How to bridge academia and industry?  
A practitioner’s perspective

Surveillance 8  
Roanne, 21.10.2015

Tomasz Barszcz

Department of Robotics and Mechatronics, AGH Kraków, professor  
EC Systems sp. z o.o., Chief Executive Officer
Agenda

• Business based on knowledge – why?
• What problems will we face?
• How to commercialize the results?
• Who should do it?
• Case study
AGH University of Science and Technology
Kraków, Poland

Established in 1919
Initially focused on mining and metallurgy. Now, Polands’ 1st technical university

www.agh.edu.pl

40400 students
15 faculties
170 specializations
2100 researchers
Department of Robotics and Mechatronics

- 35 permanent staff
- 45 PhD Students
- 90 postgraduate students, 30 in English
- 4 Laboratories:
  - Structural dynamics
  - SHM and diagnostics
  - Mechatronics and Robotics
  - Numerical modeling and simulation

Head: Prof. Tadeusz Uhl
Condition monitoring group

Contributed to over 7.45 MEUR of research funding (FP6, FP7: Alstom Power, Solaris, Vulcan, IFFM, Cetim, IET, KIC, NCBiR)

Research interests:
- vibration signal analysis
- automated data analytics
- embedded systems
- large data centers

24 years of research and industrial experience (ABB, Alstom)
CEO and co-founder of EC Systems

Over 200 research publications; citation – h=13

Head: Prof. Tomasz Barszcz
Machinery fault detection

We develop and implement diagnostic methods for various machinery. Our focus is on Variable Operating Conditions.
Business based on knowledge – why?

• High risk

• Yes, but if successful:
  – Quick return on investment
  – The best return one can get
  – Added value in knowledge, can be used further
  – Exit “the middle income trap”
Where can it work?

- Good availability of educated workforce
- Advanced research infrastructure
- “Innovation ecosystem”

- **Spirit of entrepreneur, not of a bureaucrat**
What problems will we face?

Despite a large number of Research & Development projects, only a fraction turns into successful products. The especially important gap spans between a laboratory test as a result of a university project and heavy duty proven product launch.

Happy developers in a lab is only a start…

… it needs a lot of time and money to make their system work in a demanding environment
Problems with product development

• Development of a lab prototype is only a first step to a product based on that technology (ca. 8% of the cost)

• It is not enough to understand the physics and develop a system prototype – and this is interesting for a researcher

• In order to be used in the field, the system must be industrialized – and this is NOT interesting for a researcher
  • Intensive testing in an increasingly complex environments (lab, test rig, field)
  • Often redesign, sometimes more than once
  • Manufacturing requirements
  • Service procedures

• All this process require funding (92%) and are boring, researchers will go elsewhere
Remember, there are differences across industries

<table>
<thead>
<tr>
<th></th>
<th>Pharmaceutical</th>
<th>Software &amp; IT</th>
<th>Energy</th>
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<tbody>
<tr>
<td><strong>Time Required to Innovate</strong></td>
<td>10-15 years</td>
<td>1-5 years</td>
<td>10-15 years</td>
</tr>
<tr>
<td><strong>Capital Required to Innovate</strong></td>
<td>Medium to High</td>
<td>Low to Medium</td>
<td>High</td>
</tr>
<tr>
<td><strong>New Products Primarily Differentiated By</strong></td>
<td>Function/Performance</td>
<td>Function/Performance</td>
<td>Cost</td>
</tr>
<tr>
<td><strong>Actors Responsible for Innovation</strong></td>
<td>Large Firms Reinvesting in R&amp;D; Biotech startups, often VC &amp; govt. funded; Govt. (NIH, NSF)</td>
<td>Dynamic Startups, often VC-funded; Large Firms Reinvesting in R&amp;D</td>
<td>Various: Utilities, Oil &amp; Gas Co.s, Power Tech Co.s, Startups, Govt.</td>
</tr>
<tr>
<td><strong>Typical Industry Risk Tolerance</strong></td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Innovation Intensity</strong></td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Intellectual Property Rights</strong></td>
<td>Strong</td>
<td>Modest</td>
<td>Modest</td>
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How to measure a technology?

