Editorial

Dear readers,

we are pleased to present you with the new issue of our TR 29-NEWS and would like to share the latest news from the SFB/TR 29.

In the new year we will continue with the presentation series, in which you will learn about the current research results of the SFB/TR 29 subprojects. This issue includes reports on two subprojects with research topics from the delivery and use phase of the life cycle of an Industrial Product-Service System (IPS²).

The organizational enterprise structure and the sequence of the business processes are characterized by a high diversity of possibilities particularly with IPS² providers. In order to aid with the search for individual solutions, we introduce an IPS² reference model for customer integrating and cooperative IPS² delivery processes.

In February 2009 the 2nd Spring School took place this time in Cranfield (UK). The Spring School is organized by the CIRP IPS² working group and was again a big success. The previous month Prof. Dr. Letmathe from University Siegen held guest lectures on the topic “Availability management of manufacturing systems”. In order to open up the IPS² paradigm to a wide audience, the SFB/TR 29 will participate with an example scenario in the industry fair Hannover Messe in April.

The criteria quality, time and costs are essential target goals, not only for industrial manufacturing but also in the provision of service. Ensuring an optimal and constant balance of these goals poses a difficult challenge however. The aim of the presented IPS² process control is to make full use of the automation potential with reference to the service shares.

International Spring School 2009
Industrial Product-Service Systems

On 23 – 27 February 2009 the second international Spring School on Industrial Product-Service Systems took place in Cranfield (UK). The week long event gave 16 participating PhD-students from 7 Universities the opportunity for extended scientific collaboration.

The event was especially intended to address young researchers in the field of Industrial Product-Service Systems. Via lectures and hands-on group works it provided an appreciation of the special features in IPS² business models, fundamental knowledge required for costing such systems, an understanding of different research methods as well as knowledge of different factors in IPS² design.

The participants became an insight into IPS² concepts, research and design methodologies, the areas of application for such systems were addressed, and it was point of the discussion how to collect, organize, and evaluate data for such systems. Thus the participants could gain an understanding of IPS² cost and value drivers and different costing concepts and acquire working knowledge of different methodologies.

Besides the knowledge transfer the collaboration of the participants from several countries especially strengthened the network within the international researchers’ community.

In the same way as the first international Spring School 2008 in Bochum the event this year was supported by the CIRP working group Industrial Product-Service Systems created by the collaborative research project TR29. It was organized by the participating chairs from the Ruhr-University Bochum, the TU Berlin, the University of Cranfield (UK) and the TU Kaiserslautern, but open to all students researching on Industrial Product-Service Systems.

The next Spring School 2010 will take place at the technical University of Grenoble (France) under the direction of Prof. Daniel Brissaud, involving international experts and being accessible for all interested young researchers.

Prof. Dr. h. c. Dr.-Ing. Eckart Uhlmann, Vice chairman Transregio 29
The new understanding of Industrial Product-Service Systems does not only lead to new requirements and challenges in the development, but also to challenges in their provision. Companies need to adjust to a new situation in order to create business relationships and processes in an optimal way with the novel IPS² understanding. The organization of such companies is affected by a large variety of options to design the organizational structure and the course of entrepreneurial processes. As there are no general design and process organizations for all occurring options, reference models are an approach to support companies in the selections of an appropriate solution.

Reference models are created to define a model and classes about general all circumstances. Specifications of the model can then be extracted. Models for the same circumstances can be compared with each other. Especially for Industrial Product-Service Systems a model for common actor types for the delivery and use phase has been developed. In this regard the changing type of the relationship between the customer and the provider from a seller-buyer relationship to a customer integrated provision network, the IPS² network, is very important. An IPS² network consists of the customer, the IPS² provider and additional suppliers (figure 1). The customer share will be recognized during the IPS² development and is one of the determined influences for the IPS² delivery. Figure 1 shows the necessity to add external competencies to ensure the whole IPS² product model and its demands competencies. The IPS² provider is able to deliver only a part of the IPS² product model. Supplier(s) can take over the remaining parts. This leads to the effect that there are parts which can be delivered by more than only one network partner. The IPS² provider has to decide which is the best fitting actor. Benefit of this situation is the flexibility to decide event driven and not for general.

