Molecular Crystals and Liquid Crystals
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/gmcl20

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Version of record first published: 29 Oct 2010

To cite this article: Ryszard Kozlowski, Malgorzata Helwig, George Zagner, Eugeniusz Budny & Stanislaw Soja (2002): Causes of Weakness of Technology Transfer from R&D Centres to Economy Practice and Ideas How to Make this System More Efficient, Molecular Crystals and Liquid Crystals, 374:1, 1-12

To link to this article: http://dx.doi.org/10.1080/713738298

Mol. Cryst. Liq. Cryst., Vol. 374, pp. 1-12

1058-725X/02 $12.00 + .00

Causes of Weakness of Technology Transfer from R&D Centres to Economy Practice and Ideas How to Make this System More Efficient

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Transfer of technology could be briefly defined as a technical skill taken from a nation or place where it is already established to another nation or place where it is unknown. How the different conditions determine innovation and research development? What are the weak points of technology transfer system? What could be done to improve that system? There are some questions, which authors would like to answer in this paper. Selected data on economic growth and relationships between inputs and outputs for R&D are also presented in this paper.

Keywords: transfer of technology, innovation, economic growth, knowledge-based economy, R&D.

INTRODUCTION

Science, technology and industry are now in the period of changes, reflecting the ongoing move to a knowledge-based economy [1]. Recent developments in science, technology and industry are linked to rapid

technological change, globalization and great diversity in the firm behavior [1].

Rapid technological progress, resulting from:

- productive scientific community,
- more efficient business practices,
- growing role of information and communication technologies (ICT),
- continuing shift to services,
- globalization of economy and society

are some of the key forces driving this transformation [1].

Main responsibilities of scientific institutes and R&D centers are so-called applied research and development, i.e. implementation of research results into all sorts of economic practice.

There is a common opinion that the state of applied research of a given country determines the state of its economy nowadays and in the future and the state of fundamental research determines the strategy for future development.

The shortest definition of the term "transfer of technology" is: taking of technical skill from a nation or place where it is already established to another nation or place where it is unknown [2].

However, transfer of technology is a wide term including activities from patenting inventions through establishing joint ventures and consortia to selling licenses and equipment. One of the very important aspects of technology transfer is propagation and popularization of research results in the form of publications and presentations during scientific and business conferences.

The most important conditions determining technology transfer are the following:

- Creation of links between science and industry;

- Implementation of technology wider than only in place of its origin (e.g. one country), spreading know-how;
- Exchange of experience and technologies between governmental and private research centers and laboratories;
- Creation of appropriate conditions for intellectual property concerning technology, its promotion and application to the industry.

It should be mentioned that various mechanisms for technology transfer are the following:

- Cooperation in research;
- Agreements for cooperation in R&D;
- Licenses and rights;
- Scientific and technical conferences;
- Trade fairs;
- Dissemination of information, etc.

ECONOMIC GROWTH – STATISTICAL DATA

Mr. John Trani, Chairman and Chief Executive Officer of the Stanley Works said: "Growth energizes people, provides a purpose for restructuring, delivers opportunities for career enhancement, adds to wealth, and is the 'like to do' side of becoming a Great Brand".

It is true that economic growth has a great influence on technological progress. There are, however, some other important factors, independent of economic growth, which significantly increase innovation. The best example is military industry and priority for the development of R&D supporting this branch of industry during wars.

Selected data presented in this paper are based on the OECD (Organization for Economic Co-operation and Development) statistics.

