Dear Readers,

it is our pleasure to introduce to you the latest issue of our TR29-News. We hereby present the newest research results of two particular projects as well as the up-to-date events around the Transregio 29.

In this regard, we would look into the design of shared-vision-systems and show how complex processes cannot only be guided across long distances but also demonstrate how such a system eases the dynamic interaction between the two parties involved.

Besides the multimodal user support the IPS²-life-cycle management is another important subject matter. In this context, we show why the interdisciplinary exchange of data along the entire IPS²-life-cycle is essential for a successful IPS²-design and provision. We furthermore explain, what has to be taken into account to effectively rise to this challenge.

Besides numerous contributions of the SFB/TR29 to international conferences and the organization of seminars with key speakers from all around the world, several members of the SFB/TR29 took part in the „Lange Nacht der Wissenschaft“ in Berlin by presenting their respective research topics to an audience of diverse backgrounds.

You can download our TR-News at the SFB/TR29 homepage (www.tr29.de). Enjoy reading!

Prof. Dr.-Ing. Horst Meier, Chairman Transregio 29

At June 14th 2008 from 5pm afternoon to 1am in the night the “Lange Nacht der Wissenschaft 2008“ was arranged. This event offers scientific institutes the possibility to welcome once a year people, that are interested in technology and science. All kind of people are invited to experience the broad spectrum of research and teaching. At different experimental demonstrations three subprojects of the SFB/TR29 present current research results.

Microproduction

Within the TR29 the subproject „Demonstrator“ focusses on the micro production. In order to that TR-colleagues presented the visitors technical possibilities for the production of parts with geometrical dimensions down to a micron.

Virtual Life-Cycle Unit Example

Information technology supports our daily life in many areas. The application to guarantee the functionality and availability of machine and products is a new challenge. According to the research activities in the subproject B3 of the TR29 the department of assembly technologies and factory management showed first prototypical realization.

A bicycle was presented to a broad audience, which is equipped with a product accompanying information system for function and usage diagnosis. The information system delivers information on about the bicycle functionality and it is correctly adjusted to the riders requirements, basing on his planned trip. This approach of a technical enabler to ensure the functionality and availability has been accepted from people of all ages.

Demonstration of a Shared-Vision-System

Whether technology, which is used by human beings, works properly and satisfying, depends essentially of how the interaction between human and technology is designed. The Chair of Human-Machine Systems presented examples for the intentional design of interaction in projects and experiments and invited the visitors to participate. Amongst other a brain-computer interface was demonstrated, a driving simulator was ready for test rides and a shared-vision system helped solving puzzle tasks.

The visitors experienced, how they could be supported by the technology of a shared-vision system while solving a problem. Entertaining experiments like puzzle tasks demonstrated how the industrial usage of shared-vision systems could be designed in future.
Constant availability, different qualifications of users and company-spanning cooperation in the field of industry demand a specific support concept during the delivery of services like maintenance and repairing. In the interdisciplinary special research project TR29 it is the task of subproject B4, to account for the role of the human being in the phases of planning, development and delivery of industrial product-service systems. In particular the human-machine interaction in the phase of delivery is in the focus of our research.

These aspects include the demands for usability for users of different qualification, integration of tools for coordination and communication into the human-machine interface, as well as the access to the machine’s sensor data and access to generated knowledge during operation. Due to the fact that the persons involved in IPS² pursue different interests, a security concept concerning rights of access to the data which is created during the phases of planning and operation, is needed.

These requirements demand novel forms of representation and novel forms of interaction within the dynamic and complex IPS²-processes as well as between product and service. One goal of future research is to develop the fundamentals for a comprehensive support concept in industrial product-service systems.

Only one challenge is the support of less and insufficient qualified users. As a part of a support concept, for example in a maintenance scenario, the creation of a “shared vision” (i.e. a shared view for the involved persons of the area where the problem exists) can be the last possibility for the diagnosis and solving of a problem, if other support forms were insufficient or not available in the specific business model.

During the production of a work piece the machine informs the user about a breakdown. After a detailed inspection the user realizes, that her/his qualification for the removal of the failure is insufficient. To minimize downtimes of the machine, expensive journeys of service staff and last but not least mistakes in the problem diagnosis, the user can establish an audio-visual contact to a remote service expert of the machine manufacturer by a shared-vision system (cf. photo). Now this service expert can analyze the problem in time.

