National Reserch and Development Institute of Welding and Material Testing
ISIM Timişoara

Self-Assessment report

Period 2007-2011

Contents

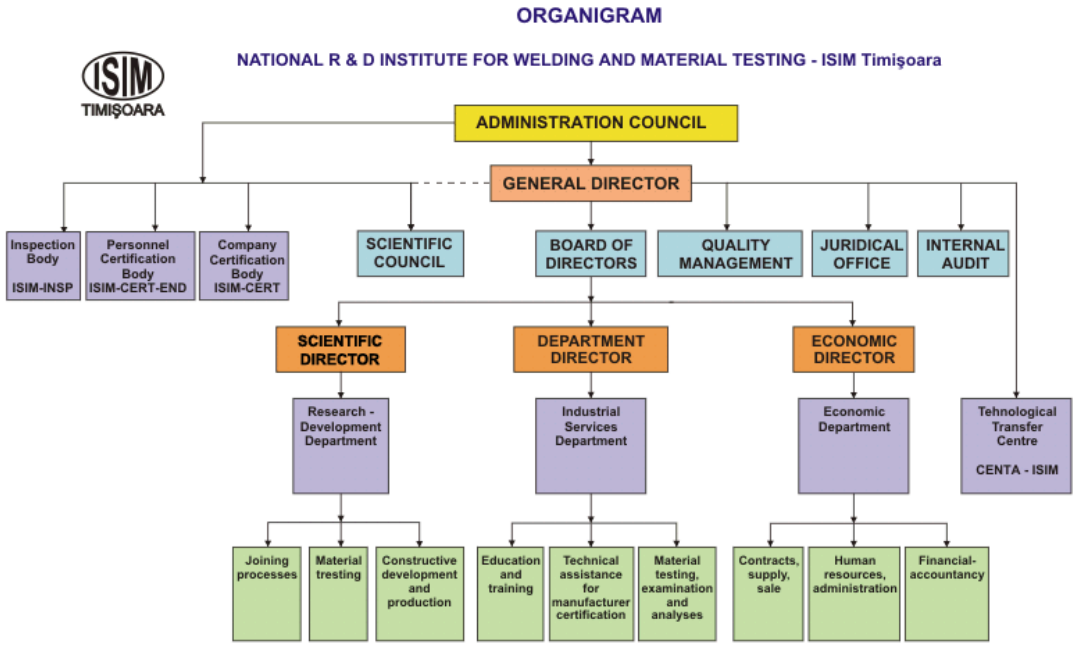
2.1. Administrative structure diagram of the institution

2.1.1 Short history of the institute

The institute was founded in 1970 and was organized as National R&D Institute in 1999 through HG Nr. 552/8 iulie 1999. From the beginning the institute was involved in the national research programs and in European research programs. The Institute is also a Romanian member of the International Institute of Welding (IIW). Additional to the research activity the institute has developed other related activities in the benefice of industrial partners, namely professional training in welding and NDT and also in the field of certification of personnel and companies. The accredited Material Testing Laboratory was involved in offering services to companies making non-destructive testing (NDT) on site, destructive testing of materials, metallographic examination (including the replica technique) having every year hundreds of clients.

2.1.2 The organizational chart (diagram) of ISIM Timisoara

The administrative structure of the institute is given in the figure bellow:



The structure of the institute is based on three departments. The first department is **the Research-Development Department**, the second one is the **Industrial Services Department** and the thirds is the **Economic Department**. On the same level is the **Technological Transfer Centre** which is directly coordinated by the General Director. The Research and Development Department was initially organized in the sections as it can be seen in the organization diagram. Because of losing personnel it was decided to unify the Joining processes and Material Testing sections in the last years. Now in the institute two sections are active in research and development: the Section "Joining processes and material testing" and the Section "Constructive development and production". The whole research and development activity of the institute was organized in these two teams.

The Industrial Services Department provides services requested by Industrial Manufacturers or other companies involved in the field of welding and inspection. The training of personnel is done according to national and international regulations, as requested by Manufacturers. Here we may mention the

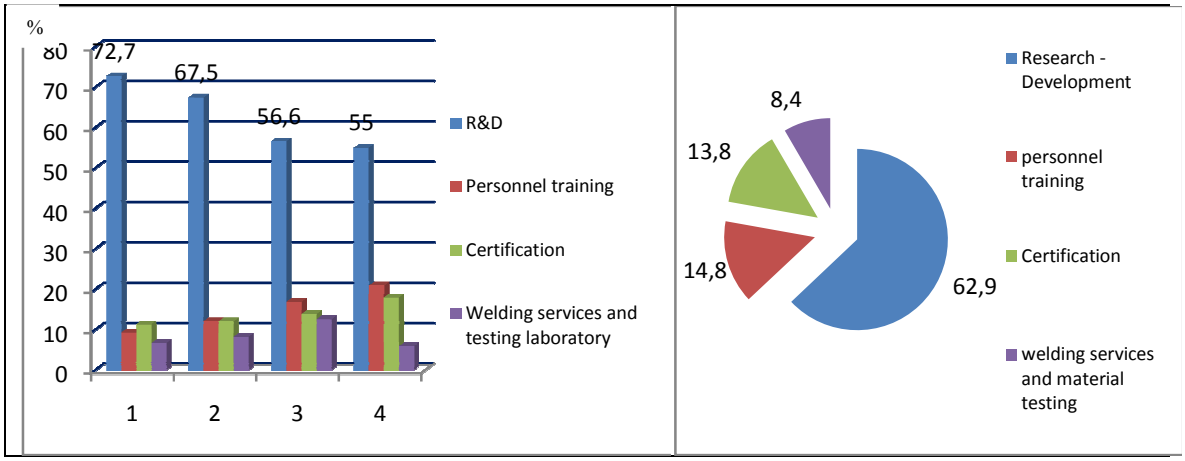
welding engineers (International Welding Engineers), welding specialists (International Welding Specialists), welding inspector (International Welding Inspectors) and non-destructive testing operators for different examination procedures, as requested by EN 473. The diplomas and certificates that may be obtained after successfully passing all exams are internationally recognised.
The training activities are realized at ISIM's headquarter and at the customers location, depending on the training type and of the number of participants. The same applies to the certification activities of welding and NDT personnel. The Metallic Structure Manufacturer certification needs always on-site assessments at customer location, according to specific procedures.
The material testing laboratory acts on the Romanian market as one of the few RENAR accredited laboratory and is also ISCIR authorised. Nearby all the usual tests (Charpy, hardness, metallographic replica, micro and macrostructure tests) some of the offered tests are unique for Romania. We refer here to the creep tests and to the tensile/bend tests until 300 tons (rails etc.).
Another main activity direction in the institute is the personnel certification and welding quality system's certification. The certification activity is made in ISIM through two accredited certification bodies: ISIM Cert and ISIM Cert END are also Notified at Bruxelles by the Ministry of Economy for the approval of welding procedures, permanent joining personnel and of non-destructive testing personnel according to the European Directive : 97/23/EC for pressure vessels).
The scientific activity is supervised by the Scientific Council. The Scientific Council is organized and acts in accordance with **a Regulation Act**. **The Scientific Council of ISIM has 13 members**, nine being researcher and technology development engineers with best scientific results and four are specialist from outside the institute that means from industry, form universities and form ANSTI. The Scientific Council is elected in the frame of a meeting of all researchers and technological engineers from the institute. The Scientific Council has the main task to coordinate the scientific activity of the institute and to establish the prior research directions. It analyse the activity of researchers and make proposals for their participation in exams for promoting in higher scientific position. General activity report of the institution

2.2.General activity report of the institution

The research and development activity of the institute is divided in two research teams: E1"Joining processes and material testing" and E2 "Constructive development and production". The **research and development activity is the main activity of ISIM** reaching 55% in 2010.
As already reported, the institute offers several additional activities for industrial partners in the field of personnel training, certification (for personnel, procedures and companies) and laboratory testing, examinations, and analysis, inspections, and expertises.
In ISIM following main activities are developed:

- fundamental and applicative research in the field of welding and material testing
- scientific counselling, expertise, prognosis, failure analysis, inspection
- constructive development of welding equipment and material testing equipment
- training of welding and NDT personnel
- certification and quality assurance at personnel and Manufacturer level
- dissemination of scientific and technical information

ISIM is the representative of Romania in the International Welding Institute (IIW) in Paris. ISIM has implemented a quality management system in compliance with ISO 9001 for his entire activity. The system is certified by TÜV CERT.
The **evolution of the incomes generated by the entire activity** of the institute in reporting period is presented below, separate for every year and as a mean value:



It can be seen that the main activity was dedicated to research founded through national funds and private company's contracts. The personnel's training activity and the certification has constantly rise because of the rising demand from the industry and solicitation from abroad.