In the reference model for IPS² delivery different actor roles are defined that vary in their responsibilities and delivery skills. To guarantee a constant quality and to minimize the risk during the provision phase the IPS² provider has to be the central actor in the IPS² network. The customer can contact the IPS² provider for all IPS² belonging aspects. Despite the heterogenic character of the IPS² solution the customer can act like he is bying a traditional product. The IPS² provider will then calculate and plan the necessary service. In the IPS² network the IPS² provider can use three different types of suppliers. These can be the Industrial Product-Service Module Suppliers, the Component Suppliers or the Service Suppliers. A component supplier is equivalent to a spare part manufacturer but with a higher flexibility in scheduling and logistic of the parts. This demand comes out of the customer integration in the IPS² network and the necessity to react flexible on changing circumstances. A service supplier is offering services that are scheduled by the IPS² provider. An IPS² module supplier is characterized by a more autonomous scheduling of his IPS² parts. Also an IPS² module consists of tangible and intangible shares and the tasks are therefore a mix of component and service supplier tasks. Important to know is that the IPS² network is necessary over the whole delivery phase of the IPS² life cycle and thus it has to react dynamically on all changing aspects. Supplier types, the delivery processes, the customer competence or the IPS² product model can vary during the delivery phase (figure 2).

With knowledge about the different roles for the IPS² network and the integration of dynamic flexibility the next step is to build up the reference model of the organizational structure and the operational workflows. First of all an IPS² organization has to decide for the right resource to deliver the IPS² part with its processes. A usefull approach to deal with this demands is the modularity. A modular organization unit (MOU) has been created (figure 3). This MOU is responsible for a defined part of the IPS² product model and therefore for a defined part of the delivery processes. The structure of the MOU is created by the principles of modularity. The IPS² network itself can then be created out of multiple MOUs that are combined and organized by their inherited processes. The necessary resources for the delivery process have to be assigned from the modular organization unit to the customer, the IPS² provider or the suppliers.

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Industrial Product-Service Systems aim at the generation of a win-win situation for customers and providers of IPS². For this purpose not only the effective but also an efficient operation of IPS² has to be guaranteed. The optimized usage of automation techniques, especially the disciplines measuring, control, feedback control, and communication offers adequate instruments to achieve this intention. While feedback control of industrial production systems is well-established, holistic approaches for the control of IPS² operation do not exist. Since Industrial Product-Service Systems are characterized by integrated product and service shares, both have to be considered within the concept of automated support of IPS² operation. Especially the almost non-deterministic character of human behavior and external factors that influence service processes pose a great challenge.

Quality, time and costs build the trilemma of the most interesting targets in industrial production. Due to interrelationship between these parameters it is very difficult to find a well balanced relation. An utmost high amount of automated support will lead to an effective and efficient solution. Concerning the intended targets it must be a main goal not only to make service processes capable but also reliable. This is also the reason why innovative solutions for feedback control of IPS² operations are developed within the SFB / Transregio 29 “Engineering of Industrial Product-Service Systems”.

An availability oriented IPS² use model demonstrates how the chosen approach of IPS² feedback control enables automatized cooperation of product and service shares and increases availability. The core of the controller to be developed is the concept of virtual Life-Cycle Units (VLCU). VLCU is an extension of Life-Cycle Units (LCU) developed at the TU Berlin. The term virtual depicts that the VLCU is an intangible unit, in contrast to the LCU which represents a hardware that is spatially restricted and mounted on a physical component. In fact VLCU is a concept of acquisition and processing of arbitrary data coming from distributed sources. The processed data is used for automated knowledge generation, monitoring and feedback control of IPS² operation.

The centralized communication architecture is based on a software agent system. Components that are relevant to IPS² operation are represented by their software agents. All communication between the software agents proceeds over the central software agent of the IPS² provider. This centralized communication architecture is chosen due to the fact that the IPS² provider takes full responsibility for the guaranteed availability of the production system of the IPS².

The software agents monitor the IPS² processes. In case of disturbed IPS² operation the software agent of the affected IPS² component sends a message about the current condition to the software agent of the IPS² provider (see figure). According to the feedback control strategy the software agent of the IPS² provider decides how to counteract.

