Introduction to the Hungarian R&D Sector

WHY INVEST IN THE R&D SECTOR IN HUNGARY?

- Rich portfolio of R&D grants
- High level of scientific research, significant results in the areas of physics, mathematics, biology, chemistry, clinical medicine and engineering
- Established knowledge centres and increasing economic role of networking
- Long-standing tradition of innovation, open economy and spread of incubator services
- Smart specialisation supported by funding system
- Supportive legal and taxation environment
- Market compatible education: successful cooperation of companies and educational institutes
- Institutions and framework conditions are rapidly developing and taking part in world-class projects
- Closer cooperation between academia and the business sector
- Increasing economic role of networking, cooperation, and innovation clusters
- Hungary ranks first according to the "trading across borders" indicator and has prominent 20th position for "getting credit" among 190 global countries[1]
- Human Resources: the annual growth rate of new doctorate graduates in Hungary is above the EU-average (3.6% vs. 2%)[2]

1 RIO Country Report 2016: Hungary, European Commission, 2017
2 European Innovation Scoreboard (2016)

GENERAL OVERVIEW

Hungary is an open European economy with a strong industry sector in which foreign investment and technology play a significant role. It has a longstanding tradition of scientific research. Research and development is one of the main priorities of the Hungarian National Economic Strategy; its importance is emphasized in every sector of the Hungarian economy. R&D investment is increasing year on year as a result of the development activity of Hungarian companies and the participation of the Hungarian Government and grants from the European Union. Total R&D expenditure (GERD) was EUR 1,375 million in 2016, corresponding to 1.22% of GDP (in 2016, up from 0.62% in 2008).

The Hungarian government invests heavily in business R&D. Direct support by government for business R&D is the second highest among 35 OECD and EU-28 countries, surpassed only by Slovenia.

Structure of government funding:

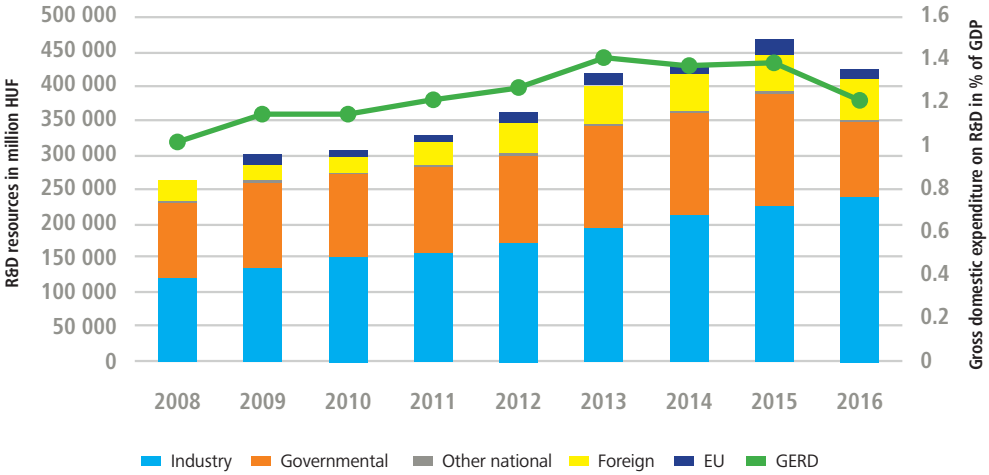
The National Research, Development and Innovation Fund (NKFIA) integrates two funds: The Research and Technological Innovation Fund (KTIA) and The Hungarian Scientific Research Fund (OTKA). The total budget of NKFIA for 2015: HUF 74.1 billion (about €247 million).