The institute was involved in several national research programs but also in projects ordered by the industry. Many of the research projects had an important contribution to the know-how augmentation of the institute and so having access to new markets in relation to industry (e.g. **ultrasound welding equipments** for ICC PROD Campulung Moldovenesc, Takata Petri Arad; **rest life evaluation** for CET Govora, CET Craiova, CET Palas Constanta, CET Rovinari; **risk Based Inspection** for ARPECHIM Pitesti, RAAN Turnu Severin etc.).

2.2.1 Major achievements.

Starting from 2007 many new research topics were addressed in the institute in the frame of research projects. We consider that all of them are of great scientific and industrial interest in the field of welding and material testing. Partially some of the research topics were being supported by the Core Program of the institute. The new research topics are coming from the needs of the industry, from the trends of the international engineering sciences and from the interest expressed by the ISIM researchers for new field of activity. A list of the most important new research topics is listed below:

- Development of the **Friction Stir Welding of light alloys** (like aluminium, magnesium, titanium and there combinations) and of **different sorts of steel**,
- Development in partnership with ICTCM of **a FSW welding equipment** used for the realization of the experimental programs,
- Development of **new ultrasound technologies and welding equipments** for industrial applications (e.g. welding equipment and technology for the French-Romanian company ICC Prod Câmpulung Moldovenesc – producer of automotive components, equipment for welding seat belts also for automotive industry at Takata Petri company in Arad),
- **Non-destructive testing equipment** using nano-structured magnetic sensors for ring shaped components (ball bearings) in railway repairing company (Atelierele CFR Grivita Bucuresti),
- Development of **new technologies in the field of surface engineering** for coating metallic support with metals, cermets and ceramics using a new procedure by re-melting by laser or electron beam of the thermal sprayed layers,
- Development of **industrial application of the risk based inspection procedure** for several chemical and power plants in Romania (RAAN Drobeta Turnu Severin, ARPECHIM Pitesti, CET Rovinari)
- **Rest life evaluation of components** in coal power plants (CET Govora, CET Mintia, CET Lignit Arad, CET LUKOIL ENERGY & GAS Ploieşti, CET Craiova II S.A, PETROTEL - LUKOIL Ploieşti, CET Turceni, OMV Petrom Petrobrazi Ploiesti),
- **Laser welding of polymers** by creating an automated control system of parameter regulation,
- Development of the **water jet cutting procedure** by updating of a self developed cutting machine with CNC process control used in application for industrial partners (INTELIFORM Timisoara, PROFIX PLAST Timisoara, EASER CONSULTING Simeria, CONTITECH Timisoara),

- Development of the **thermographic method for non-destructive examination** of surface defects in thermal sprayed coatings,
- **In-situ monitoring of welding processes by thermo graphic camera** method (active monitoring of friction stir welding process, laser welding process etc.)
- Development of **new hybrid welding processes and equipment/accessories**for industrial applications (laser-WIG hybrid welding process, ultrasound – spot welding hybrid **equipment ordered** by the German Welding Institute SLV München for the end of 2011)
- Development of **micro joining technologies** using laser and ultrasound processes (equipment developed in the frame of Core Program for applications in electronics and automotive),
- Application of fracture mechanics on polymeric materials

In the table below the number of new research direction addressed in the frame of projects developed in the institute are indicated:

Year	Number of new research direction addressed
2007	4
2008	2
2009	3
2010	4
2011	2

These main scientific and technical achievements have resulted from research projects or from contracts made with industrial partners. The friction stir welding is a relatively new welding procedure developed initially in UK at TWI (The Welding Institute). The main challenge was to weld steel specimens which are very hard being necessary to preheat it in the front of the welding tool. The ultrasound welding, a reduced energy consuming and an ecologic procedure, is in a strong development in Romania so the needs of companies are very specific. In the period from 2007 we have accumulated valuable know-how in this domain allowing us to develop new equipments and correlated technologies for present and future applications. In a CEEX project a complex automated testing equipment was created based on a nano-structured sensor. The equipment, being in exploitation at Ateliere CFR Grivita Bucharest, is applied at the testing of used railway wagon's ball bearings. The equipment was exposed at the **International Exhibition TIB in Bucharest** but also at the **International Industrial Fair in Hanover Germany in 2008**.

The rest life evaluation of industrial components like tubes, flanges, elbows, pressure vessels etc. is of great interest in the coal power plants because of the long using period of exploitation. In the same direction the application of risk based inspection get important costs reductions for those companies so a permanent need of this type of activity was reported. ISIM have acquired expert systems from Det Norske Veritas (UK) and iRis Power Germany for solving this kind of problems.

Another new developed technique is the use of **thermographic analysis in non-destructive surface defect's detection** and in monitoring different welding processes like FSW and laser. The results of these procedures are published in scientific papers published in Romania and abroad. The non-destructive testing is well correlated with surface engineering made by thermal spraying. The existing infrastructure of ISIM in this field was completed in 2010 through cooperation with the Politehnica University Timisoara by using jointly a new High Velocity Oxygen Fuel (HVOF) thermal spraying equipment. A special sound absorbing chamber was erected in order to attenuate the very high pitch noise produced by the thermal spraying equipment.

A new trend in welding of materials is the development and **application of hybrid welding processes,** meaning that means the combination of two different welding procedures acting as one welding process. Two new hybrid processes were developed in ISIM in the analysed period: **laser – WIG and US – spot welding.** The last one, developed in the Core Program, is a **completely new procedure** and the **Welding Institute SLV from Munich Germany has ordered one equipment** for making experiments on this new procedure finding out the technical advantages. A patent application is in progress.

In the field of micro-technologies also an ultrasound welding equipment was elaborated for joining thin metallic foils and thin wires together for applications in electronics.

In the analyzed period a **number of 288 papers have been elaborated** and a number of **6 patents have been given by OSIM**. Many patent applications are in evaluation at OSIM while **the institute has made 32 patent applications** in the last years.

2.2.2 Investments

In the period 2007 – 2011 a number of 10research equipments and apparatus having a value higher than 15,000 Euros were purchased. The source of financing was mainly from national projects or from budgetary allocation. In the following table the list of equipments is presented.

No.	Name of equipment	Value (€)	Year of acquisition	Source of financing
1	Phased Array ultrasound testing equipment and accessories	39,820	2007	CEEX Project
2	Cooling equipment plasma spraying	32,000	2007	Core (Nucleu) Program
3	Laser marking equipment	69,780	2008	PNCDI 2 Capacities Program
4	Programmable optic system for HL 124P LCU laser	28,000	2008	PNCDI 2 Capacities Program
5	Digital microscope	25,000	2008	CEEX Project
6	Software licence for COMSOL Multiphysics 3.4	85,957	2008	PNCDI 2 Capacities Program
7	Expert system CRACKWISE	17,700	2008	CEEX Project
8	Differential scanning calorimeter	46,540	2009	PNCDI 2 PartnershipProgram
9	Micro cutting-micro welding module for laser applications	64,996	2009	PNCDI 2 Capacities Program
10	Portable chemical analysis apparatus and accessories	11,800	2009	Budgetary allocations of the Ministry of Economy, Commerce and Business Medium

Being financed mainly from projects all equipments were used in the frame of the respective projects for complete the experimental program (>75%). It is evident that they are used in present for other research and development projects and for contracts with industrial partners. The total investment amount in the period 2007 – 2010 was of **764,600 Euros**.

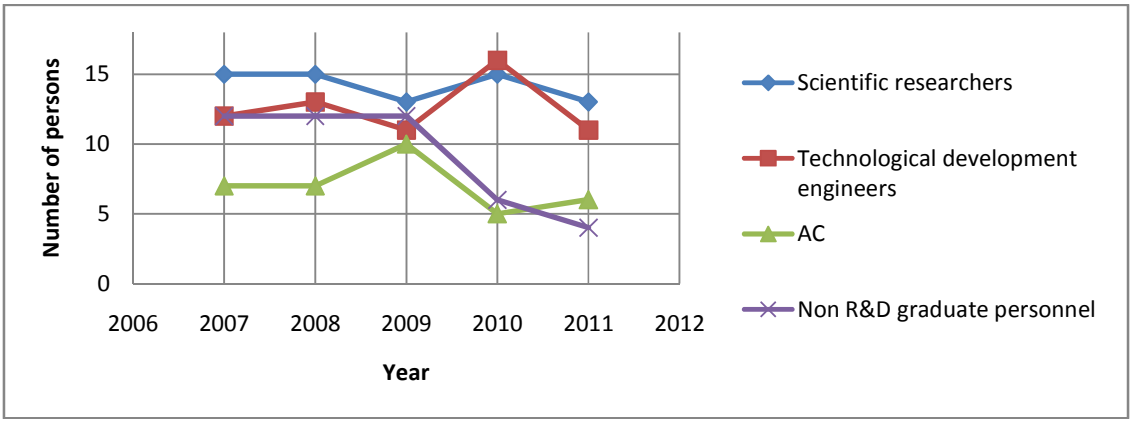
2.2.3. Recruiting action and events

The organization of ISIM includes two departments having attributions in research and development, certification, personnel training and laboratory testing and the third department for administrative and financial problems. The first department, the research and development department, includes two steams, one for welding technologies and material testing and the second one for development of welding and testing equipments. In this department a number of 10 researchers and 6 engineers for development are working. In the second department for certification, personnel training and laboratory activities a number of 1 researcher and 7 engineers for development are working. In the administrative and financial department 14 persons are working.

