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HUNGARIAN INVESTMENT PROMOTION AGENCY

SPACE INDUSTRY IN HUNGARY

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HUNGARIAN INVESTMENT PROMOTION AGENCY

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HUNSPACE

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INTRODUCTION

HUNSPACE

In our small book you will find a short collection of Hungarian enterprises and institutions engaged more or less with the past and recent space industry in Europe, Russia and North America.

The start of Hungarian space research goes back to 1944 when Zoltan Bay constructed radar equipment with a supersensible detector to measure the Earth-Moon distance. His genius is immortalized giving name to the Hungarian (Fraunhofer type) institution network (Bay Z. Inst.). In the following decades the space research appeared at some Hungarian universities and in research institutes of the Hungarian Academy of Science. Their exclusive absolute partner was the Soviet Union which ruled the Intercosmos association where interplanetary science and stratosphere research provided an opportunity to participate in coordinated science works and also in development works of certain satellite components. The academic institutions developed excellent devices such as dosimeters, magnetometers and multiprocessor systems for the various missions. Power supply systems, telecommunication equipment (receivers, routers, amplifiers etc) were designed and developed mainly in the university sector.

In 1986 a new line started in space technology while the Soviet and the Hungarian Academies contracted in order to develop a large dimension furnace for single crystal growth in space. The task was allocated to Miskolc University. To fulfil the project the uni had to find industrial partners in its neighborhood. This working group of SMEs learned a lot about space requirements and about synergistic and efficient collaboration with each other. After five years under Russian collaboration came twelve years with NASA, where the project was extended. The Hungarian Universal Multizone Crystallizator was a breaking success. Skills and expertise in space technology improved tremendously forming ties with the experts in NASA Marshall Space Flight Center (MSFC).

The Hungarian engineers participated in the design, implementation work of Materials Science Research Facility, and one complex ISS device. Ten year participation in MSFC labs, one US patent and finally a solid business line between NASA and ADMATIS were the most important results of this cooperation. After NASA business mechanical and thermal satellite components on the highest technical readiness level under the highest product assurance made by ADMATIS recently for ESA – these really are industry type space activities in Hungary.

The learned necessity of collaboration was behind the establishment of the Hungarian Space Cluster in 2007. These two entities recognized the advantages in common actions became members of HUNSPACE. Since the kick off event there are now 32 members in the cluster, including SMEs as well as universities, research institutions and non profite entities. In HUNSPACE there are four member categories: primes, supplyers, researchers and additionals. The main actor is the prime who undertakes international space projects. All the others are subcontractors.

Some of the most important HUNSPACE parameter are summarized in table below:

2014	TURNOVER	EXPORT	EMPLOYEES
	28 520 kEuro	10 500 kEuro	702

ENGINEERS	PHDS	PATENTS	PROJECTS
310	70	14	18

The decades in stiff coordinated Intercosmos time ended in 1991. Since than the Hungarian space activity has been seeking the opportunity to be integrated into European space organization ESA. Our hopeful expectation was fulfilled in 2015 when Hungary achieved the regular ESA membership. The importance of HUNSPACE increased in 2015 when the two third of the PECS projects were won by HUNSPACE cluster members. To stabilize and extend our influence we are eager to find new partners.

Dear Reader! Please study the profiles of our cluster members and select the most appropriate one. We guarantee their reliability and quality. To find partners for the cluster members HUNSPACE acts as an agency, and from time to time has subprime or transfer role. HUNSPACE intends to be the engine of further space-industrial improvements in Hungary. We hope for effective cooperation with high growth potential in the heart of Europe. Our specialists are empowered to attain challenges to engender positive surprises through efficient development at the roots of inspiration. Open and committed to a broader collaboration.

Should you require any assistance in obtaining additional information don't hesitate to contact me,

Cordially,
Dr.h.c.prof.Pal Barczy
Chairman, HUNSPACE

INTRODUCTION

HUNGARIAN ASSOCIATION FOR GEOINFORMATION (HUNAGI)

This is a great pleasure to welcome the readers on behalf of the Hungarian Association for Geoinformation, which was established in 1994 as non-profit, interdisciplinary NGO with the primary goal to promote and facilitate the availability, access and usability of geographic information and related technologies, inevitable tools intensively used in Earth Observation's downstream services, ground truth and applications.

Today HUNAGI has 60 member organizations and institutions interested in collection, provision and use of spatial data covering the sectors academia, government, NGOs and industry. Although few of them are listed on the page of this booklet, it is anticipated, that many more innovative SME members and R+D labs will be potentially capable of contributing to the development of the space industry especially in Earth Observation. This is the reason why HUNAGI puts continuous emphasis on the awareness raising, encouraging and mobilizing its members and partners to be involved. Promising technologies, open source and open data are issues frequently addressed. Partner associations represent application domains such as surveying, mapping and remote sensing, space industry, transportation and logistics, e-content industry, agro-informatics and urban planning for the benefit of citizens and society.

Participation in EU projects and keeping international links are tools to strengthen the visibility of Hungarian achievements and disseminate and share knowledge associated with spatial data and related technologies, legislations, standards and best practices via conferences and workshops. Recently HUNAGI hosted the first workshops of the EU Location Framework program and the first ESA-EUROGI Copernicus Market-Pull Pack action in Budapest. Especially close links have been established in recent years with the European Umbrella Organisation for Geographic Information (EUROGI), the Global Spatial Data Infrastructure Association (GSDI). In the past decade HUNAGI has played an active role in the International Society of Digital Earth (ISDE), and since 2006 on behalf the GSDI Association in the Committee on Earth Observation Working Group of Information Systems and Services (CEOS WGISS), Plenary and Ministerial Meetings of the Group of Earth Observation (GEO) and the United Nations Working Group on Geographic Information UNSDI of UNGIWG as well. As SDIC (spatial data interest community) registered by the JRC Digital Earth and Reference Data, HUNAGI operates a web portal (www.hunagi.hu) with topics on events, call for opportunities, links, new products and services, publications, with special emphasis on earth observation and related topics (novel data collection, big data, citizens involvement, location-based services, social media). It is anticipated HUNAGI members will become more and more convinced by the opportunities offered by the ESA membership of Hungary and will be ready to become actors.

Dr. György Szabó

Secretary General of HUNAGI, member of the Hungarian Space Council

UPSTREAM
SPACE EQUIPMENT PRODUCTION

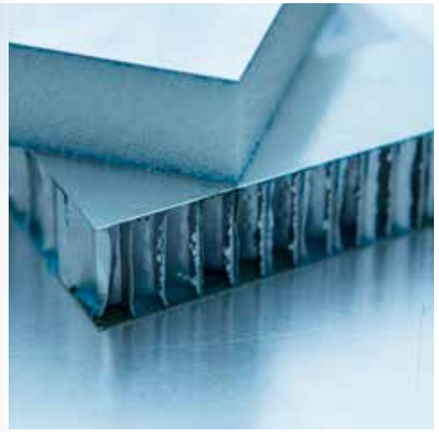
- ADMATIS LTD.
- BORSODI MŰHELY LTD.
- C3S LTD.
- CAD-TERV LTD.
- DINAS SPECIAL STEEL STRUCTURES LTD.
- ECON ENGINEERING LTD.
- EUROSZER-96 LTD.
- EURO CABLETECH LTD.
- FEINWERK TECHNIK LTD.
- GOODWILL TRADE LTD.
- GRAVITAS 2000 LTD.
- MATMOD LTD.
- MO-MECHANIKA LTD.
- QUALITATIVE PRODUCTION LTD.
- SUMPLANT LTD.
- TECHNOPLAST GROUP LTD.

UPSTREAM

ADMATIS

ADVANCED MATERIALS IN SPACE

ADDRESS	H-3535 Miskolc, Partos u. 16.
TELEPHONE	+36 46 898 154
WEBSITE	www.admatis.com
E-MAIL	tamas.barczy@admatis.com
GENERAL DIRECTOR	Tamás Bárczy
CONTACT	Tamás Bárczy
CONTACT E-MAIL	tamas.barczy@admatis.com
LANGUAGES	English
ESTABLISHED	2000



MAIN INTEREST

ADMATIS is an engineering company focusing on the space industry. The core competencies are around satellite – thermal – structural areas supported by materials science. The young ambitious team is able to manage build-to-spec projects from requirements engineering through design, analysis and manufacturing to verification with all the requested ESA documentation. Several flight hardware have been delivered to ESA and Airbus D&S in Sentinel-2 and CHEOPS programs such as passive thermal hardware, secondary structure elements and optical baffles.

ADMATIS was selected as one of a Hungarian prime inside HUNSPACE representing a wide range of capabilities served by several SMEs. As an interface between Hungarian SMEs/research institutes and customers ADMATIS is able to organize industrial consortia for various space requests.

Future interests are the extension of already existing competency with sandwich structures, MLI and MGSE.

COMPETENCIES

DESCRIPTION	ESA TECHNOLOGICAL DOMAIN
Optical barrel, baffles	TD16 - Optics
Structural design and verification	TD20 – Strustures & Pyrotechnics
Brackets, supports	
Kinematic mounts	
Debris shield concept	
Thermal analysis, thermal test	TD21 - Thermal
Radiator, thermal shield, diffuser screen	
Conversion coating, painting	TD24 – Materials & Processes
Metal foam, sandwich structure	
Cleanroom	
MGSE, trolley, large ring adapters	TD26 - Others
Stand alone flight hardware for R&D applications	

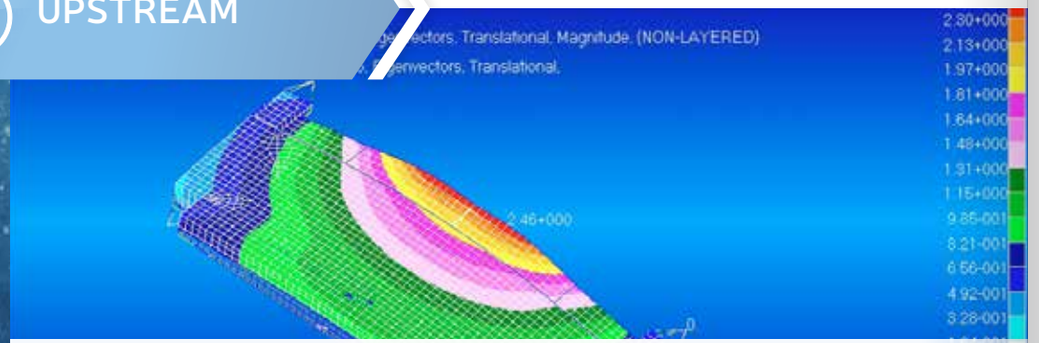
PROJECTS

Sentinel-2 MSI-MMTH Model C&D (TRL9)

This is a continuation of ADMATIS largest project. The first two sets of hardware have been delivered (see project no. 5) and other two set of equipment ordered by Airbus. Now ADMATIS is in the core team and responsible for all the 140 equipment as was the case some years before.

Reference: Jerome CRUBILHE, Airbus D&S, Toulouse, France.
Financed by ESA through Airbus D&S, (2016-2018)

UPSTREAM



ADMATIS

ADVANCED MATERIALS IN SPACE

CHEOPS CHaracterizing ExOPlanet Satellite (TRL8)

CHEOPS is the first ESA small mission project dedicated to the characterisation of exoplanet transits by means of ultrahigh precision photometry on bright stars. The industrial consortia is led by the University of Bern, and ADMATIS' responsibility is the design and manufacturing of payload **FPA and FEE radiators.**

Reference: Prof. Willy Benz, Physics Institute, Center for Space and Habitability, Bern, Switzerland.
Financed by ESA PECS, (2013-16)

Multifunctional Satellite Radiator (TRL3)

The project aims to develop a new class of **satellite radiators** for small- and medium size spacecrafts that combine the traditionally used honeycomb sandwich panels and integrally milled metal ones. The **Aluminium Foam Sandwich** (AFS) have a cellular core in the middle just like sandwich panels, which unlike honeycomb has isotropic properties and metallic bond with the skins similarly to bulk materials. A detailed feasibility study has been provided within the project.

Reference: Gregor Novak, project officer.
Financed by Horizon 2020 SME-INST, (2015)

MAF Satellite equipment development (TRL4)

This is the first Hungarian internal space industrial project supported by the EU through the Hungarian government. The ADMATIS headed consortia will develop new types of satellite thermal radiators, optical barrel, baffles, and ground segment equipment and conversion coatings for aluminium. Vibration test house development is also planned. The goal of the project is to create Hungarian capacity and capability for international space projects.

Reference: Adrián Bacsó, MAG ZRt, Hungary.
Financed by GOP 111-0078.
Financed by Új Széchenyi Terv (2012-2014)

Sentinel-2 MSI-MMTH (Multi-Spectral Instrument– Metallic Mechanical & Thermal Hardware) (TRL9)

Sentinel-2 twin satellites of 1225 kg and 3390 × 1630 × 2350 mm dimensions are parts of the GMES programme financed by the EU. Their payloads are Multi-Spectral Instruments aiming at continuous Earth Observation on 13 channels. The prime is Astrium SAS in Toulouse while the project itself integrates more than 30 other companies from 15 countries. ADMATIS was in charge of **design, manufacture** and **testing** of several pieces of **flight equipment** with all the corresponding ESA quality documentation. Two types of FEE and one harness **radiator,** thermal shields, telescope and calibration baffles, diffuser screens and harness **supports** have been provided with the support of 60 suppliers from 10 countries. In total, more than **2700 parts** have been delivered made mostly from different aluminium alloys and partly from titanium and stainless steel. All parts have a type of surface treatment: chromate conversion coating, black or white optical paints, passivation. Several procedures have been space **qualified** during this project such as **manufacturing,** surface treating, assembly, cleaning, and vibration testing.

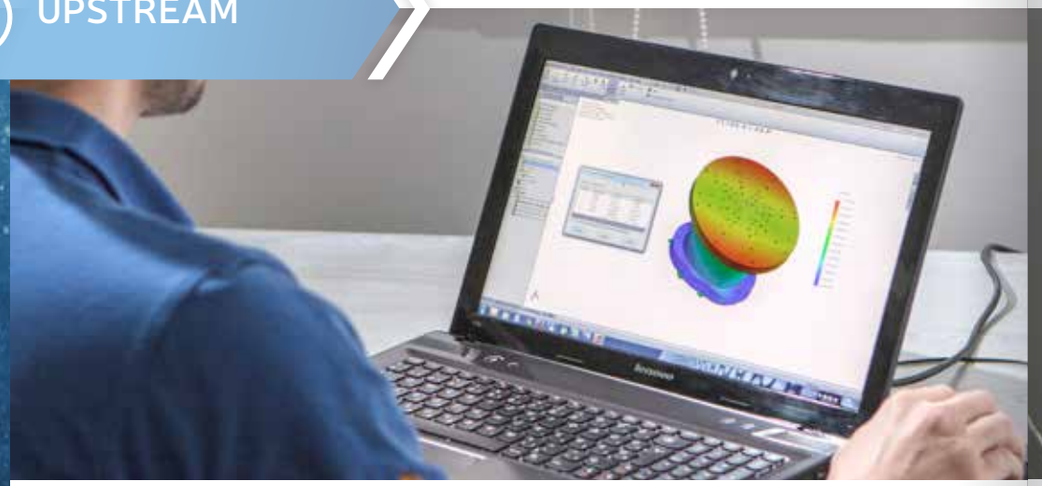
Reference: Vincent Cazaubiel, EADS/ASTRIUM SAS, Toulouse, France
Financed by ESA, (2009-13).

FOCUS Foam Casting and Utilization in Space (TRL9)

The aim of the project was to **study** the **foaming** process and foam stability in aqueous systems under microgravity in order to establish the development of metal foam production technology. The behaviour of our patented foam generator and the foam evolution was observed for 2 hours in microgravity **on board of the International Space Station (ISS).** ADMATIS had a twin role in this project because the science as Principal Investigator [PI] and engineering as **Hardware Developer** [HD] were under our responsibility. A standalone **experiment hardware** has been developed, manufactured and tested with pressurized chamber, gas tank, illumination system to support science requirements in ISS environmental conditions and safety specifications. The experiment launched successfully in 2010, and the mostly confidential results helped to defend the PhD thesis of one of our colleagues and was utilized by our metal foam technology.

Reference: Dr Sebastien Vincent-Bonnieu, ESA – ESTEC (2008-2011)
Financed by ESA, PECS 2008-2011
ID: SURE AO-019/PECS 98045, RI-TA-CT-2006-026069.

UPSTREAM



GENERAL INFORMATION

History: ADMATIS Ltd was founded by experts of Miskolc University as a spin-off R&D company in 2000 for development, manufacturing and trading of special vacuum furnaces for materials science and microgravity experiments. Proficiency in thermal control and the contribution to several scientific projects in materials science and microgravity research programmes paved the way to the space industry.

Well before ADMATIS, in 1986, a team of university scientists were given the challenge to design and prepare a special crystallizer for space flight in cooperation with Soviet **Interkosmos.** Later, **NASA** cooperation ensured the survival & extending of this know-how. The patented equipment spent several years in the US at Marshall Space Flight Center accompanied by Hungarian operators. Joint experiences convinced NASA to order the Universal Multizone Crystallizator **[UMC].** The successful procurement prepared the way for a special 'double-decker' version of the UMC. It was delivered in 2004 to the Space Science Lab in Marshall Space Flight Center at NASA, Huntsville. UMC handles operation temperatures up to **1500°C** keeping fluctuations below 0.2°C at a temperature **gradient > 100°C/cm** with 24 dynamically interrelated heating zones processing the required temperature profile over the sample. Our furnaces are characterized as special equipment with no moving parts with a high gradient temperature field to translate along the sample. Avoiding mechanical movement leads to being able to grow top quality crystals even in microgravity.

After ten years of active cooperation located in Miskolc University's lab, Admatis moved to its own building in 2011. In this new more comfortable environment, the Admatis team is ready to satisfy the various challenges of coming from the space industry.

Employees: 10

Turnover: 400,000 EUR

Location:
500 m² office, laboratory, workshop

Facilities:
- Cleanroom [30,000 m²]
- IR camera [flir]
- 3D portable measurement arm [faro]
- Electronic & pressure calibrator [beamex]

Software:
- Solidworks • Solidworks Simulation
- NASTRAN
- LabView
- ThermaCAM Researcher
- Alfresco

Patents:
- Apparatus and capsule for carrying out processes of directed crystallization, especially in cosmic space conditions, United States Patent, patent number: 5,429,341
- Apparatus and Procedure for shaped metalfoam products, HPO-228 124
- Multifunctional modular apparatus for crystal growth, HPO-225898

Quality assurance:
- AS /EN 9100 quality assurance certificate,
- NASA Trading Partner Identification Assignment (CCR and DUNS-TPIN)

ADMATIS
ADVANCED MATERIALS IN SPACE

Admatis
Advanced Materials In Space

UPSTREAM

BORSODI MŰHELY LTD.

ADDRESS	H-9027 Győr Juharfa u. 8.
TELEPHONE	+36 96 529 071
WEBSITE	www.borsodimuhely.hu
E-MAIL	info@borsodimuhely.hu
GENERAL DIRECTOR	László Borsodi Jr.
CONTACTS	Adrian Natea
CONTACT E-MAIL	info@borsodimuhely.hu
LANGUAGES	English, German
ESTABLISHED	1981

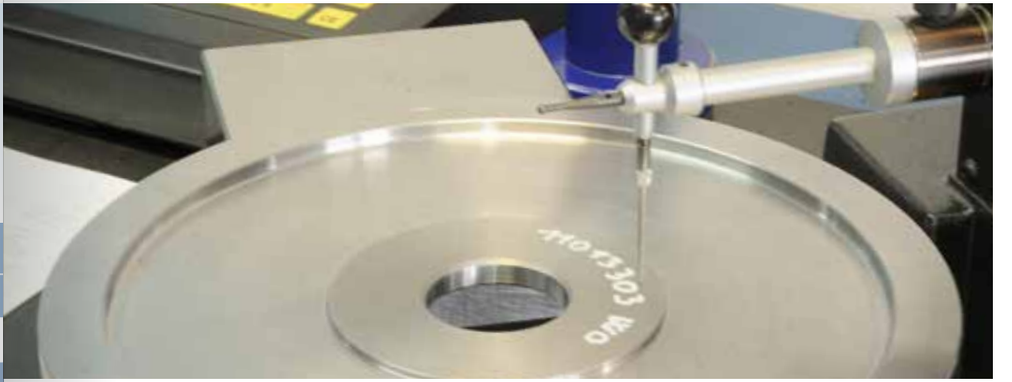
MAIN INTEREST

Our company carries its two most important values in its name. One of them is the family name "Borsodi", the trademark of our activities for two generations, which also reveals what we are especially proud of: we are a family business. The other one is the word "Műhely" ("Works") which embodies our work philosophy: "precisely, properly and honestly". These three characteristics define us to our employees as well as our partners. This philosophy has brought us where we are now. Over the last few decades, we have managed to develop into a medium-sized metallurgical firm that is proud of its past and is willing to work for its future, while serving its customers in the foodstuff, electronics, automotive and health industries at the highest possible quality in its present.

