ICT Research and Innovation -- Slovakia
(not necessarily politically correct facts and opinions)

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Abstract: Slovakia ranks at the bottom of the R&D and Innovation statistics in Europe regardless of the criteria chosen. Rather than repeating the known statistics which can be found at the web pages of EU or OECD we try to identify some plausible causes of this situation and present suggestions for change. Although stemming from the Slovak reality these can apply to other countries and to R&D and Innovation in general.

INTRODUCTION

The General Situation in R&D and Innovations

In the distant past (in Czechoslovakia) all R&D was government funded through the Academy of Sciences, Universities and Industry Research Institutes. The Research – Development – Innovation path was institutionalized by having basic research mainly at the academy and universities, applied research mainly at the universities of technology and some industry research institutes and innovation and development mainly at the industry research institutes (even some large factories). The cooperation was financially motivated. The main problem was time, especially to take the innovation to production.

In the recent past (in Slovakia) we have witnessed disappearance of most industry research institutes. The government support for R&D has been decreasing. Some EU funding became available and Slovakia, being an associate and ascending country, could benefit from the EU policy encouraging partners from Central and Eastern Europe. Inexperience and, to some extent, lack of contacts did not allow to fully utilize the potential. The economy was in bad shape, especially after the split of Czechoslovakia, and R&D was not considered a priority. Private financing was practically nonexistent. The 'wild' privatisation did not bring 'caring owners' but rather ruthless short term profit takers. The multinationals, gradually taking over, did not find investment in research profitable and they mostly concentrated on assembly lines and sales. To the worst, the well meant effort to increase quality of R&D via scientometric criteria maneuvered the universities of technology from applied research to publications (often of questionable quality but fulfilling the formal criteria). The Research – Development – Innovation path was broken. The situation in the Czech Republic has been much better. The generous support ofbuilding up large research centers, the size of grants for projects 5-10 times bigger than in Slovakia, the ability to pay from the grants PhD students and supplementary wages for researchers resulted in build up of strong research centers and brain gain instead of brain drain.

At present the situation is still bleak. The government funding keeps decreasing and the EU funds are more difficult to reach after Slovakia became an EU member. There are some signs of private research funding increase (somewhat slowed down by the current recession). For example, ESET, the Slovak company with worldwide operation in antivirus software NOD, is beginning to seek cooperation with universities in research. HP is opening its cloud computing center in Bratislava which should again result in research needs. The Czech Republic appears more attractive as a destination for research centers of multinational companies. Besides, years of better support for

research materialize in better success rate in the EU funding of research.

The Situation in R&D and Innovations in ICT

Apart from the general situation in R&D and Innovations, there are some ICT specifics.

In the distant past the whole ICT area was crippled by the government policy of declaring cybernetics (and thereby computers as its 'product') an undesirable bourgeois pseudo science. This set back the computers and components manufacturing 10-15 years back and the situation was even worse in software. This distance to the Western development was kept constant or even increasing by another bad political decision – betting on reverse engineering. The only area that was considered 'harmless' and therefore allowed to thrive was theory. The theoretical computer science in (Czecho)Slovakia managed to keep pace with the developments in the Western countries as witnessed, e.g., by the result of Szelepcsényi in 1986 which was later awarded the ACM and EATCS Gödel Prize.

In the recent past the theory area was hit by the brain drain. This was not only due to the border opening but especially due to many emerging IT companies desperate for well educated personnel. They could easily attract researchers from universities and academy institutes suffering by very low salaries. Local IT companies were mostly of the 'box shifting' kind with no interest in research. IT was well represented in the EU Framework Programs and the policy of including partners from C&E Europe helped the research teams to integrate into project consortia. Still this was not common.

At present we are witnessing shrinking of IT research teams. The brain drain continues and it is moving already to the PhD studies level with many of the best students seeking PhD and subsequently employment abroad. Some positive signs of private funding improvement mentioned above were taken from the ICT area. The EU funding is becoming more difficult to reach mainly due to the fact that many years of under-financing and brain drain decreased the competitiveness of Slovak research teams.

As a consequence of the above mentioned facts, Slovakia ranks at the bottom of all statistics related to R&D and Innovations available in EU and OECD (percent of GDP going to research funding, ...). This than correlates well with the success rate in EU project proposal funding.

MAIN INHIBITORS

In this Section we shall discuss main inhibitors of research and innovation success, some of which are not specific for Slovakia.

