

## The Role of Universities on Development of New Technologies

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**Abstract:** Companies have been looking for new way and method to develop new technology in very competitive recent economy. Invention, innovation and technological development are main stones of those ways and methods. Until market a product goes through invention, innovation and technological development process. This all process is called technological development. In recent economy, technological development has become main target of all countries. Forty-Seven per cent of economical development of developed countries comes from technological development. The main input of technological development is scientific knowledge. The scientific knowledge is produced at universities and goes to society by different ways. Companies have to collaborate with universities in order to develop new products and systems. University industry collaboration helps companies for more efficient R&D projects and to develop very competitive products. According to a study, approximately 10% of new products and new process comes out of university industry collaboration. Developed countries around 150 university project transfers to industry annually, and it make very big contribution to countries economy.

**Key words:** invention, innovation, technological development, university industry collaboration

### Yeni Teknolojilerin Geliştirilmesinde Üniversitelerin Rolü

**Özet:** Rekabetin ağırlık kazandığı günümüzde, firmalar teknoloji üretiminde yeni yol ve yöntem arayışı içindedirler. İcat, yenilik ve teknolojik gelişim bu yolların temel taşlarını oluşturmaktadır. Bir ürün pazara girene kadar icat ve yenilik süreçlerinden geçerek tüketiciye sunulmaktadır. Bu süreçlerin tamamı ise teknolojik gelişim olarak karşımıza çıkmaktadır. Özellikle günümüz ekonomisinde teknolojik gelişim, tüm ülkelerin birincil hedefi haline gelmiştir. Gelişmiş ülkelerin ekonomik büyümelerinin yaklaşık %47'sini teknolojik gelişmelerden sağladıkları görülmektedir. Teknolojik gelişimin temel girdisi bilimsel bilgidir. Bilimsel bilgi üniversitelerde üretilmekte ve farklı yollar ile topluma sunulmaktadır. Firmalar, yeni ürün geliştirmek için bilimsel bilginin üretildiği üniversiteler ile işbirlikleri yapmalıdır. Üniversite sanayi işbirliği, firmalara daha ekonomik Ar-Ge çalışması ve rekabet gücü yüksek ürünlerin üretiminde yardımcı olmaktadır. Yapılan çalışmalar incelendiğinde, mevcut teknolojilerin yaklaşık %10'unun üniversite sanayi işbirliği sonucu ortaya çıktığı anlaşılmaktadır. Gelişmiş ülkeler yılda ortalama 150 adet üniversite projesini sanayiye transfer etmekte ve böylece ülkenin gelişmesine önemli katkı sağlamaktadır.

**Anahtar kelimeler:** İcat, Yenilik, Teknolojik Gelişim, Üniversite Sanayi İşbirliği

### INTRODUCTION

Nowadays innovation and technological development became very famous words in all economies. Besides that, in daily use these three words invention, innovation and technological development are mixed. The terms Invention, innovation and technological development are used frequently in many papers. It is believed that to give

clear and easily understandable definitions of these terms is vitally important.

*Invention* can be defined as a technological achievement that has not been commercially exploited yet (Beije, 19981, s:2). And also, it is possible to explain invention as the stage which includes the discovery of a scientific or technological advance and its translation into a prototype for example a working

model (Mcyer , Mower 1987). This is the first step for placing goods in the market. Regarding this definition, to call goods an invention those things shouldn't have existed in the market before.

**Innovation** is any new idea in the business of producing, distributing, and consuming products or services. Innovation can take many different forms, for example a new management system, new financial services, new distribution facilities, or new products. Innovation is; new products and new machines or equipment or improvements of existing products and process, which have been established on the basis of some technological change created by an innovator, and which is commercially exploited (Bejie, 1998, s:1). But we should say that not all inventions are innovation; to be an innovation it should be commercialized. Only commercialized inventions are innovations. Because of that innovation is a sub-cluster of invention.

**Technology** has many different definitions. One of them is, the development and application of tools, machines, materials and processes that help to solve problems. As a social activity, technology predates both science and engineering. It embodies knowledge of solving real problems in the design of standard tools, machines, materials or processes. The term 'technology' thus often characterizes inventions and gadgets using recently-discovered scientific principles and processes [Wikipedia Encyclopedia]. Technological development includes invention and innovation. Every invention and innovation is a technological development and the outcome is a technological product.