- Machining
- Heat treatment
- Measuring and calibration
- Repair and restoring of power spindles
- Repair and restoring of machine units
- Material testing and quality control
- Design and production of purpose-built machinery and production lines.

COMPETENCIES

TD26 Others
(Heat treatment and machining)



PROJECTS

Designing and manufacturing of Semi- and full automatic assembling and testing machines, with control and measuring stations for the electronics industry.

Reference: confidential

Designing and manufacturing of complex position control gauges for checking semi-machined cast parts for the automotive industry.

Reference: confidential

Designing and manufacturing of a 13 station manual assembly line with work-benches for the automotive sector.

Reference: confidential

Machining of different kinds of smaller size Ground Supporting Elements (GSE) and their parts for the AeroSpace sector.

Reference: confidential

Designing and building a production line with 16 stations for an international customer. The task was to assemble a complete electric motor of a cooler fan for several types of vehicles. This project had been the biggest one in the company's life so far.

Reference: confidential

GENERAL INFORMATION

History: 1981 Foundation of the company by László Borsodi.

1992 Start of purpose – built machine manufacturing.

1994 Start of long – term partnership with OPEL.

1999 Construction of a second production site in Kisújszállás.

2002 New site at the industrial park.

2004 Foundation of a production site in Szombathely.

2008 Further extended our site in Győr and established a high-technology heat treatment plant that was later extended with a laboratory suitable for complex material control.

2008 Joint development programme with Széchenyi István University in Győr-new research and development division-modern workplaces for 24 design engineers.

2014 Changing generations; New managing directors.

UPSTREAM

BORSODI MŰHELY LTD.

Borsodi Műhely Ltd.- Győr

Borsodi Műhely Ltd. - Kisújszállás

Borsodi Fémmegmunkáló Ltd. - Szombathely

Facilities:

MACHINING:
Band-saw machines. Universal turning, -milling, -grinding machines. Coordinate boring machine. CNC milling centres: 3axis, 3+2axis, simultaneous 5axis. CNC lathes, CNC flat/plain grinding machines. CNC diameter grinding machines. EDM machines: Start bore drilling, Wire cut, Die-sinking machines. CNC long bore grinding machines. Coordinate grinding machine. Optical profile grinding machine,

MEASURING:
3D CMM Coordinate Measuring Machines. 2D Highness measuring machine. Optical projector. Measuring microscope. Contourographe. Surface roughness tester. Handy measuring tools: tapped- cylindrical- ring go/no-go gauges. Length etalons, Vernier calipers, Micrometers, Indicator hours. Run-out pad. Accredited (ISO17025) length measuring equipment. Torque wrench diagnostic unit.

HEAT TREATMENT:
Vacuum furnace. Quench Tempering furnaces. Universal heat treatment furnace, Nitriding furnace. Industrial washing machine. Plus smaller secondary equipment.

Software:

MS.Windows, MS.Office, DSS SolidWorks & DraftSight, AUTODESK AutoCAD, CATIA, DELCAM PowerMill, PowerShape, PowerInspect, ORACLE JD Edwards EnterpriseONE ERP system.

Patents: NO

Quality assurance:

AS9100C

ISO9001

ISO14001

ISO17025

UPSTREAM

C3S ELECTRONICS DEVELOPMENT LLC.

COMPLEX SYSTEMS & SMALL SATELLITES

ADDRESS	H-2049 Diósd, Erzsébet u. 6.
TELEPHONE	+36 212 523 523
WEBSITE	c3s.hu
E-MAIL	info@c3s.hu
GENERAL DIRECTOR	Gyula Horváth
CONTACTS	Gábor Marosy, Gyula Horváth
CONTACT E-MAIL	gabor.marosy@c3s.hu, gyula.horvath@c3s.hu
LANGUAGES	English, German
ESTABLISHED	2012

MAIN INTEREST

Field of interest in developing space technology (future ambition):

Electronics

- CubeSat technologies
- SmallSat technologies
- EPS and OBDH for small satellite and payloads

Ground Support Equipment

- Battery charger
- Battery tester and emulator
- Solar array tester and emulator
- Programmable load
- Satellite EPS tester and power balance analyzer

Fields of activity

- Embedded electronics
- Power electronics
- Control electronics
- Mechanical items/components for CubeSats
- Ground Support Equipment
- Ground Segment related software solutions
- Engineering Services

COMPETENCIES

TD 1 On-Board Data Systems

1.1 Payload Data Processing

1.2 On Board Data Management

1.3 Microelectronics for digital and analogue applications

TD 2 Space System Software

2.2 Space Segment Software

2.3 Ground Segment Software

TD 3 Spacecraft Electrical Power

3.1 Power system architecture

3.2 Power generation technologies

3.3 Energy storage technologies

3.4 Power conditioning and distribution

TD 26 Others

26.1 Ground Support Equipment

PROJECTS

The company developed the hardware and software for the Hand-held Satellite Receiver for Masat-1/CubeSats
(Clients: radio amateurs, general users, etc.)

- Better sensitivity than the TS-2000 and FT-897D radios (-133 dBm)
- Dedicated single-chip receiver with external LNA
- Firmware update via USB

UPSTREAM

C3S ELECTRONICS DEVELOPMENT LLC.

- SMA / Measuring tape antenna (50 Ohm)
- Integrated Magnetometer and Accelerometer
- Delivered with server-client software

3U/6U CubeSat Platform Technology Development (Financed by ESA PECS)

- Mechanical items
- Integration Jig
- Shaker interface/adapter

In 2013 C3S LLC developed electrical power system, telemetry & diagnostics system and control unit for industrial laser marker units (for up to 60W laser source)
In the same year the company designed a hand-held satellite receiver which can be used for receiving CubeSats, including Masat-1.

GENERAL INFORMATION

History: The C3S Electronic Development LLC was established in 2012 by four developers of the first Hungarian satellite, Masat-1. The company provides engineering services in the field of electrical engineering, and it offers design and manufacturing services in the field of complex embedded systems. The company became a member of the Hungarian Space Cluster in 2012, and it has cooperated with the Space Technology and Science Group (STSG) since 2013.

Turnover: 300,000 EUR

Patents: none

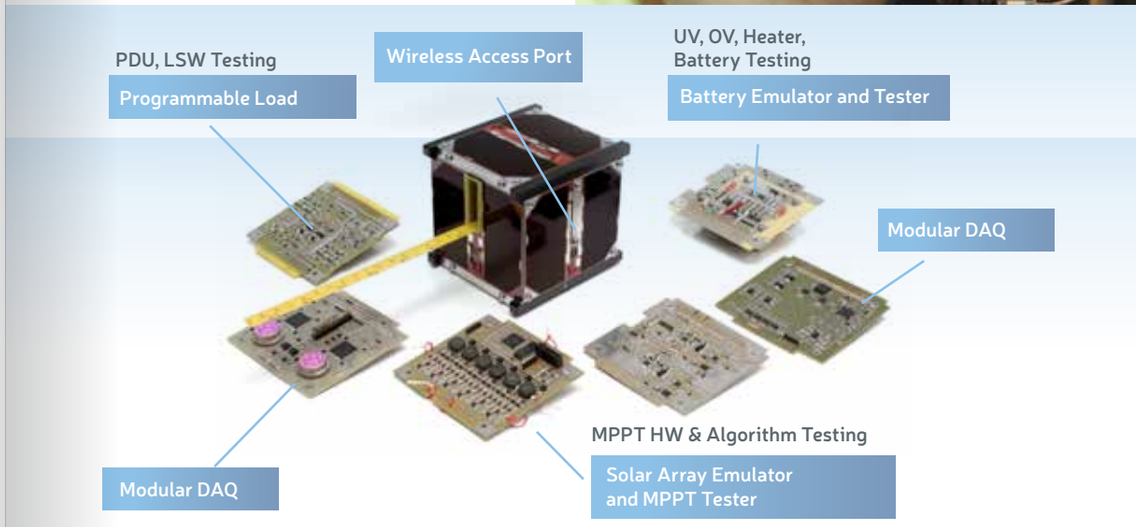
Staff: 10

Location: Erzsébet utca 6. H-2049 Diósd HUNGARY

Facilities: Embedded hardver measurement tools

Softwares: Altium Designer, Atlassian Tools (complete), Atollic TrueStudio

COMPLEX SYSTEMS & SMALL SATELLITES



UPSTREAM

CAD-TERV LTD.

Cadterv
plan with us

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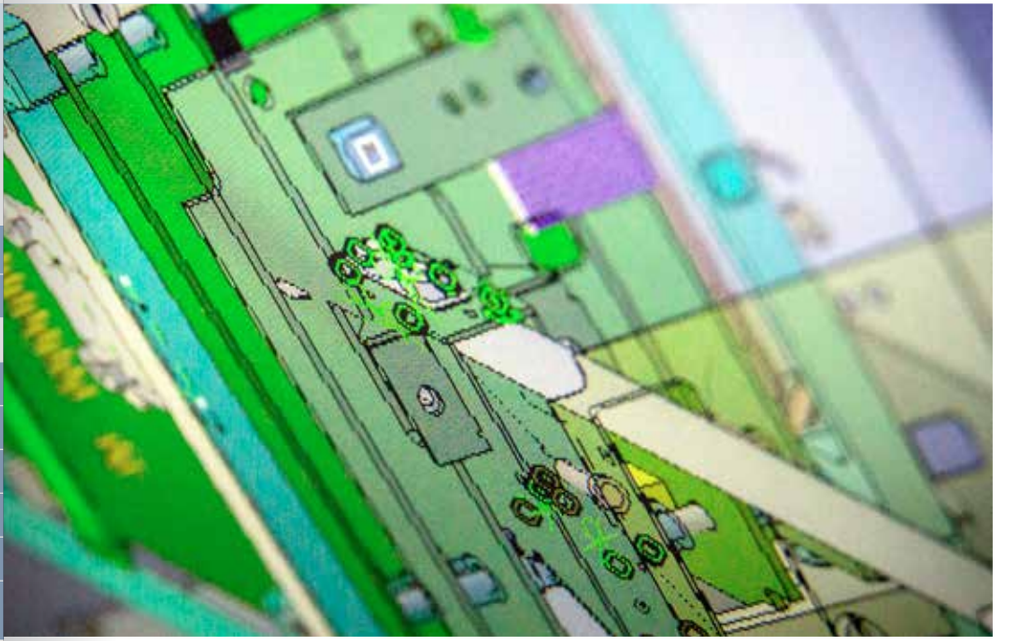
TELEPHONE	+36 1 461 9000
WEBSITE	www.cadterv.hu/en
E-MAIL	info@cadterv.hu
GENERAL DIRECTOR	István Nadj
CONTACTS	-
CONTACT E-MAIL	info@cadterv.hu
LANGUAGES	English, German
ESTABLISHED	1997



MAIN INTEREST

Today the more than 100 year-old aviation and armaments industry which as old as mankind was always characterized by constant innovation and improvement attempts. conquering space just quickened the pace. Although nobody can predict the future it is certain innovation pace will not slow down and aims are growing bigger.

CAD-Terv group is part of that minority of Hungarian firms that take an effective role in such developments. Just think of the success of the first Hungarian satellite, Masat-1.

CAD-Terv Engineering Ltd. has been offering professional services in the domestic CAD/CAM/CAE market since 1997. Thanks to the constant development and growth throughout recent years our portfolio, built on the close collaboration of four divisions, covers the complete development and design process.

Engineering services

Engineering of CAD-Terv group first met space industry and its challenges in 2008 with the Masat-1 project. Since then we have taken part in several space industry development projects and we also succeeded in engaging of the armaments industry developments.

We are a team of engineers with remarkable mechanical engineering experience and renowned references. We co-operate with various industry representatives on mechanical and product designing, single-purpose machine and appliance designing fields. In pursuance of our projects we can join effectively with our designing divisions in the designing work. The success of our solutions and the key of our continuous growth resides in our expertness, diversibility, flexibility, passionateness and preciseness. We support our partner from the rise of the idea through conception development to standardized production regardless if these are complex product developments or smaller, simpler projects.

Main industries in which we have a decisive role and extensive mechanical engineering and product design experience:

- Automotive industry and shipping: logistics and production engineering, designing vehicle parts
- Industrial instruments and devices: production engineering, designing component and single-purpose machine, designing appliance
- Aviation, space exploration and armaments industry: manufacturer devices and mechanisms, designing satellite
- Consumer goods, household products: mechanical engineering and designing of household appliances

UPSTREAM

CAD-TERV LTD.

Cadterv
plan with us

3DEXPERIENCE solutions

Using our vast experience gained from engineering projects, we created the 3DEXPERIENCE solutions group in 2003 in order to offer customized industrial solutions for our clients' typical processes, where we combine the world leading Dassault Systems solutions with our own developments.

Simulation solutions

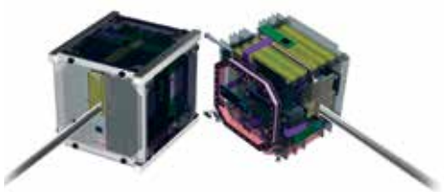
We also provide solutions in this specific industry that can be integrated by our partners into their own system to cover the whole developing process. In this field, due to the exceedingly high production fees, the precise engineering work and the related simulational inspections are surpassingly important.

Our solutions are built on the Dassault Systems SIMULIA (Abaqus) product portfolio to ensure that we can cover the requirements of high level users and new clients as well.

ECAD/MCAD solutions

Our ECAD/MCAD group is specialized on the market leading PCB design products from Mentor Graphics while also offering an answer to the communication problem that has exsited for many years by seamlessly bridging the electronical and mechanical design environments. Our solution provides a two-way communication platform without any data loss between these two engineering fields.

PROJECTS



Masat-1 project

Construction of Masat-1 satellite was initiated at the Budapest University of Technology by a group of committed students and PhD graduates in 2007; the project also found supporters among the CAD experts of CAD-Terv Engineering Ltd. Our engineering services, methods and software allowed the construction of the structural elements and design for the special antenna folding solution (with extra care for assembling/integration analysis) allowing the plan of this small satellite to be brought into existence. Along the constructional designing we had tasks with truss, the antenna module and the electronic units build in. The construction met the requirements in terrestrial and in space conditions as well. Instead of the originally set 3 months lifetime spending more than 1000 days in space the satellite had been communicating and provided information and photos for the earth unit.

Reference: C3S Ltd, Gyula Horváth

Satellite platform project

Making use of our Masat-1 experiences we began the mechanical design of the 3U sized small satellite-platform that can also host and serve a considerable amount of payload. Despite its small size the modular buildup machine consists of several thousands of mechanical components. Among the biggest challenges we also developed the opening mechanisms of Earth-orbiting solar cells and antennas.

The communication module as well as other cards are fitted in the rail system with retainer units (Card-Lok). Taking thermal and radiation protection into consideration this unit was also provided with a dedicated inner casing.

Reference: C3S Ltd, Gyula Horváth

Airbus project

For aircraft manufacturing efficiency improvements, AIRBUS redesigned its methods, applying them to new assembly buildings in terms of automation and multi-functionality and with increasing priority. The new assembly hall needed logistics equipment that can each receive a front and rear body unit of 3xx Series aircraft families. The minimized time-free specification for assembly accessories modifications following the requirements may be carried out by a single workman. The goal is a half-fuselage assembly within 11 hours. This requires all necessary components to be placed on the hall logistics service podium properly. The assembly and the preparation of components must be feasible simultaneously without hindrance.

Value-added

The design had to use CATIA V5 with respect to Airbus specifications, standards and construction regulations. The first phase of the project included preliminary designs and CAE 3D simulations with close cooperation with the logistics department. Fibre engineers worked on this one year project to create the final 3D models and the related documentation.

The extensive preparation and the virtual analysis produced the expected outcome since after installation, the multi-ton components were assembled without problems. The equipment installed in the assembly hall serves the Airbus manufacturing aims as planned, the 3xx series fuselage assembly.

Reference: Confidential

GENERAL INFORMATION

History: CAD-Terv Engineering Ltd has been offering professional services in the domestic CAD/CAM/CAE market since 1997.

Employees: 32
Turnover: 900,000,000 HUF
Location, area: Budapest
Software: CATIA
Quality assurance: ISO 9001:2008

UPSTREAM

DINAS

SPECIAL STEEL STRUCTURES

ADDRESS	H-3778 Varbó, Széldomb 0117/38
TELEPHONE	+36 46 401004
WEBSITE	www.dinas.hu
E-MAIL	dinas@dinas.t-online.hu
GENERAL DIRECTOR	Janos Bicsánszky
LANGUAGES	English
ESTABLISHED	1996

MAIN INTEREST

The highlighted activity is not serial work but designing, manufacturing and assembling of unique large scale welded, milled steel structures & components in only a few pieces.

Main activity fields are: machine industry (production of special steel structures),

30%, then production of instruments for the energy industry, instruments for the cement industry, food industry and Mechanical Ground Segment Equipment for the space industry.

Our recent field is the space industry where various ground segment equipment (GSE), components were manufactured. Our specialities are large diameter adapter rings, expander heads, special workshop vehicles and containers.

The certified aluminium welding production technology is highly adaptable in order to expand our product scale and market share.

Further one-of-a-kind-products:

- large diameter adapter rings
- expander heads
- special vehicles & containers
- elevators
- cranes
- bars
- industry level furnaces
- chimneys
- vessels
- bearing-houses

COMPETENCIES

in ESA ESTMP Technical Domains:
20.1; 26.1(MGSE)

PROJECTS

MAF Satellite equipment development (TRL4)

This is the first Hungarian internal space industrial project supported by EU through the Hungarian government. The ADMATIS headed consortia will develop new types of satellite thermal radiators, optical barrel, baffles, ground segment equipment and conversion coatings for aluminium. Vibration test house development is also planned. The goal of the project is to create a Hungarian capacity and ability for international space projects. Our special products are large diameter adapter rings for satellite vibration tests. Client: Admatis Ltd.

Reference: Tamás Bárczy, ADMATIS
Financed by GOP 111-0078, 2012-14.

Sentinel-2 MSI-MMTH (Multi-Spectral Instrument– Metallic Mechanical & Thermal Hardware) (TRL9)

Sentinel-2 twin satellites of 1225 kg and 3390 × 1630 × 2350 mm in size are parts of the GMES programme financed by the EU. Their payloads are Multi-Spectral Instruments targeting continuous Earth Observation in 13 channels. The prime is Astrium SAS in Toulouse while the project itself integrates more than 30 other companies from 15 countries. ADMATIS is in charge of **design, manufacture** and **testing** of various **flight equipment** with all the corresponding ESA quality documentation. Two types of FEE and single harness **radiators,** thermal shields, telescope and calibration **baffles,** diffuser screens and harness **supports** have been provided with the support of 60 suppliers from 10 countries. In total, more than

UPSTREAM

DINAS

SPECIAL STEEL STRUCTURES

2 700 parts have been delivered, made mostly from different kinds of aluminium alloys and partly from titanium and stainless steel. Every part has a type of surface treatment: chromate conversion coating, black or white optical paints, passivation. Several procedures have been **certified** during this project such as **manufacturing,** surface treating, assembling, cleaning, and vibration testing.

Reference: Vincent Cazaubiel, EADS/ASTRIUM SAS, Toulouse, France.
Financed by ESA, 2009-13.

GENERAL INFORMATION

History: The DINAS company was established by experienced experts as Industrial Service Deposit in 1990, then transformed into a limited liability enterprise in 1996. The profile was kept and developed to design and machine large scale steel and aluminium structures.

Our products are elevators, cranes, bars, industry level furnaces, chimneys, vessels and bearing houses, delivered in well designed and implemented state with the highest level quality assurance and official authorization.

