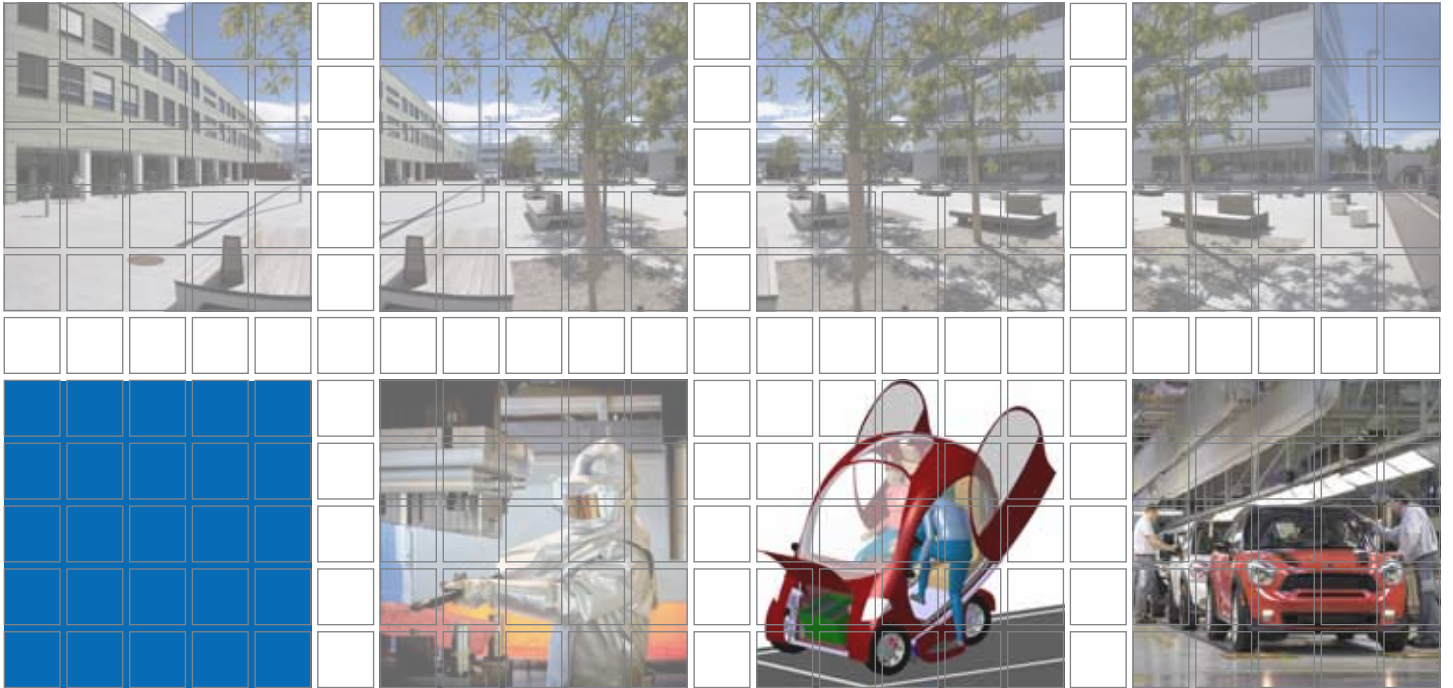


# [ FSI ]



## Annual Report 2015 Activity Report

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## PREFACE



*Andrea Hoffmann*  
Vice Rector Finance and Human Resources



*Horst Bischof*  
Vice Rector Research

**The reported year has once again highlighted the outcomes and achievements of the successful partnership between the automotive supplier Magna and Graz University of Technology:**