Furthermore he can guide the user to a solution of the problem. As the gaze direction shows the focus of attention the visualization of the gaze direction of both involved persons can enhance the communication. Perceiving the mutual gaze movement therefore means an additional intuitive source of information.

Future studies and experiments for the development of IPS²-specific forms of user support will be placed in a demonstrator scenario in the field of micro production and related to maintenance and repairing scenario.

Contact
Prof. Dr.-Ing. Matthias Rötting
Phone: +49 (0) 30 / 314 - 79520
E-mail: roetting@mms.tu-berlin.de
### C1 - Life-cycle Management

Methods for a cross-stage management of multiple IPS² life-cycles

Chair of Engineering and Computer Science
Faculty of Mechanical Engineering
Ruhr-University Bochum

For establishing a cross-stage access to various life-cycle information an IPS² meta information model has been developed in the course of the C1 subproject.

On the one hand, this forms the foundation for integrated and cooperative data management functionalities like, for instance, the search and visualization as well as the analysis and summarization of the managed information. The information, for example feedback data can be led back into earlier phases of the life-cycle. This includes customer information, generated through the IPS² customer feedback management, as well as the automatically created product use information of the IPS.

On the other hand, the cross-stage process management supports, for example approval and change processes as well as various cooperation processes between the involved project partners.

For the development of the meta information model an evolutionary procedure model has been applied (see Figure). During the individual phases of this procedure model the semantic content and the degree of formalization of the results increase. At first, the analysis of exemplary use case scenarios as well as of the individual input and output data of the stakeholders involved in the product life-cycle, represented by the various subprojects in the TR29, has been conducted. On the basis of this data a clustering of use case scenarios has been accomplished and an information demand matrix has been developed.

The information developed during the analysis phase provides the background for the following design phase. Based on this information a specific IPS² glossary and taxonomy, for the classification and the structured representation of IPS², have been established during the first part of the design phase. They create a uniform understanding of concepts and thereby enable the communication of the individual subprojects on a common level.

During the second design phase the development of a meta class diagram took place in order to represent the database-model. In this context, the relevant meta classes have been identified and compiled according to the glossary of concepts and the taxonomy. The corresponding relations and interdependencies could then be determined for the individual classes. The modeling of classes and relations has been carried out by means of the object-oriented Unified Modeling Language (UML). Throughout the development the Standard for the Exchange of Product model data (STEP) has been taken into account in order to ensure the conformity to existing data models. The UML model serves as a basis for the IT implementation, for instance in the scope of a database application.

To increase the degree of formalisation the developed UML metadata model has been converted into a semantic meta information model. The Web Ontology Language (OWL), which has been generally accepted as a standard in the semantic web, has been identified as the most appropriate modeling language. By means of this modeling language it is possible to describe the various relations between the identified classes by using formalized rules and axioms respectively. As the research progresses the identification and analysis of necessary interdependencies and the conversion into representable axioms within the meta information model takes place. On the basis of these formalized relations it is then possible to analyze and resolve the individual interactive interdependencies by using appropriate query languages.

To complete the first cycle of the design phase the review and validation of the developed meta information model has been conducted involving the different subproject partners. Here, supplements of relevant classes or relations have been made. The results of this validation are led back to the design phase in the course of the evolutionary procedure model and on the basis of this information the meta information model is iteratively adapted. This evolutionary approach increases and guarantees the cooperative acceptance of the developed meta information model among the involved subproject partners.

### Contact

Prof. Dr.-Ing. Michael Abramovici
Phone: +49 (0) 234 / 32 - 27009
E-mail: michael.abramovici@itm.rub.de

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#### Table: Activities and Results

<table>
<thead>
<tr>
<th>Activities</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>- use-case and scenario analyses</td>
<td>- IPS² use cases</td>
</tr>
<tr>
<td>- empirical evaluation of experts</td>
<td>- formation</td>
</tr>
<tr>
<td>- analysis of outputdata within</td>
<td>demand matrix</td>
</tr>
<tr>
<td>- compilation of IPS² concepts</td>
<td>- IPS² glossary</td>
</tr>
<tr>
<td>- classification of IPS²</td>
<td>- IPS² taxonomy</td>
</tr>
<tr>
<td>- development of IPS² taxonomy</td>
<td>- UML class</td>
</tr>
<tr>
<td>- development of meta class diagram</td>
<td></td>
</tr>
<tr>
<td>- identification of IPS² relevant</td>
<td>- OWL diagram</td>
</tr>
<tr>
<td>- meta classes</td>
<td>- group work/</td>
</tr>
<tr>
<td>- identification of associations</td>
<td>feedback</td>
</tr>
<tr>
<td>- between IPS² relevant classes</td>
<td></td>
</tr>
<tr>
<td>- creation of IPS² meta class</td>
<td></td>
</tr>
<tr>
<td>- description of rules and axioms</td>
<td></td>
</tr>
</tbody>
</table>

