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Research Paper

Open Innovation: the New Way of Knowledge Transfer?

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Abstract: Due to globalization, competition has increased and companies have reorganized their activities in order to maintain profitability. The consequence has been an emphasis on short term results, at the expense of long term research. Therefore, most Corporate Research laboratories were closed or built down considerably. However, long term research is required for products that are difficult to copy by competitors. Moreover, companies have come to realize that only radical innovation, based on long term research, will distinguish them from their competitors. Since the end of the 1990s, attempts are being made to combine short term financial interests with long term innovation requirements. Many of these attempts can be classified under the heading of Open Innovation, which may be viewed as a company's endeavour to profit from external knowledge without making heavy internal investment in long term research. This paper examines the prospects of Open Innovation, on the basis of own research and reported literature work. It is argued that companies cannot totally rely on external sources of knowledge, and that new ways must be found to compensate for the results that used to be achieved by companies' own Corporate Research.

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Introduction

As a result of the massive use of internet and the very cheap world-wide transport costs in the early nineties industrial competition has increased dramatically [1, 2]. This has resulted in price erosion and consequently in margin erosion of most products sold by industry. Most companies have addressed this problem by cutting the costs for long-term activities like research towards radical innovation. The result has been that although the financial performance of most companies could be maintained, at the end of the nineties companies have realized that working on the short term has resulted in incremental innovations that can easily be copied by competition [3].

Due to the abovementioned observations industrial research currently has a time horizon of maximal three years [3] and over the years few companies have been able to maintain the know-how for radical innovations that require 10-15 years between the idea generation and the successful application on the market.

However, in order to maintain a competitive position on the long term radical innovation is necessary [4-6]. But how can industry become involved in this process if they do not seem to have the know-how anymore?

This subject has been discussed by many authors [see e.g. 7-13].

One of the possibilities is that industry makes more use of the scientific results produced by universities. Although there is a massive literature on cooperation between knowledge institutes and companies we believe that we can classify all these activities in five categories:

- Through a (university) Technology Transfer Office (TTO)
- Direct cont(r)act between industry and university
- Contact between university and industry through an intermediate
- Funded by government (direct and indirect)
- Through spin-off companies

The different classes of transfer of knowledge between university and industry, directly or indirectly, can be visualized in Table 1, where also the appropriate literature references are given.

Class	Sub class	Literature references
TTO		14, 15
Direct contact		6, 16-23
Intermediate	Research Joint Venture	24, 25
	External partnership	26-28
	Public Private Cooperation	29, 30
Government supported	Direct	31-33
	Indirect	19, 34, 35
Spin-off companies		34, 36, 37

Table 1: Classes of knowledge transfer between university and industry

From all the literature covered no single mechanism surfaced whereby industry could innovate in a radical way based on science created by university. A recent study by our group [13] showed that although a carefully chosen intermediate for example a Leading Technological Institute [38, 39] already contains most of the conditions that are noted in the abovementioned literature to achieve such a transfer successfully, the recipient side (the industrial researchers) lacks the scientific quality to be able to absorb the LTI results (see also under Discussion).

New mechanisms therefore have been proposed in the literature to address the problem of assisting companies to innovate more radically of which the most recent one is "Open

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Innovation" [40]. Since this new form of innovation is very recent, not many articles [see for instance 41-44] have already been published on this topic. In this respect it can be added that in our current research new ways will be investigated (for instance by letting a post-doc work in the company to get the results embedded in the company or by starting a spin-off company first; both are forms of Open Innovation) to shorten the distance between the abovementioned LTI results and companies.

This article intends to investigate whether companies that are focused on the short-term are able to use the "Open Innovation" method as a new way of knowledge transfer.

We use hereby – in analogy with the definition of Innovation – "any form of cooperation with third parties that can contribute to improve the long-term performance of a company".

First R&D projects from 21 companies in three sectors have been classified in four categories and then in each category the intensity of cooperation with third parties was established.