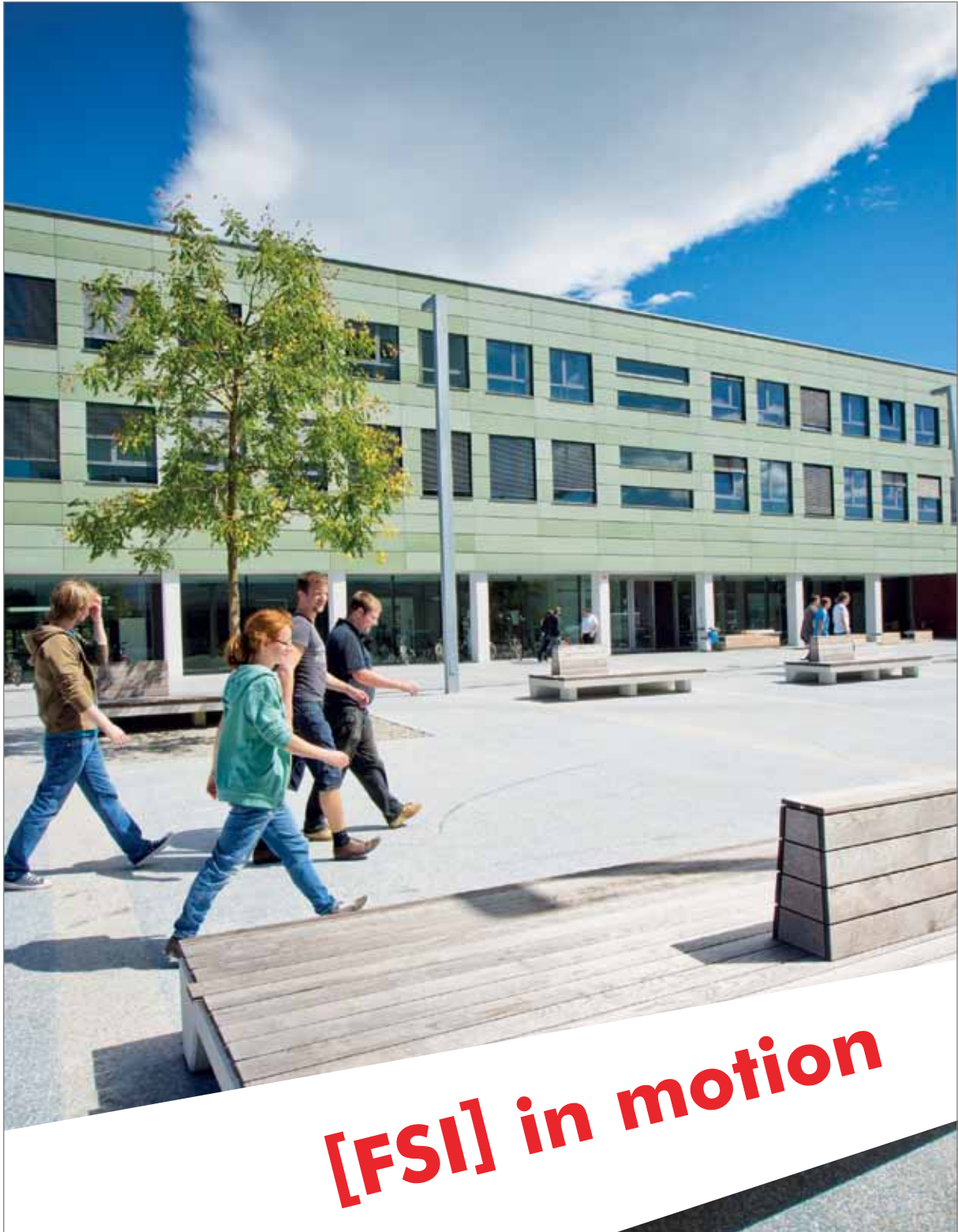
The FSI has developed into a unique center of excellence for European vehicle technology, thus generating a “win-win-win-situation” where Magna, TU Graz and students benefit from the established close cooperation:

- Magna is able to lead research activities with high-qualified scientific partners from TU Graz and to have direct contact to qualified students.
- The Institutes at Graz University of Technology conduct their research activities with Magna as a strong industrial partner for projects in their research field.

- The students at TU Graz benefit from direct contacts to the Magna Group worldwide and to other important car manufacturers or suppliers, primarily for internships as part of their studies but also for their future job position.

In the following, the report shows a summary of activities and events of FSI in 2015 spanning from a recruiting event, guest lectures and visitors to the awarding of scholarships. Since the beginning of the cooperation teaching activities and research projects have been the main pillars of the cooperation and remain the core business at FSI.

After this fruitful year further activities are planned, which require new laboratory and research space. The extension of the FSI building will be realized in 2016/17 in order to improve the positive development and achievements of FSI.