Facilities:
DINAS Ltd's main machines, instruments:

- *CNC horizontal milling machine*
  X max: 11000 mm, Y max: 1790 mm, Z max: 600+800 mm
- *CNC milling machines*
  X max: 3300 mm, Y max: 900 mm, Z max: 800 mm
- *CNC drilling machine carousel*
  6000x2000 mm
- *Carousel drilling machines*
  max. diameter: 5200mm, max. height: 2000mm
- *Drilling machines*
  1000/1000; 600/1500; 800/3000 mm
- *Wing boring machine*
  100/3000 mm
- *CNC cutting machine max.*
  300 mm thickness
- *CNC plasma cutting machine max.*
  50 mm thickness
- *CNC water jet cutting machine*
  1-60 mm, metals, polymers, ceramics, marvel, titanium.
- *CNC laser cutting machine*
  2000 x 6000 mm table
- *Sheet and profile rolling machines max.*
  2000 mm width / 35 mm thickness
- *CNC scissor*
  6/ 3000 mm
- *Welding machines*
  - MIG Aluminium welding (thickness: 3 – 40 mm)
  - SAW (submerged arc welding) - 1000 A - automatic
  - Water-cooled MAG 500 A machines, impulse MIG machine
  - Automatic welding tractor
- Edge Grinding machine

Employees: 53
Turnover: 2,650,000 EUR
Location: 5,300 m² office and workshop

UPSTREAM

ECON ENGINEERING LTD.

ADDRESS	H-2051 Biatorbágy, Ritsman Pál u. 42.
OFFICE	H-1116 Budapest, Kondorosi u. 3.
TELEPHONE	+36 1 279 0320
WEBSITE	www.econengineering.com
E-MAIL	info@econengineering.com
GENERAL DIRECTOR	Mr. Gabor Kiglics
CONTACTS	Mr. Gabor Kiglics
CONTACT E-MAIL	kiglics@econengineering.com
LANGUAGES	English, German
ESTABLISHED	2002

MAIN INTEREST

eCon Engineering Ltd. is an Hungarian engineering office, in the group work with ca. 50 engineers.

With more than 20 years' experience in finite element and boundary element methods and machine building competences, we offer our expertise in solving various problems ranging from simple analyses to complex assignments integrated into development projects.

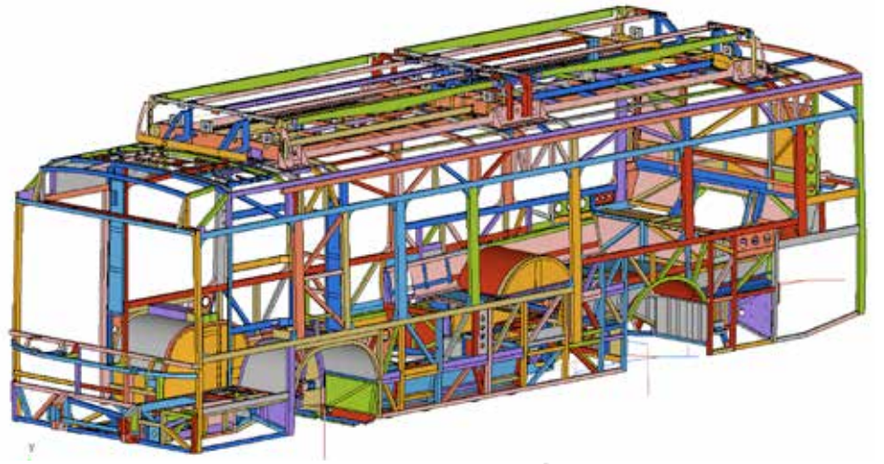
Special purpose machine design and building:

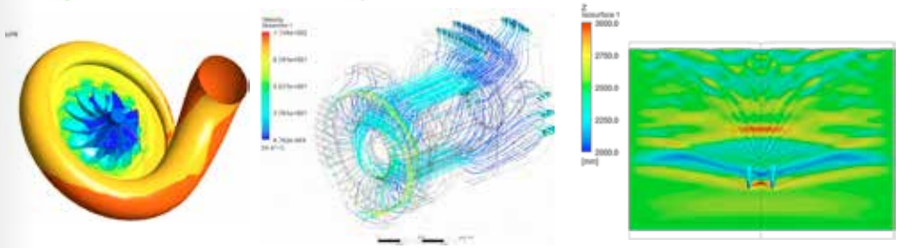
The eCon Engineering Ltd. provide special purpose machines and robot cells for their customers in the automotive and electronic industries according to them special requirement. These projects involve the whole process from developing the technology through design, produce, installation, and project leading.

Finite Element Computations:

Stress calculations – We are able to undertake a wide spectrum of projects from simple stress calculations to intricate geometry and material non-linear tasks. Based on our customers' experience and our own expertise in analyses, we are able to determine stress- and deformation parameters of structures from mechatronic scale to robust structures. We are also able to estimate life time estimation, to propose cost-efficient production technology for machinery too. The above mentioned calculations reflect only a segment of the broad palette of calculation procedures:

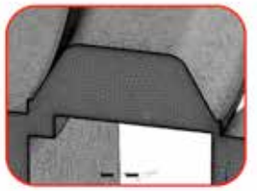
- Stress analyses (linear, non-linear)
- Analyses of steel, aluminium, magnesium, plastic, composite and non-metallic materials
- Fatigue analyses
- Optimization
- Crash simulations
- Analyses of composite layered and sandwiches structures
- Software programming (ANSYS, MATLab, Simulink etc.)
- System simulations – 1D simulations
- Validation of physical experiments
- Seismicity, earthquake resistance simulations
- Pump & valves simulations
- Pressure vessels analyses
- Piping Systems analyses





UPSTREAM

ECON ENGINEERING LTD.



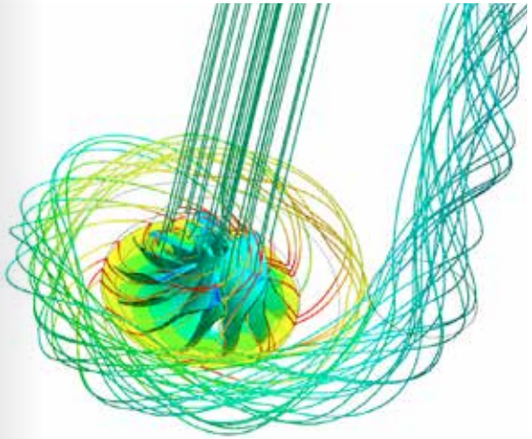
Dynamic capabilities – Our Company offers complete solutions by processing all areas from the planning and conception, development, design and testing up to the acceptance and approval of systems in the vehicles field. We claim to process our clients' projects with the highest level of expertise. We are ready with a complete virtual prototyping environment to, calculate and optimize the dynamics of vehicles for building and testing vehicles. The scope of our experience in vehicle design covers the following fields:

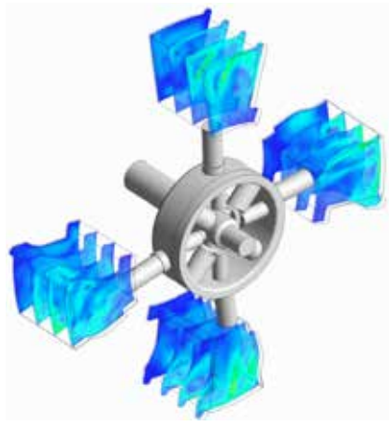
- Dynamic simulation
- Vehicle's stability analysis, determining derailment, safety clearance, and critical speed
- Hybrid dynamic model with flexible car body, dynamic loads evaluation, Eigen mode calculation
- Longitudinal dynamics, traction, braking analysis, curving
- Suspension design and optimization
- Wheel set design and optimization (including independent wheel set)
- Coupler design
- Passenger comfort
- Acoustic analysis, noise reduction
- Model verification
- Evaluation and interpretation of results, improvement of the design, documentation
- Visualization, rendered animation of vehicle movement and beyond

Other calculations, calculation methods

– this area includes electromagnetic, fluid mechanics tests, and such related calculation procedures that can be utilized to model and analyse very complicated physical phenomena:

- Electromagnetic analyses (PSD, generators, electric motors and rotary engines):
- Fluid mechanics analyses:
- Mixing
- Cavitation
- Laminar and turbulent flow
- Flows of different media etc.





- Plastic technology calculations:
- Die-casting of various materials
- Optimizing of compozite fiber-reinforced structures
- Injection molding simulation

Technical know-how and field of specialization – TD's:

TD13.2, TD13.3, TD15, TD18.1, TD19.4, TD20.1, TD20.9, TD20.10, TD21.1, TD21.3, TD21.5,

TD26.1 (Finite Element Methods)

PROJECTS

Full composite autobus complete finite element computations – feasibility study, stress calculations, material defining, optimization of composite layers, stress- and weight minimizing. (2011 to 2014).

Reference: evopro Ltd. Budapest, Hungary, CEO: Mr. Csaba MÉSZÁROS, Technical Readiness Level 1 (TRL1)

GENERAL INFORMATION

History: eCon Engineering is a member of the following clusters and association:

- Hungarian Autobus Cluster – innovative cluster
- Hungarian Aerospace Cluster
- Hungarian Space Cluster
- Hunarian Railway Cluster
- Hungarian-German Busines Association
- Hungarian Automotive Association

Employees: 45

Turnover: 7,000,000 EUR

Location: 440 sqm – office; 330 sqm – workshop

Software: ANSA, HyperWorks, ANSYS, LS-Dyna, Optistruct, AMESIM, NASTRAN, Abaqus, CFX, FEMFAT, MOLDEX3D

Quality assurance: AS9100 rev. B

UPSTREAM

EUROSZER-96

ADDRESS	H-3518 Miskolc, Állomás tér 1-3.
TELEPHONE	+36 46 780 801
WEBSITE	www.euroszer-96.hu
E-MAIL	euroszer-96@euroszer-96.hu
GENERAL DIRECTOR	Tamás Dudás
CONTACT	Tamás Dudás
CONTACT E-MAIL	euroszer-96@euroszer-96.hu
LANGUAGES	English
ESTABLISHED	1996

MAIN INTEREST

EUROSZER-96 Ltd. is a private engineering and manufacturing company. The specialist field is precision manufacturing of critical components (tools, tool parts, jigs etc) for the automotive industry. A wide range of metal working CNC and EDM machines are utilised to ensure precise machining of high strength steels and other special materials. These complex shapes, fine surface finish and tight manufacturing tolerances require special tooling and programming skills.

We develop tooling and supporting technologies for advanced materials, then utilize the resulting technologies for the automotive industry, especially for mechanical controlling devices.

COMPETENCIES

TD 20.1 Structural design and verification methods and tools

PROJECTS

Machining thermal hardware for Multi Spectral Instrument (satellite payload, Sentinel-2.) TRL9.

EUROSZER was qualified as a milling subcontractor of supplier ADMATIS for the Sentinel-2 satellite in 2011. The company has manufactured small harness supports as well as medium size brackets and radiators from high strength aluminium alloy.

Reference: Tamás Bárczy, ADMATIS Ltd, 2011-13

CNC machine redesign and conversion.

Reference: confidential

Design and production adapter sets for a large-scale vibrator.

Reference: confidential

GENERAL INFORMATION

EUROSZER-96 was established in 1996, by technologists, in order to exploit the market possibility for factory assembly in the neighbouring metallurgical and machine industry. Since 2005, the collapse of steel metallurgy in Miskolc, EUROSZER-96 has developed a new profile and focussed increasingly on partners in the hand tool and the automotive industry.

The recession and changes in ownership led it to other manufacturing areas, in particular to the precision manufacturing of special tools/parts with related additional special services such as design development, technology consulting, modification or redesign of tools and machines.

Its recent special field is to design and produce measuring and calibration devices and special tools.

In 2012, EUROSZER-96 moved to the Miskolc suburb of Pereces, where it purchased and developed its new production hall.

Main products

- Assembling jigs
- Measuring devices
- Hydro pneumatic pressing machine
- Electronic PCB punching tools
- Pressing tools

The tools and equipment we implement are used in various areas like manufacturing, positioning, clamping, verification and measurement.

Employees: 5

Turnover: 300,000 EUR

Location: 400m2

Facilities:

CNC milling devices
machining centre
lathe machines
grinding machines
EDM apparatus

Quality assurance:

ISO 9001/2008 since 2011

UPSTREAM

EURO CABLETECHNICS LTD.

ADDRESS	H-2030 Érd, Velencei u. 4.
TELEPHONE	+36 23 360 084
WEBSITE	www.ectc.hu
E-MAIL	karoly.horvath@eurocabletechnics.hu
GENERAL DIRECTOR	Károly Horváth
CONTACT	+36 23 360 084
CONTACT E-MAIL	karoly.horvath@eurocabletechnics.hu
LANGUAGES	English
ESTABLISHED	2011

MAIN INTEREST

The main activity is confectional cable production. Uniqual quality, not serial work. High variance prototypes and unical designs. Hand made high complexity cables and harnesses. Specialised services for research communities and developers - should it be only the development of a single cable.

COMPETENCIES

TD3, Spacecraft Electrical Power

PROJECTS

PULI

This is a competitive project to reach the surface of the Moon by a surveyor lander sponzored by Google Lunar X-PRIZE (GLXP). One Hungarian team led by Tibor Pacher started on this world wide competition and developed the PULI moon stracker (robotic dog). Euro Cabletechnics supported the team by assembled harnesses. (2014) Reference: PULI Space Technologies.

Standard participation with harnesses in innovative development projects of science laboratories of universities and research institutions. .

GENERAL INFORMATION

Employees: 17

Turnover: 150,000,000 HUF

Location: 400 m²

Facilities: Cable processing machines

Quality assurance: ISO-9001-2000

UPSTREAM

FEINWERK-TECHNIK

FEINWERK-TECHNIK

ADDRESS	H-3778 Varbó, Szemere u. 1.
TELEPHONE	+36 48 422 034
WEBSITE	www.feinwerk-technik.hu
E-MAIL	feinwerk.technik@freemail.hu
GENERAL DIRECTOR	Zsolt Király
CONTACT	Zsolt Király
CONTACT E-MAIL	feinwerk.technik@freemail.hu
LANGUAGES	German
ESTABLISHED	1998

MAIN INTEREST

The main activity is to produce mechanical components and complete systems. Working on the highest technology level of mechanical milling, we regularly deliver camera support components for the German film industry e.g. cranes, dollies, jibs, tracks, kits and other accessories.
In the last two years, the company has started to grow and is now contracted to manufacture small components with high precision accuracy.

Cooperating with Admatis, we developed a new special milling technology for thin-walled baffles and thermal shields
High precision, high complexity thin-wall components in the form of a prototype or short series to short deadlines, manufactured by machines to the highest level of precision.

FWT was certified by Admatis Ltd as the milling supplier for the Sentinel-2 satellite in 2009. Over 100 parts have been manufactured by FWT: the smallest was a 10mm high tie base spacer, while the largest one was a 1.2m long external baffle.

There are many smaller-larger products and components produced by Feinwerk. Typical examples are listed below.

Products:
- Cranes
- Dollies (studio camera grip)
- Jibs, jib-arms
- Kits
- Seats
- Seat support
- Camera support
- Sampling tap
- Small tap components
- Alcohol sampling-taps
- Alcohol-measuring equipment

One-of-a-kind:
- Satellite external baffle
- Satellite internal baffle
- Satellite connector bracket

COMPETENCIES

High-strength Aluminium Milling Technology

Space technological profile: TD 20.1 Structure

PROJECTS

Sentinel2-MSI-MMTH. 2009-2013

Integrally milled satellite components with thin face sheets (connector brackets, baffles, shields, radiators). Average material removal rate was 97 % by these components, which resulted in a 1 - 3 mm wall thickness of the end-product. Feinwerk-Technik, in cooperation with ADMATIS, has developed a special milling technology for thin-walled baffles and thermal shields to be able to cope with dimensional and surface finish requirements. Baffle faces as thin as 0.8 mm can be machined by this process with a 0.8 micron average surface roughness.

Reference: Sentinel-2 Satellite Parts Milling Tamás Bárczy, ADMATIS Ltd, ASTRIUM- EADS

UPSTREAM

FEINWERK-TECHNIK

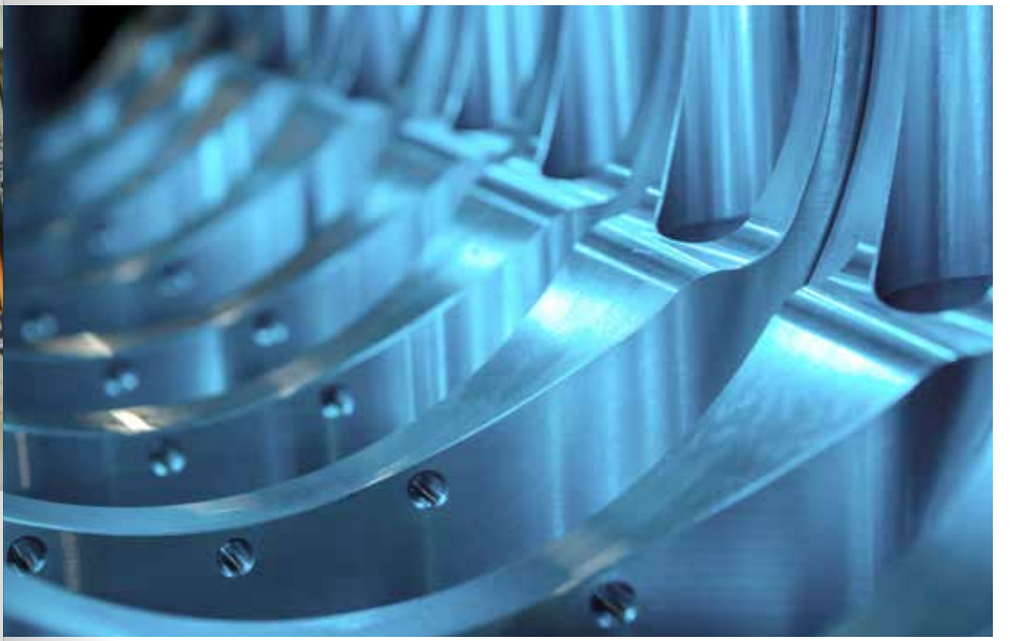
GENERAL INFORMATION

History: Feinwerk-Technik (FWT) is a privately owned company established in 1989. The company specializes in the manufacturing of professional camera support components (cranes, dollies, tracks, etc.) for the German film industry. The majority of these components are made from high-strength aluminium alloys on CNC milling and mill-turning centres. Baseline surface treatment for these components is hard anodizing to ensure maximum wear and corrosion protection.

Thanks to the company's recent investments, the CNC milling capacity has been significantly developed and extended. The company management is flexible, reliable and consequently a good cooperative partner.

Employees: 6
Turnover: 500,000 EUR

FEINWERK-TECHNIK



UPSTREAM

GOODWILL-TRADE LTD.

ADDRESS	H-4220 Hajdúböszörmény, Biró Péter u. 14.
TELEPHONE	+36 52 560 540, +36 30 953 7399
WEBSITE	www.goodwilltrade.hu
E-MAIL	goodwill.trade@t-online.hu
GENERAL DIRECTOR	György Oláh
LANGUAGES	English
ESTABLISHED	1993

MAIN INTEREST

The original profile was special purpose equipment and system design, construction and engineering. Because of elevated market needs, the company has been increasingly converting to vacuum technology and vacuum tightness testing. Having extensive experience in the field of vacuum technology, the company undertakes vacuum systems for servicing, maintenance and also servicing and renovation of vacuum pumps. Vacuum tightness testing is the combination of these two sectors. The company designs and implements vacuum tightness measuring devices then applies them to serial production lines in order to indicate and control eventual leakages on the product. The company follows customer requirements either by reconstruction of existing machine lines or developing new equipment depending on the assessment task.

The company's especially precise manufacturing skills enable it to undertake the manufacturing of components with particular and precise requirements. In this way, Goodwill has established a position in the Hungarian space industry as a manufacturer.

The company's main characteristics are reliability, cooperation and high quality.

COMPETENCIES

TD 20.1 Structural design and verification

TD 15.7 Mechanism engineering

PROJECTS

FOCUS

The company manufactured components for the Admatis Ltd materials science experiment on ISS [International Space Station], launched in 2010. These parts are mostly made of aluminium alloys and brass. The small and thin components requiring high precision were produced by CNC and manual machining. The pictures below show the flight hardware gas tank of the experiments and its light switch structure.

Reference: ADMATIS (2009-2011)
Financed by ADMATIS

Sentinel2-MSI-MMTH

From 2011, Goodwill-Trade produced various components of the Sentinel-2 satellite, using several machining technologies, for Admatis. CNC made threaded nuts and washers with complex concave-convex shapes from titanium alloy, invar spacers with complex geometry, and thin-walled CNC milled support structures from aluminium alloy have also been manufactured. Special bending processes on baffles and manufacturing of cable trays demonstrate the skills of Goodwill-Trade. Last but not least, the company successfully delivered service tools for satellite ground testing. These are milled and welded aluminium alloy structures. These components also have interface requirements characterized by very tight tolerances.

