Familiar use of IT-based word planning systems already taking place during studies

TU Bergakademie Freiberg integrates HSplan in its curriculum

Quick, cost-efficient and needs-based production is the core business of industrial manufacturing. In order to achieve effective results, the use of IT-based work planning is indispensable. Consequently, the preparation of working plans plays a major role in engineering studies. In this way, students gain an insight into interdependencies and effects of adjusted parameters on the manufacturing process. They traceably understand the influence of tool machines, processing methods, tools and cutting values.

Founded in 1765, Bergakademie Freiberg is the world's oldest and today still existent academy offering mining sciences and that states the beginning of the respective scientific study- and research programmes. Close cooperation with enterprises allows students to find internships and write minor-, bachelor-, master- and PhD theses in the industrial sector. Since the German reunification, the University for Applied Sciences Bergakademie Freiberg established itself in the international university landscape as a "resource-university" with the four primary subjects of geo, material, energy and environment. Around 5,600 students are enrolled at the University for Applied Sciences TU Bergakademie Freiberg.

"My lecture about 'production and production measurement technology' is an introductory lecture teaching basic knowledge. The analysis and assessment of processing methods necessary for the manufacturing of a work piece are a key topic of this lecture, in order to prepare a clearly defined process order in the form of a work plan, in the end. This work plan is tailor-made for a respective machine park and serves the shop floor as a template for effective production processes," explains Prof. Dr.-Ing. habil. Bertram Hentschel, professor for construction- and production technology at the Institute for Machine Elements at TU Bergakademie Freiberg. "There is no doubt that preparing such a work plan with its various work steps manually and by themselves states a great advantage for students. However, handling alternative work plans the same way in order to select the most effective work plan from a variant analysis would exceed any available time limit. Thus, we were looking for a suitable software-tool." The profile of requirements to such an IT-based work planning system does not only cover the conditions for educational implementation into the curriculum, but also:

- Sufficient functionality and flexibility for the analysis of alternative work plans
- Preparation of pre-configured process modules and short implementation times
- Intuitive handling, transparency, traceability
- Software use via server, network capability and a high system stability
- Optimal service and support

IT-based work planning from the practical field is a part of student education

Prof. Dr. Hentschel and Dr. Thomas Geipel, research assistant at the Institute for machine elements, construction and production went to several fairs and noticed the calculation- and work planning system HSplan by HSi, Erfurt. The software by HSi serves the purpose of quick and exact target time determination, preparation of work plans as well as transparent calculations for components to be produced. HSi-Technologiebasis® with its preconfigured process modules for mechanical processing methods including welding processes plays a major role. Industry-specific technology data as cutting speeds, feed rates, cutting values and algorithms for cut distribution are already assigned to the respective components. In addition, the data base contains sets of rules for target time determination (main-, secondary- and set-up times) for turning, milling, drilling etc. The concept of the process modules allows users to depict changes of the specific production situation in HSplan by the modification of technology data and sets of rules. Hence, the system may be configured and

updated appropriately.

The university decided for HSplan in order to present examples from the practical field in the lectures and to use it as an auxiliary tool for exercises in target time determination as well as work plan preparation. Students learn that the correct selection, assignment and order sequence of production methods, work stations (machines) and tools play a significant role. Geometry and material of the work piece to be produced require an exact definition of the sequence order of work steps including processing methods and/or the necessary tools with the respective cutting values. As HSplan consists of preconfigured process modules, the software system meets the requirement of time-saving in the educational process.

The system virtually provides the necessary machines, respective tools as well as technology data. Moreover, individual work steps can easily be described and the needed target times can be determined by the system. Consequently, all times are cumulated for the whole work process. During the implementation of HSplan, the virtual machine park used by the university was implemented into the system of HSi.