**[FSI] in motion**

## Future FSI: Extension of building

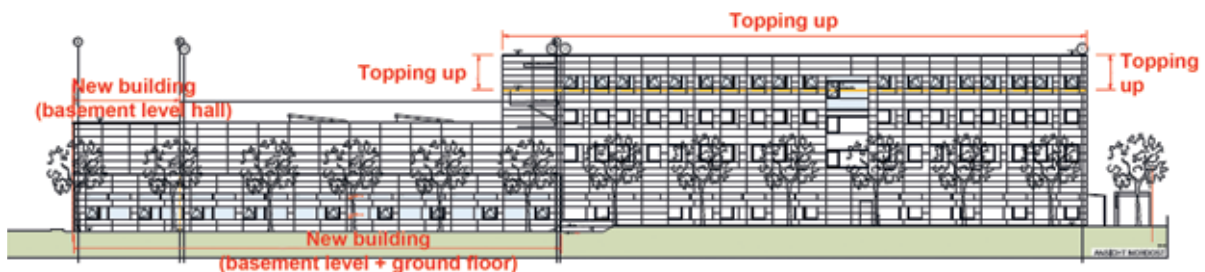
### Bigger and better: FSI 2016

2,000 employees, 170,000 square meters of floor space, 108,000 square meters of floor area – these are the figures of the Inffeld Campus, the biggest campus of Graz University of Technology – and the home of FSI. Since its beginnings in 1972, the dynamic Inffeld has been growing steadily.

Among several expansion projects on the Campus Inffeld on schedule the FSI extension is the most interesting one: After completion of the constructional negotiations in December 2015 the groundbreaking for the extension is fixed for May 2016. The FSI will be expanded to an entire floor

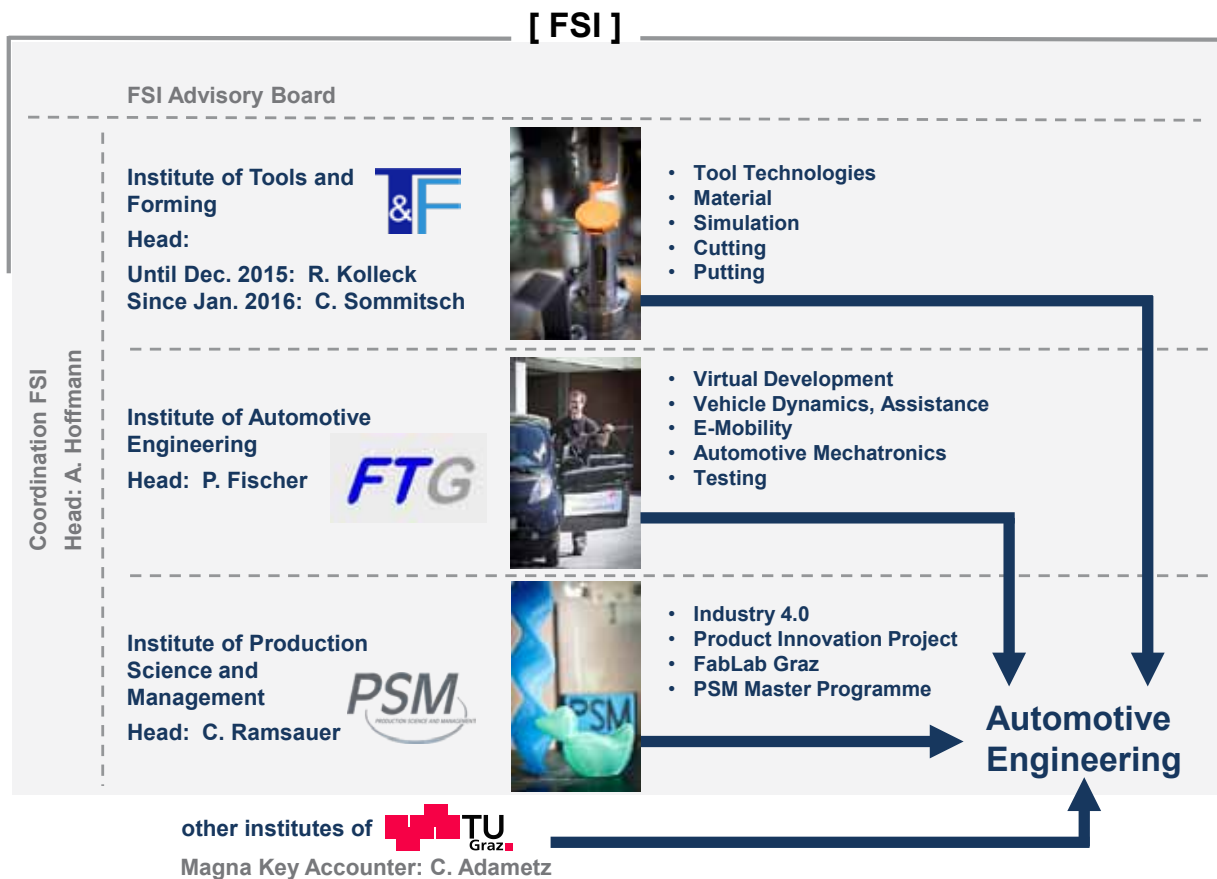
with additional laboratory space to the extent of 1,400 square meters. These measures shall provide more test benches and research space to the FSI institutes: The FabLab, an open innovation space will be enlarged to support fresh start ups. „A special feature is the construction of the first Austrian ‚Fabrication Labs‘, in which the production techniques of the future can be used by the students, as well as by companies and a wider public,“ says Rector Harald Kainz.