Methods

In September 2004 the authors of this article have started the Micord Group at the University of Nijmegen, The Netherlands. Micord stands for **M**anaging **I**nnovation, **C**ooperation and **O**utsourcing in **R**esearch and **D**evelopment. The program content is based on an observation that is also valid for "Open Innovation": a growing number of companies is using different external sources in their innovation process. To manage innovation in collaboration with external sources presents new and difficult problems to companies. It also raises issues of innovation- and technology policy for governments.

The issues to be investigated have been grouped into three levels:

Collaboration Types of collaboration, choices to be made, partners in the innovation chain, conditions for success, bottlenecks, role of intermediary institutes

Organization Role of corporate functions, absorptive capacity, links between research categories, differences between large and medium sized companies, influence of social and economic priorities

Sector Patterns per sector, links to science and technology, differences within and between sectors, influence of public infrastructure

In the first year patterns of collaboration and outsourcing have been studied in three important sectors of industry in the Netherlands: Food, Equipment Manufacturing and Polymers. We have used an Interview Guide comprising 27 questions to interview leading R&D officers from 21 different companies, five in Food, nine in Polymers, and seven in Equipment Manufacturing. It has to be remarked that the companies selected were in their sector in the Netherlands the leading companies as far as R&D spending is concerned.

The major conclusions from this research will be reported elsewhere [45] and can be summarized as follows:

The sectoral perspective is useful. It emphasizes the enormous variety of influences present in different contexts – in terms of competitive forces, consumer preferences, government regulation, and technological change. Related to this, the number and character of relevant actors in each sector is also very different. It is not always easy, though, to identify proper boundaries for a sector and it turns out to be even more difficult to collect reliable information on a sectoral basis. Also due to industry convergence in formerly separated industries (e.g. Nutraceuticals) sector boundaries are more difficult to make. The taxonomy of sectors developed by Pavitt many years ago [46], turned out to be helpful for the organization and interpretation of the sectoral findings. According to his taxonomy Polymers fall in the category Science Based, Food in the category Scale Intensive and Equipment Manufacturers in the category Specialized Equipment Suppliers.

The flow of knowledge between universities, non-profit research institutes and companies is less intensive, less structured and more dependent on incidental and personal contacts than might have been expected. In spite of the existence of the Leading Technological Institutes and in spite of the existence of a specialized

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research university in the field of food and agriculture, cooperation between university institutes and companies appears limited. Generally, the fact that there is only limited cooperation appears to be a result of a considerable gap between the kind of knowledge universities are generating and the knowledge companies might find useful. This gap is seldom blamed on university professors losing themselves in useless, overspecialized exercises, but rather more frequently on the considerable time and investment needed before the knowledge generated by the universities can be put to commercial use. Companies, including their R&D departments, are unwilling and / or unable to get involved in projects with a long-term perspective, even if they potentially could lead to radical innovation. This raises various questions concerning the interaction between corporate innovation strategies, the 'absorptive capacity' of companies, the programming and control of academic research, and the transfer and 'valorization' of such research. The case of consumer electronics also raises questions about the impact of vertical disintegration and geographical dispersion of elements of the value chain on knowledge sharing and the innovative capacities of companies.

The realization of radical innovations is very difficult in modern corporations organized in business units operating with a very short time perspective. Research is driven by the same short term perspective and where this is not the case, researchers find it difficult to get business units interested in product ideas that go beyond the current portfolio. Companies are increasingly aware of this problem and are exploring various solutions involving the creation of new units or companies by means of venture capital funds, incubators and other arrangements. There is a clear need for research departments to have access to marketing knowledge. Entrepreneurial capacities are also in short supply.

Out of the available results from this study [45] we have selected the part that is in our opinion extremely useful to understand the potential of "Open Innovation".

This part deals with the classification of research projects in the following four categories (see also Figure 1):

Category A: mainly supporting research activities for the **current** product portfolio; these activities have a short-term focus

Category B: adaptation of **existing technologies** for **new markets**; for instance making polymers for paints suitable for printing inks

Category C: development of **new technologies** for the **existing markets**; for instance developing waterborne polymers for paints where now solvent-borne polymers are used

Category D: development of **new technologies** in **new markets**; for instance waterborne polymers for printing inks where now solvent-born products are used

In this respect "new" (both in technology and market) means new to the company (expansion of the geography is not considered as a new market).