In order to talk about innovation and technological development, inventions have to be commercialized in the market. If inventions couldn't be turned into a products at the marketplace, then it worths nothing and as far as it worths nothing, it is wast of time, money and effort. Sometimes we, human being, have to wait to see results of some inventions for years. For instance, in spide of patenting first technology, relating to the TV technology in Berlin at 1882, first long distance signal receving was found in St. Petersburg at 1907, but first TV was invented in USA at 1939 (Freeman, Soete, 2003, s:236). So, for the having TV which is innovation in our homes we had to wait 47 year just

after the invention of TV. But sometimes we have to wait much more time to have inventions in our homes. For example *rayon*, which is a kind of fibre, came into market 200 years and computer 100 years later of their inventions (Freeman, Soete, 2003, s:195).

### IMPORTANCE OF TECHNOLOGY

Competition has become very important subject in the free market economy. Because, in that type of economy the only way of being monopol is inventing and innovating new goods and services and getting their *Intellectual Property Rights* (IPR) and use them in the market. As a result of very harsh competition in the market, many companies couldn't compete others and go out of economy. In order to be successful in the competition, the only way is being very innovative, R&D orientaited and fallow all technological development in related field for the companies.

First of all, new technologies or new products which were brought into marketplace after a technological development, creates new share in the market for itself. So, this helps companies to increase its own market share in an economy. This is the only way to be more profitable for the companies. To invent or innovate something and get its IPR, be monopol, define the price and creat more profit. This is the only way to stay alive for hundreds of years for the companies. For instance, Du Pont is one of the biggest companies in the world. The thing is behind the succes and over 200 years age, inventing nylon. As it is know, nylon was invented by Wallace Caruthers in during his studies at Du Pont company (Mansfield, 1996, s:124).

The other success is Intel company. Intel was the leading semiconductor manufacturer, with the revenues of \$26.5 billion in 2001. More than 83.000 employees working in over 80 countries all over the world. How Intel caught this succes. As it is know Intel was formed by Gordon More, Robert Noyce and later Andrew Grove joined them. The first success within the company was random access memory (DRAM) chip. In 1970's Intel invented the world's first microprocessors, the 4004. The company created variety of semiconductor products, but the microprocessor product line became the bulk of the company's bussiness. Intel gained an important design win in 1980, when IBM selected Intel's 8088 prosessor

as the microprocessor in its first PC. The growth and success of IBM PC, so too did the success of the Intel Company. Although Intel has many different products, those microprocessor products has very important place in variety of products (Chesbrough , 2003).

The technological development is one of the main sources for economic growth of countries. In order to obtain additional perspective on the relationships between technological development and economic growth, it is useful to look at some countries' examples. Rapid economic growth in the developed countries through 1973 has resulted in unprecedented levels of world economic prosperity. During the period 1960 to 1970, the Japanese economy grew at the rate around %11 in a year. The economies of France and Germany expanded at rate %6 and %5.4 in a year. The thing is behind of this huge economic growth is the rapid change in the technology [Jorgenson, 1996].

According to Denison's works on G-5 countries for various periods, technical development has big impact on growth of economies [Table -1].

In table 1, the estimated contributions are presented of three sources of growth, namely; capital, labor and technology. While technology and labor has same impact on growth rate between 1909 and 1929, labor lost its power on growth more than 50 per cent the years between 1929 and 1957.

During this period, technology almost doubled its impact on growth rate. During these periods, it is clear that technology played tremendous role on growth while capital and labor lost its impacts. To sum up, the period between 1909 and 1985, technology has 47% impact on growth while capital 20% and labor 24%.