The completion of the new laboratories and research space is scheduled for the beginning of 2017.



2003	Co-operation contract between Magna Education & Research and Graz University of Technology
2004/05	Studies in Mechanical Engineering: First diploma program Production Science and Management (PSM)
2005	Start of first Magna research projects with FSI institutes
2005	Start of construction of the new FSI building
2006	Completion and opening ceremony of the FSI building
2006 - 2008	Configuration of the technical equipment at the FSI laboratories
June 2012	Prolongation of the cooperation contract until 2018
May 2014	10th Anniversary Celebration
January 2015	1st FSI Recruiting Event with industrial partners
2015/16	Start of extension of FSI building

# FSI ORGANIZATION



FSI Organization Chart

The FSI is an independent academic institution integrated into the Faculty of Mechanical Engineering and Economic Sciences at Graz University of Technology. Its three institutes - FTG, T&F, and PSM - pursue their own special research and teaching interests. They are guided by the FSI Advisory Board and supported by the Coordination FSI whose head is the Vice Rector for Finance and Human Resources.

**The Coordination FSI** is a one-stop service centre for FSI partners, FSI employees and FSI students, supporting communication between partners, Magna and Graz University of Technology as well as between the FSI institutes.

**In 2015, the Coordination FSI was responsible for the following tasks:**

- Organization of the FSI Advisory Board meetings
- Operative handling for FSI Scholarships
- Organization of visits at FSI for persons or groups
- Organization of FSI events, such as the second Annual Project Meeting, guest lectures
- Administration and optimization of the FSI Website [www.fsi.tugraz.at](http://www.fsi.tugraz.at)
- FSI Reporting: Providing with statistical evaluations and Key Performance Indicators
- Budgeting and budgetary control of the FSI Budget

# FSI ORGANIZATION

**FSI Advisory Board**







						
<b>Karl-Friedrich Stracke</b>	<b>Dave Pascoe</b>	<b>Maria Gabriele Ferruffino Vidal</b>	<b>Horst Bischof</b>	<b>Andrea Hoffmann</b>	<b>Christof Sommitsch</b>	<b>Franz Heitmeir</b>
<i>Chair</i>	<i>Member</i>	<i>Member</i>	<i>Member</i>	<i>Member</i>	<i>Member</i>	<i>Member</i>
Magna Steyr Fahrzeugtechnik	Magna International	Magna Education & Research	Vice Rector Research	Vice Rector Finance and Infrastructure	Dean Mechanical Engineering & Economic Sciences Until Dec. 2015	Dean Mechanical Engineering & Economic Sciences Since Jan. 2016

*FSI Advisory Board Members*

**The FSI Advisory Board is composed of respectively three representatives of Magna and Graz University of Technology.**

In 2015 three regular meetings took place at the FSI in January, June and October. In these meetings the Advisory Board performed their main duties and responsibilities including:

- the definition and monitoring of common research areas
- reporting and evaluation of scientific results
- consulting for the optimization of the curriculum "Production Science and Management"
- budgeting and budgetary control of the FSI budget
- defining the selection criteria as well as selecting the students for the hearing and awarding of the FSI Scholarships for qualified students



## FSI ACTIVITIES AND EVENTS 2015



Human Resources – Expert talk

### FSI Recruiting Event

On 28 January 2015 the FSI organized the first FSI Partnerday, an all-day recruiting and networking event for the partner companies such as AVL, Mahle, Miba, Ventrex, Siemens, MAGNA Powertrain, MAGNA Steyr, Magna Steyr Fahrzeugtechnik and the IAESTE, an international student organization, to get in contact with students of the Graz University of Technology.

The program of the Partnerday included company presentations and an expert talk of representatives of the Human Resources Departments of the companies in the lecture room, recruiting possibilities as well as CV checks for the students. During this networking event also many internships – in particular for PSM Internship applicants – and summer jobs were offered and could be arranged. About 100 students took the chance to get in touch with the representatives at the company booths. Afterwards the guests of the companies were invited to a meeting together with FSI researchers and lecturers to deepen company and university relations.



### Annual Project Meeting

On 22 October an internal Annual Project Meeting was organized as a get-together-event for Magna employees and FSI staff for the second time, aiming at giving an overview and an update over ongoing projects and basic research topics.