There are six operational programmes of the EU Structural Funds, co-funded by the central EU budget, that are available to the Hungarian regions[3]:

- Economic Development and Innovation OP (GINOP) Total budget (2014-2020) Priority 2 (Reinforcement of research, technological development and innovation): €1,687.9 million
- Economic Development and Innovation OP (GINOP) Total budget (2014-2020) Priority 7 (Financial instruments to top up R&I support): €2,553.2 million
- Competitive Central Hungary OP (VEKOP) Total budget (2014-2020) Priority 1 (Improvement of companies' competitiveness and development of the knowledge economy): €202.2 million
- Competitive Central Hungary OP (VEKOP) Total budget (2014-2020) Priority 2 (Financial instruments and development of services): €44.1 million
- Human Resources Development OP (EFOP) Total budget (2014-2020): €898.3 million
- Rural Development Programme (VP) Total budget (2014-2020): €25.3 million

3 Pre-Peer Review of the Hungarian Research and Innovation system, Horizon 2020 Policy Support Facility, 2015, p.26

STRUCTURE OF R&D BUDGET AND GERD



Source: https://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_ohk001.html and https://www.ksh.hu/docs/hun/xstadat/xstadat_eves/i_ohk004a.html

INNOVATION POLICY

Hungary's innovation policy is the cornerstone of the country's overall development strategy, defined in line with the European Union's cohesion and innovation policies for the 2014-2020 programming period.

National Research and Development and Innovation Strategy

"Investment into the Future - National Research and Development and Innovation Strategy 2020" (RDI strategy) was approved by the Hungarian Government in June 2013. The strategy aims to raise RDI investments and, as a result, to mobilise the Hungarian economy and to strengthen its competitiveness. The strategy set the target of raising the total amount of R&D expenditure to 1.8% of GDP and the amount of business enterprise R&D expenditure to 1.2% of GDP by 2020. Hungary is one of only four countries in the EU that are forecast[4] to be able to reach the target metrics (the others are Slovenia, Slovakia, and Belgium).

National Smart Specialisation Strategy

The Smart Specialisation Strategy (S3) is developed in every member state in the framework predefined by the EU. Hungary's smart specialisation strategy was approved in November 2014. It sets the directions for the entire country along which research, development and innovation are planned to be supported in the most sustainable way, with the greatest social profit and the promise of the best financial utilisation rate.

4 Science, Research, and Innovation performance of the EU, by the European Commission, 2016, p.36

The Strategy sets six sectoral and two horizontal research and innovation priorities. These priorities encompass domains, areas and economic activities where Hungary has a competitive advantage or has the potential to generate knowledge-driven growth.

Sectoral priorities:

- Healthy society and wellbeing
- Advanced technologies in the vehicle and other machine industries
- Clean and renewable energies
- Sustainable environment
- Healthy local foods
- Agricultural innovation

Horizontal priorities:

- ICT (info-communication technologies) & Services
- Inclusive and sustainable society, viable environment

A HISTORY OF GREAT INNOVATION

Historically, Hungary has performed rather well in terms of inventions and patents. There are many inventions that are known and recognised worldwide, although, in most cases, Hungarian scientific inventiveness and innovation are not recognised. The most popular inventions include (just a few of the most well-known Hungarian inventions and discoveries from a long list):

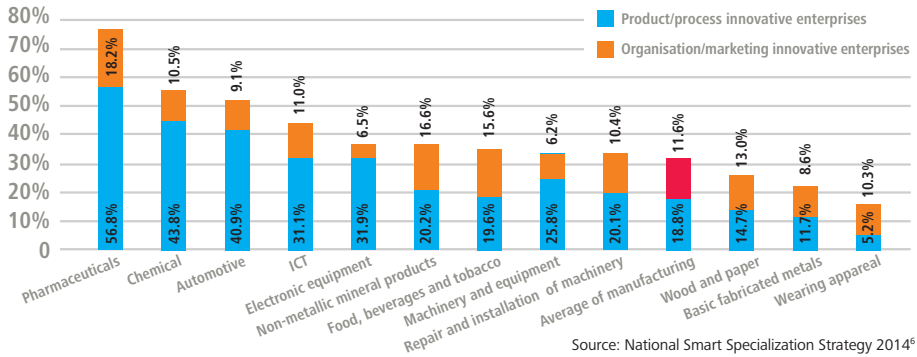
- Segner wheel, water turbine – János András Segner (1750)
- Transformer – Ottó Bláthy, Miksa Déri, Károly Zipernowsky (1884)
- Dynamo – Ányos Jedlik (1861)
- Telephone exchange – Tivadar Puskás (1877)
- Carburettor – Donát Bánki, János Csonka (1893)
- Vitamin C – Albert Szentgyörgyi (1931)
- Nuclear chain reaction – Leó Szilárd (1933)
- Ball point pen – László József Bíró (1938)
- Colour Television – Péter Károly Goldmark (1940)
- Digital computer – János Neumann (1945)
- Holography – Gábor Dénes (1947)
- Basic Programming language – János Kemény (1964)
- Rubik's Cube – Ernő Rubik (1974)