The personnel's evolution of the institute is indicated in the table and in the diagram below:

Type/ Year	2007	2008	2009	2010	2011
Scientific researchers	15	15	13	15	11
Technological development engineers	12	13	11	16	11
AC	7	7	10	5	6

Non R&D graduate personnel	12	12	12	6	4
Technicians	13	13	11	9	7
Workshop workers	9	9	9	5	3
Administrative personnel	21	21	21	17	14
TOTAL PERSONAL	89	90	87	73	55



The general personnel reduction in 2010 and 2011 was determined by retiring, transfer in other working places and three persons were dismissed because of insufficient performance.

At the date of evaluation the institute has 55 employed personnel and 28 of them are working in R&D. Other 13 non administrative personnel are active in personnel training, certification, material testing laboratory and in workshop. In administration 14 persons are working. From the diagram can be seen that the number of attested R&D personnel was nearly constant but the research assistants AC and the non R&D personnel was reduced, partially the promotion of research assistants as researchers and/or as technology development engineers or by voluntary changing the working place.

In the evaluation period **two recruiting actions** took place. For the recruitment of new research personnel we applied the actual national legislation. The recruitment actions were mainly focused on young graduated personnel in order to ensure a basis for future development of the institute In 2007 a number of 20 persons were be employed and from them 7 are active in the institute. In 2008 a number of 10 persons were be employed and from them 5 are working in the institute. Because of the crisis in the last two years nobody was employed. In the last part of 2011, 4 new research assistants were employed in order to strengthen the research potential. The newcomers are all doctor students which mean that they will be doctors in few years and be able to fulfil one of the main the access conditions for research projects.

The **promoting actions** are listed below:

Type	2007	2010
CS3	2	-
CS	1	3
IT3	3	-
IT	1	6

The present average age of the personnel is of 46 years.

In the analysed period some mobility actions took place in institutes and universities abroad.

Year	Number of mobility actions	Country
2007	2	Germany, Netherland
2008	3	France, Hungry
2009	1	France
2010	2	Germany, France
2011	2	UK, France

2.2.4. Technology transfer activities

The technology transfer activity was performed in the Technology Transfer Centre CENTA and by the R&D teams. ISIM is an active member in the South-East European Technology Transfer Network SEEWELD through the Technology Transfer Centre.

The application of research results in industry was related to the development of **industrial application of the risk based inspection procedure** for several chemical and power plants in Romania (RAAN Drobeta Turnu Severin, ARPECHIM Pitesti, CET Rovinari). Another direction was the r**est life evaluation of components** in coal power plants (CET Govora, CET Mintia, CET Lignit Arad, CET LUKOIL ENERGY & GAS Ploieşti, CET Craiova II S.A, PETROTEL - LUKOIL Ploieşti, CET Turceni, OMV Petrom Petrobrazi Ploiesti).

Starting from the demand of industrial partners a **new ultrasound technologies and welding equipments** was developed for industrial applications (e.g. welding equipment and technology for the French-Romanian company ICC Prod Câmpulung Moldovenesc – producer of automotive components, and equipment for welding seat belts also for automotive industry at Takata Petri Company in Arad),

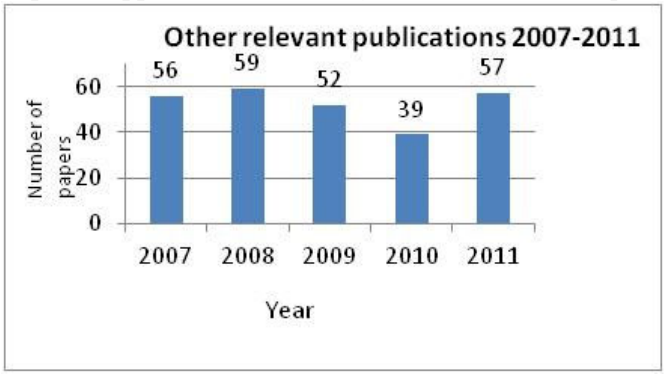
As a result of a CEEX project **non-destructive testing equipment** using nano-structured magnetic sensors for ring shaped components (ball bearings) in the railway repairing company Atelierele CFR Grivita Bucuresti was realized in cooperation with other to institutes. The equipment is now in operation at that company.

Year	Values generated by application of R&D results (Thousand Euros)
2007	58
2008	32
2009	140
2010	105
2011	77

As a form of technology transfer ISIM organises technical seminars and workshops in place and in other locations in order to present to the industrial medium the newest welding and testing procedures, new standards or regulations, new technical achievements, practical application of known technologies, recent results of own research activities having industrial application etc.

2.2.5. Publication and communication initiatives

In the analyzed period a **number of 263 papers have been elaborated** and a number of **6 patents have been issued by OSIM**. Many patent applications are in evaluation at OSIM while **the institute has made 28 patent applications** in the last years. The evolution of publication's number is given below:



ISIM organizes every year two traditional conferences:

- "Innovative Technologies for Joining Advanced Materials" held always in June
- "Structural Integrity of Welded Structures" held always in November.

Both events are international with participants from Germany, France, Spain, Serbia, Hungry, Brazil, UK, Bulgaria, Italy, Portugal, Austria, Holland, etc.

ISIM is editing since 20 years a scientific journal **BID-ISIM - Welding and Material Testing.** The journal Welding and Material Testing / Sudarea şi Încercarea Materialelor - *Bulletin of the National Research & Development Institute of Welding and Material Testing Timişoara, BID-ISIM,* is a peer reviewed, scientific journal dedicated to publishing papers on innovative researches and applied technologies, review articles, studies on trends, synthesis within the welding and related fields. It has appeared as a quarterly publication since 1992. The journal *Welding and Material Testing* is classified, by the *Romanian National University Research Council* (CNCSIS), in the **B+ category** (CNCSIS code 549). It is included in international data bases like *CSA - Metadex* (USA),

CSA - Technology Research Database (USA), *Weldasearch* (UK) and in international catalogues of abstracts *Welding Abstracts*(UK) and *IIS-Data* (Italia).The content of the journal is posted on the internet site of the institute www.isim.ro.
Another publication issued by the institute in the analysed period is **ISIM-News,** a publication presenting new information about the activities and achievements of the institute and the cooperation with partners abroad. Through this publication many ongoing research projects, initiatives and activities were be presented.
In order to be more visible ISIM has **a regular participation every year at national and international conferences, exhibitions and fairs.**

2.2.6 Other significant aspects for institutional evolution and development

In ISIM the following accredited/notified bodies are active:

a) Certification body **ISIM CERT (Manufacturer certification acc. to EN ISO 3834)**

b) Certification body **ISIM CERT END** is accredited by RENAR for the Certification of welding personnel, the personnel in the field of non-destructive examination and qualification of welding procedures. Also acts as a Notified Body in this activity field.

c) ISIM INSP represents a third part inspection body (of A type) according to EN 45011, being an autonomous structure inside ISIM Timisoara.

d) **Testing, Examination and Analysis Laboratory (LIEA)** is accredited by RENAR, according to EN ISO 17025, and authorized by ISCIR and CNCAN.

ISIM is the representative of Romania in the International Institute of Welding (IIW) located in Paris and is member of the Romanian Welding Association (ASR) and of the Association for Multidisciplinary Research in the Western Part of Romania (ACM-V).
In the Timis County the Chamber of Commerce, Industry and Agriculture Timisoara organizes every year the "Top of Companies", the ISIM getting every year the **Award for Creativity and the Diploma for the first or the second price in science activity in the region.**
In **the field of personnel training** many courses were organized for industrial partners. The list of main courses is given below:

- International welding engineers (IWE),
- International inspection personnel (IWI),
- International welding specialists (IWS)
- Non-destructive testing operators for different testing procedures (VT,UT,PT,MT,RT) following EN 473
- Qualification of welders and welding operators for different welding processes (WIG, MAG, etc.) according to EN 287-1, ISO 9606, EN 1418 etc.
- Qualification of welding operators for welding thermoplastic materials mainly water and gas pipes according to EN 13067 and for ISCIR authorisation.