Reference: ADMATIS (20011-13)
Financed by ADMATIS

GENERAL INFORMATION

History: The company was founded in 1993. Since 1998, Goodwill has been participating increasingly in space oriented developments and hardware implementation. In cooperation with Admatis Ltd, several space industrial components have been manufactured at Goodwill-Trade, including both ground & flight hardware. The first space related vacuum components order dates back to the beginning of the millennium when Admatis Ltd & the University of Miskolc developed the UMC [Universal Multizone Crystallizator]. This was a high temperature vacuum furnace with 24 heating zones with a sample holder and sample change manipulator. The vacuum tank, the vacuum system and the vacuum lead through was also manufactured by Goodwill. The project took more than ten years because of the extraordinary technical challenge. The first prototype was designed under Intercosmos cooperation interfacing with NIKA-T platform. Further versions were made for NASA MSFC as part of the Materials Science Research Facility.

Employees: 19
Turnover: 666,000 EUR

UPSTREAM

GRAVITÁS 2000 LTD.

ADDRESS	H-1139 Budapest, Lomb u. 31/C.
TELEPHONE	+36 1 350 8851
WEBSITE	www.gravitas.hu
E-MAIL	lajos.hajagos@gravitas.hu
GENERAL DIRECTOR	Lajos Hajagos
CONTACT	Sándor Markos
CONTACT E-MAIL	sandor.markos@gravitas.hu
LANGUAGES	English
ESTABLISHED	1993

MAIN INTEREST

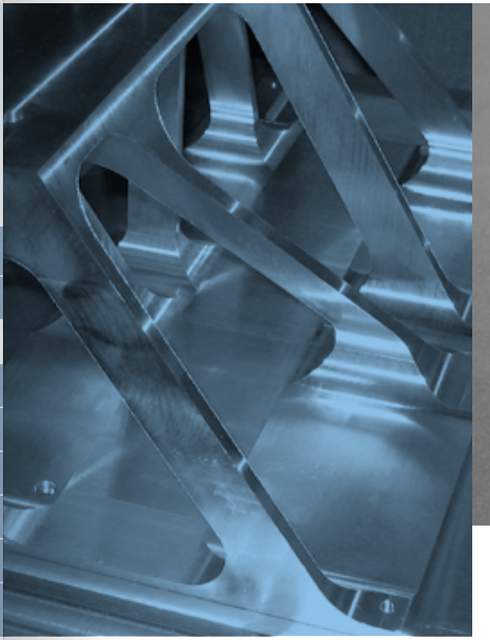
The original mission and the activity today is the production of metallic machine elements, tools, fixtures and **special machinery design and manufacturing.** The links between the medical, aerospace, and fine-mechanical part manufacturing are precision and the solution of difficult manufacturing tasks.

The engineers are experienced in the design of injection and blow mould tools, fixtures and prototypes.

The most significant products of our company are machine parts, units and **prototypes in single, small and medium size series.**

Gravitas 2000 is a premier Mechanical Machining facility with a talented work force using the latest subtractive manufacturing technologies that ensures a quality product at the most affordable price.

When it comes to machining, Gravitas has engineering and machining skills capable of the most advanced technical projects. We have the ability to design and process the most difficult 3D surfaces, simultaneous 5-axis machining and metal fabrication. We machine one-of-a-kind prototypes, through production runs, for the medical, tooling and partly aerospace industry. Our capabilities also include multi-axis wire EDM and all types of milling and turning.



Special machinery design & manufacturing
We undertake:

- machinery & equipment for special requirements
- material handling and assembling subsystems
- waste material conveyor systems [with metal straps] for extreme requirements [strains]
- hydraulic and pneumatic mounting press
- unique measuring equipment
- hanging manipulators for assembling lines
- testing, training, **verifying equipment for special loading**
- unique conveyor chains: design and manufacturing on the spot assembly and installation.

Our tool manufacturing section is able to produce small and medium size, **highly complicated** injection moulding, blanking, vacuum forming and blow **moulding tools, and prototype tools.** The tool making process is supported by spark erosion machines of sinking and wire types, CNC HSC milling and turning-milling, **laser etching machines.**

Included among what we can supply are, PVD based different materials of hard surface coatings. Products made by GRAVITAS 2000 Ltd are delivered with quality certificate according to ISO standards.

COMPETENCIES

TD 24 Materials processing, TD 26 Others: Mechanical manufacturing of parts and subassembly of different equipment

UPSTREAM

GRAVITÁS 2000 LTD.

PROJECTS

Confidential.

GENERAL INFORMATION

History: Gravitas 2000 Ltd was founded in 1993. Our production area is in Hungary, but we export most of our products to EC countries [England, Sweden, Germany] and Switzerland. During recent years, the company has been continuously developing and has become a dominant enterprise in part and tool production. Our customers are satisfied with the quality of our production and our services due to our modern machinery, up to date process technology and experienced colleagues. The management targets the continuous development of its quality control system – first introduced in 1996.

Employees: 48

Turnover: 7,710,000 EUR

Area, location: The company headquarters is located in District XIII of Budapest.

Area: 5,000m²

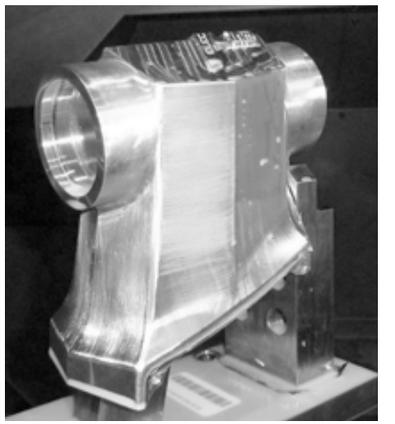
Facilities:

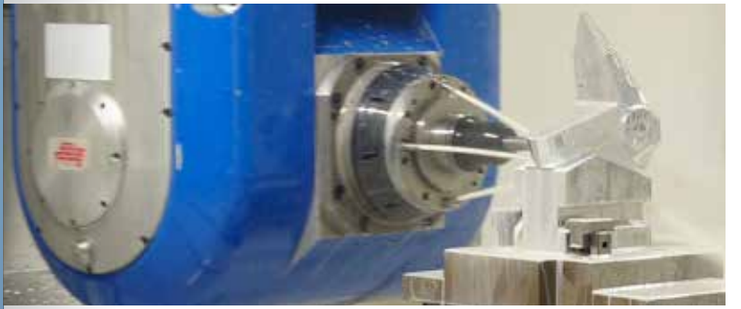
- **4-5 axis machining**
- High speed and hard milling
- **Micro milling**
- Sinking EDM
- Wire **EDMing**
- Laser etching and engraving.

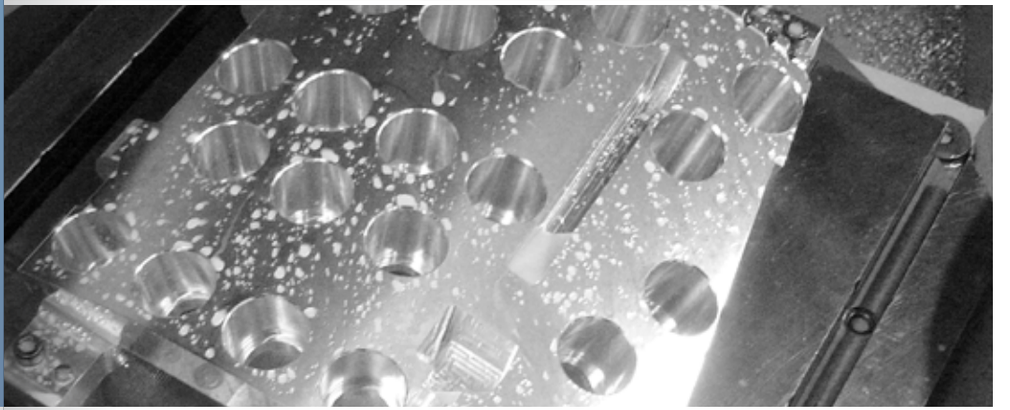
Software:
The kinematical simulation of the NC programs completes the tool path design process.

CAD design, modeling:
UG NX, SOLIDEDGE. CAM, NC programming: UG NX, EDGECAM, ESPRIT. Integrated software 3D CAD/CAM – called UG NX – as part of our fully equipped mould making facility. A CAM system is available to generate CNC programs for manufacturing the prototypes of complicated geometrical shapes. Between the programming computer and machining centres CNC programs are transferred by local network. To reduce the delivery time and increase efficiency, we use cavity/core machining in a hard condition and HSC machining.

Quality assurance:
ISO 9001(2008); ISO 14001 (2005); ISO 13485 (2004); **AS 9100** Rev C (2009).







UPSTREAM

MATMOD LTD.

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LANGUAGES	English, German
ESTABLISHED	1996

MAIN INTEREST

The main activity of MATMOD Ltd is to manage HUNSPACE; the association of 31 space oriented entities in Hungary. HUNSPACE is the nerve centre of its members and also the engine of cross-border communication. Space related work in Hungary is gaining both ground and attention as the industrial commissions are becoming dominant instead of the formerly typical scientific background activity. We intend to keep & strengthen our links between science & industry through mutual gain and to increase the rate of effective international cooperation. We repeatedly apply for ESA tenders, FP7 and also Horizon 2020. As a member of the Hungarian Space Board, we support ESA membership for Hungary and emphasize the growing significance of our space industry, for example, urging the setting up of specified competency-centres in the course of preparing economic recovery programmes.

The leading profile of MATMOD is generating cluster level projects. This includes project proposal preparation, organization, writing, joint management together with the organization of Cluster Committee meetings. We support members by development works, provide a unified internet homepage (www.hunspace.org) and provide information for members about events, conferences and workshops, open calls, applications, EMIT surveys etc. Further, we initiate and organize combined participation at international fairs; cluster level PR activity; publishing of booklets, flyers, banners, provide a complete financing background for projects with prime-subcontractor-supplier type or even consortia structures.

The most important task is to be present on the market place with space products to the highest quality level. One secondary aim is to widen the circle of space oriented Hungarian companies. This is part of the active preparation for our near ESA membership.

PROJECTS

Technology developments in HUNSPACE.
This is a complex project with two parts. The first is the overall management of the cluster including participation in fairs, in the ESA space technological harmonization procedures, in different European space actions and marketing activities (bulletins, in situ public events, web site, inform partners about calls and tenders etc). The second aim is to implement new devices for space technology (CNN machines, vacuum test equipment, painting cabin, 3D measurement apparatus).

Reference: NORDA
Financed by ÉMOP 121-2011-0002. (2011-2013).

Space Centrum.
This is a project to implement the building and infrastructure centre in Miskolc for HUNSPACE offices and some fundamental laboratories (clean room, test lab).

Reference: MAG Zrt
Financed by GOP 2011-211/M -0219. (2011)

UPSTREAM

MATMOD LTD.

Space Centrum Expansion. As a continuation of 3.2, the Space Centrum was extended with a further 200m2. The new rooms are planned for extended space industrial activity for satellite components.

Reference: MAG Zrt
Financed by GOP 2012-211/M-3841 (2013).

Hungarian Space Industry. This is a project to conceive, write and edit a marketing booklet about all Hungarian SMEs. The aim is to demonstrate their competencies and references in space technology. The task is to collect all data and illustrations then edit, design and write the opus. **Financed and published by** Hungarian Investment and Trade Agency, HITA, (2013-14).

Reference: Andras Wittek, HITA

Budapest meeting. This was a fundamental meeting to prepare the Hungarian accession to ESA. New ESA member countries and aspirant countries were invited to study the requirements and advantages of ESA membership. (09.10.2013).

Reference: ESA, Antonio Garutti.

GENERAL INFORMATION

History: MATMOD Ltd was founded as a spin-off R&D company in 2007 for development, manufacturing and to manage materials science and microgravity experiments. Its main role soon changed to that of organizing the first Hungarian space cluster in order to integrate the space oriented Hungarian competencies and ensure transparency for potential partners abroad. MATMOD's first action was an international workshop on the Hungarian space industry in Visegrad, 23-26.09.2010. For the first time, a SWOT analysis was carried out by an expert German company (Hildeman &Partners) to demonstrate transparency in the industry. Our training, "How to write an ESA tender?", was also a pioneering event.

MATMOD's general role was also to represent the Hungarian SME community in SME4SPACE.

HUNSPACE is one active member of SME-4SPACE, which is an organization of small and medium enterprises with space interests in Europe. Within this framework, HUNSPACE is able to participate in all the preparative steps of ESA and EC space industry guideline decisions with SME relevancy. The Hungarian Space Cluster attended three workshops [Paris, Darmstadt, Frascati, 2012] respectively and had the right to influence the conclusions. To maintain and develop contacts with ESA actions, HUNSPACE distributes ESA papers, questionnaires, tenders, ITTs to cluster members. To maintain an informed position in specific ESA topics, HUNSPACE delegates attended the workshop of the 3rd generation Meteosat project in EUMETSAT, Darmstadt; the informal day of the EUCLID mission in ESTEC; the payload consortia meeting of CHEOPS in Bern, and the CubeSat Industry Day in ESTEC. To improve our public relations and widen our marketing efforts, exclusive HUNSPACE stands were exhibited at the AEROSPACE FAIR in Seville, the UK-East Europe Space Board meeting in Prague, and also in Warszawa. A dedicated HUNSPACE video was presented at Space Expo 2013, Budapest. To be integrated into the ESA, the European Space Technology Harmonization Work plan is a standard task. A proposal has recently been made to accept the area of focal sheet cooling technologies. The Hungarian contribution to the European Space Technological Master Plan [ESTMP] is continuously updated. To maintain our up to date status, we are in continuous contact with ESA through its TIA/ARTES system and EMIT/ITT service.

Employees: 3
Turnover: 100,000 EUR
Location: 300m^2 office and workshop

UPSTREAM

MO-MECHATRONIKA BT.

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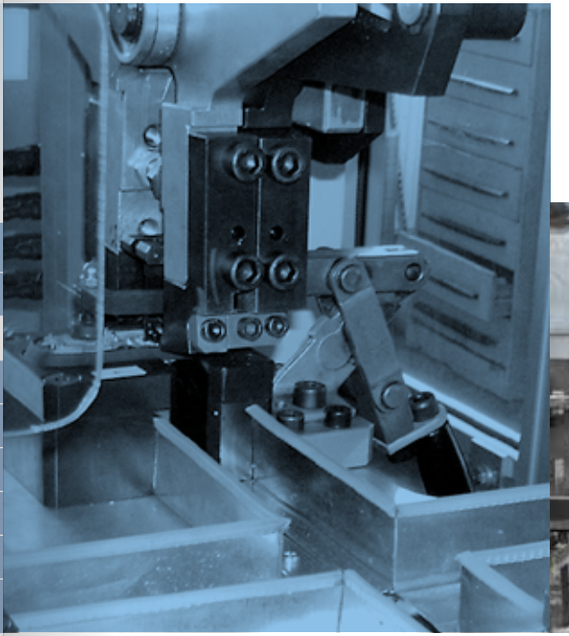
LANGUAGES	English
ESTABLISHED	2001



MAIN INTEREST

The main activity of MoMECH is designing and implementing machines for special purposes in various industrial fields. In most typical projects, the work is complex from design and manufacturing to assembly, integration and tests. We are capable of implementing exact specifications into function/status test-equipment and for other industrial needs. MO-MECHATRONIKA offers expertise in different technological equipment types, in logistics, in precision & also in heavy duty machines.

In energetics and mechanical engineering profiles, we are also able to realize cooperative research and development works with universities and research institutions.

Our main objective is to satisfy partner demands through flexibility and cooperation.

COMPETENCIES

TD 15.7 Mechanism engineering

TD 19.4 Supporting Propulsion Technologies and Tools

TD 24.3 Cleanliness and Sterilization

PROJECTS

Precision welding machine

This is a delicate technology and special equipment for precision welding of stainless steel tubes. We carried out the design & development and successfully implemented it with one of our partners. This special machine enables the welding of gas turbine combustor components under stringent technological conditions; other special containers and technological mediums are also demonstrable. The equipment is available in two versions suitable for two support/hitch requirements.

Specialized supporting parts have also been developed with the special equipment operating in a wide range of sizes on noble gas.

Reference: GE Hungary

CVD/DVD tester set. The key feature of our engineering services is flexibility, cooperativeness and the diligence to fully satisfy our partner's needs. One of our first successful projects in this spirit is the CD/DVD tester special purpose machine for controlling serial production lines. These products have been manufactured for over a dozen generations. On this basis we developed other test equipment series operating in different areas. We are capable of implementing exact specifications into test-equipment and for other industrial needs.

Reference: Philips Component Ltd.

Self setting laser technology

Over a number of years, we have developed a self-setting laser technology for sheet metals that enables very cost effective production of structural steel elements in various sizes at medium precision class. The telescopic boom in the photo is the largest example of this method that we widely use

UPSTREAM

MO-MECHATRONIKA BT.

for the manufacturing of special purpose equipment. Further analysis of our method is ongoing at Óbuda University as it is an interesting hybrid of two types of bonding [substance and form-locking modes]. The first article in the topic can be found in GTE "GÉP" ["Machine"] technical journals [2008/10-11.]

Reference: confidential

Puffed rice production

To evidence our flexibility we developed an advanced food technology and sold these special purpose machines as a full production line. Our puffed rice system aids the modern diet for many and is an interesting, valuable product to be proud of; although it not a space industrial level project, it is nevertheless an example of our steady humility to engineering missions.

Reference: confidential

GENERAL INFORMATION

MO-MECHATRONIKA, established in 2001, is a Hungarian company with its main activities in engineering services, design and implementation of special purpose machines and manufacturing. Our initial objective was to serve local or regional development needs. We targeted SMEs and also multinational firms in our strategy. After successfully penetrating the market it has become clear that larger and more far multinational firms require more of our capacity; as a result, the majority of our commissions are related to them. Recognizing the opportunities we now have countrywide activity.

Research, Development and Innovation have been a fundamental part of our services from the beginning. We have had several fruitful RDI projects and procured industry-technologies and logistic systems in collaboration with Óbuda University, Donát Bánki Faculty of Mechanical and Safety Engineering.

Employees: 9

Turnover: 300,000 EUR

Location:
210 m^2 workshop + 18 m^2 store

Facilities:
universal milling machines, welding machines, assembly tools

Software:
Pro/E Wildfire 2, CREO2, ZWCAD, Pro/D

Patents:
HPO-4357/86 Rolling friction gear shift

UPSTREAM

QUALITATIVE PRODUCTION ZRT.

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LANGUAGES	English, German
ESTABLISHED	1993

MAIN INTEREST

- Design and manufacturing of individual machines and devices in the small, medium and large size ranges, from parts to special-purpose machines, 3D production of tools
- Manufacturing of motor components in series production (preliminary machining of cylinder head)
- For our contracted partners we can immediately replace the defective parts in their production lines. We have more than 15 years of experience in providing this non-stop repair service.

COMPETENCIES

TD 13 Automation, Telepresence & Robotics

TD 15 Mechanism & Tribology

TD24 Materials & Processes

PROJECTS

1) Vertical take off and landing (VTOL) airplane: The aim of this R&D project is to develop an ultra-light aeroplane, which is able to take off and land vertically. The power chain, the take-off and landing driving and geometry and other parameters make this model uniqe on the European market. The speed and other travel parameters may even exceed the ones of conventional aeroplanes and the unit distance cost will be significantly lower than of conventional helicopters. Reference: Confidential. **Financed by** GOP 2.1.1

2) Assembly lines: Designing and manufacturing of several manual and semi-automatic assembly lines with work-benches for the automotive and machining sector. References: several, confidential

3) Fixtures: Designing and manufacturing of several hydraulic and manual fixtures and measuring gauges for the automotive and machining sector. Designing and manufacturing of full in-house demand for fixtures to Serial Business Unit. References: several, confidential

4) Machining of castings: in a very wide size ranges up to 5200 x 3200 x 2700 and different material types for Tier I and Tier II automotive suppliers

GENERAL INFORMATION

History: Founded in 1993, our company's philosophy is to serve our clients and partners according to the highest standards, using the most up-todate technologies. our competitieness is based on flexibility and high-quality services.

The company had built up its competencies and markets in the individual and small range series production segment. By 2015 the individual production division had clients from the automotive, railway, food and press industries, to whom we are able to provide complex service from brain-storming to implementation.