INNOVATION PERFORMANCE BY SECTORS

Business enterprise sector

In 2015, business enterprises spent over EU 775 million on research and development, which corresponds to 56.4% of the total domestic R&D expenditure. The proportion of companies engaged in innovation is differs significantly among the various sectors. In terms of size, large enterprises spend 30% more on research than micro-, small- and medium-sized enterprises combined. With regard to the source of funding, while only 4.1% of the R&D expenditure of large companies comes from public sources, this ratio is 18% in the case of medium-sized companies and over 40% for micro and small enterprises[5].

SHARE OF COMPANIES ENGAGED IN INNOVATION IN THE MANUFACTURING INDUSTRY



Source: National Smart Specialization Strategy 2014[6]

Innovation in the economy

As for the role of innovation in the economy, Hungary has been on an upward trajectory in terms of business expenditure on R&D and innovation performance, due to a large extent to the strong presence of foreign firms investing in R&D.

The country has a comparatively high level of public support for business enterprise R&D (EC, 2016b, pp. 34-35), with both indirect and direct funding measures, which are partly funded via an unique tax called the "innovation levy" (0.3% of taxable revenues of medium-sized and large companies). Furthermore, innovative firms in Hungary (and in particular large firms) tend to collaborate widely with academic organisations.

5 National Smart Specialisation Strategy, Nemzeti Innovációs Hivatal, 2014, p.19
6 National Smart Specialisation Strategy, Nemzeti Innovációs Hivatal, 2014, p.21

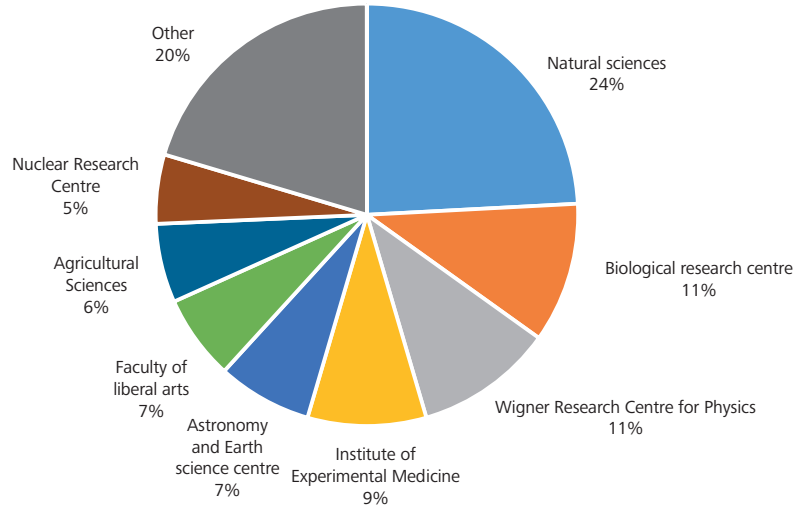
Higher Education sector and the Hungarian Academy of Sciences

The most important areas of higher education research are health sciences, natural sciences and technical sciences. Industry is intensely engaged with development; the higher education sector collaborated with companies in 37.4% of the more than 2,400 research projects (2014), a figure which is considered high[7].