Software agents in context of IPS² feedback control are mainly characterized by their abilities of communication, perception, and goal-oriented action. Therefore these software agents have implemented behaviors which they use to achieve the objective of correcting deviations within IPS² processes. To perceive their environment they use different information sources. Such sources are sensor signals as well as information provided from semantic web applications and system platform internal messages. Corrective actions of IPS² processes have to take into account that most of the service processes within an availability oriented IPS² are characterized by human-machine interaction. Therefore supporting systems like teleservice and augmented reality applications are integral parts of IPS² feedback control system.

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On 1 February 2009 Professor Dr.-Ing. Ewald Georg Welp was torn away from us completely unexpectedly. The Transregio 29 grieves for his valued member, as well as for the Wissenschaftliche Gesellschaft für Maschinenelemente, Konstruktionstechnik und Produktentwicklung (WGMK) for their board member and the Berliner Kreis (BK) for its dedicated member. Prof. Welp since the beginning actively conducted the Transregio 29 and always strengthened it with his ideas. Since 6 years he was responsible for the joint research activities within the WGMK. During the preparation of DFG priority programmes he always pushed for a strong focus on modern mechanical engineering marked by mechatronics.

Prof. Welp studied mechanical engineering at the Technical University Darmstadt and achieved his doctor’s degree at the chair of machine elements and gears of Prof. Müller. During his long-time industrial work at the company Jagenberg in Düsseldorf he was head of the research and predevelopment department. Already there his outstanding creativity arose. He demonstrated his dedication to innovation by numerous patent applications. At that time he also assumed lectureships at the Niederrhein University of Applied Science and the Technical University Darmstadt and thus showed his ability to motivate and inspire young people. Since 1997 he headed the chair of engineering design at the Ruhr-University Bochum; he was dean from 1999 to 2001. In October 2002 he was appointed as a professor and in July 2009 as technical coordinator of the Chinesisch-Deutsches Hochschulkolleg (CDHK) at the Tongji-University in Shanghai/China.

Prof. Welp educated several generations of students; many of them today are in responsible position in industry, economy and science. He took care of numerous dissertations and is author of many scientific publications. Until recently he was also board member of the VDI EKV as a vice chairman. In October 2004 the EKV awarded him its highest honour, the Fritz Kesselring-Ehrenmedaille. In the journal KONSTRUKTIONS Professor Welp published some scientific papers on mechatronics, shape memory technology and robotic. His dedication and his professional advice will be missing for everyone.

Prof. Welp was always kind and helpful to all his colleagues; all staff members of the SFB/Transregio 29, the chair of engineering design at the Ruhr-University Bochum, the Berliner Kreis and the WGMK will ever keep honourable memories of him.

PhD Thesis in the Context of Industrial Product-Service Systems

The promotion of young academics is of particular concern to the collaborative research project SFB/TR29. The young academics get the possibility to work with a high level of self responsibility on their complex and interesting research areas. Since the beginning of our collaborative research project three research assistants have successfully finishing their PhD thesis.

Mr. Dr.-Ing. Daniel Kortmann focused 2007 on the “Design of Services in Industrial Product-Service Systems”. Ms Dr. Katja Wasmuth regarded 2008 an economic view on the “Cost Management in Service Engineering of Industrial Services”. This year Mr. Dr.-Ing. Tim Sadek finished his thesis about “A Model Based Approach for the Conceptual Development of Industrial Product-Service Systems”.

Their work and research results accounted a lot to the development of the IPS² theory.

We congratulate them for their successful finishing of the doctor’s degree, thank them a lot for the inspirational cooperation and wish them success for their future life.

Hannover Messe 2009

We present exemplary results of our latest research at the HANNOVER MESSE 2009. You will find us from 20 - 24 April at Hall 2, Stand D19/21.

Transregio 29 Seminar Series

Since the last issue of the TR-News a successful workshop with an economical background took place in the seminar series of the SFB/TR29. Some project related networking was achieved with Prof. Peter Letmathe (University of Siegen) who informed the staff of SFB/TR29 about his current progress in his research field.

Prof. Letmathe is in charge of the research project Vera-Pro, that deals with the availability management of production systems with a process accompanying, rule-based current state information system.

The members of the SFB/TR29 would like to thank Prof. Letmathe for the presentation of his economical experience in this field.