Research

Research is not a priority of the government despite the fact that for decades governments have declared the importance of research and innovations. Regardless the orientation (right or left) the governments have failed to materialize their declarations and promises. Even worse, as mentioned above, the financing of R&D keeps decreasing. One can only speculate about the reasons. One possible explanation of this phenomenon is the fact, the the 'utility function' of politicians optimizes for the best result in the next elections. Investment in R&D and education is a long term investment and therefore does not fit the immediate goals of politicians. Another feasible explanation relates to the often cited problem of corruption in Slovakia and some other E-12 countries. One can much easier see opportunities for corruption in large expensive projects (buildings, roads, equipment, software for e-government, etc.) than in research and innovation projects.

Decades of low government funding resulted in decreased competitiveness of research teams. For reasons beyond understanding the government funding of research motivating joint projects by several institutions in Slovakia (thereby stimulating cooperation and creation of stronger competitive teams) initiated about ten years ago was dropped.

EU Policies make it more difficult for Slovak research teams to participate. After Slovakia became an EU member, the 'incentive' projects encouraging established teams in E-15 to take on board teams from E-12 disappeared. Moreover, the evaluation criteria are more closely looking at justification of having a particular team as part of the project consortium. Combined with the dwindling size of the Slovak research teams it made it more sensible for the EU-15 projects to reach for best individuals and hire them instead of risking the inclusion of a whole team. This hidden incentive for brain drain is made even stronger by the fact, that according to the EC rules, Slovak experts get paid better being part of a team in an EU-15 country than being part of a team in Slovakia.
Multinational IT companies keep most of their research at home for reasons one may guess but I prefer not to speculate on them. The multinationals get the largest proportion of the ICT related revenue generated in Slovakia. This means that a large part of resources that would normally be used for R&D is spent in other areas (or outside Slovakia). Fortunately we do see change in this area in some EU-12 countries (e.g., Hungary and the Czech Republic, incidentally both are countries where governments pay real attention to R&D) and there are positive signs this may also happen in Slovakia.
Local IT companies lack funds and can still live without research using tried-out technology and processes. There are some exceptions which can usually be traced to some excellent university graduates who after stabilizing small companies they established returned to their 'hobby' of thinking and looking for better solutions. So far this does not lead to financing teams of researchers and research cooperation with the universities (cooperation on development is a rare exception).
Administrative complexity of research funds (both EU and local) is discouraging participation, especially of those who already tried it. It started by the procedures in Brussels, but local grant providers were quick learners. It is becoming almost a necessity to have a professional company, knowing the 'right formulations', to assist in writing up a proposal, keeping track of and reporting on finances, etc. It is unlikely this administrative burden can be significantly reduced before the European administrations approach – everyone is automatically expected to be a criminal unless proven otherwise – could lean more towards the American – everyone is automatically expected to be trustworthy unless proven otherwise. The administrative burden and auditing exercises should be commensurate with the size of the grant.
Support structure for FP7 projects is neglected and apparently not considered important. It moved from the the Ministry of Education, Science, Research and Sport of the Slovak Republic to the Slovak Research and Development Agency and back again all since the beginning of the FP7. For example, there were already two NCPs for the Ideas Program and there has been none since January 1st of 2011.

Innovations
The pool of knowledge in IT is drying out. This is not specific to Slovakia. Breakthrough innovations need breakthrough research results. We seem to be happy with 'cosmetic' improvements at present. And here I consider constructing a processor twice as fast as the best so far among the 'cosmetic' improvements. We need qualitative change. For example, we are still living with the definition of the notion of information by Shannon which is over half a century old and which was introduced as an abstraction allowing to study problems related to the transmission of information. At present we do much more with information than just transmitting it. Do we have a theory allowing us to handle the information overflow we are experiencing? Most of the ICT areas could benefit from a breakthrough in understanding and insight.
Broken Research - Application - Innovation path. The traditional role of Universities of Technology - applied research – was replaced by publications due to the new evaluation criteria for universities. As usual, good intentions (increasing the quality) marked the path to hell. This only underlines the importance of the choice of the evaluation criteria. Traditionally universities of technology served as a bridge connecting the basic research to the needs of industry through their ability to understand both ends. Quality here was demonstrated by the ability to understand the current basic research

results and their potential and at the same time the needs of the industry. They gradually moved away from understanding the needs of the industry and closer to 'publishable results'.
Most companies lack 'Innovation departments', i.e., people capable of understanding new research results and communicating 'pressing issues' back to research. It is rare to see at a research conference a person from industry understanding to some extent what is going on, communicating with the researchers and 'fishing' for useable things.
Most companies lack courage to leave the tried out path. The bigger the company the more difficult it is to change the processes used. This applies especially to software companies where it takes considerable time before the new research results make it to practical use.