In the following table a synthesis of al courses is made.

Year	Number of training actions	Number of participants	Number of companies involved	Number of participation attests	Number of diplomas	Number of qualification certificates
2007	27	291	76	68	50	197
2008	36	416	82	362	110	197
2009	39	410	107	384	60	102
2010	18	357	132	329	43	85
TOTAL	120	1474	397	1143	263	581

It can be seen that an important number of companies, **distributed on the whole country**, have send nearly 1500 specialists in 4 years to the institute for obtaining different diplomas and certificates. Here we could mention the International Welding Engineer course that was realised, during the years in Romania, Serbia, Turkey and in the Republic of Moldova. The **diplomas awarded are recognised in all European countries**. The same recognition level is related to the courses for non-destructive testing operators made in accordance with EN 473, **the certificates of competency being valid whole over Europe. Those courses are held almost on a regular basis, under ISIM umbrella and assessment, with partners from Turkey.**

2.3.Activity report by team

In the institute two R&D teams are working. The first of them is "Joining Technologies and Material Testing" and the second is "Constructive Development and Production".

2.3.1 Research team: E1

Name of the team: **Joining processes and materials testing**

2.3.1.1. Activity description:

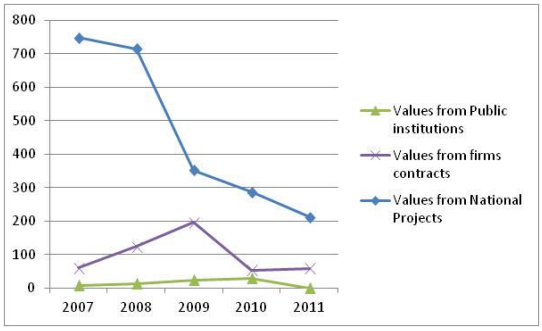
S3 Team activity "Joining processes and materials testing" was based in the period 2007-2010 on welding domain and materials testing research with the implementation in the institute of Quality Management System according to ISO 9001/2000.

The research activity of the team was made on the following programs:

- Excellence Research Program (CEEX)
- National Research, Development and Innovation II Program (PNCD2)
- Nucleu Program (PN)
- Sectoral Program of Ministry of Economy, Trade and Business Medium (METBM)
- Contract financed from industry (PL)

Year	Activity type*	Values from National Projects (thousands euro)	Values from firms contracts (thousands euro)	Values from Public institutions (SECT) (thousands euro)
2007	1.1 (R&D)	748.99	0	8.63
	1.2(SST)	0	60.30	0
2008	1.1 (R&D)	715.36	0	13.78
	1.2(SST)	0	124.36	0
2009	1.1 (R&D)	352.20	0	24.44
	1.2(SST)	0	196.46	0
2010	1.1 (R&D)	287.49	0	28.85
	1.2(SST)	0	53.69	0
2011	1.1 (R&D)	212.82	0	0
	1.2(SST)	0	59.24	0
Total	A1 (R&D)	2316.86	0	0
	A2(SST)	0	494.05	0
	A3 (SECT)	0	0	75.7

National project values (R&D) present a decreasing tendency on 2007-2011 due the lack of national projects (non-adequate financing of the research activity), the maximum value of SST projects is in 2009 due the increasing contracts of industrial equipments expertise.



2.3.1.2. Research directions addressed by the team

The main research directions in the period 2007-2011 were:

- Elaboration and verification of welding technologies for welded components from energetic industry
- Realization of protective coatings by surface engineering methods
- Evaluation of lifetime duration of the heavy loaded components
- Welding/bonding of polymeric materials
- Techniques of risk based inspection
- Joining techniques of advanced ceramic materials

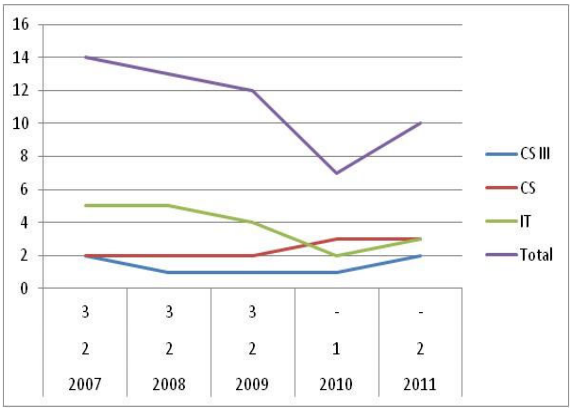
The research was focused on establishing of the welding parameters for welding technologies of industrial components by classic processes (electric manual, WIG, MIG) and after acquisitioning of specialized equipments the research were diverse being focused on application of new modern welding processes by CMT method (Cold Metal Transfer), thermal spraying of metallic or ceramic materials

using plasma thermal spraying and HVOF method, and determination of the lifetime duration by classic methods and RBI (Risk Based Inspection).

2.3.1.3. Human resources dynamic in the team

Type/year	2007	2008	2009	2010	2011
CS I	2	2	2	1	2
CS II	3	3	3	-	-
CS III	2	1	1	1	2
CS	2	2	2	3	3
IT	5	5	4	2	3
Total	14	13	12	7	10

The dynamic of the human resource presents a continue decreasing tendency starting with 2007. The deceasing from 2010 is due to leaving to others jobs from our country and others countries; the increasing in 2011 is explained by merging of some sectors from the institute.



2.3.1.4. Major Achievements:

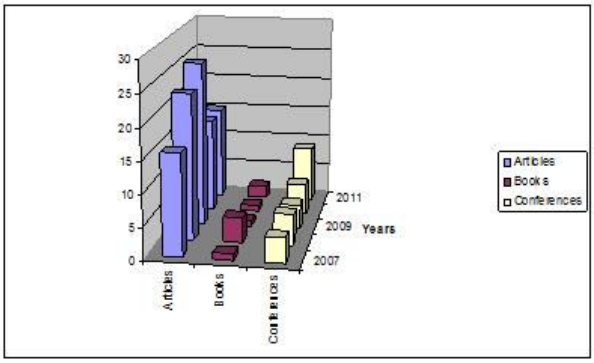
Year	Portofolio of competences	Research projects	Value (thousands euro)	Related achievements	Beneficiaries
2007	-Inspection methods (destructive and non-destructive) for evaluation of welding and allied processes	Expanding the infrastructure for personnel evaluation and certification in regulated field for products made by welding and allied processes	141.84	Quality manual and procedures of ISIM CERT certification body fo personnel certification in regulate field for products made by weldin and allied processes Infrastructure of the certification body	Romanian Accreditation Association, National Accreditation Body RENAR Bucuresti
	- Elaboration of technology and ecologic installation for welded constructions	Technology and ecologic installation for stress relieving of cast, forged steel or welded components	11.51	Modern technology for heat treatments of welded constructions; Patent No. 123100	Mecanoenergetica Dr. Tr. Severin
2008	- Finite element analysis of welded metallic structure nodes -Stress measurement -Destructive and non-destructive inspection of metal construction	Modern technology to increase durability of metal construction	55.66	Research reports Technology for increase durability of metal construction	UPT Timisoara CNMP - UEFISCDI Bucuresti
	- Increasing the wear/corrosion resistance of titanium alloys with plurifunctional micro layers	Plurifunctional micro layers for covering titanium alloys by advanced technologies	129.34	Thermal spraying laser technology; Remelting for hardening of plurifunctional micro layers Realization of a modern wear testing installation; Patent No. A00394-2008	ICMET Craiova
2009	-Management of Industrial risk -Risk assessment of equipments and installations -Evaluation of damage mechanisms	Integrated system for risk management at equipments and installations from the energetic field	280.58	Research reports Quality manual and procedures of an Risk Management Body Specialized database (useful tool for risk assessment and management)	CNMP - UEFISCDI Bucuresti S.C. Complexul Energetic Rovinari S.A.
	-Rehabilitation of welded structures -Surface hardening of	Structural and mechanical rehabilitation of weldable thermo resistant steels and	49.64	Technology of: -rehabilitation of weldable thermo resistant steels	RAAN-THERMO ROMAG