We have asked all companies as part of the interview to answer the following questions:

Can you indicate in Figure 1 (see below) the number of FTEs (full time equivalents) working on R&D projects in each quadrant in your R&D organization and also per quadrant the number of FTEs involved in cooperation with third parties?

Although not all companies were familiar with the model presented, they all were able to supply the figures from their R&D budgets.

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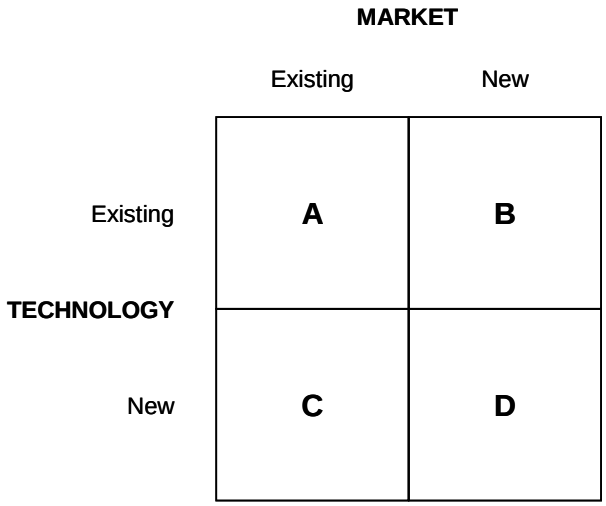

Figure 1: Division of R&D projects over 4 categories

Results

For all 4 categories results per sector have been obtained. A total of 2,430 FTEs (1005 in Food, 1,252 in Polymers and 173 in Equipment Manufacturers) have been assigned to projects from the companies we have interviewed. Out of this total close to 20% are involved in cooperation with third parties in general.

The results per sector have been summarized in Table 2, where for each quadrant the column **R&D** means the number of R&D FTEs per sector and the column **COOP** the number of R&D FTEs involved in cooperation with third parties in that sector.

The results in this table can also be presented in a relative way (Figure 2).

Quadrant	**A**		**B**		**C**		**D**	
	R&D	**COOP**	**R&D**	**COOP**	**R&D**	**COOP**	**R&D**	**COOP**
Food	502	0	232	72	196	53	75	53
Polymers	535	14	204	27	332	73	182	73
Equip Man	23	0	2	0	78	60	70	57

Table 2: Number of FTEs involved in cooperation per sector in each quadrant

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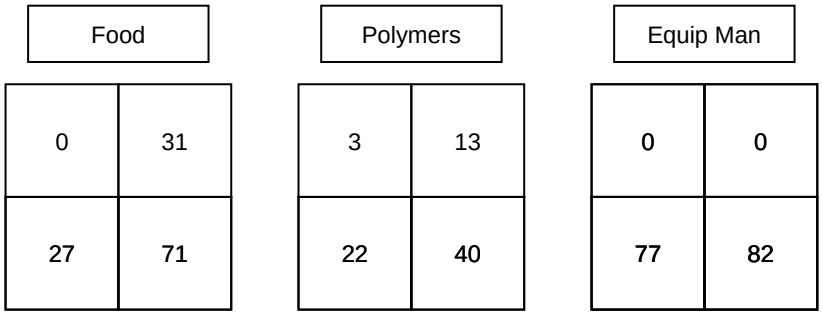

Figure 2: Percentages of cooperation in different sectors

In each quadrant per sector the percentage of cooperation is given.