CAN WE SUCCEED?

Let us Assume Ideal Conditions (via some miracle). These could include sufficient financing of research and innovations, research to innovations pyramid functioning, industry eager to change, government having real interest in research, etc. Would this mean a research and innovation heaven? Perhaps yes. The problem is that miracles normally do not happen and we would need to imitate them.
How Long Would It Take to Imitate the Miracles? It is important (and hopefully awakening) to realize that to imitate some of the miracles may take a long time even with the best effort and intentions. The *money miracle* is the easiest to carry out. Especially small countries like Slovakia can multiply the budget for research and innovation in the next budget year by slightly delaying some of the other items (e.g., delaying few kilometers of the highways). The *government miracle* is clearly easy to perform by sudden change of attitude. The *pyramid miracle* will take at least 20 years with the best efforts. To rebuild the pyramid of interconnected layers from basic research through applied research to innovations and implementation in industry will take time. It will have to start from basic and secondary schools. Besides informatics, which is of main interest to this grouping of informatics societies, it is important to bring back the emphasis on mathematics. Once compulsory part of the baccalaureate it has become just an elective and less than 15% of secondary school students take this exam. It is an alarming situation especially for the engineering faculties of the universities of technology. Incentives should provide for revival of communication between the basic and applied research teams via joint seminars and conferences. Similarly there should be communication between the applied research and industry and incentives for industry to take part in this communication. Companies receive incentives from the government to build factories and assembly lines in Slovakia. There should be incentives for cooperating in the research to innovation pyramid. The companies tend to wait for results coming on a silver plate and then they complain that what is served is not as tasty as expected. It takes time to populate the layers of the pyramid and to come up with evaluation criteria that would support its functioning. The *industry miracle* is most difficult to imagine. I can see the only thing that could make industry thirsty for change – reincarnation of quality. I do not think industry can/will go for this change by itself. Producing a lot of cheap (indeed both inexpensive and cheap) goods has become a norm. It would take years of education to make consumers realize that it is from many points of view better to go for less but of a good quality (perhaps two generations?).
Changes at Meta Level are Needed to Make-Up for Miracles. This means, we need to reconsider the substance of research and innovation. I find three items to be of highest importance.
First we shall need to *reconsider the INTENTION of innovation.* I find 'Improving Life' more appealing than 'Helping EU Economy' or 'Increasing Profit'. While I understand the interest of companies in increasing their profits, I completely fail to understand why should governments, representing citizens, use profit of companies as 'the' criterion of success. I am convinced, that Steve Jobs' motivation for his user interfaces and gadgets was to make ICT easier to use by people and thereby usable to make their life better. The profits for Apple came in as a natural consequence.
Second, *reconsider oversimplified success CRITERIA.* Using 'Profit' as THE success criterion is convenient but treacherous. Criteria based on few simple parameters that can be checked by a

person with limited experience (and often not having education in the particular field) by simply going over a form with checkboxes should raise worries. It was not accidental that old tribal societies paid extreme attention to the advice of seniors who could use experience and analogy to help the tribe avoid disasters. Imagine that there would have been a criterion saying that a tribe member is better if he kills more animals of certain kind. This would have inevitably led to overkilling and perhaps extinction of animals important for the tribe. Are we sure that the criteria we use are not leading to the extinction of research and technology?

Third, *reinvent QUALITY*. We seem to live in a 'cheap economy' era. My thirty years old refrigerator still works without interruption (well, I moved three times) to my full satisfaction. It is likely to consume a bit more energy than the new ones do. But, within the last five years we had to buy two refrigerators for my mother-in-law because it was almost as expensive to repair the first one when it broke than to buy a new one (what about the energy used to produce and to dispose off the broken refrigerator?). Cheap 'disposable' things are becoming a norm. Unfortunately, growing used to cheap goods makes us more tolerant to cheap services, cheap education, cheap ... To bring back quality will be a process taking many years. It will require educating generation(s) which have become used to cheap 'throwaway' goods and low quality services. It will also require to redefine the success criteria for economy, where it is easy to measure growth but difficult to measure increase in quality.

These (+ more) changes at the meta level should lead to better education, better understanding, and teams capable of moving from innovation as an improvement to real INNOVATION. I am strongly convinced that it is worth to embark on this road.