In several posters and presentations the project members and PhD students showed their research progress and results. Moreover some new ideas for additional projects were introduced.

Both partners benefit from this Annual Project Meeting because Magna and the FSI institutes can better plan their common projects and make the best of the expertise developed at the FSI.

### 5<sup>th</sup> Stainless Steel Colloquium

Taking place from 19 to 20 February 2015, this T&F event is a highlight among the metal-forming events. It is supported by Schuler AG and Outokumpu Nirosta GmbH. Processors often know too little about stainless steel, alloys and varieties on the application. Thus, the lecture series was bridled chronologically by the manufacturing and processing workflow. Subjects were duplex steels as well as the various methods and applications, engineering and design issues of the simulation, surface engineering and lubricants.



picture: Thyssen-Krupp



# FSI ACTIVITIES AND EVENTS 2015

## FSI GUEST LECTURES



### Future Challenges in Vehicle Development and Production

On 24 June 2015, a prominent audience listened to **Karl-Friedrich Stracke**, president of Magna Steyr Engineering, who explained the future challenges in vehicle development and production. Rector Harald Kainz welcomed around 70 interested guests. Among others, several members of the TU Graz rectorate, TU Graz students and employees, guests from FSI partner companies like AVL and several MAGNA divisions as well as guests from Fraunhofer attended this highly informative event.



*Sandra Brozek, Magna; VR Horst Bischof, TU Graz; Kurt Hofstädter, Siemens Austria; VR Andrea Hoffmann, TU Graz, Christian Moser, TU Graz*

### The Digital Enterprise – Industry 4.0

**Kurt Hofstädter** is Head of Digital Factory Central Eastern Europe with the special focus on „Industry 4.0.“ at Siemens Austria. On 12 November 2015 he visited the Institute of Production Science and Management and the Institute of Automotive Engineering at FSI and held a guest lecture on his key issue.

### Research abroad period at the Tongji University in Shanghai

Shanghai is one of the largest cities in the world and an important economic center in East Asia. The area of about 6,300 km<sup>2</sup> provides space for 24 million people – including all challenges in view of infrastructure and transportation. The Tongji University was founded in 1907 and is one of the top universities in China. The Jiading Campus is placed one hour driving to north-west from Shanghai Downtown, and includes several technical Institutes, e.g. the School of Automotive Studies. In May 2015, Associate Prof. Mario Hirz spent an abroad period there, where he gave lectures and supported research teams in the topics alternative propulsion systems, development me-



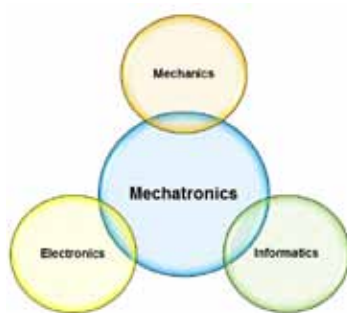
*Shanghai Downtown Skyline*

thods and automotive mechatronics. In addition, he planned a joint project of Tongji University and Graz University of Technology, which will provide a double degree study for the students of both partner universities.

# TEACHING AT FSI

## AUTOMOTIVE ENGINEERING

Two new lectures were newly introduced at the Institute of Automotive Engineering in 2015, which provide effective knowledge in the area of automotive mechatronics. The courses are given by Associate Prof. Dr. Mario Hirz and Dr. Jürgen Fabian.



*Mechatronics – integrating the disciplines of Mechanics, Electronics and Informatics (Source: Hirz)*

### Automotive Mechatronics 1, lecture no. 331.051

After the successful completion of the lecture, students have gained basic knowledge about automotive mechatronics. They are familiar with the classification and operation of mechatronic systems. Students know mechatronic components and are able to model mechanical and electrical systems. With the acquisition of basic skills and knowledge of automotive mechatronics, students are qualified to attend special follow-on subjects of automotive engineering with a focus on development methods, control and feedback control systems of components and drives within automotive engineering.

### Automotive Mechatronics 2, lecture no. 331.052

Students receive in-depth knowledge of automotive mechatronics. With the acquired specialized knowledge of mechatronic requirements, SW-architectures, and BUS-systems within vehicles, students are able to independently perform simulations of complex mechatronic systems. The students are able to set up model descriptions with the help of graphic editors and object-oriented modelling with different simulation programs. The attained knowledge can be applied for practical tasks within automotive engineering, e.g. control of hybrid and electric drives, dynamic driving systems, and on-board diagnostics.

## TOOLS AND FORMING

The teaching focus is on providing a basic knowledge of forming technology and non-cutting manufacturing. A variety of technical services and consulting are also offered to industry.

