AGH UNIVERSITY OF SCIENCE AND TECHNOLOGY

How to bridge academia and industry? A practicioner's perspective

Surveillance 8
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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

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

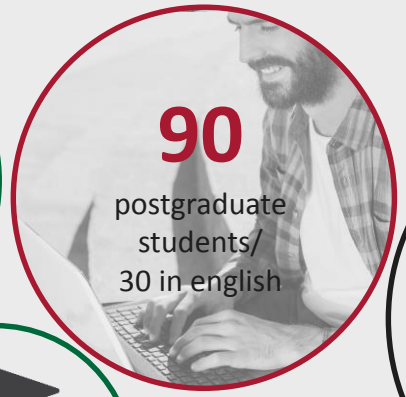
www.agh.edu.pl

40400 students
15 faculties
170 specializations
2100 researchers

› **Department** of Robotics and Mechatronics

35
permanent staff

90
postgraduate students/
30 in english



45 PhD Students

4 Laboratories:

- Structural dynamics
- SHM and diagnostics
- Mechatronics and Robotics
- Numerical modeling and simulation

Head:
Prof. Tadeusz Uhl

› **Condition** monitoring group

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

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

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”

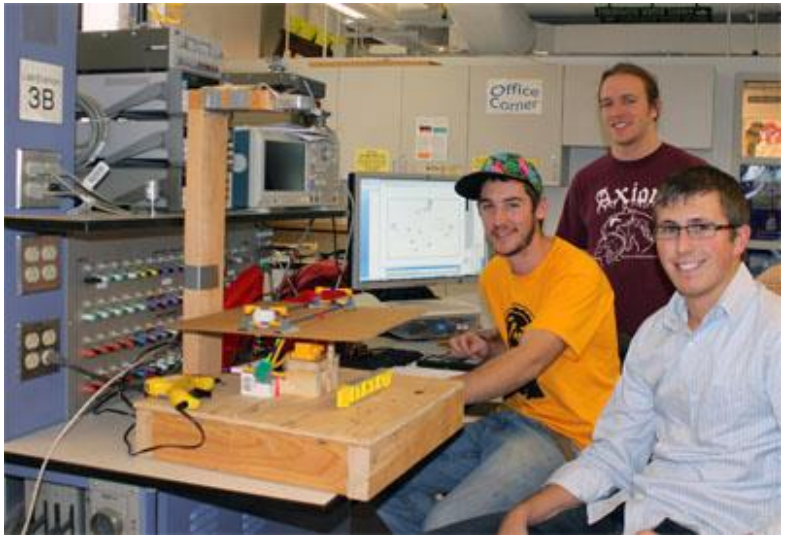
Where can it work?

- 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 successfull 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