	super alloys thermo resistant -Realization of hardened mill's hammers	characterizations of the super alloys which contribute to surface hardening		-of fabrication of hardened hammers mills - of surface hardening of super alloys Patent No. 00601-2009	Dr. Tr. Severin
2010	-RBI concept -Management of industrial risk	Implementation of risk based inspection and maintenance concepts on specific equipment of ROMAG PROD branch of RAAN	23.70	Report and risk evaluation for eight heat exchanger Risk matrix Future Inspection plan according to estimated risk level of each component	RANN ROMAG PROD Dr. Tr. Severin
	-Evaluation of quality naval, railway, aeronautic transport; -Establishing of competitivities parameters in the transport sectors; -Elaboration of fabrication sector by others transport ways strategy	Development of fabrication sector by others transport ways (naval, railway, aeronautic), integration in European and Worldwide development tendencies, the impact of implementation of specific regulations	28.82	Quality parameters of fabrication sector by others transport ways; Evaluation of competitivity parameters at Romanian and European level Patent No. 00014-2010	ICEPRONAV Galaţi and Naval Shipyards (Galati, Brăila, Constanţa, Dr. Tr. Severin) AFER Bucureşti with specialized firms in railway sector IAROM Bucharest with specialized firms in aeronautic sector
2011	-Assessment of damage mechanisms -Microstructural analysis using replicas method -Quantitative evaluation of microstructural replica based on A parameter	Nondistructive inspection to evaluate of lifetime duration of the room coke material 180-RB1	10.66	Inspection Report and evaluation of the remaining life for 180-RB1 coke chamber material	OMV PETROM PETROBRAZI
	Evaluation of the used hammer rods; Brazing/ welding of steel with bronze by CMT method	Brazing/ welding deposition with aluminium bronze of hammer rods.	3.00	Quality evaluation of used hammer rods ;Technology of brazing/ welding by CMT method;Establishing of the optimal parameters of the coatingsPatent No. 01294-2011	CAMPINA FORJA NEPTUN TMK Reşiţa RANK Reşiţa ARCELOR MITTAL Hunedoara

2.3.1.5. Dissemination: Articles, books, conferences, awards and medals

YEAR	ARTICLES	BOOKS	CONFERENCES
2007	16	1	4
2008	23	4	5
2009	26	1	4
2010	15	1	5
2011	15	2	9
Total	95	8	27

The dissemination activity (articles, books, conferences) presents increasing values on the period 2007-2009 due to finishing of the R&D projects and in the period 2010-2011 it is observing a decreasing tendency of the dissemination activity because in this period it were finished project only 4 PNCDII-Partners projects and 1 Sectoral Program



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2.3.2 Research team: E2

Name of the team: **Constructive development and production**

2.3.2.1. Activity description:

Team S2 „Constructive development and production„ concentrated its activity during 2007 – 2010, mainly, on research and development for new modern joining and cutting techniques for materials and their implementation in the industry.

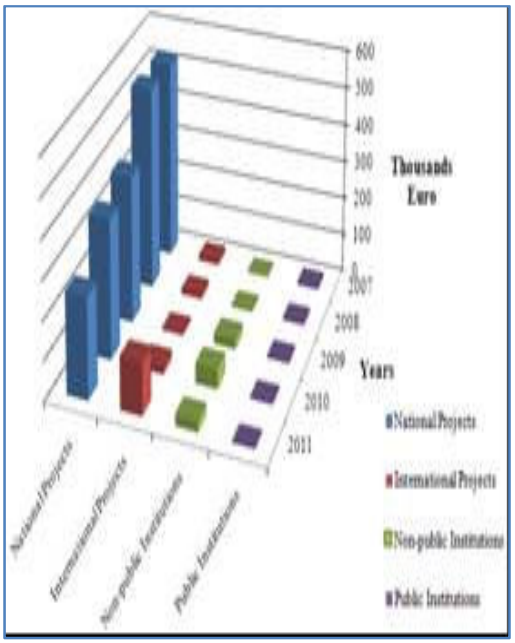
The activity of the research team was conducted in the following programs:

- European Programs (FP 6, Manunet)
- Excellence Research Program (CEEX)
- National Research, Development and Innovation I and II Program (PNCDI I and PNCDI II)
- Nucleus Program (PN)
- Contract financed from industry (PL)

Activities carried out and their contribution per year is presented in Table 1, respectively Figure 1.

Table 1. Activities types

Year	Activity type*	Values from National Projects (thousands euro)	Values from International Projects (thousands euro)	Values from firms contracts (thousands euro)	Values from Public institutions (thousands euro)
2007	1.1 (R&D)	523.7	13.390	0	0
	1.2(SST)	0	0	1.1	6.3
2008	1.1 (R&D)	529.8	12.927	0	0
	1.2(SST)	0	0	3.69	4.54
2009	1.1 (R&D)	380.4	6.084	0	0
	1.2(SST)	0	0	26.13	3.78
2010	1.1 (R&D)	358.36	20.87	0	0
	1.2(SST)	0	0	50.0	2.86
2011	1.1 (R&D)	258.83	133.250	0	0
	1.2(SST)	0	0	27.78	0
Total	A1 (R&D)	2051.09	186.521	0	0
	A2(SST)	0	0	108.7	17.48
Total Team	-	2051.09	186.521	108.7	17.48



*R&D – Research and Development

*SST – Scientific Services and Technology

2.3.2.2. Research directions addressed by the team

During 2007 – 2010 the main research directions were:

- Development of modern processes, efficient cutting and welding: ultrasonic welding, laser beam processing, water jet cutting;
- Developing new processes with own contributions, innovative worldwide to implement in the Romanian industry (eg friction stir welding - FSW);
- Implementation of advanced innovative methods of nondestructive control using specialized automated equipment;
- Research for the design of specialized equipment to specific applications in industry (eg. fusion butt welding with intermediate melting, functional layers coatings using sparks);
- Online monitoring of welding processes (e.g. using thermographic infrared technology).

New research directions (2) developed in this period is due to industry demands that were expressed in the seminars / workshops organized at economic agents in the country (water jet cutting – 2008 – 2 patent applications) or own ideas developed at ISIM (online monitoring welding process using infrared thermography technology – 2007 – patent application).

2.3.2.3. Human resources dynamic in the team

Staff structure in the period 2007 - 2011, is presented in Table 2. It is observed (graph in Figure 2) that during 2010-2011, the number of certified CS** personnel significantly increased at the expense of IDT** staff, respectively research assistants and students.

The department had at its disposal CS** and IDT**, PhD (5) and doctors of engineering (2) with proven skills in specific areas addressed with complementary basic training (university degree) TCM**, UTS**, mechatronics, electronics, and physics.

The evolution of the PhD, PhD students and master graduates is presented in Table 3, respectively Figure 3, and the evolution of average age is presented in Table 2 and Figure 4.

The percentage of young people in the department of max 30 years / every year is presented in Table 2.

Based on the existing collaboration protocol with the Polytechnic University of Timisoara (UPT), a young employee obtained his Ph.D. in technical sciences (2009) and a total of five employees of team S2 are students. One young employee got a scholarship for a doctoral training abroad (Universite du Bourgogne, France).

Table 2. Personnel structure

Type/year	2007	2008	2009	2010	2011
CS	2	2	2	5	5
IDT	5	5	5	4	4
Research assistants	2	4	4	3	2
Students	2	1	-	-	-
Basic studies	1	1	1	1	-
Total	12	13	12	12	11
Age average [years]	47,3	40,5	42,8	40,2	41,6
Youths max. 30 years	25%	46%	42%	42%	36,4%

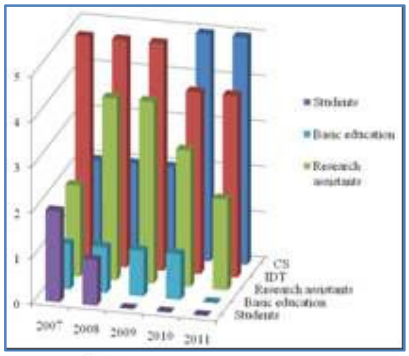
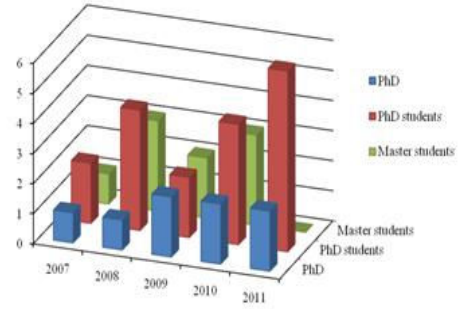


Table 3. Personnel evolution - improvement

Type/year	2007	2008	2009	2010	2011
PhD	1	1	2	2	2
PhD students	2	4	2	4	6
Master students	1	3	2	3	0