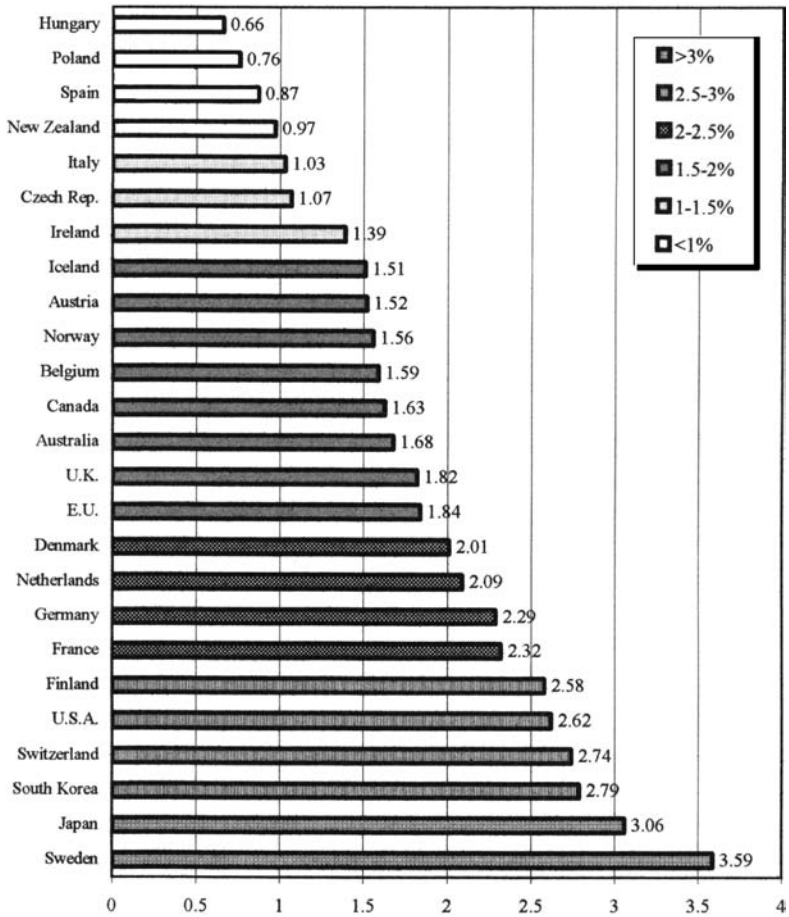

FIGURE 1. Total funds spent on R&D as % of GDP in different countries in 1998 [8].

Analysis of technology performance and policies has traditionally focused on inputs (e.g. expenditures on R&D and quantity of research personnel) and outputs (such as patents, publications) [3]. These indicators are standardized across OECD countries. However, their limitations have become evident over the time. Conventional indicators do not offer convincing explanations of

trends in innovation, growth and productivity [3]. Their ability to measure the general 'innovativeness' of an economy, or its capacity to produce new knowledge and technology, is limited [3]. And they present a rather static view of technology performance, which neglects how the various individuals and institutions – private enterprises, universities, public research institutes and the people within them – interact in the generation of new products and processes [3].

Technical progress is largely the result of a complex set of relationships among these institutions and individuals, who produce, distribute and apply various kinds of knowledge, and thus translate the inputs into outputs with higher level of value added [3]. The links that tie them can take the form of joint research, personnel exchanges, cross patenting, co-publication, purchase of equipment, etc. [3]. The performance of a country in innovation depends on the effectiveness of these ties in uniting the diffuse elements of a collective system of knowledge creation and use [3].

One of very important simulating factors for technological progress is the expenditure on R&D in a particular country. Figure 1 presents percentage of GDP spent by different countries on R&D in 1998.

In the innovation process science makes only one of its elements. Investment in development should create the utility of the product, based on idea [1]. The traditional model of technological development, according to which the science system is the basic initiator of innovation and increase in science inputs directly increases the rate of innovation and technological development, is obsolete now [1].

Systematic approach, instead, gives much more complex picture. In this view, innovation arises from many sources and at every stage of the process of research, development, marketing and diffusion [1]. Firms'

assessment of their innovation expenditures confirms this model. Figure 2 presents data on the structure of innovation expenditures in different countries [1].

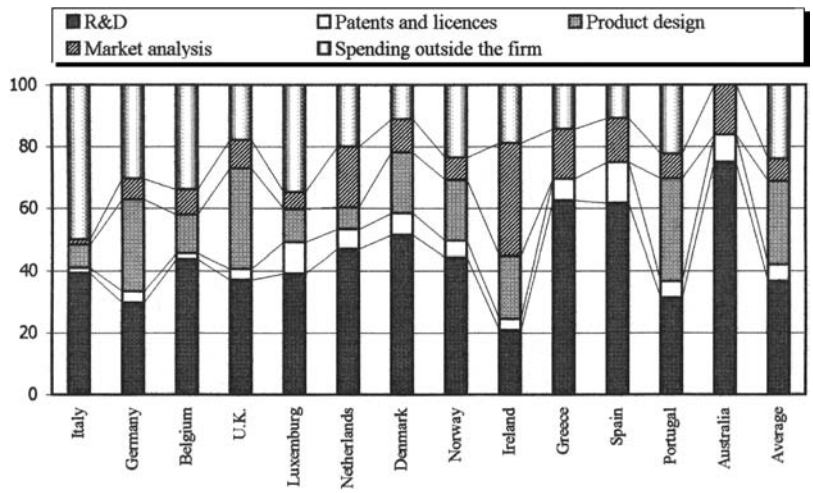

FIGURE 2. Breakdown of innovation expenditures - percentages [1].

Another trend can be observed in OECD countries where funds for R&D from government sources are shrinking and funds coming from business sector are growing. Figure 4 shows those trends in the years of 1981-99. While the macroeconomic performance of OECD economies has improved over the past in areas of higher growth and lower inflation, concerns about employment performance, widening income distribution, and instability in financial markets remain in several countries. At the same time, globalization is increasing flow of goods, services, and investment among the countries (Figure 4), leading to changes in organization of production, and intensifying competition [1].