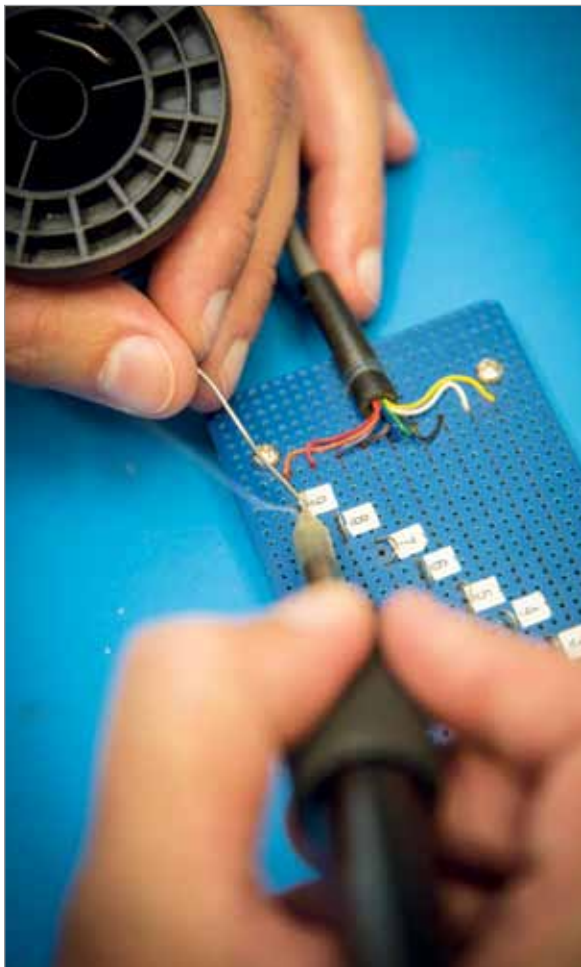
Research focuses include tool technology, materials, simulation, cutting and joining. Among other things, the Institute of Tools and Forming developed and built the prototype of an induction furnace for the automobile industry. The induction furnace was meant to speed up the production of component parts with ultra-high strength properties and considerably reduce energy expenditure.



# TEACHING AT FSI

## PRODUCTION SCIENCE AND MANAGEMENT

Since the 2007 winter semester the Production Science and Management master's program has been held in English. 18 experts from a variety of industrial backgrounds make up part of the training program and bring in their know-how and practical experience in the lectures. Students and companies take advantage of the service of the Institute of Production Science and Management to propose topics and projects for final papers in cooperation with industry. More than 250 diploma and doctoral theses have been completed at the FSI institutes since 2005.



### Master's program Production Science and Management

**Duration of study:** 4 semesters

**ECTS credit points:** 120

**Academic degree:** „Diplom-Ingenieurin“ or „Diplom-Ingenieur (Dipl.Ing. oder DI)“, equivalent to the Master of Science (MSc)

#### Content

- Deepen fundamental knowledge in production science and the economic sciences
- Understand current theories, principles and methods of production science and apply these in practice
- Combine technical knowledge with economic capabilities and social as well as international competence skills
- Gain knowledge about building up industrial production: product development, planning, procurement, production, sales and marketing
- Conduct independent research and application-oriented projects
- Prepare and present results of work effectively and using modern tools
- Write scientific reports
- Develop and hone social skills such as teamwork, team leadership and negotiation strategies
- Improve English terminology and gain international experience through subsidized stays abroad

#### Specialization Subjects

You can specialize in

- Advanced Technologies or
- Management and Social Economics.

For more information please visit:

**[fsi.tugraz.at/studying](http://fsi.tugraz.at/studying)**

# RESEARCH HIGHLIGHTS 2015

## AUTOMOTIVE ENGINEERING - INTERNATIONAL SUCCESS

One research highlight included the participation of two members of the Institute of Automotive Engineering (FTG) at the International CAD Conference and Exhibition 2015, which took place in London.

In his presentation titled “A Knowledge-Based Framework for Integration of Computer Aided Styling and Computer Aided Engineering”, Severin Stadler introduced extracts of his PhD-project. Markus Salchner presented a “Multi-CAD Approach for Knowledge-Based Design Methods”.

At the International Conference on Advances in Software, Control and Mechanical Engineering in Antalya, Markus Ernst contributed with a presentation titled “Optimisation of Automotive Software Quality Management by Use of Analysis Methods in the Development Process of Mechatronic Systems”.

For his outstanding research, he was honored with the Conference Best Papers Award.