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#### Diagram: Evolutionary Procedure Model

- Analysis
  - Development of IPS² glossary
  - Development of IPS² taxonomy
  - Identification of IPS² relevant meta classes
  - Identification of associations between IPS² relevant classes
  - Creation of IPS² meta class diagram
  - Development of semantic model
  - Description of rules and axioms
  - Extension of relevant meta classes and associations
  - Extension of semantic model
  - Review of model design

- Design
  - Development of meta class diagram

- Validation
  - Review and validation of the developed meta information model
This year the events CIRP Conference of Manufacturing Systems (CIRP MS), SPRING Seminar und PSS Workshop had taken place in May in Japan with the topics service and industrial product-service systems. A group of 5 researchers from the TR29 had used these conferences as platforms to present their research results. In total 4 research papers have been presented on the CIRP Conference of Manufacturing Systems in special service engineering sessions. On the SPRING Seminar Prof. Meier gave a presentation, as chairman of the TR29, in line with international highly ranked PSS researches.

We have established an new cooperation agreement to regulate the future collaboration of Japanese researchers with Bochum and Berlin. Therefore visits of guest researchers in near future are under preparation. The TR29 thanks for the hospitality and the beneficial information exchange.

Within the bi-annual PSS workshop, organized by the International PSS Design Research Community, the TR29 researchers Patrick Müller and René Geguschn exchanged experiences on IPS² with an international group of PSS and service engineering researchers. In all three events the members of the TR29 had a close look on the Japanese service engineering methodology and got experiences with „Service Explorer Nu“, their service CAD system.

The Transregio 29 seminar series is a good example to show the relevance of the topic of Industrial Product-Service Systems. During the last issue of the TR29 news three succesful seminars had taken place with guest professors out of Denmark, Sweden and America.

New methods for value creation from offering product-service systems is one of the research topics at the Linköping University. Prof. Tomohiko Sakao could be won as a guest researcher to present his experiences and his current research topic to the members of the SFB/TR29. Prof. Sakao is currently working in a research project with the title „Integrated Product Service Engineering“ (IPSE). The demonstration of high industrial relevance of Swedish research projects could be useful to extend the SFB/TR29. For future a strong cooperation of the research groups is intended.

Many thanks go to Prof. Sakao for the close insight the Swedish research and we are looking forward for a succesful cooperation.

On Oct. 15th and 16th Prof. Jay Lee from the University of Cincinnati, OH and Director of the Center for Intelligent Maintenance Systems (Center of IMS) visited the TR29 for two guest presentations. In his first presentation about “Dominant Design Tools for Product and Service Innovation” he introduces the concept and strategies for product and business innovation based on his innovative dominant design approach. Innovation Matrix and Customer Application Space Mapping tools for developing smart product service business have been introduced with case studies and discussed for the application of Product Service Systems. The second presentation was about the Center of IMS activities and in particular about applications of system prognostic for failure prevention. Both presentations gave an input for the activities of the TR29 and its demonstration case, a micro manufacturing system.

Also many thanks go to Prof. Lee. His presentations and the following discussions gave us interesting and good input for future research in the TR29 and can also be used for the detailing of our demonstration scenario.

Prof. McAloone from the DTU in Denmark visited the TR29 in June to refer on his experiences in PSS, eco-design and lifecycle-oriented engineering. He gave presentations and participated in working groups. The whole event was organized as a full-day workshop.

Many thanks to Prof. McAloone for sharing his valuable knowledge on PSS and for his great advises to enhance TR29 methods for the IPS² idea and requirements generation.

Transregio Seminar Series

Contact:
Chair of Production Systems, IB 2/126
Ruhr-University Bochum, 44780 Bochum
Tel.: +49 (234) 32-26310
Fax: +49 (234) 32-14157
Internet: http://www.tr29.de
E-mail: meier@lps.ruhr-uni-bochum.de

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