cuts are larger than necessary, to provide the surgeon enough room to perceive the anatomy. Because the procedure depends on hand-eye coordination, incisions through normal tissue layers are necessary to reach deep targets. For example, during tumor surgery, if the tumor boundaries are not clear and accurate and exact localization is not possible, normal tissue has to be removed in order to assure complete tumor removal. Further, in today's reality, the evaluation of the surgical procedure, such as assuring that all tumor tissue was removed is done after surgery in a separate diagnosis session. This approach to surgery is termed 'cut and see approach' where many of the observations and conclusions made by the surgeon are possible only after the surgical cut is performed.

The future "See and cut approach"

As a result of major advances in imaging technologies, some of these limitations can be overcome. This will allow the operating room to enter into the realm of the 'see and cut approach' where most observations and conclusions made by the surgeon are possible even before the surgical cut is performed. The introduction of new scanning technologies, novel tumor detection capabilities, and three dimensional computer graphics into the operating room should greatly and positively affects the outcome of many therapeutic procedures. On the one side, the utilization of imagery as part of the therapeutic procedure, termed Image guidance Therapy, could reduce the inherent invasiveness of surgery and improve navigation, exact localization and targeting. On the other side, images will be used to provide the surgeon within information on unseen regions and views of the affected area from 'impossible' viewpoints, for example, views of a region that is inaccessible to an endoscope's penetration. Images will provide the surgeon, prior to and during surgery, with additional anatomic and pathological information including patient history data. Further, in the future operating room, novel diagnosis methods will be available intra-operatively, to provide the surgeon with real-time feedback. Therefore, full integration of advanced imaging into therapeutic methods is expected to cause fundamental changes in strategies, approaches and methodologies related to health care delivery.

The results of these techniques and activities are expected to lead surgeons to the "operating room of the future". This will be a combination of several key technologies (real time image acquisition and display by medical scanners, advanced techniques and tools for minimally invasive surgery, and intraoperative diagnosis and evaluation methods) that will have to be integrated to perform effectively. The threads that bind all these technologies and deliver their advantages to the surgeon are computer-imaging techniques. For example, navigation path will be displayed on an anatomical image as a road map, location of diseased tissue detected in the operating room will be displayed onto preoperative images, and location of minimally invasive tools and the progress of ablation procedures will be assessed by real time image acquisition and display.

The users need for consortia

The realization of the capabilities associated with image guided therapy, so essential for the future of operating room, required the development of several core technologies, which are the target of the IZMEL consortium. The construction of real-time high quality intraoperative medical imaging capabilities, the development of minimally invasive surgical tools and technologies, and the implementation of real-time computer imaging were all imperative capabilities for the realization of the future operating room. Thus, these technologies and their successful integration are the focus of the IZMEL consortium. Only through a collaborative effort, could the vision of many experts from different disciplines and the strategies of various actors be aligned in order to realize the future operating room. No useful product could come out of these developments if they were not, designed, implemented and tested under the supervision of clinical partners. This required close collaboration of multiple academic, industrial and clinical partners each bringing in his expertise and know-how, in order to establish leadership and innovation in this field of medical treatment.

The six projects of the IZMEL consortium

The IZMEL consortium is structured around 6 collaborative and interacting projects. Each of the projects links participants from the industry collaborating with an academic institute and/or a clinical site as shown in fig 5 below. The integration between the various actors inside one project and between the various projects is a crucial issue. Users involvement is a main asset for this purpose and was fostered by the way the consortia was created, that is by users wishing to overcome limits of existing techniques, who mobilize other actors to achieve their aims.