#### WAYS OF TECHNOLOGY DEVELOPMENT

Before 1950's there weren't many different organizations which are expert on developing new technologies around the world. Broadly speaking, there are three main sources of technological change in the countries' economy: these are; *industrially financed R&D*, *R&D financed by the government (universities and government laboratories)*, and *foreign R&D both privately and publicly fund* (David, Mowery, 1987). In this point the institutions given below can be accepted as the leaders in technology production;

- *R&D Department of Private Companies*
- *Private R&D Centers*
- *Government Laboratories and R&D Centers*
- *Universities (All faculties and Research Centers of Universities)*

Table 1. Contributions of Different Sources of Growth

Authors and Time Periods	Capital	Technical Development	Labor	Scale
Denison (1962)				
[1909-1929]	26%	32%	32%	10%
[1929-1957]	15%	58%	15%	12%
Denison (1967)				
[1950-1962]	25%	47%	19%	9%
Denison (1979)				
[1929-1976]	15%	50%	26%	9%
Denison (1985)				
[1929-1985]	19%	46%	26%	9%
<b>AVERAGE</b>	20%	47%	24%	10%

Source: Boskin, [1996]

One of them, which come into mind at first thought, is *R&D departments of companies*. For

instance, light bulb was invented by Thomas Edison. That was the invention which behinds General Motors'

success and power today. But it doesn't mean that all big inventions invented by companies' R&D department. Generally developing of new products and process without the findings of recent academic research is sometimes possible, but more costly and time consuming for companies.

The other institution for the technology development is *private R&D Centers*. There are so many private centers which are working upon the request of companies and investors. Companies can apply there to ask producing of new technology which company needs, and this way companies don't need any more to have R&D department and outsource their technology development work, to other private R&D centers. This is better than first option but still it has some items which may cause some problems. The purpose of private companies is making profit and their R&D works will be expensive as well. Besides this, there will be some conflict on Intellectual Property Rights and use of those rights.

*Government laboratories and R&D centers* other important institutions to produce new technology for the companies. They can work with those laboratories and R&D centers as well. In this point, it won't be as expensive as other private R&D centers but there will be different problems like quality and duration of work. Not all, but some governmental laboratories' infrastructure is not sufficient enough to develop new technology on requested quality and time.

The important and hidden power of technological development is *universities*. According to data in the literatures, which were obtained from seventy six firms in seven industries, about 10 percent of their new products and new process couldn't have been developed (without substantial delay) in the absence of recent academic research; that is academic research accruing within fifteen years of commercialization of the innovation (Mansfield E, 1995, s: 124-125). Although firms technically could have developed those technologies without the findings of recent academic research, it often appeared economically unwise to have attempted to do so. Substantial delay means a delay of a year or more. But this 10 percent rate is not accepted as good meaning by some experts when it

was thought the investment to universities and number of universities and scientists (Mansfield, 1995, s: 124-125). Life long success of companies depends on how effectively they make use of the findings of academic research results. If they are good enough on that, they will gain competitive advantage in the economy.

For instance, Department of Technology Licensing Office (TLO) of North Carolina State University transfers over 150 projects to industry in one year. Most of the applicant companies are relatively big companies which work in many different sectors and they grant big amount of money to just be the first company to negotiate with the university on newly developed products.

#### **ROLES OF UNIVERSITIES ON TECHNOLOGY DEVELOPMENT**

Universities are not likely to play a central or direct role in development of new products or processes. One of the principal roles of universities is to provide well trained students to industry. Besides this, they have diversified aims like research, and working on technology development. According to a study 10% of technology came out of the university researches at that time (Mansfield, 1995, s: 124-125). That 10 percent is acceptable rate but not enough for future targets like fast development and growth. In order to reach the main target, the share of universities in R&D studies should be increased.

Each country has many universities in many different fields. There are many researchers who have good knowledge and ability to produce new technologies or necessary solid knowledge to produce technology. Besides this, universities have competitively good and well equipped laboratories. It is very important source for the companies to get benefit. The companies and universities have to work together more often. With the assistance of universities, companies can have new projects and technology without having R&D department even more economically.

The proportion of new products and processes based on this way on recent academic research was highest in the drug industry and lowest in the petroleum industry (Mansfield, 1996). According to same paper new processes first commercialized in

1982-1985 that couldn't have been developed in the absence of recent academic research accounted \$ 24 billion of sales in 1995 alone. This statistic proves that university based researches and projects have privileged importance for industry in order to widen production variety and reach the highest level profit.