The Hungarian Academy of Sciences (MTA), together with its research institutes and its several university research groups, is a major player in the Hungarian R&D sector. The HUF 52 billion (€167 million) budget for R&D expenditure is particularly significant, with fifteen faculties sharing this research portfolio[8].

The total expenditure of MTA in 2015 was HUF 67.6 billion (€219 million). The budget is comprised of the following[9]:

SHARE OF THE €167M BUDGET AMONG FACULTIES OF THE HUNGARIAN ACADEMY OF SCIENCES



Others: Centre for Energy Research; Economic and Regional Studies Research Centre; Institute of Linguistics; Centre for Ecological Research; Alfred Renyi Institute of Mathematics; Computer and Automation Research Institute; Social Science Research Centre

- The budget support was HUF 40 billion (€129 million), which is expected to reach HUF 46 billion (€149 million) by 2017. Nearly three quarters of this amount was directly spent on research plans.
- Own revenues amounted to HUF 26.1 billion (€84.5 million), a 2.1% increase from the previous year

In the Higher Education Strategy (2014), the government set a goal of increasing the counts of R&D personnel employed by HEIs to 56,000 in 2020 (FTE) from 23,647 in 2012 (KSH, 2015b). In addition, there is a target of having 12 R&D employees per 1,000 employees by 2020 compared with 8 per 1,000 in 2011 (Ministry for Human Capacities, 2014, p. 35).

7 National Smart Specialisation Strategy, Nemzeti Innovációs Hivatal, 2014, p. 17
8 Source: http://mta.hu/data/cikkek/106/1066/cikk-106693/orszaggyulesi_beszamolo_2013-2014.PDF pp.42
9 http://mta.hu/kozgyules2016/no-az-akademia-koltsegvetese-emelik-a-kutatoi-bereket-penzugyi-beszamolo-106428

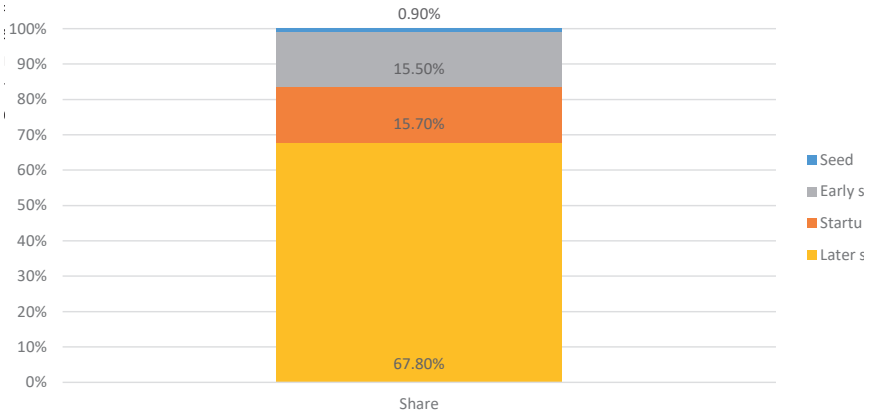
Collaboration between academia and industry

In Hungary, there are R&D-intensive companies which have established close, long-lasting cooperation with universities and play an active role in undergraduate and PhD training.

Key programmes:

- Ericsson Telecommunications Hungary has developed close cooperation with two major universities: Budapest University of Technology and Economics and Eötvös Loránd University. The collaboration allows students and their supervisors to work on industrial problems as part of the MSc and PhD programmes. Furthermore, the collaboration extends to the fields of software, hardware and microwave networks.
- Dunaújváros College and Hankook Tire Hungary launched a joint Rubber Technology Engineer programme in 2009: while the theoretical education takes place at the college, the practical training is conducted at Hankook's state-of-the-art facilities.
- Kecskemét College has established dual vocational training with Mercedes-Benz Manufacturing Hungary and Knorr-Bremse. The aim of the collaboration is to ensure a highly qualified workforce in the field of mechanical engineering. This is achieved by offering practice-oriented training to the students in addition to the courses at the college.
- The University of Miskolc and the Hungarian Bosch companies founded the Robert Bosch Department of Mechatronics in 2005. The target of the cooperation is to support practically oriented education and research activities in the engineering sciences, placing special emphasis on the wide-ranging applications of mechatronics.
- The more than ten–year-old collaboration between Audi Hungaria and Széchenyi István University of Győr (SZE) reached a new milestone in 2015 with the establishment of the Audi Hungaria Faculty of Vehicle Engineering at SZE.
- Knorr-Bremse and the Budapest University of Technology have a joint research programme running since 2011 to develop a method for the qualification of cured rubber products.