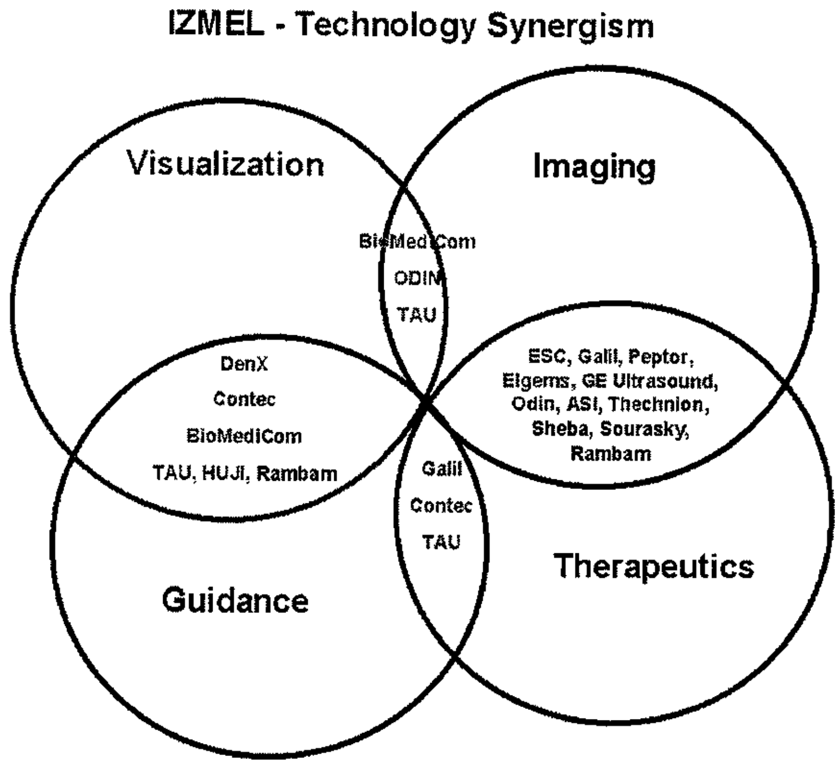

Fig.5: IZMEL - Technological synergism

Tissue Viability Project: a system to offer minimally invasive procedures able to assess tissue viability and to monitor the end point of the surgical procedure.

- Registration Project: a system that will convert, a two-dimensional medical image into a three-dimensional one, providing the surgeon with "a true image of the patient".
- Accurate tracking Systems Project: to develop a tracking system for the guiding, navigation and accurate tracking of surgical tools within the patient's body.
- Intra-Operative Imaging by Interventional MRI Project: to bring the MRI into the operating room.
- Radio-labeled Tumors Project: to develop novel system for the labeling of tumors via radioactive substances and scintigraphic imaging.
- Workstation Project: to integrate all of the imaging technologies used by the operating team and place them on one monitor.

It was the needs and vision of the doctors that motivated the establishment of the IZMEL consortium. It is their presence that assures that the various components respect their needs. They believed that full integration of advanced imaging into therapeutic methods could cause fundamental changes in strategies, approaches and methodologies related to health care delivery. To achieve their goals, they had to put together their respective clinical institutions as well as academics and industrials with the needed complementary competencies and experience. It is noteworthy that in other places in the world, surgeons also share the needs and vision of the Rambam surgeons. In fact, we found similar consortia established in US, Canada. OCITS or the Ontario Consortium for Image-guided Therapy and Surgery is a unique linkage of academic institutions and the private sector. Its mission is to develop new image guidance technologies for therapy and surgery applications in urology, oncology, neurosurgery and orthopedics. There is a twin consortium also in the US called "CIMIT". CIMIT's mission is to improve patient care by bringing together scientists, engineers, and clinicians to catalyze development of innovative technology, emphasizing minimally invasive diagnosis and therapy. Meanwhile, coordination of such consortium is a complex task that requires extensive management and governance mechanisms. It should be noted that inside IZMEL, during the development and life of the consortium, coordination task shifted from a surgeon to an industrial academic. Potential impact on the definition and management of the program has not been investigated at this time.

Conclusion

For us, these two case studies point to a needed trend in user involvement in innovative technology and product development. It is one thing to consider that most of the work and the uncertainties are linked mainly to technological and scientific options, something that do not necessarily require users involvement at the beginning. In which case the commercial, marketing and practicing issues can be postponed to the day the technology or product is ready to be released. It is another to consider that technological, marketing, and organizational and utilization problems are linked and construct themselves simultaneously, requiring users involvement as soon as possible in the innovation process.

If many government schemes and industrial development still rely on a sequential and linear model of innovation, these cases clearly show that users have internalized, may be unconsciously, what academics have been saying for years about the iterative non-linear chaotic nature of the innovation process. That is, that in some situations, users should not wait passively that technology and products develop before being released to the market and then accept or reject what is proposed. They indeed should engage themselves in the innovation process in order to participate in the definition of the characteristics of the technologies and products they need as well as the context in which they will have to use them in the future.