Based on these outstanding competencies, in 2009 the company was given its first big serial production contract by a Tier 1 automotive OEM producer. By 2015 we were providing five car makes in the serial business and employing 150 people and 14 machining centers.

UPSTREAM

QUALITATIVE PRODUCTION ZRT.

In 2015 the company and the CEO were granted 'Best Enterprises' and 'Best Manager of the Year' Award by the European Business Assembly.

Employees: 200

Turnover: 7,000,000 EUR (2015)

Location:

Site 1: Individual Production Division, Győr 2,500 m²

Site 2: Serial Production Division, Győr Industrial Park 3,000 m²

Main machines:

- Machining centers: up to 5200 x 3200 x 2700 size range and up to 5 axis, and within IT 5-7 accuracy classes
- Turning lathes
- Line-boring machines
- 3D coordinate measuring machines up to 5000 x 2500 x 1800 size range and within 1,2-6μm accuracy.

Software:

TopSolid 6.16 and 7.9 CAD/CAM package, CATIA v5-6R2014, NormaX production planning and supporting system

Patents: None

Quality assurance:

ISO TS 16949 international automotive industry quality management system

ISO 9001-2008 quality assurance system

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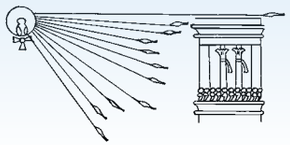
SUNPLANT LTD.



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LANGUAGES	English
ESTABLISHED	1994

MAIN INTEREST

SUNPLANT Ltd is a science oriented engineering micro-firm based on the collaboration of three highly qualified engineers. We have operated in the area of design-engineering, and consultancy for nearly two decades. Testing and implementation of unique equipment or prototypes is also part of our activity. Since 2013, our activity has been open to design and realization of space simulation experiments. Thermo-vacuum test facilities are available in our laboratory.

COMPETENCIES

TD 26 Thermal tests and vacuum GSE

PROJECTS

SP-14 Vacuum Furnace

This is a high precision laboratory vacuum furnace to examine surface tension of different metallic alloys.

Reference: G. Kaptay
Financed by Bay Zoltán Public Nonprofit Ltd for Applied Research and Hungarian Academy of Sciences (2014)

SP-72 Vibration Test Adapter

FOCUS Project

Reference: Admatis (2011)
Financed by Admatis Ltd.

Space Simulator

Design and implement vacuum equipment for space simulation and its laboratory background, TRL3.

Reference: NORDA
Financed by ÉMOP 121-2011-0002 (2011-2013)

GENERAL INFORMATION

History: Sunplant Ltd was established as an engineering office for mechanical construction of test equipment in 1994. Since the start-up phase, there have a number of successful developments; more than 23 unique pieces of equipment have been designed and tested since then. In 2004, following steady development and increasing profitability, we changed the business structure to a Limited company. Nowadays the firm is Hungarian owned by the founders.

Employees: 3 engineers
Turnover: 20-60,000 EUR
Location: 96 m²
Facilities: Space simulator
Software: Autocad Lt., Theben- Obelisk

Patents:

P. Bárczy, G. Búza, Gy. Czél, J. Fancsali, P. Makk, A. Roósz, Cs. Raffay, B. Tolvaj: Apparatus and Capsule for Carrying out Processes of Directed Crystallization Especially in Cosmic Space Conditions. United States

Patent US 5,429,341

Date of Patent: Jul. 4, 1995.

Czel Gyorgy Dr Fancsali József+2 Coextruson Centrifugal Apparatus to Fibre Formation, European Patent Application, Publication HU0700795 20071210

Date of filing: 2009-04-28

Priority date: 2007-12-10

Blaskovics, Venglovecz, Zsoldos, Marossy, Czél, Wear resistant gradient polymeric material and process for the preparation of same European Patent Application EP 09178527.9

Date of filing: 09. 12. 2009.

Date of publication: 16.06.2010

Szabó Imre, Eckhart László, Czél György, Energy Storing spring from wood, European Patent Application Number. 07011755.1

Patent number: EP 2002759

Date of filing: 15. 06. 2007

UPSTREAM

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LANGUAGES	English
ESTABLISHED	2011 (1980)

MAIN INTEREST

Technoplast Group is a manufacturer with a broad production profile. The main activities are rapid prototyping (SLA 3D printing, Vacuum casting, RIM casting, Low volume moulding), tooling (injection moulding, forging, die casting), 3D, 4D, 5D CNC metal and plastic machining, machine building.

COMPETENCIES

TD 15.1 Mechanism core technologies

TD 20.1 Structural design and verification methods and tools

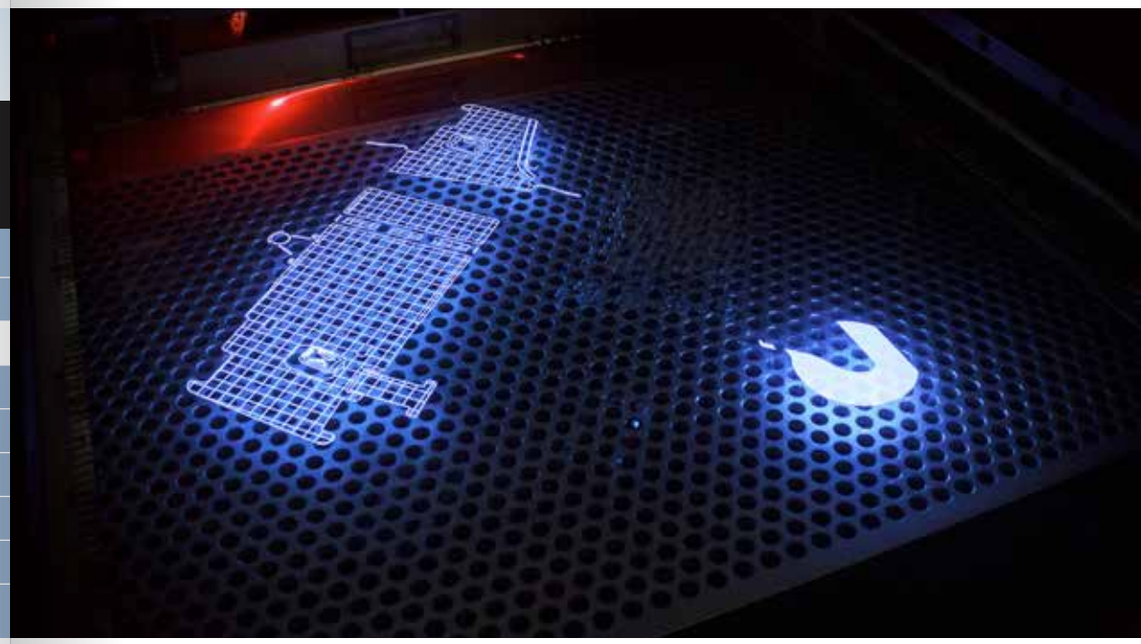
TD 24.1 Novel Materials

PROJECTS

FOCUS (Foam Casting and Utilization in Space) (TRL2)

Technoplast as the subcontractor of Admatis Ltd. produced CNC machined mechanical parts (box, window, cover, buttons) for test equipment. The aim of the project is to study the foaming process and foam stability in an aqueous system under microgravity in order to establish the development of metal foam production technology. The equipment was tested on 07.02.2010 in the ISS space station by Mr Jeffrey Williams, astronaut.

Reference: ADMATIS
Financed by ADMATIS, 2009.



Sentinel 2 Satellite (TRL2)

Technoplast as the subcontractor of Admatis Ltd produced Multi Spectral Instrument CNC machined Parts (Heat Shield Elements: baffles, brackets). The aim of the project is to provide mechanical parts for the Sentinel 2 Satellite. The pair of Sentinel-2 satellites will routinely deliver high-resolution optical images globally, providing enhanced continuity of SPOT- and Landsat-type data. Sentinel-2 will carry an optical payload with visible, near infrared and shortwave infrared sensors. The satellite was launched in 2014. Data from Sentinel-2 will benefit management services associated with European and national institutes, the agricultural industry and forestry, as well as disaster control and humanitarian relief operations. Sentinel-2 will provide optical imagery for Global Monitoring for Environment and Security.

Reference: ADMATIS
Financed by ADMATIS (2010-12)

3. Shaped Metal Foam Development

Technoplast as a consortium member of the Jedlik Project, which was led by Admatis Ltd, developed a new method and technology to produce shaped aluminium metal foam. Our company work on the foam blowing technology with the other members and designed and built test equipment for the trials.

The procedure and the equipment are protected by patent No. P0900629.

The metal foam is a cellular structure consisting of a solid aluminium metal, as well as

UPSTREAM

TECHNOPLAST GROUP LTD.

a large volume fraction of gas-filled pores. The defining characteristic of metal foams is a very high porosity: typically, 75–95% of the volume consists of void spaces making these ultra-light materials. The main goal for the use of metallic foams in vehicles and other equipment is to increase sound dampening, weight reduction in automobiles, and increase energy absorption in the event of crashes.

Reference: ADMATIS
Financed by: GOP (2011-13)

DYNAMILL

(DYNAnamic manufacturing of thin-walled workpieces by MILLing process)

Technoplast as the member of a consortium, which is led by Fraunhofer IPT, developed the total milling process for alloyed aluminium and titanium parts production. Lightweight components are gaining in importance in key EU industries and have good market growth potential (aerospace, automotive, power generation, medical technology etc.). To achieve weight reductions, complex thin-walled structures are combined with high strength materials. However, the lower stiffness of work pieces leads to serious challenges during the milling process. DynaMill aims at achieving the complete control over the milling process of thin-walled work pieces. This will be realised through a threefold approach combining the development of process planning, adaptive clamping devices and improved cutting conditions.

Reference: Fraunhofer IPT.
Financed by FP7-2012-NMP-ICT-FoF.

GENERAL INFORMATION

History: TECHNOPLAST GROUP Ltd is a privately owned company. Its predecessor was established in 1980. The company placement changed in 2011. The present company has 60 employees. Among our activities are design, rapid prototyping, tool-making, low-volume trial production and mass production, and machine building. In order to maintain the quality of our products and services at a high level, we have been using the ISO 9001:2009 quality assurance system for more than 15 years.

Designing: Our design team prepares CAD drawings and CNC programs needed for parts, tools and devices manufactured by ourselves; we also carry out design orders for our customers.

Rapid prototyping: The essence of these methods is that a part of the same shape as the original product and with similar properties can be produced quickly and at low costs. The prototype is suitable for demonstration, for performing assembly and mechanical tests. Based on the results of tests, after occasional modifications, final mass production tools can be manufactured. Rapid prototyping methods are mainly used by rapidly developing industries: automotive and electronics; initially, exhibition models are produced from these parts, for instance in the case of cars.

We use the following rapid prototyping methods:

- SLA: stereo lithographic laser technology
- VACUUM CASTING: gravity vacuum casting
- RIM: low-pressure injection moulding
- Small series injection moulding

Through our subcontractors and partners, we can also fulfil orders that require the application of SLS, SLM, POLYJET and metal coating methods.

Toolmaking: Our company has almost three decades of experience in manufacturing tools for injection moulding of plastics, rubber vulcanisation and drop forging.

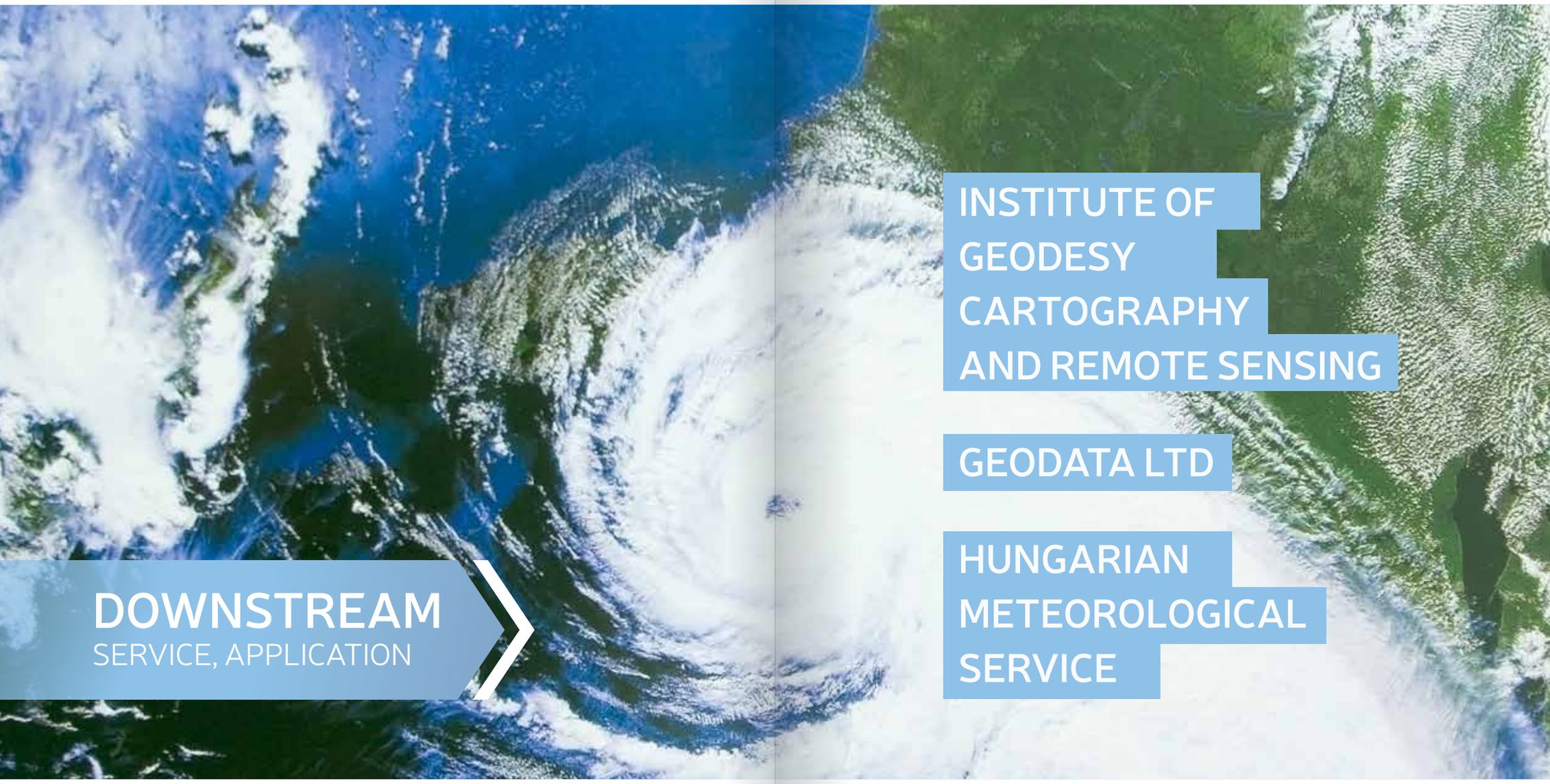
Injection moulding of plastics: We produce assembly line devices and assembly jigs as solutions for individual technical tasks, mainly for the electronics industry. Our injection moulding tools for plastics are used primarily by automotive and electronics companies.

Machining: By CNC machining, we produce small series metal parts for the space, automotive and medical industries.

Plastic surface coating: We coat surfaces of plastic computer parts with metal-containing paints using special painting masks and jigs, which we have developed and produced. The purpose of this technique is to protect the electronics, located behind plastic parts, from disturbing electromagnetic fields.

References: Audi, VW, Mercedes, BMW, Bosch, Delphi, Lear, Denso, Leoni, Porsche AG, Decoma, Liebherr, Draxlmaier, Initial SA, Siemens AG, Electrolux, Flextronics, Hewlett Packard, IBM..... and more than 250 other customers.

Employees: 60
Turnover: 1,050,000 EUR
Location: 1,050 m²
Facilities:
Rapid prototyping machines: SLA 3D printer, Vacuum casting machines, RIM casting machines, 4-axis, 5-axis CNC machines
Software:
SolidWorks
Patents:
Apparatus and Procedure for closed cell shaped metal foam products with metalfoam injector" Patent No. HPO-228 124
Quality assurance:
ISO 9001:2009.



DOWNSTREAM
SERVICE, APPLICATION

INSTITUTE OF GEODESY CARTOGRAPHY AND REMOTE SENSING

GEODATA LTD

HUNGARIAN METEOROLOGICAL SERVICE

DOWNSTREAM

INSTITUTE OF GEODESY CARTOGRAPHY AND REMOTE SENSING

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LANGUAGES	English, German
ESTABLISHED	1967

MAIN INTEREST

The Institute is the central surveying and mapping organisation of all official activities in Hungary in the field of land management, surveying and mapping. It is financed by the state budget and has the competence of a national authority. Its direct professional supervisory authority is the Ministry of Agriculture, Department of Land Administration. FÖMI, as a governmental institute, has a national mandate in land management, surveying and mapping and also plays an important role in these areas. Through its official, operative and R+D activities, during the past couple of decades FÖMI became a respected participant and organiser of various national and international cooperation. FÖMI has an active role in Hungarian Higher Education.

The Department of Geoinformation Technologies (Institute of Geoinformatics, Alba Regia Technical Faculty, Óbuda University) operates at the Institute. FÖMI has several cooperation agreements with Hungarian Universities in the field of R+D and education. Some of FÖMI's experts deliver several lectures at cooperated Universities in the field of Geoinformation Sciences. FÖMI, as an LMO within the INSPIRE framework, nominated experts to TWGs, commented, tested different data specifications and related documents. FÖMI's successful professional activity is honoured by the membership of several scientific committees, various national and international associations of geodesy, cartography, remote sensing, geoinformation and space research.

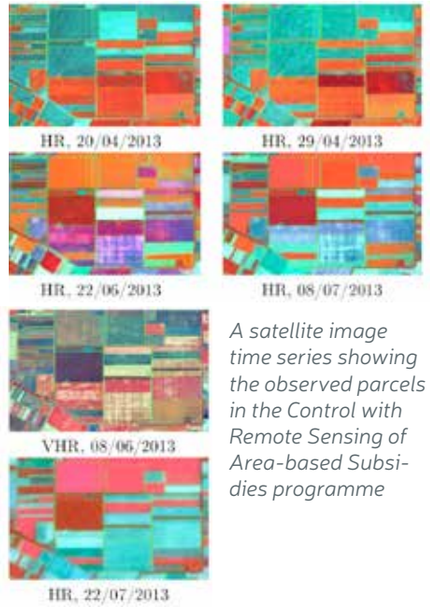
Satellite Geodetic Observatory of FÖMI focuses on the introduction and application of space geodetic techniques including Global Navigation Satellite Systems (GNSS), Synthetic Aperture Radar Interferometry (InSAR) and Very Long Baseline Interferometry (VLBI). Sectors of activity are professional scientific and technical activities, scientific research and development, research and experimental development in the natural sciences and engineering. The Observatory is responsible for the supervision and technical development of the national geodetic reference networks implementing up-to-date satellite-based positioning technologies.

The main components of the LPIS: physical blocks (red) serving as reference parcels, ineligible areas (cyan), block identifiers (black) and cadastral boundaries (dark grey) on orthophoto background.

PROJECTS

Land Parcel Identification System (LPIS) is the exclusive reference, identification and geographical information system of the agricultural and rural development subsidies financed by EU and national sources *(Fig. 1)*. Orthophotographs are the main background data of LPIS creation and operation. LPIS registers areas eligible for area-based subsidies (arable land, pasture, plantation, and kitchen-garden) and non-eligible areas (such as forest areas). Based on its thematic layers, LPIS includes and supports several subsidy schemes, e.g. "Afforestation of agricultural areas", "Less favoured areas", "Natura 2000" and "High nature value areas".

Control with Remote Sensing of Area-based Subsidies – as a part of on-the-spot controls – is carried out by FÖMI. Crop identification is based on time-series of high-resolution (HR) images, while very high-resolution (VHR) images and orthophotographs are used for accurate area measurement *(Fig. 2)*.



A satellite image time series showing the observed parcels in the Control with Remote Sensing of Area-based Subsidies programme

DOWNSTREAM

INSTITUTE OF GEODESY CARTOGRAPHY AND REMOTE SENSING

Hungarian National Vineyard GIS (VINGIS) is a GIS-based system that complies with the community regulations of the sectorial vine cadastre. It is the basis of subsidies for vineyard uprooting, planting and restructuring activities. VINGIS plays an important role in the preservation of wines of protected origin and geographical indications as it contains information on the delineation and nomenclature of protected vineyards.