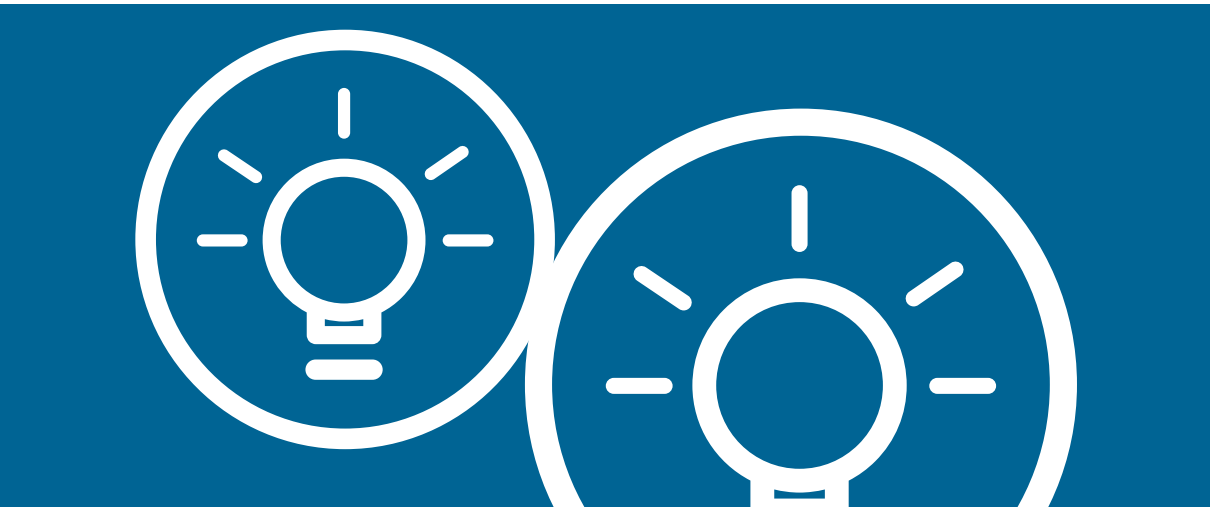
VENTURE CAPITAL INVESTMENT IN HUNGARY BY PHASE (2013)



Source: Pre-Peer Preview of Hungarian Research and Innovation System, Directorate-General for Research and Innovation Horizon 2020 Policy Support Facility, 2015

To boost early stage, startup and seed phase projects the Hungarian government differentiated allocation of funds by stage of company life cycle and launched the JEREMIE I and II programmes and the New Hungary Venture Capital Programme, and developed the "Budapest Runway 2.0.2.0. – A Start-up Credo" ecosystem, which envisions the Hungarian capital as the start-up centre of Central and Eastern Europe within a decade. These led to the emergence of startups with high growth potential.

There are numerous opportunities for both private and state financed accelerators, one of the key players being Hiventures, which has a €160 million budget to invest in incubation, seed, and startup phase companies. Other main incubation players (with budget) are: BNL Start Partners Kft. (€ 2.3M); Creative Accelerator Kft. (€ 2.4M); EH Invest Zrt. (€ 2.2M); Első Közép Európai Hardver Akcelerátor Kft. (€ 2.4M); Negos Tárgyalási Tanácsadó Zrt. (€ 2.4M); OXO Labs Üzletviteli és Tanácsadó Korlátolt Felelősségű Társaság (€ 2.3M); Quantum Leap Innovációs és Iparfejlesztési Kft. (€ 2.3M); Virgo Ventures Technológiai Inkubátor Kft. (€ 2.4M).