While universities are continuing basic research and student training they should emphasize on R&D and new technology development. There will be many pioneer projects which will be waiting for entrepreneurs. But universities are not expert to transfer those projects to industry for investment. Because of that, there have to be effective and dynamic interface institutions between universities and industry in order to transfer applicable projects to industry. For instance, The Netherlands formed a Centre which calls *Netherlands Organisation for Applied Science and Research –TNO*, to increase university industry relation at 1937, just after the establishment of Turkish Republic. Since than TNO office has been working on new projects to produce and transfer them into industry. This centre has been running by a committee which includes representatives from industry, military and universities. This committee decides and define the topic of researches. This Center transfers over 120 new technologies which hasn't been introduced to industry before, in a year (Netherlands Organisation for Applied Scientific Research). We believe that, these inventions and innovations helped the Netherlands to reach today's reach wealth.

In addition to contracts and grants to universities, the other important avenue by which university expertise is mobilized to help knowledge transfer to companies industrial consulting by individual faculty members. According to a study, consulting activities of academic staff are very fruitful for industry. Besides that, most of the academic researchers receive financial support for their future academic research, and their students have taken jobs by these companies (Mansfield, 1995, s: 134-135).

In Turkey, university industry relationships is not in the desired level, but it has been moving forward year by year. There are many reasons for staying

behind of many developed countries regarding the industry university relation level. But, conditions has been changing and today, there are a lots of possibilities to work with companies and receive financial support from the government for R&D projects. One of those organisation which support university industry joined project is TUBITAK. It is available to receive financial support for their R&D project up to 75% from TUBITAK. Besides this institution, the other national organization which support joined R&D projects is Turkish Technology Development Foundation (TTGV).

Under these facilitative and encouraging supports, we should increase the number of joined research projects between university and industry. Because this is the most effective way to introduce new products into markets, in this manner creating new companies, reducing unemployment rate and increasing of export rate of the country could be realized. For this reason, we have to increase the number of project valorisation centre like Ege University Science and Technology Centre (EBİLTEM). EBİLTEM has been working as a project valorisation centre since 1994. Until today, EBİLTEM organized 5 brokerage event at national level and at these events 488 projects, which are applicable to industry, were gathered and promoted to entrepreneurs and investors. Thirty-eight projects, out of 488 were transferred to industry. Some examples for transferred projects: spirulina, kefir (drink of fermented milk), bone filling material, etc.

It is believed that, main source of economic growth is technological development to create new products and services to markets. For it, each entity and person should do its/his/her responsibility. As researchers we should be in much more closer relationship with industry and we have to work to transfer our project to industry, and for that purposes we should have close contacts with project valorisation Centres like EBİLTEM.

There are 93 public and private universities and thousands of researchers around Turkey. These researchers have been creating new knowledge which is the first step of inventions and innovations. When we compare the number of Turkish patented projects or projects which were transferred from university into industry with the annual number of TNO, it proves that we haven't done our responsibility properly. On the

other hand, our entrepreneurs and businessmen haven't done their responsibility neither. When it is analyzed our 100 years back, it is very difficult to come across with high added value products. They have been doing what their predecessors had done. Most of the times they choose the easiest which is unprofitable way. Entrepreneurs and businessmen don't have habit to visit universities and receive consultancy from research institutions. In fact it is very difficult and time consuming for companies to reach university campus and find right researchers for his business area. Again, it shows what we need to improve as a country. We should increase the numbers of project valorization centers and improve their effectiveness. If we success it, after that there will be much more joined projects between university and industry and many projects will be transferred from university into industry and this is what we should do to increase the growth rate of economy.

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## CONCLUSION

One of the best ways to catch developed countries is to produce new technology, invent and innovate new goods and services. For that purposes there are number of ways but, the most effective one is university industry relationship for the countries. Because, most of the universities do have really well educated researchers and enough number of researchers to study in different field. Researchers should work closely with members of industry and create new projects together. By this way, they can create financial sources for their further research and they can find very good job for their students.

It is very difficult and long way for companies to visit different departments in universities and find right researchers. For that, universities should set up a Centre to shorten the way between university and industry.