Environmental land monitoring
Land monitoring services provide geographical information on land cover and on variables related, for instance, to the vegetation state or the water cycle. It supports applications in a variety of domains such as spatial planning, forest management, water management, agriculture and food security. FÖMI plays a key role in the national and - as the member of supporting institutional network of the European Environmental Agency (EEA) - in the European land monitoring as well.

European land monitoring: The objective of the Copernicus Land Monitoring Service is to provide European land-cover information to users in the field of environmental and other terrestrial applications. Since 2001 FÖMI experts have continuously participated in activities of the land cover - related European Topic Centres, which is part of the background institutions of European Environment Agency (EEA):

- 2001-2006: European Topic Centre - Terrestrial Environment (ETC-TE)
- 2006-2010: European Topic Centre - Land Use and Spatial Information (ETC-LUSI)
- 2011-2014: European Topic Centre - Spatial Information and Analysis (ETC-SIA)
- 2015: European Topic Centre - Urban, Land and Soil Systems (ETC-ULS)

Experts of FÖMI, as a core member of the consortium forming the Topic Centres, have played key role in coordinating the preparation and the quality control (verification) of the pan-European land cover databases (CLC2000, CLC2006, CLC2012, GIO High Resolution Layers), as well as in training the experts of the participating 39 countries.

CORINE land cover data: The CORINE Land Cover (CLC) inventory was initiated in 1985 (reference year 1990). Updates were produced in 2000 and 2006, and the latest 2012 update is under production. It consists of an inventory of land cover in 44 classes. CLC uses a Minimum Mapping Unit (MMU) of 25 hectares (ha) for areal phenomena and a minimum width of 100 m for linear phenomena. The time series are complemented by change layers, which highlight changes in land cover with an MMU of 5 ha. *(Fig. 3)*

European CLC: Hungary - namely the Institute of Geodesy, Cartography and Remote Sensing (FÖMI) - took part in all of the initiatives above, relying on different funding mechanisms. CLC1990 was prepared within the framework of the PHARE Regional Environmental Programme; CLC2000 and CLC2006 projects were jointly financed by the European Environment Agency (EEA) and the Hungarian Ministry of Environment and Water. Creation of CLC2012 datasets was performed between 2012 and 2014 within the frameworks of GIO-Hungary project, fully financed by the EEA.

CORINE land cover map of Europe

Land cover map of Budapest and surroundings (GIO-land High Resolution Layers)

National CLC data (CLC50): In response to this need and to support Hungary's accession to the European Union, the Ministry of Agriculture and Regional Development initiated the CORINE Land Cover mapping project at scale 1:50.000 (CLC-50) within the frameworks of the Acquis National Programme in 1996. For the nomenclature of this national survey the standard (level-3) CORINE Land Cover nomenclature has been enhanced to include nearly 80 level-4/5 classes. The 4 hectare minimum mapping unit (1 ha for water) provides enhanced geometric detail.

GIO-land High Resolution Layers: Within the framework of the COPERNICUS GIO Land program 5 High Resolution Layers covering all Europe were produced in 20/100m resolution.

1. Degree of Imperviousness,
2. Forest (tree cover density and forest type),
3. Permanent grasslands,
4. Wetlands,
5. Permanent water bodies.

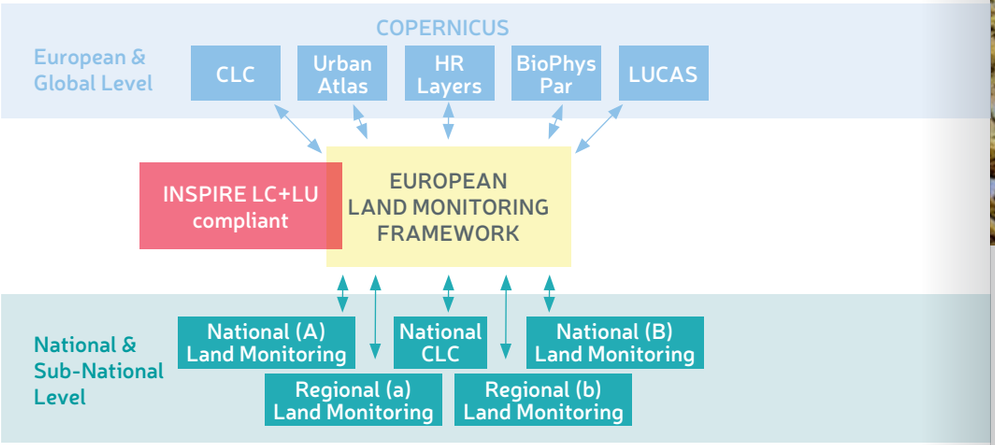
GIO land HRLs are produced by European Service Providers, verification, enhancement and distribution of GIO land data for Hungary (in national projection) is provided by FÖMI *(Fig. 4)*.

Strategic developments: FÖMI experts actively participate in long-term strategic development and planning of land monitoring in Europe. The aim of the FP7 HELM project (2011- 2013) was the improvement of

DOWNSTREAM

INSTITUTE OF GEODESY CARTOGRAPHY AND REMOTE SENSING

Integration scheme of EAGLE concept

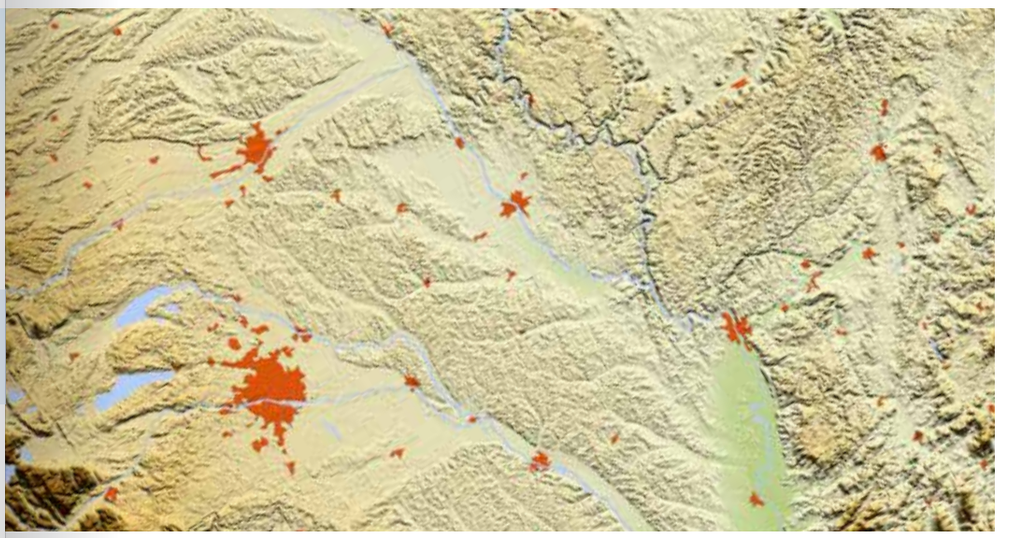


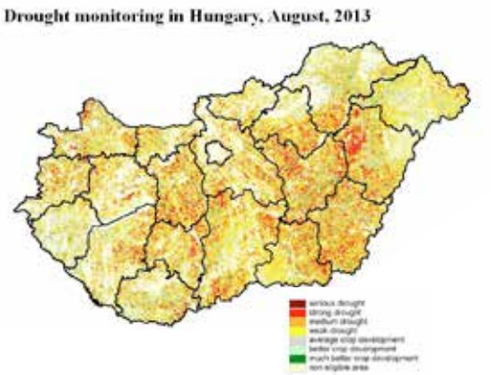
the European land monitoring concept. In the EAGLE (Eionet Action Group on Land Monitoring in Europe) working group, we played key role in the elaboration of a common European land cover data model. The EAGLE model may serve in the future as a core element of the European land monitoring framework, supporting bottom-up collection of land related information.

Development of Agricultural Risk Management System (MKR project). The objective of the MKR is to support and establish an information development, which should meet all the requirements of a damage liability system entirely. This information development, resting both on commercial and administrative sectors, was established by act 2011. / CLXVIII. regarding climatic and environmental risk management in agricultural production *(Fig. 5)*.

Furthermore, its emphasized aim is to level up services provided for stakeholders (individuals, enterprises, companies), and support the administrational liabilities of contributors involved; as a result, missing deadlines or failures in procedures in the fulfilment of processes can be lowered or minimized . The project has been carried out within the framework of a consortium led by ARDA (Agricultural and Rural Development Agency). Other members: Research Institute of Agricultural Economics; Institute of Geodesy, Cartography and Remote Sensing; National Food Chain Safety Office; National Meteorological Service; National Hydrological Service; Ministry of Rural Development, and National Infocommunication Service Zrt. as fellow associates. According to the project - in the event of drought, waterlogging and floods - FOMI provides damage assessment thematic maps generated by remote sensing processes by using satellite data. These maps provide more detailed information about the areas damaged or affected. These analyses significantly support the reconsideration of damage-relief applications, which is why in most of the cases on-the-spot checks are not necessary. Duration 2013-2014.

Financed by EU and National Funds.





Drought monitoring in Hungary based on high-resolution satellite imagery

DOWNSTREAM

Sentinel-1

Automatic classification (segmentation) of building blocks based on Digital Surface Model and aerial imagery compared with the cadastral vector data.

InSAR Integration: Common Referencing and Combined Three-dimensional Hazard Mapping with Sentinel-1 *(Fig. 6)*. In 2013, as first milestone we worked on multi-technique geodetic hazard monitoring in various environments. We carry out high precision GPS measurement campaigns, perform scientific data processing, organize 0-order (highest standard) levelling and gravity measurements, and perform C-band PSI analysis in water pumping, urban and mining areas with full comparisons of results and techniques. The next major task is the investigation of SAR transponders and passive reflectors, and their application in common space and land-based geodetic referencing. Finally, we have been prepared for Sentinel-1A and have performed tests of Sentinel-1 wide area mapping, and the implementation of Sentinel to hazard monitoring and multi-technique common referencing. In addition to the major project tasks, we participate in larger InSAR related domestic and international cooperation and also perform PSI infrastructure monitoring. We are working on the introduction of InSAR to Hungary through information dissemination, Hungarian applications, university lectures and student consultations, employment of a young scientist and with InSAR related supervisions and reviews of related works. Duration 2013-2015.

Financed by ESA-PECS.

IQmulus is a 4-year Integrating Project (IP) in the area of Intelligent Information Management within ICT 2011.4.4 Challenge 4: Technologies for Digital Content and Languages. IQmulus started on November 1, 2012 and will finish October 31, 2016. It is a collaborative project executed by a Consortium of 12 European partners from seven countries. For geospatial applications, huge amounts of heterogeneous data sets are collected nowadays with different data acquisition techniques. Airborne and mobile platform LIDAR data is becoming specially ubiquitous, but SAR and stereo-photogrammetry also contribute to the rapid growth to the scale of tens to hundreds of TBs. Due to the problems of handling such a large data volume and the difficulty of fusing point clouds, rasters, volumetric data and 2D vector data of heterogeneous provenance, many of those new data sets are not used appropriately or not used at all. Therefore, IQmulus targets the enabled and optimized use of large, heterogeneous geo-spatial data sets for better decision making through a high-volume fusion and analysis information management platform. This platform will transpose approaches and IT standards from distributed computing to enable distributed, service-oriented geospatial processing, analysis and visualization. Two testbeds are being implemented in IQmulus (Maritime Spatial Planning and Land Applications for Rapid Response and Territorial Management) to demonstrate the benefits of the approach.

Building Monitoring (ÉMO project) includes automatic classification of buildings from remote sensed data in cooperation with other (e.g. height) data, and serving the classified data via the internet (WMS) from FÖMI to the partners at the building authorities. In this project FÖMI produces the digital surface model for the whole country and a special orthophoto cover. It uses the already existing digital terrain model, classic orthophotos and the aerial photos, and produces the nation-wide building coverage *(Fig. 7)*. On the basis of the cadastral data, the orthophotos and the building coverage, all the differences from the cadastral data will be determined. After that the building authority will initiate the arrangements of all of the technical and legal differences. Duration: 2012-2014.

Financed by EU and National Funds.

INSTITUTE OF GEODESY CARTOGRAPHY AND REMOTE SENSING

DOWNSTREAM

INSTITUTE OF GEODESY CARTOGRAPHY AND REMOTE SENSING

On-line Service of Digital Aerial Photos Archive (DLA project). The goals of DLA are the conservation of 412 000 aerial photographs taken in the past, their digitization, georeferencing and uploading them into a database, and to establish an on-line service of them. Duration: 2012-2014.

Financed by EU and National Funds.

Integrated National Real Property Cadastre (INIK) project was started by FÖMI for the preparation of a unified structure and harmonized content central transaction database, which is financed by EU and National funds. The most important goal of the project is to renew the Land Administration IT systems by modern, central hardware infrastructure and software applications, this is the foundation-stone to introduce a central transaction database. Duration: 2012-2015.

Financed by EU and National Funds.

Establishment of Electronic Document Repository of Land Offices (DALNET24 project). The planned application will provide handling of documents and floor-plans of condominiums in an electronic document repository related to Land Office transactions. The new system based on electronic documents will provide back-office and front-office services in the fields of data services and Land Office transactions. Duration: 2012-2015.
Financed by EU and National Funds.

GENERAL INFORMATION

History: The **Institute of Geodesy, Cartography and Remote Sensing (FÖMI)** was founded in 1967. During its long history, numerous space-related projects have been accomplished successfully. This has resulted in a significant enrichment of the original ("classical") profile of FÖMI, fostering further progress and contributing to competitiveness through the provision of better services.

Research in the field of remote sensing and the execution of operational applications has formed the main activity at FÖMI Remote Sensing Directorate since 1980, especially in the field of agriculture and environmental protection. Within the framework of **National Crop Monitoring and Production Forecast by Remote Sensing Programme (CROPMON)**, FÖMI supplied the Ministry of Agriculture and Rural Development (MARD) with estimated figures on crop yields and areas at country and county level between 1997 and 2003. Currently, the Directorate of Remote Sensing and Satellite Geodesy and Directorate of Agriculture and Rural Development are participating in the implementation and coordination of several ongoing national and European remote sensing projects. For thematic applications, mostly series of high-resolution satellite images (e.g. Landsat and SPOT) are used, but some of our projects are based on orthophotos. FÖMI has considerable experience both in the field of numeric evaluation and visual interpretation. Operational applications have a stable scientific background, and they rely on advanced institutional information technology infrastructure.

Assessment of insect damage targeted at two main areas so far: Between 2004 and 2006, **damage in forests caused by gypsy moths** was monitored near Lake Balaton. The comparative quantitative analysis of medium resolution satellite images allowed the spatial and temporal monitoring of impairment and regeneration processes. In 2007, FÖMI developed and successfully applied a unique methodology for the identification of the **damage caused by the western corn rootworm.** It was based on the simultaneous evaluation of optical and radar image time series.

Employees:
210

Location:
6,500 m^2

Turnover:
11,925,000 EUR

Quality assurance:
FÖMI's quality assurance system is compliant with ISO 9001:2001 Standard and its information security system is compliant with ISO/IEC 27001:2006 Standard. Auditor of the integrated quality assurance system is SGS HUNGARIA LTD.

DOWNSTREAM

GEODATA

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WEBSITE	www.geoadat.hu
E-MAIL	geoadat@geoadat.hu
GENERAL DIRECTOR	Péter Hargitai
CONTACT	Péter Hargitai
CONTACT E-MAIL	phargitai@geoadat.hu
LANGUAGES	English, German
ESTABLISHED	1997

MAIN INTEREST

Connected to task in project-based performance, GeoData Services undertakes database building, update of databases, quality controlling and process monitoring.

Major services:
Earth Observation services and image information mining

- Special GIS databases
- Groundmap (cadastral) processing
- Database services for the public utility network

COMPETENCIES

TD 26 Earth Observation

PROJECTS

Control of the area based subsidies with remote sensing, Saarland

In 2008, the consortium of GeoData Services Ltd and Luftbild Brandenburg GmbH. was assigned to carry out the CwRS in the German Federal State of Saarland.

Within the consortium, GeoData Services Ltd coordinates and manages the project and the cooperation with sub-contractors (FÖMI, ILV). A major part of the responsibility of GeoData Services Ltd is the administration of the agricultural database within the framework of the Integrated Administration and Control System (IACS) and the interpretation of remotely sensed data.

In the course of the project, applications from approximately 90 km² will be checked. A main part of the project besides the classic remote sensing control tasks is the checking of Good Agricultural and Environmental Conditions (GAEC).

Financed by: Federal Ministry for Food, Agriculture and Consumer Protection, Germany

Control of the area based subsidies with remote sensing, Brandenburg

The consortium of GeoData Services Ltd and Luftbild Brandenburg GmbH was accepted for the CwRS-project 2009 in the German state of Brandenburg.

The project is carried out within the framework of a multi-year treaty. During the work, GeoData Services Ltd is responsible for coordinating the entire project as well as the work of the subcontractors (FÖMI, ILV) - a similar position to the CwRS project in Saarland. Up-to-date satellite images and up-to-date aerial imagery are used for the CwRS of almost 4700 agricultural parcels in an area covering 1603 km².

Financed by: Federal Ministry of Food, Agriculture and Consumer Protection, Germany

Project timeframe:

April 2009 – December 2009

April 2010 – December 2010

April 2011 – December 2011

April 2012 – December 2012

April 2013 – December 2013

DOWNSTREAM

GEODATA

External Quality Control of the Control with Remote Sensing of the Agrarian Subsidies

The Romanian Ministry of Agriculture and Rural Development contracted the consortium led by GeoData Services Ltd (partnered by the Institute of Cartography and Remote Sensing, and S. C. GeoGIS 2000 S.R.L., Romania) for the external quality control of the remote sensing measurements.

GeoData Services Ltd fulfilled the following tasks during the realization of the project: leading the project, checking the consistency and the conformity of the databases, checking the subsidy allocations, checking the evaluations of the raster files (satellite images, ortho-photos) and checking the observance of the GAEC regulations.

During the project, we had to check the quality of the result data from the agrarian subsidies controlling process, which was based on the remote sensing measurements of farms at different places in Romania, totalling 16 000 square kilometres.
The project had been performed under special circumstances as 2007 was the first control year in Romania, and the number of the farms were the highest in this country among the member states, and the sizes of each farm and cultivated parcels were relatively small.

Financed by: Ministry of Agriculture and Rural Development Agricultural Paying and Interventions Agency, Romania

Project timeframe:

June 2008 – End 2009,

November 2009 – End 2010

Earth Observation Knowledge and Technology Dissemination, Hungary

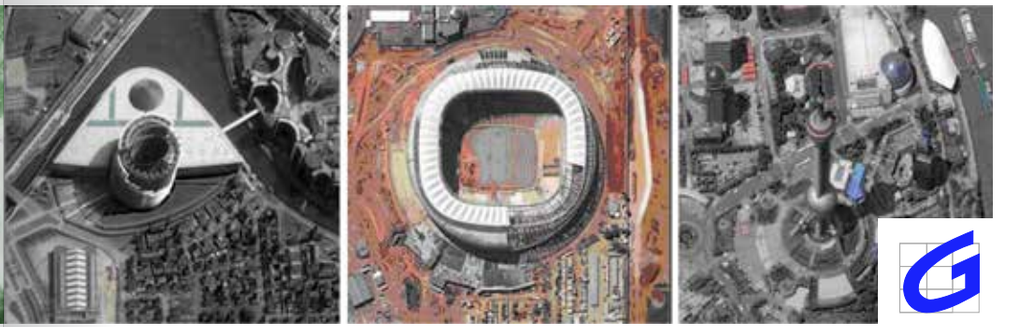
The purpose of the Earth Observation Knowledge and Technology Dissemination, Hungary (EOS Knowledge and Technology Dissemination) project is to develop remote sensing data, technology and related fields knowledge and an acceptance level in Hungary to the general ESA expectance level.

The aim of the project is to gather and spread knowledge about earth observation data and applications as well as accessing the potentialities of ESA environments in support of research and application exploitation.

Financed by: ESA ESTEC

Project timeframe:

September 2009 – March 2012



GENERAL INFORMATION

History: In 1997, GeoData Services Ltd was established to manage and realise large volume geo-information related databases.

GeoData offers effective and high quality work to partners and customers. Projects are realised over a long-term commitment; most customers have been in connection with us for many years. Our customers are from the regional utilities, state administration, and research and development organizations. GeoData together with its partners have successfully participated in several EU projects with high added value.

GeoData Services:

- Provides Earth Observation services since 2001 in several EU countries
- Is a member of Hunspace and of Hunagi
- Has ISO9000 certificate on its Earth observation services
- Meets official "IT-Sicherheit" performance level on a yearly basis
- Has reseller contract for all main image providers

Employees: 20 staff

Turnover: 744,000 EUR

Location:

*Main office: H-*1088 Budapest, Szentkirályi u. 8.