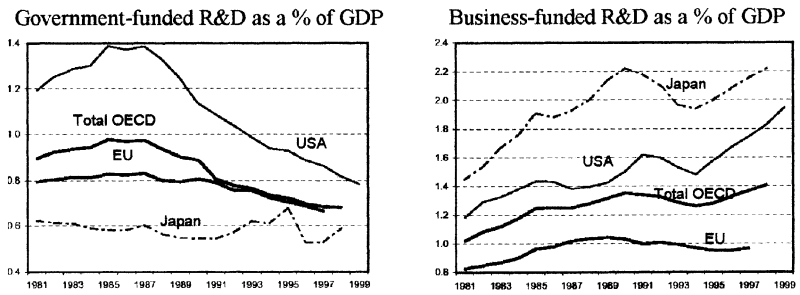

FIGURE 3. Trends in funding R&D in the OECD area, 1981-1999 [4].

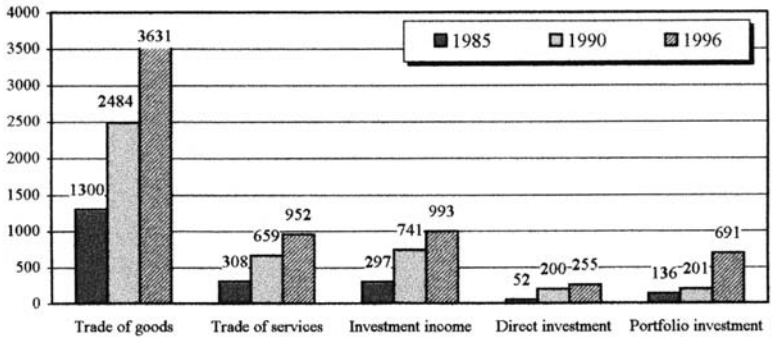

FIGURE 4. The globalization process – value of the main components of international transactions, total OECD, in US$ billions [1].

Structural changes in OECD economies reflect the ongoing move to a knowledge-based economy [1]. The output and employment shares of agriculture, mining and low technology manufacturing industries, which depend on low-skilled labor and are exposed to international competition, continue to decline [1]. Technology-intensive manufacturing industries maintain steady growth but also experience productivity increases that reduce their share in the economy [1]. At the same time, parts of the services sector – primarily finance, insurance and business services and

community, social and personal services – continue to grow in importance. This is due to growing demand for these services as well as slow productivity growth in some sectors [1].

Figure 5 presents the level of innovation in different branches of industries in EU [5].

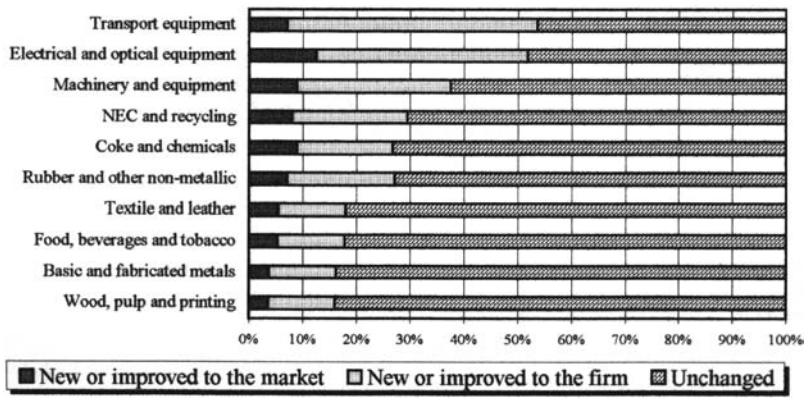

FIGURE 5. Sales new to market, new to firm, and unchanged, all manufactures, 1996 [5].

One of the main outputs of R&D is patent issue. Figure 6 shows the share of OECD countries in patent families in 1998. A patent family is set of patents taken in various countries to protect a single invention. The graph includes patents that are filed in the three main OECD areas i.e. at European Patent Office, the Japanese Patent Office and the US Patent and Trademarks Office [6].

Leaders from OECD countries in patents are USA and Japan as well as Germany, which together issued more than 76% of all OECD patents in 1998.