EUROPEAN R&D COOPERATION

European Framework Programmes for Research and Technological Development

European cooperation in R&D and Innovation is increasing in scope and importance. Most cooperative R&D projects in Europe are carried out within the European Framework Programmes for Research and Technological Development, such as FP7 (2007-2013) and Horizon2020 (2014-2020). Hungary's performance in FP7 ranked high among the new member states (EU13):

- 1,602 participants receiving a total of € 290 million
- Rank in grant awarded: sixteenth (EU28); second (EU13)
- Rank in number of participants: sixteenth (EU28); second (EU13)
- Top collaborative links: Germany, United Kingdom, Italy, France, Spain

Horizon 2020 (AS OF NOVEMBER 2017):

- 589 participants receiving € 168.01 million
- 182 SMEs (Small and Medium Enterprises) receiving € 47.98 million
- Ranking in grant awarded: 17th (EU28); 3rd (EU13)
- Rank in number of participants: 18th (EU28); 4th (EU13)
- Top collaborative links: Germany, United Kingdom, Spain, France, Italy

TOP BENEFICIARIES OF THE HORIZON2020 (AS OF NOVEMBER 2017):

Name	EC financial contribution in € M
NATIONAL RESEARCH, DEVELOPMENT AND INNOVATION OFFICE	13.74
MTA Wigner Physical Research Center of Physics	11.01
Central European University	10.45
INSTITUTE OF EXPERIMENTAL MEDICINE - HUNGARIAN ACADEMY OF SCIENCES (IEM HAS)	8.98
BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS	7.14

European Institute of Innovation and Technology / Knowledge and Innovation Communities

The European Institute of Innovation and Technology (EIT), established in 2008 with its headquarters in Budapest, is the first Europe-wide institution based in Hungary. The EIT is the EU's flagship institute designed to connect European business and research, and to integrate innovation, research and economic growth in Europe. The mission of EIT is carried out through the so-called Knowledge and Innovation Communities (KICs), integrating European innovation platforms of leading European stakeholders from industry, academia, and policy. Hungarian participation on established KICs:

- Climate-KIC: Central Hungary hosts a regional centre
- EIT Digital has an Associate Partner Group consisting of two universities (BME and ELTE) and their industrial partners (consortial partners: Ericsson Hungary, Magyar Telekom; cooperating partners: Cisco Systems Hungary, Nokia Solutions and Networks, and General Electric Healthcare).
- KIC InnoEnergy has an Accelerator HUB in Budapest
- KIC Health has a regional office in Budapest and four Hungarian Innostar partners: GE Healthcare, Semmelweis University, University of Debrecen and the National Healthcare Service Center

KEY DEVELOPMENTS IN RESEARCH AND INNOVATION

Hungary has a vast science and innovation potential that could bring about a structural shift in its economy. Important progress has been made and the country has now a golden opportunity to build on the emerging collective feeling of a "new beginning" for its R&I system. To better exploit its intellectual capital, the proven excellence in its science base and the presence of highly innovative international enterprises will require a dedicated will towards reform accompanied by sustained increases in public funding for those carrying out R&D.

Business enterprises can benefit from indirect support measures: tax incentives for R&D, and the government distribution of institutional funding to public research organisations, including the Hungarian Academy of Sciences and universities. The most notable development is the increased willingness to develop and implement demand-side innovation policy measures, such as public procurement of innovation (PPI) and pre-commercial procurement (PCP).