German office: 55118 Mainz, Josefstraße 18.

Facilities:

- 5 server PC
- 25 client PC
- Earth observation and GIS application software tools
- High performance A0 size input and output devices
- Process management tools

Quality assurance:

GeoData considers high quality as a consistent requirement of its work with the introduction of a quality assurance system according to the standard EN ISO 9001:2008. The company's quality assurance system includes an engineering operation on analogue and digital data processing, remote sensing and quality control. Company management is EOQ (European Organisation of Quality) certified since 2012.

DOWNSTREAM

HUNGARIAN METEOROLOGICAL SERVICE

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WEBSITE	www.met.hu
E-MAIL	omsz@met.hu
PRESIDENT	Dr. Kornélia Radics
CONTACT	Eszter Lábó
CONTACT E-MAIL	labo.e@met.hu
LANGUAGES	English
ESTABLISHED	1870

MAIN INTEREST

The Hungarian Meteorological Service (OMSZ) is a central budget institution. It is responsible for supplying short range and long range weather predictions and atmospheric environmental and climate information; and for the provision of severe weather warnings in Hungary. The archived climate data, and climate models of the Service are used to provide processed meteorological data, perform climate analyses and to produce impact studies for different branches of the economy.

OMSZ carries out activities on atmospheric transport modelling, and operates the national air quality reference centre; it is responsible for the greenhouse gas inventory in Hungary.

All this is based on the extended national and international infrastructures. The ground observational network over Hungary includes automatic weather stations, radio-sounding and radar measurements, and lightning localization measurements. OMSZ runs a telecommunication and informatics system and obtains all the meteorological data from the Global Telecommunication System of the World Meteorological Organization. It maintains intensive cooperation with various international organizations (European Centre for Medium-range Weather Forecasts (ECMWF), the European Organization for Exploitation of Meteorological Satellites (EUMETSAT), and the Regional Cooperation for Limited Area Modelling in Central Europe (RC LACE). OMSZ carries out research and development activities mostly within national and European Union development projects. The main application of satellite data at OMSZ is related to weather forecasting; especially imagery and products from geostationary Second Generation Meteosat (MSG) satellites. Our limited area numerical weather prediction models use assimilated data from MSG and also from polar orbiting NOAA and MetOp satellites.

COMPETENCIES

TD26 – Other
Meteorology, climate, weather forecasts, applied earth observations, air quality, in-situ observations.

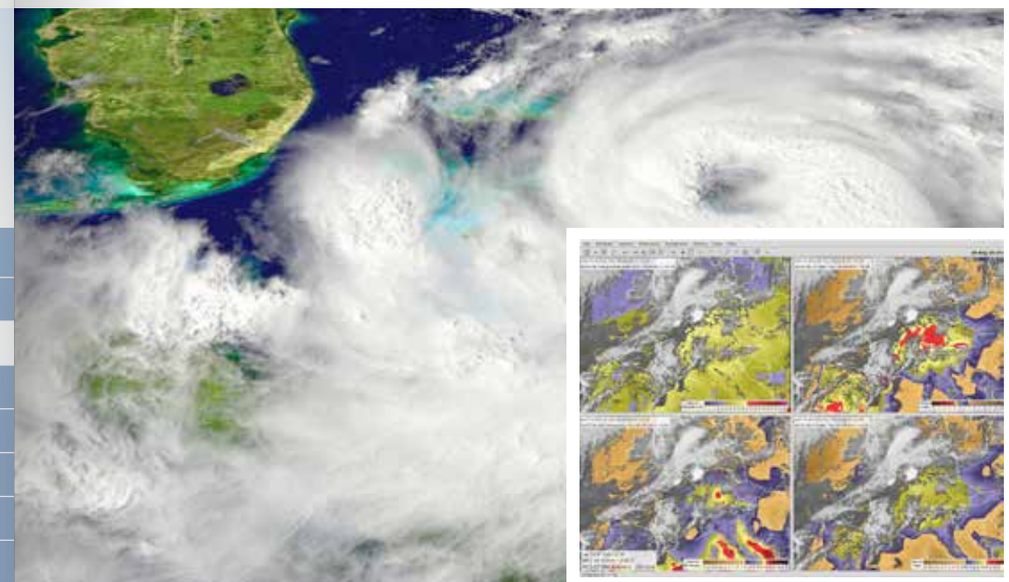

Fig. 1: *Satellite derived parameters for the cloud free regions: vertically integrated water vapour content (top left) and instability indices (Lifted Index – top right, Maximum Buoyancy – bottom left, K-Index – bottom right). In the cloudy regions, an infrared (10.8 μm) image is presented. 18 August 2011. 15:25 UTC*

PROJECTS

1. CI Convective Initiation

Within the framework of three EUMETSAT studies, we analyse the pre-convective environment (water vapour content and atmospheric instability, like in ***Fig. 1.***) and convective initiation based on Meteosat Second Generation data.

Reference: Marianne König, EUMETSAT.
Financed by EUMETSAT 2012-14
Contact: Mária Putsay - putsay.m@met.hu

DOWNSTREAM

HUNGARIAN METEOROLOGICAL SERVICE

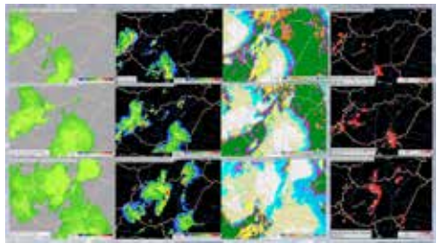

Fig. 2: Comparison of H-SAF product with different meteorological parameters, 29th July 2012. Precipitation rate information from the H-SAF product (left panel) and from the Hungarian radar network (middle left panel), cloud classification derived by Nowcasting-SAF (middle right panel), LINET lightening product (right panel).

H-SAF

As a member of the EUMETSAT Satellite Application Facility on Support to Operational Hydrology and Water Management (H-SAF), we verify satellite retrieved precipitation fields with Hungarian weather radar data and surface rain-gauge measurements as shown on ***Fig. 2***.

Reference: hsaf.meteoam.it
Financed by EUMETSAT. Duration 2005-2017
Hungarian contact: Judit Kerényi, kerenyi.j@met.hu

EUMe Train

For the EUMeTrain project, (helping the use of satellite data through e-learning) we produced on-line presentations and a case study about severe storms, and also a training module on the use of satellite derived water vapour content and instability indices. Financed by EUMETSAT and participating countries. We have been co-operating with the team since 2012, and plan to join as a member in 2014.

ImagineS

Implementation of Multi-scale Agricultural Indicators Exploiting Sentinels

ImagineS is an FP7 project continuing the work of FP7/Geoland2 to support the operations of the Global component of the Copernicus Land Service, preparing the exploitation of the future Sentinel data in an operational context. The role of OMSZ within the consortium is to calculate CO2 fluxes and agricultural indicators with the SURFEX numerical model and assimilate LAI, soil moisture, albedo and FAPAR data.

Reference: fp7-imagines.eu
Financed by EU/FP7. 2012-16.
Contact : Balázs Szintai, szintai.b@met.hu

Vegetation monitoring

We monitor the vegetation by satellite data. We produced 10 year averages of vegetation indices calculated from polar orbiting satellite data; during the vegetation period we monitor and visualize the deviation of the actual vegetation index from the average. We have another project: "Methodologically established satellite born phenological observation to detect the response of global change induced reaction of the ecological system".

Contact: Enikő Vincze, vincze.e@met.hu.
Financed by Hungarian Scientific Research Fund (OTKA) 2010-14

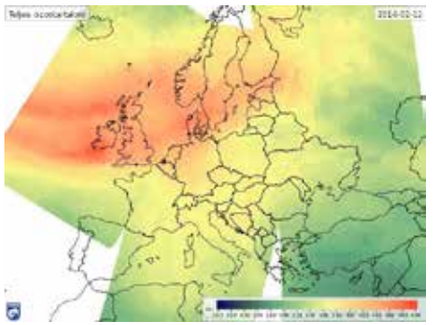

Fig. 3: Total ozone content from MetOp satellite in Dobson Unit for 12 Feb 2014.

Total ozone content

Total ozone content of the atmospheric column derived from GOME-2 instrument data on board EUMETSAT's polar orbiting satellite, MetOp, as calculated by the Ozone SAF (Ozone and Atmospheric Chemistry Monitoring Satellite Application Facility), is compared to Brewer spectrophotometer ozone data measured at the Budapest reference observatory of OMSZ. Ozone content is visualised by IDL tools and also within the Hungarian Advanced Weather Workstation (HAWK), as in ***Fig. 3***, in order to share it on our homepage once a day fulfilling public interest.

Financed by the Hungarian Ministry of National Development (URKUT_10-1-2011-0018), 2013-14
Contact:
Zsófia Kocsis, kocsis.zs@met.hu

DOWNSTREAM

HUNGARIAN METEOROLOGICAL SERVICE

GENERAL INFORMATION

History: Apart from the operational routine, the Satellite Research Laboratory of OMSZ has taken part in several international projects, like SoDa (EU FP5) for building radiation data archives or a NATO project for flood detection in the Körös river basin. We co-operated several times with the NOWCASTING SAF team of EUMETSAT for validating the products and developing applications. We are a member of the Hydrology SAF team and the Convection Working Group of EUMETSAT.

In the past three years, one colleague of OMSZ has been awarded the Order of Merit of the Hungarian Republic (civilian), and two colleagues the Knight's Cross from the Order of Merit of the Hungarian Republic. Two colleagues received the Shenzl Guidó Award and nine the Pro Meteorology Award from the Ministry of Rural Development. In 2010, one colleague received the World Meteorological Organization Research Award for Young Scientists.

Employees: 194

Turnover: 6,700,000 EUR

Location: 5,600 m^2

Facilities: In total, 106 automatic weather stations across Hungary, 35 global and five pieces of UV-B radiation measurement equipment, 141 hydrometeorological stations, and three meteorological radars (the fourth is being installed), three satellite (EUMETCast) receivers. Calibration laboratory for meteorological instruments. Computer resources: two clusters with 3.3 TB and 192+208 GB RAM, a database server, Central Processing and Controlling System, Central Archive and Storage System, two web servers. LAN, SAN, WAN, internet connections.

Software: Own developed Meteorological visualization system workstation (HAWK3), Interactive network database access (INDA), several web portals

Quality assurance: ISO 9001:2008 (Certificate Nr. HU02/0017, Issue 4.), valid until 15 February 2015, and air navigation service provider compliance Certificate (Nr. HU-031-MET), valid until 30th of September, 2016.

RESEARCH

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BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

ECOTECH ECOTECH CO.

MISKOLC UNIVERSITY

RESEARCH

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E-MAIL	bayzoltan@bayzoltan.hu
GENERAL DIRECTOR	Tamas Skultety
CONTACT	Zoltan Hantos
CONTACT E-MAIL	zoltan.hantos@bayzoltan.hu
LANGUAGES	English, German
ESTABLISHED	1993

MAIN INTEREST

BASIC MATERIALS (TRL1)

The Department of Nanomaterials at the BAY -LOGI Institute (Miskolc) has been developing new, light-weight aluminium-based materials, which can be used in aero-structures. Those include carbon fibre-reinforced aluminium matrix composites, particle stabilized metallic foams and emulsions, and monotectic alloys. We are seeking partners to develop our prototypes further and to build them into aero-structures.

TD 24.1 Novel materials.

Contact: gyorgy.kaptay@bayzoltan.hu

STRUCTURE (TRL1)

Structural Integrity studies for reliable and safe operation of different structures and components. It includes the research of damage mechanisms in structure materials, reliability assessment of various error detection methods, condition and lifetime estimation of structures, numerical modelling methods in the design, in development engineering and in the assessment of the operational safety and residual lifetime.

TD 20.10 Advanced structural concepts...

Contact: szabolcs.szavai@bayzoltan.hu

Static and fatigue mechanical tests under uniaxial and biaxial (tension/torsion) load. High accuracy measurement of material properties in wide temperature ranges (-150...1400 °C). Strain measurements in ranges 50-500 mm. Sample dimension to max. 900x800x1500 mm. The static and fatigue tests, requiring extreme load and torque, can be carried out up to 500 kN and 2400 Nm.

Contact: peter.rozsahegyi@bayzoltan.hu

LASER TECHNOLOGY (TRL1)

Laser Beam Assisted Surface Alloying. Alloying with various additives. Laser welding. Special cutting (cutting of special materials, and 3D cutting), joining by welding (with or without additional filler materials, deep penetration welding), welding methods involving deposition of additional material, surface hardening, surface alloying and surface structuring of steel, laser beam assisted surface cleaning.

TD 24.2 Materials processes.

Contact: gabor.buza@bayzoltan.hu

ELECTROCHEMISTRY (TRL1)

Nano-structured metal coatings. Production of nano-structured magnetic soft iron thin layers; surface modification of medical implant alloys; development of methods for assessing modified metal surfaces/coatings; making copies of photolithographically created patterns by electrochemical deposition of a nano-structured Ni-layer.

TD24.2:Materials processes

TD 24.1 Novel materials.

Contact: eva.fazakas@bayzoltan.hu

RESEARCH

BAY ZOLTÁN NONPROFIT LTD. FOR APPLIED RESEARCH

PROJECTS

STYLE

Structural Integrity for lifetime management – non-RPV components Goals: The overall objective of the project is to assess, optimize and develop the use of advanced tools for the structural integrity assessment of reactor coolant pressure boundary components (RCPB) relevant to ageing and lifetime management and to integrate the knowledge created in the project into mainstream nuclear industry assessment codes.

Reference: Grant Agreement N°249648 (Coordinator: AREVA NP GMBH)
Financed by EU FP7 – EURAT OM (2010-2014)

MULTIMET

Structural performance of multi-metal component Goals: to provide recommendations for a good practice approach for the integrity assessment of dissimilar metal welds as part of overall integrity analyses and leak-before-break (LBB) procedures.

Financed by: EU FP7 – EURATOM (2011-2015)

VIRTLAB

Virtual Reality Laboratory for Factory of the Future Goals: The focus of the project is to establish a virtual environment to study and develop the manufacturing process and the product behaviour, develop the synergy of the existing knowledge and experience in the field of scientific research and technological development.

Reference: Technical University of Košice, Slovakia
Financed by Hungary-Slovakia Cross-border Co-operation Programme 2007-2013, HUSK/1101/1.2.1/0039
(2012-2014

STRAPAMO-MATELCOMP

Performance oriented material laws for the simulation of elastomer and composite components under complex loading situations Goals: Evaluate the potential of existing fatigue design methodologies for conventional materials (metals, plastics) and their applicability for elastomers and composites based on theoretical considerations and the existing know-how with various partners, and to define the limitations of these methodologies for these material classes. Carry out selected case/feasibility studies to substantiate and verify the conclusions. Define research objectives of high importance for the development of novel fatigue design methodologies that allow for a better predictability of component performance and enhanced safety of components in service.

Reference: UID-Nr.: ATU 54829208
Financed by Austrian Federal Ministry of Economics and Labour

CF/AL-MMC

(carbon fibre reinforced aluminium matrix composite strands). Electric cables are produced of aluminium with a steel core. Aluminium conducts electricity, while the steel core maintains the strength. Our long term engineering goal is to replace the high density steel core with a low density aluminium matrix composite core. In the latter, the mechanical properties are ensured by carbon fibres. Subsequently, the production technology should be developed.

Financed by: OTKA-NKTH project No CK 80255 (Hungary)

NEWMAT

The Lighthouse Innodriver "NewMat" large project concerns the materials science input in innovation regarding sustainable energy systems. The anticipated implementation of new materials will lead to an enhancement of existing, and the introduction of innovative technologies for energy production. New materials with improved properties, more resistant to exposure in aggressive environments, will also influence cost savings and significantly increase efficiency in (clean) energy production.

Financed by: European Institute of Innovation and Technology, under a KIC Inno Energy.

GENERAL INFORMATION

History: Bay Zoltán Nonprofit Ltd is a research institution conglomerate located in five Hungarian towns. There are five departments around the materials science profile who have space business relevance. The expertise of the Departments of Nanomaterials, Structural Integrity, Material Testing, Laser Technology and of Electrochemistry are eminently suited to new challenges from the space industry.

Bay Zoltán
Nonprofit Ltd.
for Applied Research

Employees: 240

Turnover: 8,716,000 EUR

Location: Four Institutes, eight laboratories located in Budapest, Miskolc, Szeged, Eger, Tatabánya

Facilities: Fully equipped mechanical test lab for tensile test (low-, room- and elevated temperature), compressive tests; fatigue testing with three and four points bending; uniaxial fatigue tests (LCF, HCF); fracture mechanics tests (KIC, JIC, dadN, DKth); biaxial tests (axial/torsion) static and alternate loading; technological tests (welds, bonding units); impact testing (300 J), drop test (2700 J); instrumented hardness test (HV, HRC indentor) and surface roughness measuring.

Patents: about 25 patents or other IPR

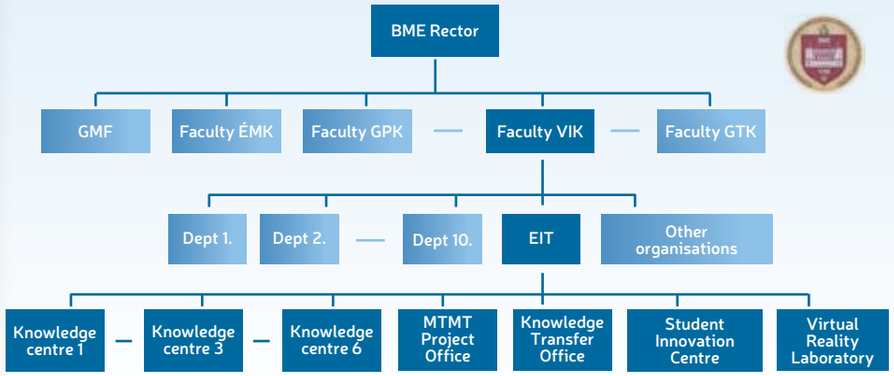
Quality assurance: ISO9001

RESEARCH

BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS (BME)

ADDRESS	H-1111 Budapest, Műegyetem rkp. 3.
WEBSITE	www.bme.hu (nb: BME is the Hungarian acronym)
RECTOR	Gábor Péceli
ESTABLISHED	1792
CONTACT	Federated Innovation and Knowledge Centre of BME (EIT BME)
ADDRESS	H-1111 Budapest, Egry J. u. 18. V1 C201
WEBSITE	www.eit.bme.hu
DIRECTOR	Kálmán Kovács
TELEPHONE	+36 1 463 1669
MOBIL	+36 30 441 1669
CONTACT E-MAIL	kovacsk@mail.bme.hu
LANGUAGES	English
ESTABLISHED	2009

EIT IN STRUCTUAL CONTEXT



MAIN INTEREST

The BME is, by its mission, a research university, and its primary task remains the provision of high-level training of mechanical, IT and natural science engineers as well as economics, business and management professionals; all capable of solving creative and innovative R&D problems, able to elaborate and implement new products and to encourage entrepreneurship.

The contact point inside BME is the Federated Innovation and Knowledge Centre (EIT BME). EIT BME operates as a R&D service centre. Its activity is focused on the promotion of the research-development activity at BME; initiating cooperation with institutions, industrial companies and other domestic and international organizations; providing project management services (incl. professional coordination) to departments and research groups, and organizing project groups of faculty departments and research groups to participate in tenders.

One of its functions is to organize and integrate the **Space research and technologies** at university level. Currently, there are nine departments involved in space research and technology. The list of departments and abbreviations are detailed later.

The BME space research and technologies profile is very broad.