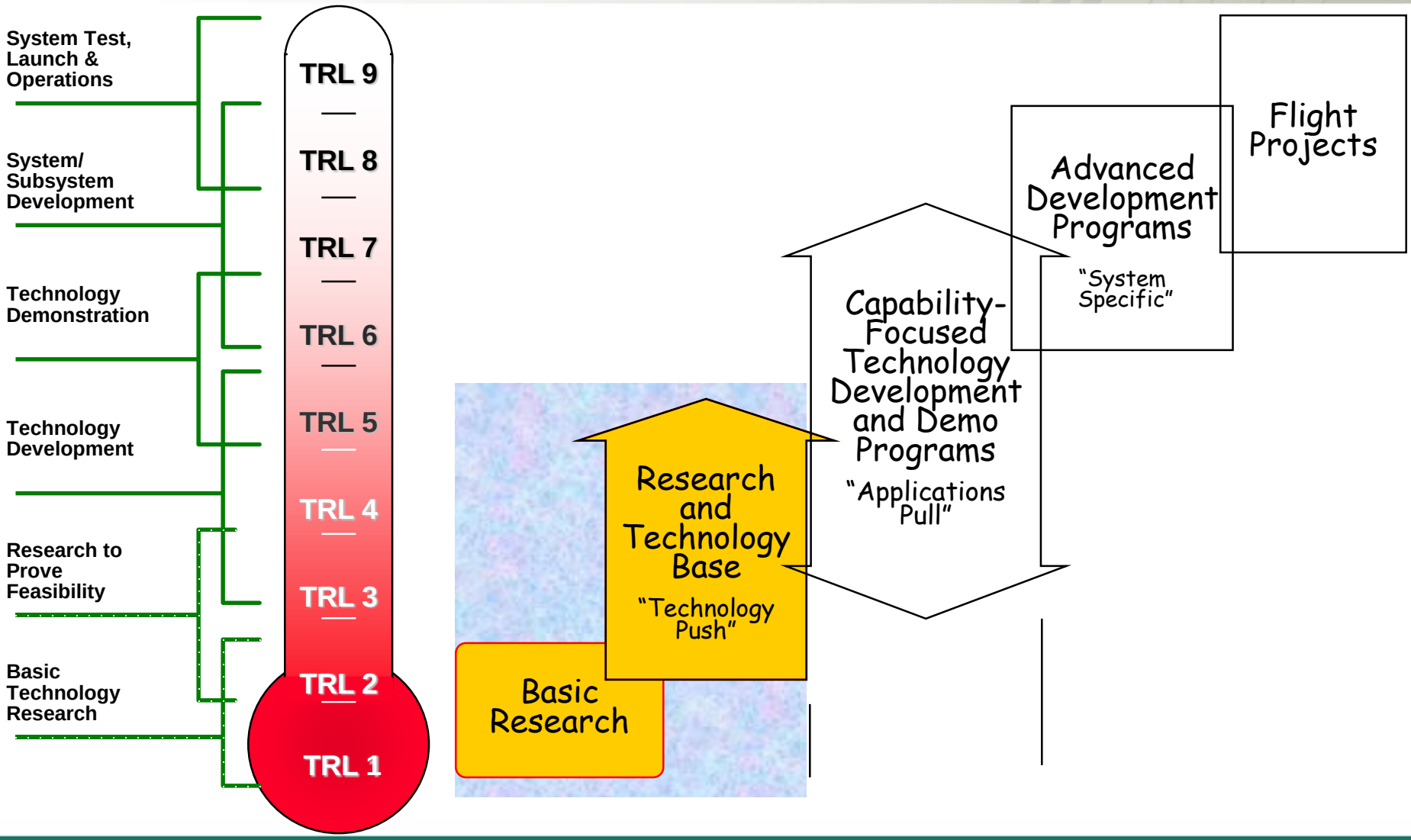
	PHARMACEUTICAL	SOFTWARE & IT	ENERGY
Time Required to Innovate	10-15 years	1-5 years	10-15 years
Capital Required to Innovate	Medium to High	Low to Medium	High
New Products Primarily Differentiated By	Function/Performance	Function/Performance	Cost
Actors Responsible for Innovation	Large Firms Reinvesting in R&D; Biotech startups, often VC & govt. funded; Govt. (NIH, NSF)	Dynamic Startups, often VC-funded; Large Firms Reinvesting in R&D	Various: Utilities, Oil & Gas Co.s, Power Tech Co.s, Startups, Govt.
Typical Industry Risk Tolerance	High	High	Low
Innovation Intensity	High	High	Low
Intellectual Property Rights	Strong	Modest	Modest