2.3.2.4. Major Achievements:

Year	Competences portfolio	Research projects*	Value [thousand Euro]	Additional achievements	Beneficiaries
2008	NDT, engineering, informatics, automation processes, simulation for defects, manufacturing equipment	F 36	145,86	Automatic examination system with nano-structured magnetic sensors; patent; scientific papers	Grivița Bucureşti Shops
2008	Advanced materials science, welding process control, weld characterization, numerical modeling for technological processes, design, manufacturing equipment, infrared thermography, etc..	F 39	131,36	FSW machine; FSW welding technologies for advanced materials; 1 patent approved and 1 patent request at OSIM; 18 scientific papers; promotion and awareness of new welding process FSW in Romanian industry	UEFISCDI Bucureşti
2009	Specialist in ultrasounds, design, process automation, informatics, control joints, welding technologies, process modeling	F 55	8,73	Ultrasonic welding equipment and technology, auto armrests, implementing at beneficiary (leather or artificial leather joints with plastics)	ICC PROD Câmpulung Moldovenesc
2010	Ultrasonic welding specialist, design,	F 67	5,92	Experimental equipment and	Obrist Eastern Europe

	process automation, informatics, joints control, welding technology.			joining technology. Joining for the first time Deo-Roll balls in Europe	– Parța, jud. Timiş
2010	Textile materials, laser processing, joining processes, process control technology, processing control.	F 73	33,267	New method of assembling advanced materials specific to textile architecture; method of stiffening / strengthening of diaphragm structures	SME that participated in the project; textile manufacturer (CANOBIO, Italia)
2010	Welding with intermediate welding, specialist, design, process automation, informatics, joints control, welding technology.	F 75	29,56	Automated equipment and fusion welding technologies with intermediate melting, components from freight wagons implemented at beneficiary.	ASTRA VAGOANE Arad
2011	Ultrasonic specialist, materials science, informatics, design	F 81	7,45	Ultrasonic welding equipment and technology for thermo-plastic materials	TAKATA PETRI Arad
2011	Materials science, welding, welded joints characterization, modeling processes, infrared thermography, design, etc.	F 83	159,83	FSW – TIG hybrid welding tool; new method for coating a surface with functional layers; process technologies validated; 2 patents request; 25 scientific papers; 8 seminaries in industry for promoting results	Potential applicants in the following fields: marine, aerospace, automotive, railway.
2011	Ultrasonic welding, engineering, informatics, welding technology, joints control	CF 3	13,85	Automated specialized machine with process control and ultrasonic welding technology for metallic materials	COMPACT MM TRADE – SERBIA
2011	Ultrasonic welding, electrical resistance welding, engineering, informatics, welding technology, joints control	CF 4	14,0	Hybrid specialized welding machine (US+ electrical resistance welding)	GSI Gesselschaft fur Schwestechnik International mBH, SLV Munchen

Obs: * according to codes within the projects list

2.3.2.5. Interdisciplinary initiatives

The high degree of complexity and great diversity of research work carried out in different areas required interdisciplinary initiatives. Long-term partnerships were initiated with important institutions: UPT Timisoara (eg optimization processes using factorial experimental method), UDJ Galati (eg finite element modeling of complex welding processes), ICPC Bucharest (automating processes), IFT Iasi (nanostructured sensors), ICTCM Bucharest (design complex welding machines), etc.

2.3.2.6. Dissemination. Articles, books, conferences, awards and medals

Dissemination activities (articles, books published and participation in conferences) are presented in Table 5 and graph presented in Figure 5.

Table 5. Dissemination activities

Year	International Articles	Books	International Conferences	Total/Year (s)
2007	17	0	8	25
2008	18	1	14	33
2009	12	0	7	19
2010	9	0	5	14
2011	17	1	9	27
Total	73	2	43	118

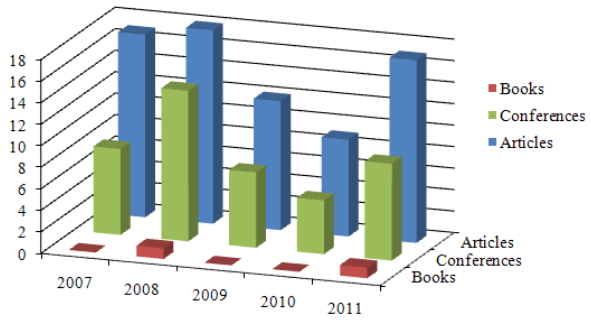


Figure 5. Dissemination activity

The evolution of scientific papers is closely related to start and end cycle of projects developed by national programs. For example at the completion of CEEX projects Programs (2008), and the programs PNCDI I and II (2010-2011), the results have allowed the development of a greater number of scientific papers. The results obtained within the team were presented at annual International Fair Bucharest and also in the International Fair in Hanover (2008).

2.4. Representative project:

Friction stir welding (FSW)

2.4.1. Research motivation

The problem of the developing **new advanced material joining** processes is present at horizontal level in the **priority** scientific and technological fields of research at the European level, as for example, in those that aim the **future fabrication processes**, **new materials**, **transports**, **aeronautic**, inclusively, but also those related to the **restructuring** of new traditional industrial sectors such as the **steel industry** and **constructions**.

The development of these domains impose **special requirements** to the joining processes from the **technical** point of view (materials, shapes, sizes, structures, loading), economical (productivity, consumption, cost) and **environment** (pollution, toxic fumes). The respective requirements, in continuous growth, cannot be entirely met by the **welding processes** used at **present** industrial level.

The innovative FSW welding process answers to these high requirements by its extraordinary potential for development.

The process **developed rapidly**, having a good grip on some **prestigious research centers in the world**, as well as on famous industrial **companies** in top sectors such as **aerospace** or **land transport**.

Until the year 2007 the FSW process was unknown in the Romanian industry.

Friction stir welding - FSW is a solid state joining process based on heating by friction and plastic deformation sub sequences made at the interaction between a non-consumable tool that rotates on the contact surfaces to be jointed. The tool is dived into the material and then moved with the welding speed along the joining line. The material brought into **plastic state** is transferred behind the tool creating a welded joint, figure 1. The FSW process allows the joining of a great number of **similar and dissimilar** materials **difficult** or **impossible** to be jointed through other processes.

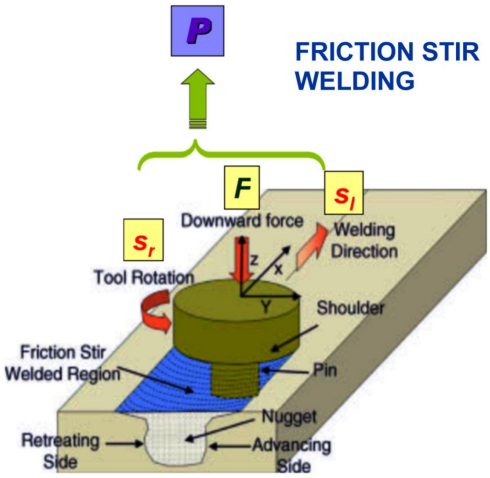


Figure 1. FSW process principle

Having these considerations as a basis, after the year **2000** the research of welding by the FSW process is included in the **scientific program of the institute**.

2.4.2. Conception

Until 2007 the department has placed **special emphasis** on research for FSW process for a better **understanding** of it.

Preliminary experimental programs were conducted on a system with specific adjustments done for welding on a **classic milling machine**. The results consisted as the base and developed the expansion and further research in this area during 2007-2010 in a **CEEX project**, within a project from the **Nucleus Program** and a draft **project PNCDI II.**

Implementation and commissioning of the **specialized FSW machine** in 2007-2008 allowed the start of a **wide and complex** long term research.

The entire research program is based on the use of **advanced materials** as **aluminium**, **titanium** and **magnesium alloys**, metallic matrix **composite materials**, high performance steels, material combinations, complex structure from extruded light materials.

Scientific and technical content of the work aimed the following **research directions**:

D1 Research on the FSW process

The following aspects will be in view:

- influence of **welding parameters** on the process and **optimization** of welding process

Considering the complexity and the number of welding parameters the **multi-criteria optimizing** method and the **factorial experiment** will be used, results will complete precarious data existing in the literature for different materials. There will be **established and validated** correlations between

welding parameters. The **energetic balance** and the diminishing of the **input energy** into the material when welding will be followed.

- **optimizing the processing tool**, inclusively the interaction mode tool-part to be welded

The research program takes into account the investigation on the influence of **material**, **shape** and **interaction mode** between the tool and the part on the welding process, on the tool **wear**, respectively. **Original solutions** will be used related to the **tool geometry** (conical), its moving way (with variable speed), Control of the FSW process by **overlapping an external heat source** (laser or electric arc) for processing hard materials, respectively by forced cooling of the tool, by conceiving a new underwater welding mode, inclusively.

D2 Complex modeling of the welding process

The research aims to create a **theoretical model** to predict the **viscous-plastic flow** of material. Using the **finite elements method** and adequate calculus programs, existing at partners (ANSYS or anticipated to be acquired within the project (SYSWELD), a **complex modeling** will be made in coupled **thermal field –structural** and considering **residual stresses** and **strains**, the created model will develop the existing models in the literature which refer to the individual modeling of thermal processes, structural and of the stress state. The created **model** will be experimentally **validated**.

For the first time thermo graphical method will be used to appreciate welding thermal processes, especially the complex process for heating the tool.