## SHORT-TERM HEAT-TREATMENT (SHT)

The use of aluminum components in car bodies, powertrains, and chassis offers the highest potential of weight saving in the automotive sector. Thus, to increase the number of aluminum parts in the field of car body construction, the material’s disadvantage of a degraded formability compared to deep drawing steel qualities must be improved. A promising method for enhancement of the forming behavior of heat-treatable Al-Mg-Si aluminum alloys (6xxx) is the local reduction of strength, in order to reduce stress in the critical zone, when failures occur during forming processes. This can be achieved by a partial short-term heat-treatment (SHT) on the aluminum sheet in a process state before the actual forming process.

The Institute of Tools and Forming has developed a contact heating tool to provide near-series conditions during the SHT process in order to investigate the influence of different SHT parameters on the deep drawing performance. The outcome of the research provides knowledge for the design concept of an integrated SHT process in industrial applications.

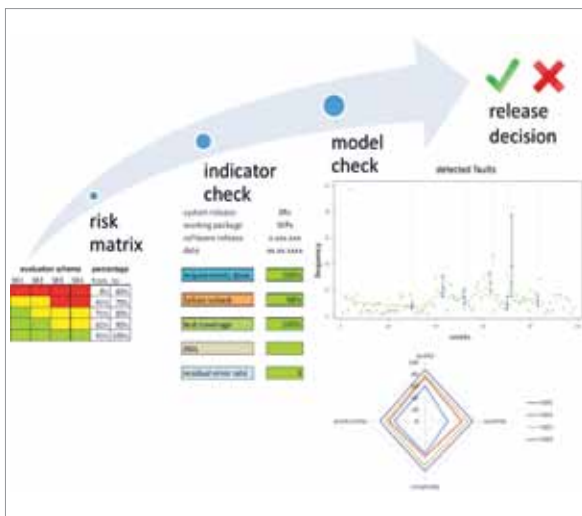
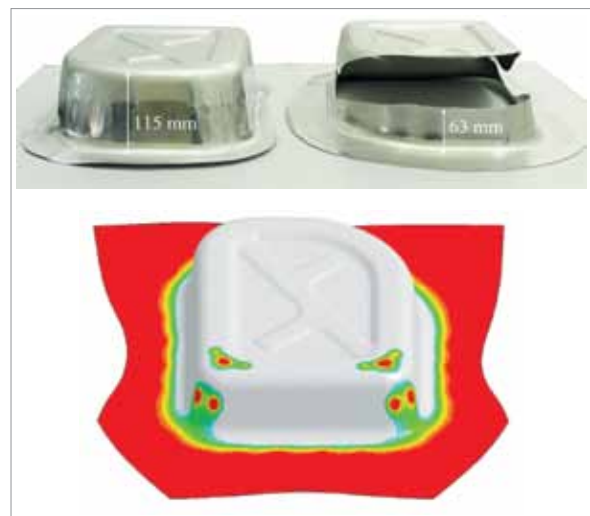


Fig.: Approach of risk analysis in automotive software release process (source: Ernst)



Above: Deep drawn test part with and without SHT (drawing depth 85mm); below: SHT - Layout

## SELECTED PROJECTS 2015



Fotos: © Helmut Lunghammer

### FABLab Graz

**Digital fabrication at the laboratory of the Institute of Industrial Management and Innovation Research (IBL) and the Institute of Production Science and Management (PSM).**

FabLab Graz is a high-tech space for small-scale digital fabrication. Neil Gershenfeld at the Center for Bits and Atoms of the Massachusetts Institute of Technology set up the first FabLab (Fabrication Laboratory) in 2002. The basic idea is to offer possibilities for individuals to produce own products by providing them access to digital manufacturing tools. At a FabLab you can find machines like a laser cutter, vinyl cutter, CNC milling machine and 3D printer. Moreover, tools for traditional manufacturing activities such as metalworking, woodworking and electronics prototyping are provided.

At present time, the worldwide FabLab community consists of more than 625 FabLabs in 70 nations. Prof. Christian Ramsauer has a strong focus on teaching practical skills and applying them creatively. Therefore, he heavily encourages students to invent and prototype – not only in the well established lecture “Product Innovation Project”. Open to a wide public of inventors, entrepreneurs and creatives, FabLab Graz is a place of teaching, testing and exchange of knowledge as well as a hub for hardware start-ups.

**For more information visit [fablab.tugraz.at](http://fablab.tugraz.at)**



## FSI SCHOLARSHIPS



January: Christof Sommitsch, Thomas Tscherner, Helmut Brunner, Siegfried Sharma, Stefan Redl, Gerhard Krachler, Dave Pascoe

Magna and TU Graz have the intention of supporting excellent services of the diploma and doctoral students at FSI within the framework of the cooperation with FSI. Therefore, a FSI-grant has been set up which will be granted to especially qualified students of the TU Graz.