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

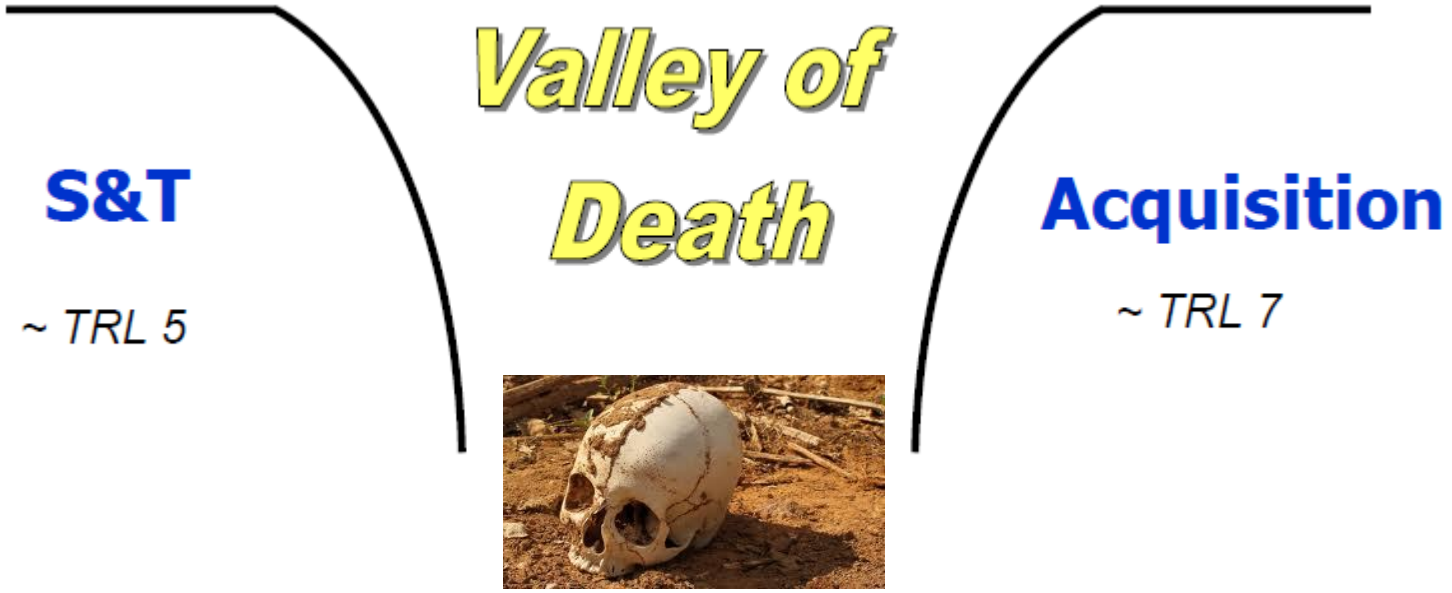
- The technology maturity can be described with the TRL
- Introduced by NASA in 80’s, then became popular across many industries

Technology Readiness Level areas during development



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 comercialization?

- **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

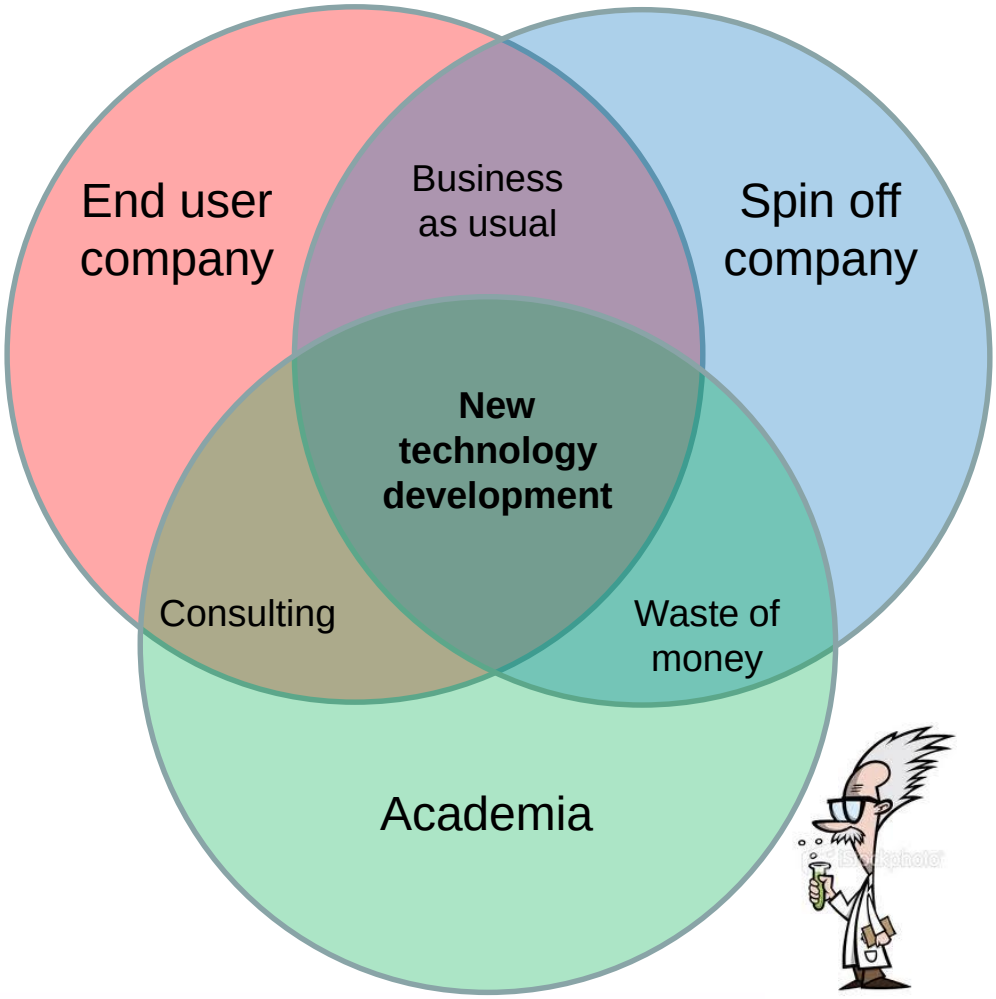
- **The commercial goal should be clear from the very beginning of an applied research project**
- **All the team should be aware that every decision has an impact on the economics**
- **Market research should be paralel to the project**
- **Marketing of results is not only to create a web page**
- **The 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