D3 Welded joints characterization

The **characterization of quality** and welded joint **behavior** is a complex development to be made experimentally, the investigation program follows the micro-structural evolution and that of the mechanical characteristics, of the fracture, fatigue, and creep and corrosion behavior. A special research direction will have as target the **non-destructive examination** of the FSW welds, identification of mechanisms to produce imperfections typical for the process (kissing bongs and tunnels), selection of the adequate examination processes and conceiving a **specific examination procedure**.

Investigations will be made with the material base existing in the laboratories of the partners. **For the first time** the **thermo-graphic control method** assisted by the RX fluorescent control will be used, respectively the **US control** method will be adapted by the **phase array technique**. This is a new technique for examining by immersion with an increased capacity to detect **small size imperfections** (under 0.1mm), and allows the analysis and storage of a large data volume and is can be used for **on-line examination**.

D4 Welding process control

The project foresees the conceiving and achieving of an original monitoring and on-line control system of the welding process using thermal field sensors and the infrared thermography to acquire input data. The system will compare these data with those existing in a technological data base to be created within the project; also a monitoring system for the welding process was designed and created by controlling the vertical down-force that exerts pressure on the welding tool and welding materials.

D5 Researches on the performances of the welded structures

By processing the obtained data within the **previous phases design concepts** will be established specific for FSW welded joints. **Static and dynamic loadings** with repeated character are considered.

The analytical approach will be accompanied by laboratory tests to establish calculus parameters, results of testing being validated by the finite element method. By **fracture mechanics** testing to define base parameters a prediction method for the **residual lifetime** of the FSW welded structures will be elaborated. The European norms EC3 and and EC9 will be used as reference base and they will be adopted, too.

Results will be included in an original specific design guide. All necessary testing will be done in partners' laboratories that have the corresponding apparatus, less a pulse device which is to be acquired by the project.

D6 Development of new methods to modify the superficial properties of materials

The FSW **processing** will be used to study the mechanism and effective conditions to modify at the **micro scale**, the materials characteristics. The investigation will be made with the welding

equipment existing at CO (adapting the process parameters) for the case of aluminium alloys and will aim aspects such grains, eutectics distribution, hardness and porosity.

The project will also experimentally investigate the possibility to recondition some superficial defects of the cracks or pores types in elements made out of composite materials and other alloys presenting high hardness.

Also experimentally it was investigated the possibility of **repair** for superficial defects such as cracks or pores in composite and cast materials.

2.4.3. Elaboration

During the period 2007 – 2010 the researches in the FSW field were carried out within 3 major projects with different objectives; a CEEX project (FSW of soft metallic materials), a project from the Nucleus Program (FSW of hard materials) and a PNCI I and II project (own contributions towards developing the FSW process). The evolution for researches and achievements in the FSW field during 2007 -2010 can be structured according to the diagram presented in Figure 2.

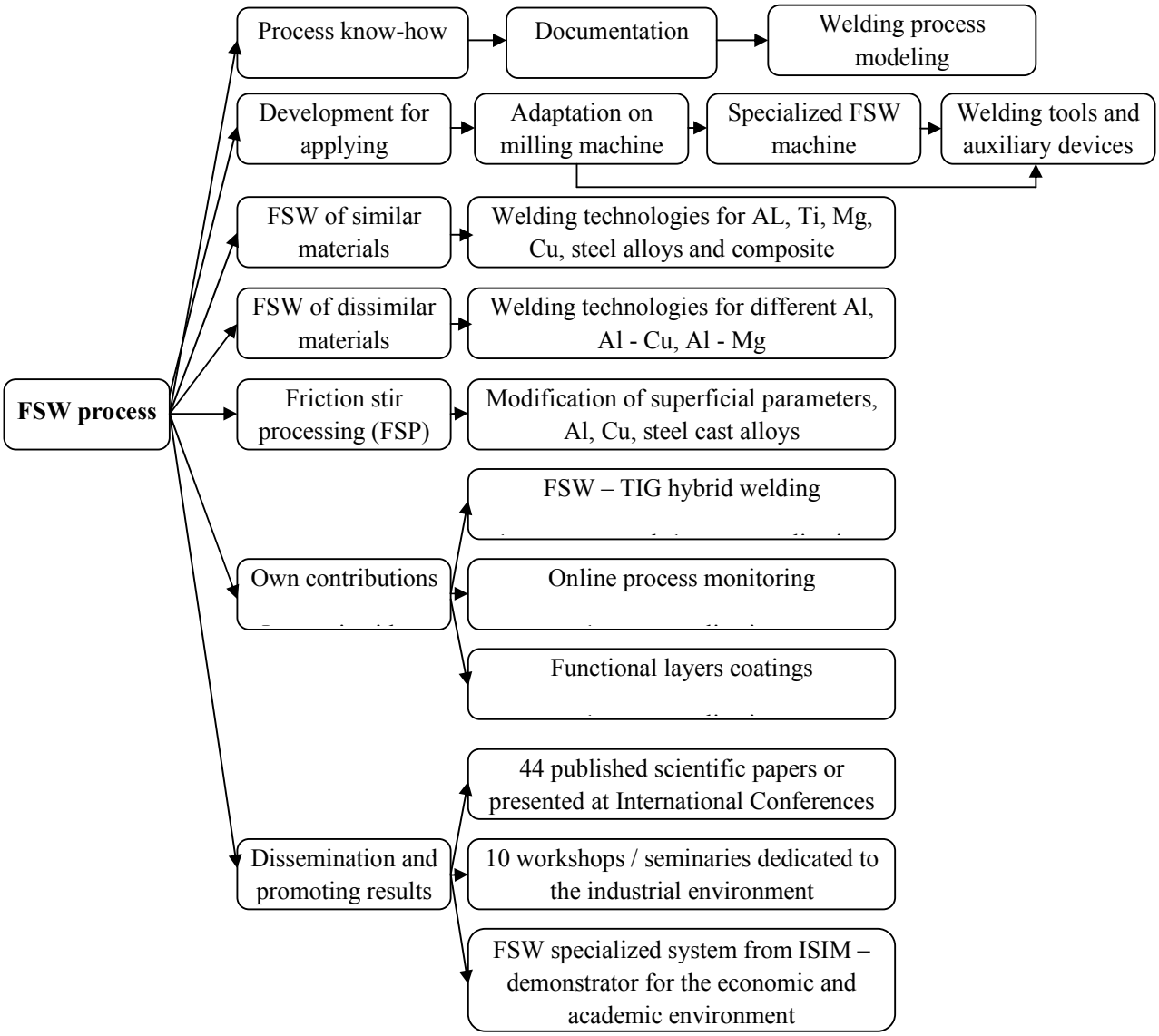


Figure 2. Research and achievements diagram

2.4.4. Execution

FSW **research papers** were obtained progressively in each of the three projects which approached different themes:

- **CEEX project** (finalized in 2008) – **welding low hardness materials**:
  - **FSW specialized welding machine** (the only one in the country)
  - **FSW tools and technologies** for welding aluminium alloys series 1xxx and 2xxx, magnesium alloys, titanium and copper materials
  - **FSW technologies** for dissimilar materials such as aluminium – magnesium, aluminium – copper
  - **Numerical models** for welding processes
  - **Characterization methods** for FSW joints
  - Studies on welded joints **defectoscopy**
  - **Implementation** of a **nondestructive** control method for **ultrasonic** welding using of **phase array** etc..
- **Nucleus Program project** (finalized in 2010) – **welding of hard materials**
  - **Improved FSW machine**, with technical characteristics necessary for FSW of hard materials
  - **welding tools and technologies** for welding high hardness materials (aluminum alloy EN AW 7075-T651, steel S235, S420, 304L stainless steel)
  - **FSW technology** for aluminum to **dissimilar alloys** (7075-6082, 7075-5083, 6082-5083, 6082-1200, etc.).
  - Complex study of **wear behavior** of materials used for welding tools
  - Making welding tools from sintered tungsten carbide
  - **FSP** of cast aluminium alloys, copper alloys and steels
- **PNCDI II project** (finalized in 2011) – **own contributions for developing FSW process**

  - Innovative ideas for broadening the possibilities to apply the FSW process

    FSW-WIG hybrid welding (patent granted through OSIM no. 4111/30.05.2011 decision and patent request for no. A01277/06.12.2010). FSW-WIG welding applications consequences:
    - Increase in welding speed with aprox. 80%
    - Increase of tools lifespan up to 50 % especially when welding materials with high melting temperature (e.g. steels).
  - **Online monitoring** of welding process using **infrared** thermography (patent request no. A/00921/28.12.2007)
  - Obtaining **functional layers** with a **consumable tool**, (using FSW process), patent request no. A01278/06.12.2010, registered at OSIM Bucharest.
  - **Hybrid welding** process **modeling** with additional heat input (FSW - WIG)
  - FSW loading process with functional layers modeling
  - **Improvement of specialized FSW** machine by adding equipment and monitoring the process using online infrared thermography and necessary conditions for application of hybrid FSW-TIG process. A complex system for FSW technology resulted with the role of **demonstrator** for industrial applications.