Therefore, users could be mobilized by R&D producers, a condition, which is not so frequently encountered in government support schemes, but they indeed sometimes act as a leading and driving force to align together various industrial and academics components willing to engage in the innovation process. As knowledge brokers they do not restrict innovation to clinical institution, academics or industry but on the contrary act as catalyst to put together actors that would otherwise stay apart. Through this process, they define not only innovation but also strategic partnerships that consequently impact on the strategies of mobilized industrial actors. Together the cases we have analyzed emphasize the following points:

- The interaction of users with R&D producers (industry, academic) with or without government incentives.
- The reconfiguration of industrials strategies that occur when they engage in partnerships with already structured users.
- The existence of an "implication model" where users do not delegate but implement the innovation process in close relation with other actors, sharing and negotiating possible options, problems and successes.

These two cases point to only two of the possible forms of users involvement as drivers and leaders in the innovation process. It could be that even inside IZMEL, various forms of users involvement coexist. Clearly, more work is needed to document other forms of involvement and to assess their relative performance. Nevertheless, as they are, these two cases allow us to draw implications for the various actors involved in the innovation process.

For R&D producers (industrial and academic), they put society on the agenda and emphasize the interest of looking and fostering for participation of potential representatives of users of their products. There is as much difficulty in achieving users identification and involvement as there is in driving the technology or the product from an idea to its realization but there is also equally as much at stakes in these two goals. It can be said that users do not necessarily know their needs but engaging with them in the innovation process could be a way to advance on this question. Having users take the lead should be considered as an interesting opportunity. Testing their relevance and avoiding that they become technology "corrupted" during the innovation process are critical issues.

For users, our case studies show that there is a valuable niche for their intervention. Users can and should try to act as the missing link in the innovation process as they do in the cases we analyzed. As we show, various options and form of involvement exist and taking the lead is only one of that options. The issue for users is about identifying R&D producers who have the needed R&D producing assets, that are prepared to interact with them and to build influence in order to make the point when needed. Whatever the form and level of involvement, looking for strategic interaction not only with academic producers of R&D but also with industrial ones foster the possibilities to have innovation deliver and address users need. Users are active and valuable interested agents who do not need to resist innovation they dislike or do not suit them. Mostly, they can influence the matters or leave the network and enter other one (Loudin, 2001).

For government operators active in innovation policies, user incorporation should be considered as a key issue when innovative networks are built. Interestingly, besides IZMEL where users involvement was the result of circumstances, Magnet has tried to help built what has been called "users associations". Although, they are at present restricted to intermediate users, they may offer a possible future scheme for users involvement. Thus, we briefly describe below ILTAM, one of these users associations. MAGNET Users Associations are comprised of industries engaged in the same line of activity. ILTAM- Israeli Users Association of Advanced Technologies in Electronics" - the first such association established in 1992, has today a membership of about 70 enterprises. ILTAM's aim is to support and encourage knowledge sharing among its members on the latest technological breakthroughs developed in Israel and abroad. Additional associations are currently in the process of being established.

Beside this approach, which speaks of users but stops short of requiring users involvement in innovative networks, we have identified other schemes that have been designed in other countries (ESRC, 2002), which seem to offer more potential on this matter. These schemes are specially designed first, to have users engage in the innovation partnerships, second, to allow various users group to exchange and learn mutually on ways to do it. Should we prepare ourselves to see more and more users building the innovation partnerships they need?

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How Users Build the Innovation Partnerships They Need

Innovation is unlikely to be successful if it is founded on the supposition that the innovative process is essentially simple, linear and sequential. It is not. The innovative process is complex, intricate and irregular and basically it can be considered as a learning and information process. Successful innovation is the product of a total information package to which R&D makes only a partial contribution. There are additional contributions from other participants in the process, including the users of the new technology, whose input is just as vital as the information derived from R&D.

Thus, initial and continuous users' implication in the innovative process is a key factor, which points to the potential of partnerships involving not only R&D producers' (academic and industry) components but users as well. Nevertheless, although even if such a goal is looked for, successful incorporation of users in the innovation process is a difficult task since their identity, their legitimate representatives and ways of interaction with them are not necessarily obvious. To help answer this issue, we here report through two very different case studies, forms of strategic partnerships for innovation, which not only incorporate innovation users, but also are initiated and shaped by them. These contrasted situations (one in Israel, the other in France; one outside of any government support, the other inside such a scheme) show how users find their way to shape new kind of alliances in order to achieve innovation. They stress the interactive nature of the innovation process and the interest of moving government intervention beyond academy industry relation, in order to incorporate innovation users.

This project was carried out within the framework of the Neaman Institute for Advance Science and Technology, at the Technion, Israel Institute of Technology

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