Talented students who write their final papers at the FSI (diploma, master's or doctoral thesis) are eligible for the merit-based scholarship awarded by Magna.

Requirements and application modalities for students can be found under:

[www.tugraz.at/institute/fsi/coordination-fsi/scholarships/](http://www.tugraz.at/institute/fsi/coordination-fsi/scholarships/)



October: Dave Pascoe, Christian Jungmair, Gerhard Krachler, Felix Schober, Christof Sommitsch, Felix Fehrer, Horst Bischof, Andrea Hoffmann, Rene Nagl

## FSI SCHOLARSHIPS



*June: Horst Bischof, Christof Sommitsch, Karl-Friedrich Stracke, Michael Martin, Gabriele Ferrufino Vidal, Stephan Reinhofer, Andrea Hoffmann, Harald Kraus, Harald Kainz, Dave Pascoe*

**In 2015 the FSI Advisory Board granted FSI scholarships to 10 students.**

**From the beginning of this supporting program more than half a million Euros have been granted to about 100 scholars.**

## FSI VISITORS IN 2015



*Detlef Heck, Vicerector Academic Affairs TU Graz; Prof. Peter Fischer, Institute of Automotive Engineering, TU Graz; Prof. Hans Jürgen Prömel, President of the TU Darmstadt*

### TU Darmstadt - President Prömel

On 20 April 2015, one day before his talk at TU Graz about the role and future prospects of technical universities, Prof. Dr. Hans Jürgen Prömel, President of the TU Darmstadt visited the FSI institutes and laboratories together with Harald Kainz, Rector of TU Graz, and several representatives of both universities. Since 2014 Prof. Prömel has been President of TU9 – the alliance of leading Institutes of Technology in Germany –, since 2013 speaker of ARGE TU/TH.



### Swamy Kotagiri Visit

On 29 July 2015, Swamy Kotagiri, Executive Vice President and CTO Magna International, met with the Rectorate of Graz University of Technology and top researchers of FSI. Projects were presented, further synergy potential identified, and future innovation approaches and activities discussed.



*Alumni Activity: Golden and silver diploma graduates visited the FSI*



*Harald Kainz, Rector TU Graz; Swamy Kotagiri, Executive Vice President and CTO Magna International*

### TU Graz Alumni & Alumnae: Golden and Silver Diploma

On 21 May 2015 about 50 graduates of the TU Graz were awarded with a golden diploma, on 18 June 2015 the silver diploma of the TU Graz were given in a ceremony to about 50 alumni who got in contact with their „Alma mater“ after several years. On both days the FSI followed the request of the groups of alumnis to find out more about the current processes and status of the TU Graz and gave an interesting insight into the research areas and the teaching topics of the three institutes.



## FSI VISITORS IN 2015



### Visits of Secondary Schools

FSI also offers special guided tours for pupils of secondary schools through the institutes, labs and studios whereby tools, products and research topics are explained to the pupils and teachers. These presentations often give pupils an important stimulus to opt for a FSI related study at the TU Graz, where young scientists are very

welcomed and promoted. The cooperation with Magna provide students at TU Graz direct contact to the Magna Group worldwide and to other important car manufacturers or suppliers, not only for internships as part of their studies but also for future job positions.

In 2015, FSI welcomed a delegation of teachers of the HTL Vöcklabruck and scholars of the HTL Braunau, HTL Zeltweg and HTL BULME Graz.

### Prof Belšak – University Maribor

Prof. Dr. Aleš Belšak from the University Maribor performed an abroad period at the Institute of Automotive Engineering (FTG) as a visiting researcher from September to December 2015. With his expertise, he contributed to research projects in the area of clutch system design and friction simulation.





# FSI COOPERATIONS with third-party companies





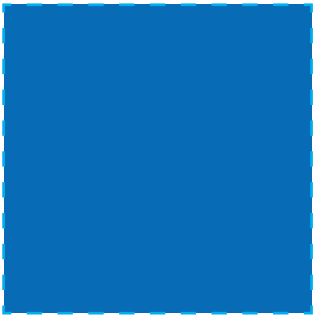
**Contact:**

Coordination FSI, Inffeldgasse 11/ 2, 8010 Graz, Austria

Phone: +43 316 873 9471

Fax: +43 316 873 9472

Email: [fsi@tugraz.at](mailto:fsi@tugraz.at)



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