A BRIEF OVERVIEW

DGS:

Products and Services for GNSS and Satellite Geodesy (GOCE AO)

DPG:

Spaceborne Remote Sensing

DAM:

- Applied sciences in solid mechanics and dynamics
- Force control, haptics, teleoperation and attitude stabilization

RESEARCH

BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS (BME)

DMOE:

- Embedded system development, Robotics and motion control
- 3D visualization in intelligent space and in robotics

DET:

- Aerospace applications
- Thermal chamber, thermal shock, highly accelerated stress test

DED:

- Complex (HW-SW co-design) embedded system
- Innovative Nano and Micro Technologies

DNSS:

- Analysis, Design and Development of ICT Systems
- GIS modelling and applications, Environmental remote sensing

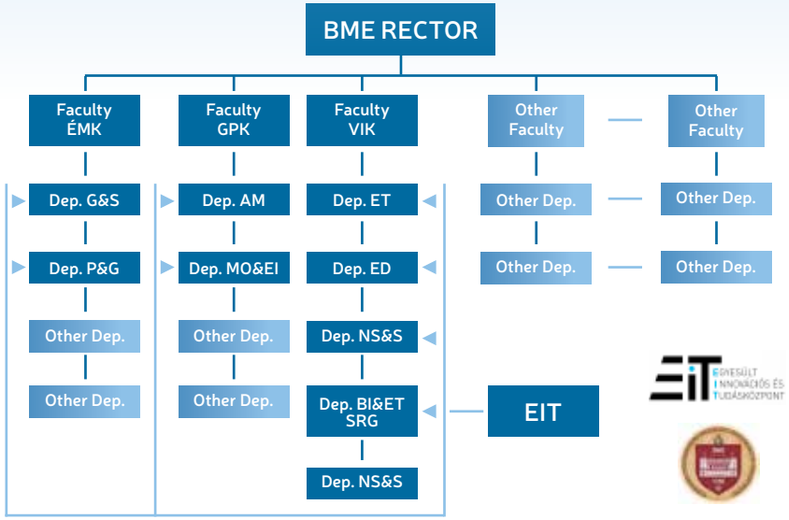
SRG:

- Power subsystems and onboard data collection systems for satellites
- Redundant systems; High reliability and radhard electronics

FTSRG:

- Fault Tolerant System Engineering
- Automated model-based traceability assurance

EIT IN SPACE ACTIVITY COORDINATION AT BME



PROJECTS

Within the framework of its major task of project management and coordination, EIT BME has managed eight projects to the value of 13.6 M EURO since 2010 and employed 2,200 persons in 5,000 contracts. The projects involved the creation of over 20 patents and nearly 1,200 articles and studies. To illustrate the wide range we have listed the titles of some projects

DGS:

- Continuous operation of a real-time GNSS station at the BME and inclusion to the Hungarian active GNSS network.
- Continuous operation of an EGNOS monitoring station at the BME and data transfer to the EuroControl.

DAM:

- Development of mechatronic systems for Knorr-Bremse Kft
- Analysis of nonlinear vibrations for Hungarian Nuclear Power Station Paks ZRt

DMOE:

- Development of a detector objective with narrow angle lens and ortometric calibration of two CCD detectors for VEGA space programme
- Development of the image processing operations and investigation of the optical filters for ROSETTA.
- Development of Cosmic radiation measurement platform for several missions

RESEARCH

BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS (BME)

DET:

- Design of communication interface module between cosmic radiation measurement device and OBC (AlmaSpace)
- Dosimetric Laboratory of the Centre For Energy Search (for TriTel)
- ESA educational projects (BEXUS 14-15, ESEO, REXUS 17-18)

DED:

- SC development and space technology (Masat-1)
- Smart integration of GaNandSiC HPE for industrial applications (FP7 Smartpower)
- Modelling, Control and Management of Thermal Effects in Electronic Circuits of the Future (FP7 THERMINATOR)
- Innovative Nano and Micro Technologies for Advanced Thermo and Mechanical Interfaces (FP7 NanoTHERM)

DNSS:

- Content and cOntext aware delivery for iNteraCtive multimEdia healthcaRe applicaTiOns (FP7 ICT CONCERTO)
- Energy Aware Radio and Networking Technologies (FP7 IP - EARTH)
- EU-MESH (FP7 ICT - The Network of the Future)

SRG:

- Onboard Power Supply System for ESA Rosetta and ESA ESEO
- Onboard data collection system for ESA Rexus/Bexus
- Picosatellite development in cooperation (Masat-1)
- Continuous operation of satellite control ground station for Masat-1

FTSRG:

- Scalable Modelling and Model Management in the Cloud (EU FP7 MONDO)
- Embedded Systems for Manufacturing and Process Automation (EU FP7 R5-COP ARTEMIS)

GENERAL INFORMATION

BME

BME is the leader in Hungarian technical higher education. On an international level, BME is a renowned university of the Eastern Central European Region. Its degrees are recognized throughout the world. From among its excellent students, three were awarded the Nobel Prize: György Oláh (1994), Dénes Gábor (1971) and Jenő Wigner (1963). Webometrics 2012 ranks

BME as the best Hungarian university, 277th globally. BME is the most successful Hungarian institution in EU FP6 and FP7 programmes

Turnover: 110,000,000 EUR

Employment: 2,793

(including 1,297 FTE for research and education)

EIT BME

EIT BME (Federated Innovation and Knowledge Centre) was created at the Faculty of Electrical Engineering and Informatics of BME in 2009. Its aim is to stimulate the research and development activity and the utilization of the research results at the Faculty, and to be able to do the same at university level. EIT BME operates as a R&D service centre.

Turnover: 3,473,000 EUR

Employment: 10 FTE for project management and 650 (217 FTE) contracted researchers.

Departments involved in space research and technologies

Currently, 73 departments of eight faculties encompass the research and education activities of the BME. From among these, nine departments of three faculties took part in the present information provision:
Department of Geodesy and Surveying DGS; Department of Photogrammetry and Geoinformatics DPG at the Faculty of Civil Engineering (ÉMK); Department of Applied Mechanics DAM; Department of Mechatronics, Optics and Engineering Informatics DMOE at the Faculty of Mechanical Engineering (GPK); Department of Electronics Technology DET; Department of Electron Devices DED; Department of Networked Systems and Services DNSS; Department of Broadband Infocommunications and Electromagnetic Theory, Space Research Group SRG; Department of Measurement and Information Systems, Fault Tolerant Systems Research Group FTSRG at the Faculty of Electrical Engineering and Informatics (VIK).

Turnover: 3,066,000 EUR

Staff: 231 FTE

RESEARCH

ECOTECH CO.

AT UNIVERSITY OF DUNAÚJVÁROS

ADDRESS	H-2400 Dunaújváros, Táncsics Mihály u. 1/A.
TELEPHONE	+36 25 551 295
WEBSITE	www.ecotechnpzrt.hu
E-MAIL	info@ecotechzrt.hu
GENERAL DIRECTOR	Otto Szabados
CONTACT	Dr. Gabor Por
CONTACT E-MAIL	porg@uniduna.hu
LANGUAGES	English, Russian
ESTABLISHED	2008

MAIN INTEREST

Research and Development in Natural Sciences and Engineering Research and Development Division: Lifelong R&D Laboratory (vibration and heat and environmental testing of components) Surface Laboratory (salt testing, surface examination); MAID Laboratory (all kinds of non-destructive testing, ultrasound, acoustic emission, eddy current, heat camera, fast camera, testing); E-engineering consulting (final element analysis, mechanical and heat analysis of systems)

Education division: Adult education (welding, CNC programming, CAD-CAM informatics, cameraman, sports manager, tax-officer, etc.); On-line studium (developing e-learning, on-line courses, polymedia, green-box techniques); Language Courses

COMPETENCIES

TD 8 System Design & verification

11.1 Measurements

14.4 Applied Physical Science Technology

15.7 Mechanism engineering

TD 20 tructures & Pyrotechnics

20.1 Structural design and verification methods and tools; Damage tolerance and health monitoring

20.2 Advanced structural concepts and materials

TD 21 Thermal: Thermal Analysis Tools

Non-destructive assessment, structural and condition monitoring, material testing, teaching and education.

References: Robert Bosch Elektronika Kft.; Robert Bosch Kft.; Robert Bosch S. R. L.; ADMATIS Kft.; FLEXTRONICS International Kft.; SMR Automotive Mirror Technology Hungary Bt.; ThyssenKrupp Presta Hungary Ltd.; TRIGO Quality Support Kft.; Valeo Auto-Electric Magyarország Kft.; Vincotech Hungary Ltd.; Jabil Circuit Magyarország Kft.; Prettl Hungária Kft.; Diamond Electric Kft.; Continental Automotive Hungary Kft.; Yourcontact Marketing and Reklámügynökség Kft.

PROJECTS

- Development of thermal and optical elements of satellites, Financed by GOP-1.1.1-11-2012-0078, Lead by ADMATIS Ltd
- Investigation of high performance structural materials, Financed by: TAMOP-4.2.2.A-11/1/KONV-2012-0027 Lead by University of Dunaujvaros
- From material properties to application. Financed by: TAMOP-4-2-2.A-11/1/KONV-2012-0071, lead by University Dunaujvaros

GENERAL INFORMATION

History: Ecotech Co was established by the University of Dunaujvaros, which stands behind our work. That means, besides the well established shaker tests, climate tests, scanning ultrasound testing, that our company is ready to solve special problems of our customers, since there are more than 300 experts working at the university, who are ready to help us with any questions. There are elector microscopes and there is a Thermomechanical Simulator with Nanoprocessing (Gleeble 3800), or Zeiss Scanning Electron Microscope, Welding Laboratory Altogether, 15000 kEuro invested in equipment, and 40000 kEuro for other infrastructures at the University, which all can be involved in solving rare and interesting problems in industry and space research.

Employees: 27 persons

Turnover: 160,000,000 HUF (2014)

Location: 220 sq.m

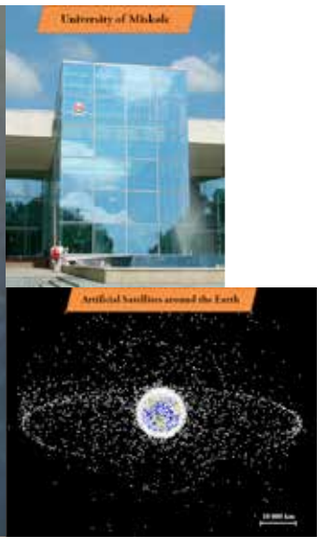
Facilities:
Shakers, LDS 875/440, TIRA, Climate chambers: Vötsch, Heat shock machine: Weiss, Salt spray machine, Olympus 1000-i, Olympus LTD, **Olympus i-SPEED 3**, **Olympus - IPLEX LX/LT**, **OLYMPUS - OmniScan MX** (eddy and UT), **Brüel & Kjaer - Ometron VH-1000-D National Instruments - cDAQ-9172 and cRio-9074** AED-40 32channels Acoustic emission, PXI Nat.Instr., Pro TP8S, **IR FlexCam - Pro 320**

Quality assurance:
ISO 9001, by Det Norske Veritas.

RESEARCH

UNIVERSITY OF MISKOLC

ADDRESS	H-3515 Miskolc-Egyetemváros, Hungary
TELEPHONE	+36 46 565 111
WEBSITE	www.uni-miskolc.hu
RECTOR	Prof. Dr. András Torma
CONTACT	Dr. Béla Viskolcz
CONTACT E-MAIL	bela.viskolcz@uni-miskolc.hu
ESTABLISHED	1735



GENERAL INFORMATION

The campus of the University of Miskolc is a city within the city of Miskolc, and is unique in Hungary in this respect. The constantly renewing and dynamically developing institution not only strengthens the regional role and influence of Miskolc, but directly contributes to the economic and social revitalization of the city and the region.

The university continues to enrich values through its educational and research work worthy of its 270-year history. The modernization and development of university infrastructure continues in a separate part of Miskolc, creating a modern environment for the 10,000 students and 1,100 employee of the region's most important universities.

Materials engineering – the science of the structure and properties of materials, as well as material manufacturing by energy efficient and environmentally safe technology – is a dynamically developing field worldwide. The Hungarian "capital" of materials engineering is Miskolc. The University of Miskolc is a proud successor of the Mining Academy of Selmecbánya, the oldest institution of technical higher education in Europe (dating back to 1735). This is a heritage that gives us the example of fine engineering education and the one that is also a responsibility for the future.

SPACE SCIENCE ACTIVITY

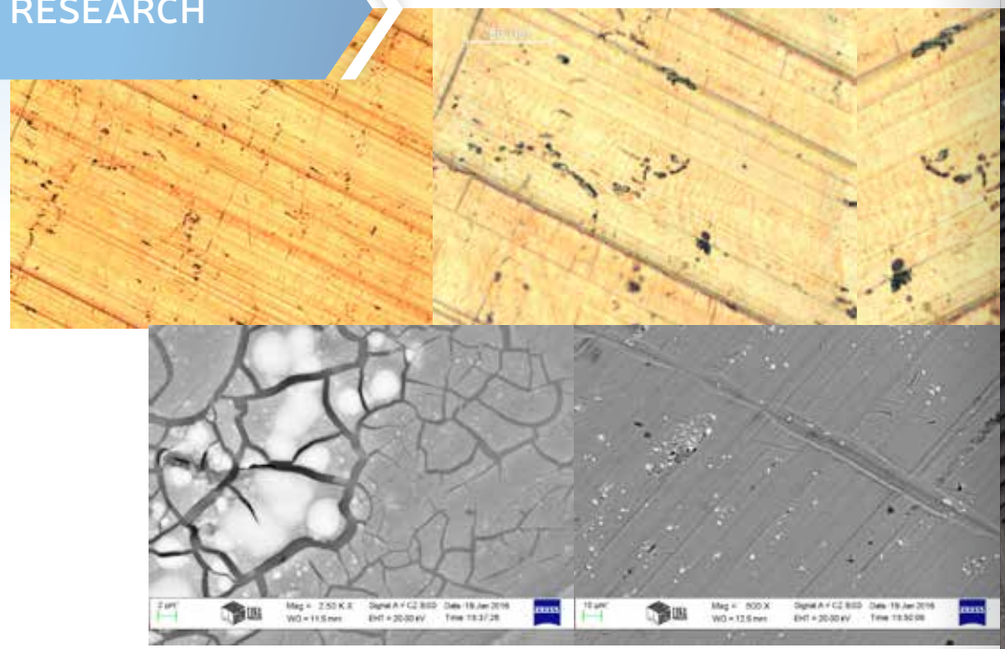
The Institute of Materials Science of the University of Miskolc (and its predecessor, the Department of Metallography) started its research activity on solidification processes in the 1970s. These activities provided the foundation for the BEALUCA space material technology program, which was implemented in 1980 for a joint Soviet-Hungarian space flight.

One of the lessons of the program was that the crystallization equipment used on the SALIUT-6 space station was not up-to-date; therefore the results obtained were not very accurate. In 1987 the Department was invited to design and build a new, so-called multi-zone crystallization equipment (it became known to the public as the "space furnace"), at that time with a Soviet partner for a Soviet space expedition. Following the changes in the political system, this partnership has come to an unfortunate end, but at the same time experts at NASA showed an interest in the equipment.

The first international conference on Solidification and Gravity was organized in Miskolc-Tapolca in 1991 with the participation of 35 research specialists from 10 countries. The success of the equipment and the internationally acknowledged research results of the Department, have made a conference series possible every fourth year. This conference is aimed to attract everyone with interest in the investigation and simulation of different types of solidification processes and both micro- and macro-gravity effects. The 7th International Conference on Solidification and Gravity will be held in 2016 in Lillafüred (a resort by Miskolc).

The researchers of the Institute of Physical Metallurgy, Metalforming and Nanotechnology have participated – amongst others - in the Materials Science Laboratory project for the ISS (Columnar-to-Equiaxed Transition in Solidification Processing and Microstructure Formation in Casting of Technical Alloys under Diffusive and Magnetically Controlled Convective Conditions, MSL-CETSOL and MICAST) developed by ESA and sponsored by NASA. The consortium for the project involves several research teams worldwide as well as companies in Hungary.

RESEARCH



In the Space materials and technologies branch of "Kerpely Antal Doctoral School of Materials Science and Technologies" some microgravity influenced material phenomena were studied. Heat conductivity of liquids was studied by drop experiments in Drop Tower Bremen. Gravity effects on foaming phenomena was experienced on ISS Colombus modul.

The faculty collaborates with the space industry in materials development research work with aims of corrosion protective layers and layered panels. The main interest is to fulfill high level material R+D projects on the basis of our laboratory capabilities (property tests, chemical and structure analysis) and engineering skill (TRL1-3).

PROJECTS

Long term collaboration with NASA Marshall Space Flight Center Space Science Lab for single crystal growth. During cooperation lasting over ten years the University was involved in the design of the Materials Science Research Facility for the Destiny modul of the International Space Station. (Reference: Ching-Hua Su, NASA Marshall Space Flight Center)

The University of Miskolc is also involved in the various space industry actions of HUNSPACE. Tasks includes laboratory tests, failure analysis, mechanical and thermal property inspection.

UNIVERSITY OF MISKOLC

A VISION FOR THE FUTURE

The University of Miskolc has competence in a broad range of fields, a unique combination with the potential to form a Space Science Research Center. Most of the open questions of a future space mission (such as space travel or the establishment of human colonies on the moon) are complex issues and any solution needs interdisciplinary teams from the enginneering and/or social faculties. This is where the fields covered by the Faculties of the University of Miskolc seems to be at an optimum (e.g., interstellar mining, space materiels and technologies, recycling and waste recovery, mechatronics, mechanical engineering under micro or super gravity, space law, social aspects of an isolated community, health issues, etc.)

This is a vision for the future only, and presently open to discussions.

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... location search & evaluation
+
site visits.

...meetings with HR & Real Estate agencies, Law firms and other consultants based on your needs.

...reference visits at companies that are already established in Hungary.

...assistance with your incentive application.

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YOU HAVE CHOSEN
HUNGARY

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Customer service: **investment@hipa.hu**
Telephone: +36 1 872 6520
Web: www.hipa.hu

HIPA
INCENTIVES OVERVIEW

GOVERNMENT INCENTIVES

As a member of the European Union, Hungary's regulations on incentive opportunities are in accordance with the EU rules. One of Hungary's competitive advantages over other countries in the region is the Government's strong commitment to increase the competitiveness of SMEs and large enterprises in Hungary.
Alongside the regulatory tools that contribute to the competitive business environment of local companies, Hungary offers a wide range of incen tives to facilitate foreign direct investments and reinvestments by local enterprises. Subsidies may be granted as regional aid or specific aid, such as R&D subsidies.

THESE INCENTIVES INCLUDE, BUT ARE NOT LIMITED TO

CASH SUBSIDIES
for investments, training, job creation and R&D

TAX INCENTIVES
reduction of corporate tax, social tax, or for encouraging R&D activities...

LOW-INTEREST LOANS

SPECIAL INCENTIVES
of the free enterprise zones

Regional grants are the most typical forms of incentives for greenfield / brownfield investments or reinvestments. The maximum amount of regional incentive is shown in the regional aid intensity map. The map below illustrates that regional aid available for investment by a large enterprise may be up to 50% of the eligible costs of the investment, depending on the region. For investments not exceeding €50 million, the maximum intensity ratio can be increased by 10 percent for medium-sized and by 20 percent for small enterprises.

The maximum available aid intensity decreases if the investment is a large investment (exceeding €50 million): 50% of the maximum aid intensity determined in the regional aid map is available for investment between €50 and €100 million, with 34% of the maximum aid intensity for investment over €100 million.

For information on up-to-date and individual incentive packages please contact HIPA directly.

COMPETENCY MAP

	On-Board Data System	Space System Software	Spacecraft Electrical Power	Spacecraft Environment & Effect	Space System Control	Electomagnetic Technologies and Techniques	Systeme Design & Verification	Flight Dynamics an GNSS	Ground Station System and Networks	Automation, Telepresence & Robotics	Life & Physical Sciences	Mechanisms & Tribology	Optics	Optoeletronics	Aerothermodinamics	Propulsion	Structures & Pyrotechnics	Thermal	Materials & Processes	Quality, Dependability	Earth Observation	GSE
Admatis Ltd.													X				X	X	X			X
Borsodi Műhely Ltd.																						X
C3S Ltd.	X	X	X			X																X
CAD-Terv Ltd.																	X					
DINAS Special Steel Structures Ltd.																						X
eCon Engineering Ltd.										X		X			X	X	X	X				
Euro Cabletechnics Ltd.						X																
EUROSZER-96 Ltd.																	X					
Feinwerk Technik Ltd.																	X					
Goodwill Trade Ltd.												X					X					
Gravitas 2000 Ltd.																			X			X
Matmod Ltd.												X							X			
Mo-Mechanika Ltd.												X				X			X			X
QP Ltd.										X									X			
Sunplant Ltd.											X								X			
Technoplast Group Ltd.												X					X		X			
Institute of Geodesy Cartography and Remote Sensing																					X	
GeoData Ltd.																					X	
Hungarian Meteorological Service																					X	
Bay Zoltán Public Nonprofit Ltd. for Applied Research																	X		X			
Budapest University of Technology and Economics	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X	X	X		X	
Ecotech Co.						X																
University of Miskolc											X				X				X	X		

Upstream Downstream Research

NOTES

NOTES