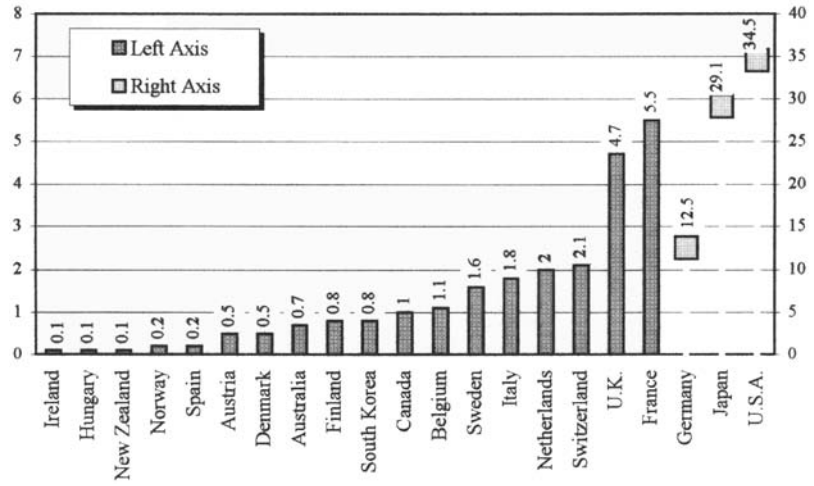

FIGURE 6. Share of OECD countries in patent families, grant year 1998 (by country of invention, as a % of total OECD) [6].

CAUSES OF WEAKNESS OF TECHNOLOGY TRANSFER SYSTEM

Despite of existing many institutions responsible for technology transfer as e.g. Innovation Relay Centres, Research Corporation Technologies, etc., which are important tools for successful cooperation between science and industry, a lot of weak points, not only of financial and organizational nature but also of psychological one, still exist in this system.

In our opinion the main causes of weakness of technology transfer system are the following:

- A great gap in the way of thinking between scientists and people from industry.
- The lack of efficient information flow from universities and R&D centres to the industry and vice versa.
- Frequent wrong attitude of the industry people who are concerned about

the problems or hazards associated with the field of their activities.

- The lack of suitable links capable of transforming research results into the form acceptable to industry.
- R&D organizations not sufficiently support technology transfer.
- Low expenditures on R&D, especially in developing countries.
- Non-complementarity of R&D units and universities, which frequently believe that published (or just written) research data are sufficient, without their verification on a pilot plant scale and without consultations with collaborating units as well as with those providing equipment and installations.
- Bureaucratization of the system, which distributes research funds by government agencies and other institutions. It causes that researchers avoid difficult projects, capable of ensuring adequate progress and instead, work on small projects of little importance, which do not result in progress in technological development.
- Ineffective system of research projects acceptance, which often caused approval of unimportant projects to the development of a given branch of economy.

HOW TO IMPROVE THE SYSTEM?

In our opinion the following actions could effectively improve the transfer of technology in every country:

- Attempts at obligating universities and R&D units to create maximal links between their activities and industry by:
  - direct research orders from industry,
  - fighting bureaucracy in governmental agencies evaluating reports on economic development.
- Reorganization of the system of activities of universities and R&D centres in

such a way that the service to the development of new technologies will become their all-important task.

- Appropriate policy concerning patents, licenses, and royalty distribution, which should give preference to the units showing the highest activity and being the most useful.
- Further globalization in the field of international collaboration between scientists and industry as well as government agencies and research centres.
- Create the opportunity to employ by particular R&D centres high-ranking specialists from all over the world.
- Improve reliability of scientific research results.
- Possibility of creating new, independent, self-supporting, non-profit institutions, which would act as a missing link between R&D centres and the industry.
- It would help to transfer research results into practical form, which would be acceptable to the industry. With heavy emphasis on Internet and practical approach, this kind of institutions would greatly improve technology transfer worldwide and regionally.

CONCLUSIONS

1. The analysis of statistical data showed that there is a relation between total R&D expenditures and economic growth. However, other factors such as distribution of funds, globalization, appropriate employment policy, etc. play an important role in the innovation process of a particular country.
2. Business R&D is still growing and we are convinced that this system is more effective than government–supported R&D.
3. Unfortunately, governmental and intergovernmental (e.g. EU) systems of R&D financial support create bureaucracy and waste of funds.
4. The main causes of weakness of technology transfer are as follows:
   - The lack of suitable links between R&D centres and industry;

- Wrong and insufficient organization of R&D centres and their financial supporting system;
- Low expenditures on R&D;
- Non-complementarity of R&D;
- Ineffective system of research projects acceptance.

5. The proposed ways for improving the technology transfer system are the following:Possibilities for creation maximal links between R&D and industry;
   - Improvement of R&D activities in the field of technology transfer;
   - Direct research orders from industry;
   - Further globalization in the field of international collaboration;
   - Appropriate policy concerning patents, licenses, and royalty distribution.

The above-mentioned rules apply not only to developing countries, but to countries with strong and developed economies as well.

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