Hungary's performance in the ease of starting a business and in contract enforcement are above the EU average (EC, 2016b, pp. 87-97). Low barriers to entrepreneurship resulted in a strong increase in the share of international patents from 2000 to 2012[10]. The strongest growth rates of business R&D intensity over the 2007-2014 period can be observed in the economies of Central and Eastern Europe. In recent years, the Hungarian R&I system has undergone major changes. The establishment of the National Research, Development and Innovation Office (NKFIH) integrates the activities of the previous National Innovation Office and ministry departments responsible for innovation policy (January 2015). The establishment of the National Research, Development and Innovation Fund integrates the Hungarian Scientific Research Fund (OTKA) and the former Research and Technological Innovation Fund (KTIA) programmes (January 2015). The Innovation Body consisting of nine distinguished members who represent both the economic and scientific spheres was also established. The main goal of this body is to ensure the effective use of financial instruments available for

10 Science, Research, and Innovation performance of the EU, by the European Commission, 2016, p. 56

research and innovation (March 2015). New research measures were launched and funded by the Operational Programmes (i.e. GINOP, VEKOP, EFOP) and co-funded by the Structural Funds. The long-term consolidation of the Hungarian public R&I system allows the necessary critical mass and attractiveness to be built in order to reinforce public-private cooperation in R&I as well as the international reputation and attractiveness of Hungarian science and innovation.

SUCCESS STORIES FROM THE R&D SECTOR

Prezi.com

The company provides cloud-based presentation software and a presentation database. It started in 2009 and has expanded its user base rapidly year by year. By the end of 2015, the number of registered users exceeded seventy five million, and the number of presentations created is already beyond two hundred and sixty million. With these figures, Prezi.com is the world's biggest open presentation database. It received a USD 57 million investment in November 2014, which indicates the huge potential of the development.

Ustream

Founded in 2007. Provider of an open live video streaming platform that is capable of one and a half million simultaneous viewers. In the last two years, it has increased profits and turnover by 400%. At the end of 2014, it achieved a monthly average of 50 million users. In 2008, Doll Capital invested USD 11 million into Ustream, and in 2010, Softbank injected USD 20 million of capital into the company. UStream was acquired by IBM in 2016, in a deal valued at USD 130 million (price not confirmed by IBM).

3DHISTECH

3DHISTECH develops and manufactures high speed digital slide scanners that create high quality brightfield and fluorescent digital slides, digital histology software and tissue microarray machinery. The company is one of the market leaders in the field of digital pathology with more than eight hundred systems sold worldwide to large pharmaceutical companies like Roche or Sanofi-Aventis and to leading research institutes like Harvard Medical School or Vanderbilt University. Founded in 1996 by European Inventor Award finalist Dr Béla Molnár, 3DHISTECH employs one hundred and twenty people and has a turnover of EUR 8 million.

LogMeIn

LogMeIn Inc., founded in 2003 in Budapest, is a provider of software-as-a-service and cloud-based remote connectivity services for collaboration, IT management and customer engagement. The company's products give users and administrators access to remote computers. There are over 300 million devices connected through LogMeIn servers, and it is ranked as the most reliable remote access tool. The company employs more than 800 people around the world. LogMeIn completed an IPO in 2009 and has a market capitalisation of $2 billion.

NEXT generation production systems

NEXT is the biggest initiative ever undertaken in Europe in the production systems area. This project integrated the complete value-chain for the European production machinery sector with the aim of determining the machines of the future and the sector's new business models that will contribute to the transformation the manufacturing industry. The project involved 25 partners, including the Technical University of Budapest as a key contributor, and a budget of 24 million euros. Europe's knowledge and innovative drive powered the industrial revolution, introducing machines into the production process and changing society forever.

The consortium developed a new business paradigm for the customer-machine builder relationship, transforming it into a long-term partnership based on sharing risks and increasing mutual benefits. The project made significant contributions to manufacture and use of production machines, providing substantial reduction in environmental impact as well as enhanced machine performance via automation and the use of new materials. The team developed a new type of 'green machines' that use fewer resources in the manufacturing process, consume less energy and water during operation, and are designed to be dismantled and recycled at the end of their useful lifespans, and so may represent the beginning of the next machine revolution, providing a major competitive edge to Europe in a huge global market.