Table 2 and Figure 2 suggest very clear differences between sectors concerning the distribution of R&D efforts over the quadrants, and concerning the proportion of R&D collaboration involved:

- Most R&D efforts focus on existing markets (total of quadrants A and C is much more than 50% of the total)
- R&D collaboration is virtually absent in R&D work that concerns existing technology/existing markets (quadrant A)
- To some extent in the food sector (and to a small extent in the polymers sector) R&D collaboration is present in R&D work that concerns existing technology/new markets (quadrant B)
- In the machinery and equipment manufacturing sector (and to a lesser extent in the other sectors) R&D collaboration is present in R&D work that concerns new technology/existing markets (quadrant C)
- In all sectors R&D collaboration is present in R&D work that concerns new technology/new markets (quadrant D), but more in the machinery and equipment manufacturing and in the food sector than in the polymers sector.
- The percentage of R&D collaboration in the machinery and equipment manufacturing sector is considerably higher than in the other sectors.

A more general observation is that the percentage of FTEs involved in cooperation with third parties is highest in the quadrants C and D, which is to be expected since companies are usually not willing to share their existing technologies with others.

More interesting is then the question with whom the companies cooperate.

The summary of the findings is given per category.

Category A: hardly any cooperation at all; cooperation with other companies (competitors!) undesired

Category B: cooperation takes place with other companies, especially those that are already active in the new markets to be explored; universities are only used to understand the technology (e.g. analysis)

Category C: almost all projects in this quadrant are a cooperation with universities to develop the new technology, as here the cooperation with other companies active in the same market is undesirable

Category D: very often new projects are initiated in collaboration with specialized institutes like the Dutch Polymer Institute for the sector Polymers, the Wageningen Center for Food

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Science for the sector Food and the Institute for Metal research for the sector Equipment Manufacturers. Very often this is pre-competitive research where companies develop the new concepts together with scientists

If the definition of "Open Innovation" is "any form of cooperation with 3rd parties that can contribute to improve the long-term performance of a company" then the picture above demonstrates that this new paradigm is not yet fully embraced by companies. Taking into account that we only have interviewed R&D intensive companies, the fraction of FTEs involved in cooperation with external sources is a disappointing 20%. All interviewed companies only indicate cooperation with Universities in quadrant C and that means with the data from Table 2 that max 186 FTEs are involved (about 7.5%) in cooperation with universities.

Discussion

From the limited set of data presented and the limited information from the open literature we can conclude that companies are not yet massively embracing the new paradigm of "Open Innovation". And maybe that is for a good reason. During the time that Corporate Research flourished in multinational companies (1965-1995) there was intimate contact between these research institutes and universities [see for example 47]. When however due to the effect of globalization (massive use of internet and very cheap transportation costs) competition increased, companies started reducing costs to maintain margins and profits. Because the explicit results of most Corporate Research Laboratories were not very visible in the bottom-line of the companies' profit and loss statements, most companies have decided to build down their corporate research. In the current situation, where research is carried out close to the customer, interaction with universities is much more difficult than in the past because the business researchers do not speak the academic language anymore.

Although the explicit results of Corporate Research was in most cases hard to find there were a number of intangible reasons (assets of a Corporate Research organization that are very difficult to measure) that were underestimated by the top management of most companies. The values associated to these intangible reasons were:

- newly hired employees could work for a certain period in Corporate research after which a career path could be established

- many business researchers used Corporate research as a sparring partner for difficult research questions

- Corporate researchers were able to judge the quality and applicability of academic research

- Corporate Research was seen by the universities as an equal and therefore serious partner

- in times of less business questions the researchers could be temporarily placed in Corporate Research

It is very questionable whether the new wave of "Open Innovation" can replace the abovementioned values. Although for instance the Shell Company has announced very recently that they will restart their Corporate Research it will not have the size the former KSLA laboratory had. It is not unlikely that other companies like Rohm and Haas and DSM will follow with a form of Corporate Research.

We can therefore safely conclude that although "Open Innovation" seems a promising way to improve the long-term performance of a company without having to invest heavily in their own Corporate Research organization, much more research is needed to find out how to realize this improved performance.

This will be the focus of the research of the Micord group in the coming years, whereby both the subject "improve the ability of companies to innovate more radically" as well as the subject "better use by companies of the science developed at universities" will be investigated in the three mentioned sectors Polymers, Food and Equipment Manufacturers.

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