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

How to organize it?



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**

Promote culture of innovation

- **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 commited 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**

Our experience

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

› EC Systems team

› **2** technical teams

› **Certifications:** management and technical level

› **60+** employees

› Electronic, software, automation, diagnostic **engineers**

KAStrion PROJECT -

RELIABLE WIND TURBINE CONDITION MONITORING

2012 - 2015

Process params

Mech vibration

Electrical signals

Data Transfer Process

Embedded Condition Monitoring System

output data

configuration data

Remote Diagnostic Centre

› 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.

True Data Validator™

› VIBmonitor

1. › Based of True Data Validator™ technology
2. › Built-in diagnostic analyses
3. › Modular structure based on functional cards
4. › Internal memory. Historical data recording
5. › 24bit measurement resolution, sampling up to 100kHz
6. › Protection relay outputs. Integration with SCADA systems
7. › Access from any place in the world (Ethernet)

True Data Validator™

› VIBnavigator

› 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

ENERGOBALTIC

- Established in **1997**
- Part of **Lotos Group**
- Energobaltic Sp. z o.o. core bussines:
  - Exploitation of petroleum and natural gas from Baltic Sea
  - **3%** domestic consumption
  - Manufacturing and sales
    - LPG (mixture of propan-butan),
    - 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

Kompresor

›

Bariery EX

Moduł monitorowania
VIBmonitor

›

TCP/IP

System diagnostyczny
VIBnavigator EE

›

Usługa **VIBcare**

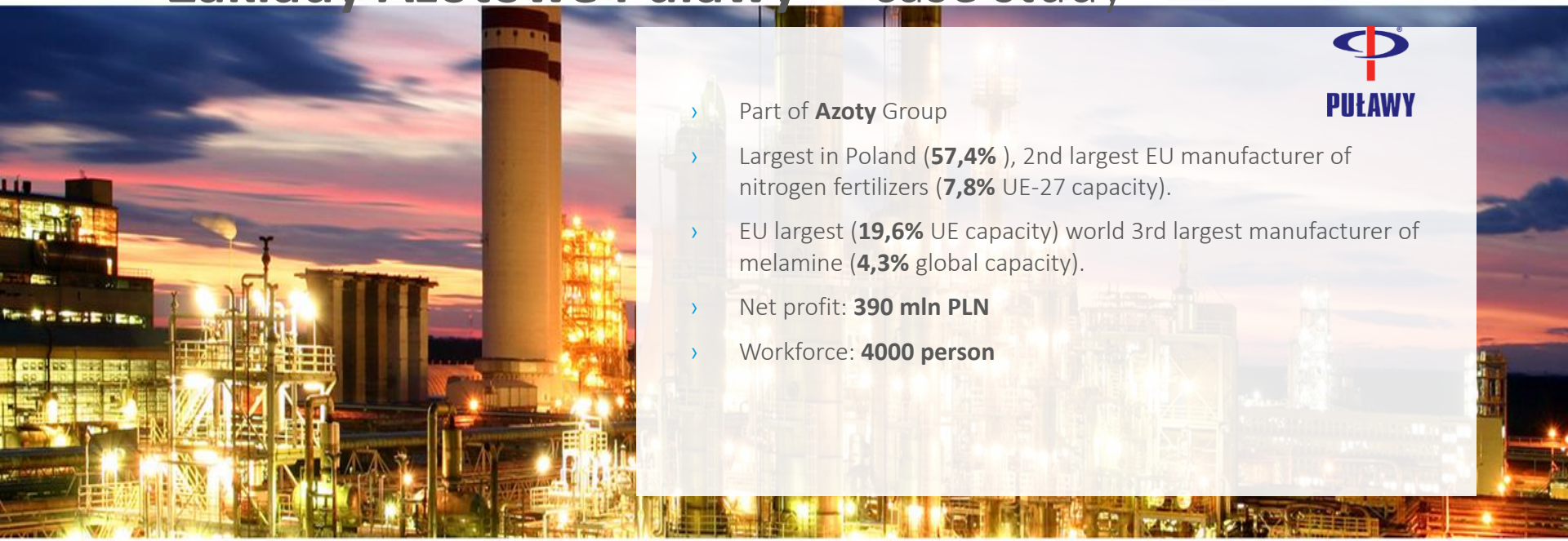
› **20** sensors (EX)

› **1** x ACQ card
› **1** x CPU card
› **5** x VIBRO card
› **1** x PV card

› Remote access ECS
› Remote access EB

› **24/7**

› Zakłady Azotowe Puławy – case study

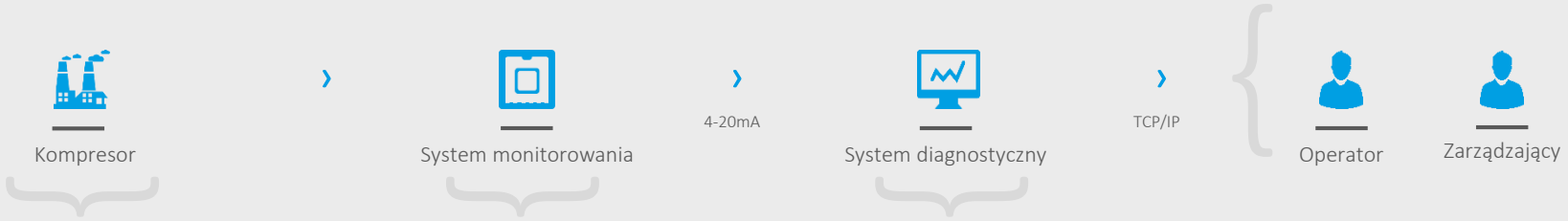


- Part of **Azoty** Group
- Largest in Poland (**57,4%**), 2nd largest EU manufacturer of nitrogen fertilizers (**7,8%** UE-27 capacity).
- EU largest (**19,6%** UE capacity) world 3rd largest manufacturer of melamine (**4,3%** global capacity).
- Net profit: **390 mln PLN**
- Workforce: **4000 person**

› **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.



- **12** vibration acc. EX
- **5** vibration disp. EX
- **4** barriers EX

- VIBtransmitter 1002D

- HMI: SCADA

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 enterpreneur, meet interesting people, solve their problems and make a lot of money**

One more thing …

6th ICTD The 6th International Congress on Technical Diagnostics 2016

5th CMMNO The 5th International Conference on Condition Monitoring of Machinery in Non-Stationary Operations

http://www.ictd2016.polsl.pl/

You are welcome!

12 – 16 September 2016

Gliwice, Poland – Silesian University of Technology

Thank you for your attention!