- The level of technology development can be described as a continuum
- The lowest level is the idea itself
- The highest level is the product introduced to the market

- The technology maturity can be described with the TRL
- Introduced by NASA in 80’s, then became popular across many industries
Technology Readiness Level areas during development

TRL 9
TRL 8
TRL 7
TRL 6
TRL 5
TRL 4
TRL 3
TRL 2
TRL 1
Valley of Death

- Valley of Death is the time when the research funding has finished, but there is no reliable product which can be offered to customers
- In most cases it is a period between TRL 4 and TRL 7
- Required investment is so high, that skeletons of many projects are left here
Who should do the commercialization?

• **Large multinational companies**
  – Own laboratories
  – Strong workforce in R&D
  – Often focus is on improving existing products
  – *Still interested in competent partners*

• **Spin – off companies**
  – Research projects
  – Labs at universities
  – Enthusiastic researchers (rather younger)
Spin-off development scenarios

I. Product development, market building, sales network – long and expensive

II. Product development, further improvements and research, initial sales, acquisition by a global company – more interesting for researchers

III. Development of know-how, outsourcing of R&D services for large companies
How to bridge the gap?

• The problem is researched by European and American agencies

• Solution requires balanced partnership between government, academia and industry

• Key element are motivated people, oriented on the market success
How to bridge the gap?

• Most people say, that we simply need more money, but it is only partially true
  • Insufficient funding in critical TRL levels will kill the project
  • Too much money too early will cause waste of money

• Proper decisions are based on the risk/reward profile for a given case

• You should be able quickly start /or kill/ projects
Be careful about each step

• The commercial goal should be clear from the very beginning of an applied research project
• All the team should be aware that every decision has an impact on the economics
• Market research should be parallel to the project
• Marketing of results is not only to create a web page
• The team members should be able to earn – not to spend

• You have to be quick, the first one get the real premium
**Try hard to understand each other**

<table>
<thead>
<tr>
<th>Academia</th>
<th>Industry</th>
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<tbody>
<tr>
<td>• Are „mad scientists” type</td>
<td>• Are boring and no sense of humor</td>
</tr>
<tr>
<td>• Prototype driven</td>
<td>• Requirements driven</td>
</tr>
<tr>
<td>• Learn by doing</td>
<td>• „Do it right the first time”</td>
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<tr>
<td>• Say „What if”?</td>
<td>• Say „Prove it”</td>
</tr>
<tr>
<td>• Nurture infant technology</td>
<td>• Kill the weak and move on</td>
</tr>
<tr>
<td>• Ask: „Can it be done”?</td>
<td>• Decide: „Should we do it”?</td>
</tr>
<tr>
<td>• Fill the funnel: create new options</td>
<td>• Narrow the funnel: increase focus</td>
</tr>
<tr>
<td>• Objective: UNDERSTANDING</td>
<td>• Objective: DELIVERY</td>
</tr>
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</table>
How to organize it?

- End user company
- Spin off company
- Consulting
- New technology development
- Waste of money
- Academia

Business as usual
Who should start a spin-off?

• Matching the academia and industry is best when there is efficient transfer of people from one to the other

• The method is very efficient ...
• ... but one has less social security

• New model of PhD studies may help in this model in a rather unexpected way
• Make sure to understand the end-user’s

• Accept risk, anticipate failure and prepare for alternatives

• Efficient communication without regard to formal hierarchy

• Team members must be responsible and committed to the project
What can be achieved?

- Overcome the „death valley” in innovations
- Find the way from the product to the market
- Create career paths for university graduates
- Increase mobility of researchers

- Earn on new, high profit margin products: more profit, more safety, better environment, healthier economy
Transfer of people through the TRL levels is the best way to achieve the commercial success

Advantages: people have the know-how and the market, are experienced and have teamwork skills

Disadvantages: only a few are able (and willing) to change the attitude to the market – the goal is to EARN, not to SPEND
History of EC Group/EC Systems

- Founded in 1992
- 500 employees in the holding (EC Grupa)
- ISO 9001 standard since 1999
- Implementation of engineering and software development projects worldwide
- EC Systems as separated company from 2005

www.ec-systems.pl

info@ec-systems.pl
› EC Systems team

› 2 technical teams

› 60+ employees

› Certifications: management and technical level

› Electronic, software, automation, diagnostic engineers
Embedded Condition Monitoring System

Data Transfer Process

Remote Diagnostic Centre

- Process params
- Mech vibration
- Electrical signals

output data
configuration data
VIBstudio: Condition monitoring and diagnostics

VIBstudio is a platform designed to:
- Continuous condition monitoring,
- Failure protection,
- Vibration diagnostics of machines and equipment.