FSW research team was composed of **SR** and **TDE**, **doctors in engineering**, **students**, graduate and **doctoral students** with complementary basic education and specialization: **numerical modeling** of processes, experiments using **factorial design experiments**, development of **research programs**, characterization of welded joints, the joint **development and optimization**, **concept and design**, (computer aided) welding equipment and related devices, etc..

2.4.5. Final stage

Activities to disseminate and promote the results were a very important objective and were focused mainly on the following **directions**:

- **knowledge**, **promotion** and **identifying** the opportunities for **application** of FSW process in the **Romanian industry**.
- **use** of complex technological FSW system, provided in ISIM Timisoara, improved and supplemented with new modules, as **demonstrator** for specific industrial applications.

- **international visibility increase** by publication or presentation at international conferences of a number of 44 scientific papers in the FSW field.
- **knowledge and promotion of the process** in university environment by participating in conferences organized by the Technical University (Timisoara, Turnu Severin, Galati), but also through practical demonstrations at ISIM Timisoara and UDJ Galati, for graduate students.
- **protection of original innovative ideas / achievements** worldwide in FSW field.

The **innovative character** of ideas as **own contributions** have materialized in the granting of a **patent** and request for **3 more patent applications** filed at OSIM.

To **promote** the friction stir welding process in **Romanian industry** and for identifying potential industrial applications, 11 **seminars / workshops** were organized designed especially for participants from industry, where presentations were made on the FSW field process (Timisoara, Turnu Severin, Bucuresti, Sibiu, Cluj).

2.4.6. Valorization of results

The **promotion** of the procedure **to the industry** through promoting materials and questionnaires submitted and through direct contacts with the leading businesses has lead to the creation of a database with approx. **150 companies**, potential applicants of FSW welding process (particularly in priority sectors: **auto**, **railway**, **marine** and **aviation**).

The events were organized and held in Timisoara, Bucharest, Cluj, Sibiu, Turnu Severin and Galati.

The potential beneficiaries were contacted which were interested in the production and implementation of FSW, in order to establish cooperation relationships. Also additional data on products made and materials used in current production were requested in order to achieve the FSW welding samples.

ISIM Timisoara approach to **knowledge** and **promotion** of FSW process and the **business trips** to industry (during the project) resulted in the **identification of possibilities for application** of FSW process (industrial partners and the interest manifested in this respect), and requests for information regarding:

- **FSW** at "technological addition to shells from **Al 2024 and Al7075**, thickness 1.6 mm" (aeronautics)
- **Implementation** of the FSW process for the manufacture of **extruded products** (aeronautics).
- The possibility of **applying** the FSW process in making **flat panels** for certain categories of materials **Al 5083 H111**, **steel-EH36** (naval field)
- Possibilities of **application** of the process for specific items – making **extruded profiles** from Al 5083 of **side walls** for **railway wagons** (railway)
- FSW welding of sheets of **S 235 JR + N**, 2 mm and 2.5 mm thickness (railway)
- **Advice** and **technical assistance** for implementation of FSW welding process and the necessary equipment (railway).
- **Advice** to **identify** opportunities for application of FSW (for **carbon steel** and **low alloy steels**, **stainless steels**) in specific activities (production of tracked equipment, freight cars, etc..), and also in the **repair** of components of **aluminum and magnesium** alloys (railway).

An **industrial application** was found in the call received from the Institute of Welding in **Slovenia** for a FSW joint for Al 99,5 for a **TV equipment producing company**. For the request made by Slovenia Welding Institute several welded FSW samples were made (Al99, 5 of thickness s = 2mm) and technological parameters have been outlined. The first samples submitted for analysis were consistent with Slovenia technical conditions required by the customer.

The efficiency of researches and obtained results in the FSW field is demonstrated by the **patent obtained (2011**), the **3 patent requests at OSIM**, the first prize **and gold medal** obtained at the Innovation Saloon PROINVEN – Cluj 2008, the **44 scientific papers published** or presented at International Conferences (ISI quotations), the communication of results at annual Conferences of International Institute for Welding (IIW) and the rising interest of industrial applicators.

Based on ISIM achievements in FSW, and the fact that Romanian industry began to show **interest** in the **implementation** of **new welding techniques**, the research will continue so that the process will be **developed**. In this respect, plans addressing FSW joints and FSP of **metallic foams** will be researched, because they represent a very attractive topic in **auto transport**, **naval** and **railway** industry, as well as in **aeronautics**. On this topic a **project proposal** was submitted to the competition launched in September 2011, Partnership Program.

GLOSSARY

AROTT	*Romanian Association for Technology Transfer*
ASRO	*Standardization Association in Romania*
CALIST	*Funding programme of National Plan for Research, Development and Innovation - National Programme of Quality and Standards*
CAPACITIES	*Funding programme of National Plan for Research, Development and Innovation that relates to developing research capacity, by RDI system by opening the international scientific environment and connection to the national socio-economic*
CEEX	*Research Excellence Program*
CIP programmes	*Competitiveness and Innovation Framework Programme*
CNCSIS	*National Council of Scientific Research in Higher Education*
CNFPA	*National Council for Adult Vocational Training*
CNMP	*National Centre for Programme Management*
CORINT	*Funding programme of National Plan for Research, Development and Innovation that relates to international cooperation and partnership*
COST	*Intergovernmental framework for European Cooperation in Science and Technology, allowing the coordination of nationally-funded research on a European level*
CS	*Scientific researcher*
CSI	*Scientific researcher with first degree*
CSII	*Scientific researcher with second degree*
CSIII	*Scientific researcher with third degree*
EC	*European Commission*
EN	*European standard*
EPO	*European Patent Office*
ERANET	*European funding scheme created to step up the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States*
ETUF-TCL	*European Trade Union Federation of Textiles, Clothing and Leather*
EU	*European Union*
EU HORIZON 2020	*Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020*
EUREKA	*European funding programme that supports the competitiveness of European companies through international collaboration and in creating links and networks for innovation*
EUROSTARS	*European Joint Programme dedicated to the R&D performing SMEs*
FEDR	*European Fund for Regional Development*
FP7	*Seventh Framework Programme*
FSW	*Friction stir welding*
FSP	*Friction stir processing*
GDP	*Gross domestic product*
HG	*Government decision*
IDEAS	*Funding programme of National Plan for Research, Development and Innovation that relates to obtaining scientific and technological results, consistent with those of Europe reflected by increasing visibility and international recognition of Romanian research*
IDT	*Technological Development Engineer*

INFRAS	*Funding programme of National Plan for Research, Development and Innovation that relates to the consolidation of standardisation and quality infrastructures*
INNOVATION	*Funding programme of National Plan for Research, Development and Innovation that relates to increased capacity for innovation, technology development and uptake of research results into production, to improve the competitiveness of national economy and quality of life*
ISO	*International Organization for Standardization*
INSME	*International Network for Small and Medium Sized Entreprises*
INTERREG IVC	*European funding programme that supports Innovation & Environment Regions of Europe Sharing Solutions*
ISPIM	*International Society for Professional Innovation Management*
IT	*Information technology*
MATNANTECH	*Funding programme of National Plan for Research, Development and Innovation that relates to New Materials, Micro and Nanotechnologies*
MECMA	*Ministry of Economy, Trade and Business Environment*
NUCLEU Programme	*National Autorithy for Scientific Research programme*
OHSAS	*Occupational Health and Safety Advisory Standards*
OSIM	*State Office for Inventions and Trademarks*
PARTNERSHIP	*Funding programme of National Plan for Research, Development and Innovation that aims to create conditions for better cooperation between different entities of RDI, business and / or government units to address the problems identified*
PhD	*Doctor of science*
PN	*National plan*
PNCDI	*National Plan for Research, Development and Innovation*
POSCCE	*Sectoral Operational Programme Increase of Economic Competitiveness*
POSDRU	*Human Resources Development Operational Programme*
R&D	*Research and Development*
RELANSIN	*Funding programme of National Plan for Research, Development and Innovation that relates to Economic Recovery through Research and Innovation*
RENAR	*Accreditation Association Romania - National Accreditation Body*
RO	*Romania*
SEE	*South East Europe Transnational Cooperation Programme*
SME	*Small and medium-sized enterprises*
SR	*Romanian standard*
T I	*Technician first level*
T II	*Technician second level*
TS	*Technician*
TT	*Technological transfer*
UEFISCDI	*Executive Unit for Financing Higher Education, Research, Development and Innovation*