VIBstudio is a summary of the 15 years experience of EC Systems.

VIBstudio is comprised of
- VIBmonitor modules and
- VIBnavigator software.
VIBmonitor

- Based of True Data Validator™ technology
- Built-in diagnostic analyses
- Modular structure based on functional cards
- Internal memory. Historical data recording
- 24bit measurement resolution, sampling up to 100kHz
- Protection relay outputs. Integration with SCADA systems
- Access from any place in the world (Ethernet)
VIBnavigator is the user interface of the VIBstudio platform. It is primarily used for event monitoring, data viewing, configuration and administration of the system.

VIBnavigator is available in two versions:
- **Standard Edition (SE)** – for small installations, allows to verify the causes of warnings and alarms,
- **Enterprise Edition (EE)** – diagnostic center, allows direct access to live and historical data from any number of machines.
Energobaltic – case study

- Established in 1997
- Part of Lotos Group
- Energobaltic Sp. z o.o. core business:
  - Exploitation of petroleum and natural gas from Baltic Sea
  - 3% domestic consumption
  - Manufacturing and sales
    - LPG (mixture of propan-butane),
    - natural gas liquids (NGL)
    - electric energy and thermal energy
- Sales: 33 mld PLN, profit: 802 mln PLN.
Energobaltic – case study

- 2007 – CM system installation on compressor Dresser-Rand
- Two major system upgrades
- System consists of 20 vibration channels on:
  - Compression chamber,
  - Intermediate chambers,
  - Crankshaft bearings,
  - Motor bearings.
› **Energobaltic** — Dresser-Rand reciprocating compressor

![Diagram](image.png)

- **Kompresor**
  - 20 sensors (EX)
- **Bariery EX**
- **Moduł monitorowania VIBmonitor**
  - 1 x ACQ card
  - 1 x CPU card
  - 5 x VIBRO card
  - 1 x PV card
- **TCP/IP**
- **System diagnostyczny VIBnavigator EE**
  - Remote access ECS
  - Remote access EB
- **Usługa VIBcare**
  - 24/7

VIBstudio

www.VIBstudio.pl

www.ec-systems.pl
Zakłady Azotowe Puławy – case study

- Part of Azoty Group
- Largest in Poland (57.4%), 2nd largest EU manufacturer of nitrogen fertilizers (7.8% UE-27 capacity).
- EU largest (19.6% UE capacity) world 3rd largest manufacturer of melamine (4.3% global capacity).
- Net profit: 390 mln PLN
- Workforce: 4000 person
Zakłady Azotowe Puławy – case study

- Beginning of CMS installations: 2008
- Over 20 compressors with installed condition monitoring systems
- Over 200 vibration channels
- Successive installations on further machines
- 23 detected failures in 6 years
› Zakłady Azotowe Puławy – Ariel reciprocating comp.

› Kompresor
› System monitorowania
› System diagnostyczny
› VIBtransmitter 1002D
› HMI: SCADA

› 12 vibration acc. EX
› 5 vibration disp. EX
› 4 barriers EX

› 4-20mA
› TCP/IP

› Operator
› Zarządzający

www.VIBstudio.pl  www.ec-systems.pl
Our experience

• AGH executed numerous projects in the area of machinery monitoring

• Many of these had significant commercial potential

• Fundamental rules were:
  • Government/ EU funding on low TRLs
  • Additional funds on medium TRLs (NCBiR, PARP, EU Regional Funds, KIC)
  • Spin-off companies with very motivated teams for quick commercialization on highest TRLs (1st friendly customer)

• AGH provided continuous support and encouragement, facilitated IPR usage for commercial use
Conclusions

• Awareness of the “death valley” issue is growing

• Researchers must be aware of needs of the industrial partners

• There is a place for small, innovative companies who bridge the worlds of academia and industry

• If you do it right, you may have an exciting adventure as an entrepreneur, meet interesting people, solve their problems and make a lot of money
One more thing ...

http://www.ictd2016.polsl.pl/
You are welcome!

12 – 16 September 2016
Gliwice, Poland – Silesian University of Technology
Thank you for your attention!