Work plans accessible via Internet

"We are using HSplan in order to train our students since summer semester 2011. We access it via internet with an ASP-solution (Active Server Pages) to the HSi-server in Erfurt. We are, therefore, always provided with the latest version without spam or viruses. In addition, we can ensure a sufficient computer capacity and uninterrupted operation. Moreover, we are saving on the administration effort as well as any other maintenance efforts", reports Dr. Geipel. "The solution put into practice via the HSi-server allows us to use HSplan together with our students. Moreover, everyone has the chance to work with HSplan individually, which we highly appreciate. Thus, one can also use the programme at home – via internet." The average amount of students is 40 to 50 mechanical engineering students per semester, who all intensively deal with the topic of work plan preparation using HSplan. In total, the knowledge about HSplan is shared by 200 students, as students from other study programmes such as mining, industrial engineering as well as technology-, quality- or environmental management specialising in 'mechanical engineering' are allowed to attend common lectures.

HSi GmbH — Arbeitsplan — imkf

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10	300258 Bügelsäge Saegen Halbzeug auf Laenge 55 Sägelänge=160mm		tr=1,2min, te=26,4min trg=1,0min th=22,86min tn=0,10min
20	310310 CNC-Drehmaschine Drehen linke Seite, Zentralbohrung: Bohren und Ausdrehen Rüsten und Spannen 1xPlandrehen kpl., D=150/0, A=6,5, Rz10 2xAbsatz, D=150/140, L=14, Rz10 Drehen Innenkontur 1xSpiralbohren, D=20, L=54, SS=HSi, 3xEntspänen, WW=J 1xAbsatz innen, D=20/38, L=54, Rz10 1xAbsatz innen, D=38/60, L=2		tr=20,7min, te=7,4min trg=16,6min tn=1,66min th=1,48min tn=0,03min th=1,73min tn=0,03min th=1,59min tn=0,43min
30	310310 CNC-Drehmaschine Drehen rechte Seite Rüsten und Spannen 1xLängsdrehen kpl., D=150/70, L=40, Rz10 1xPlandrehen kpl., D=70/38, A=6, Rz10 1xKegeldrehen, D=48/38, L=1, Rz10		tr=20,7min, te=6,5min trg=18,6min tn=1,05min th=4,07min tn=0,33min th=0,16min tn=0,01min th=0,03min tn=0,01min
40	320320 Radialbohrmaschine Bohrungen auf Lochkreis Rüsten/Spannen beim Bohren/Fräsen Rüstzeit Basiswert=10min; WZ-bezogen=0.5min Nebenzeit Spannen=2.7min zusätzl. für Teilen 3x=1min 4xZentrieren, D=3, L=3, SS=HSS, WW=J 4xSpiralbohren, D=12, L=14, SS=HSSi(B), WW=J		tr=12,1min, te=8,1min trg=10,5min tn=0,70min th=0,34min tn=1,31min th=0,32min tn=1,34min
50	340375 Räummaschine Raeumen der Nut Rüst- und Nebenzeit 1x Räumen, Nutlänge=56, Zage=1		tr=17,3min, te=3,9min trg=15,0min tn=2,19min th=0,65min tn=0,55min
60	700940 Verpackung/Versand Sichtprüfenkontrolle Verpackung und versand		tr=10,0min, te=1,0min

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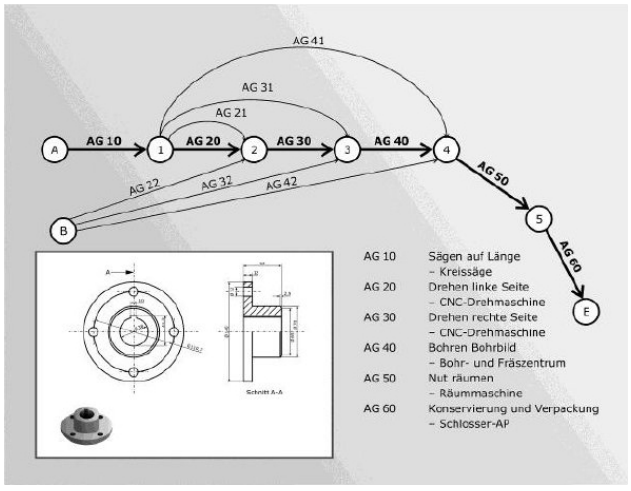

In the scope of the study programme, the question of whether the technology data used as a basis lead to absolutely exact target times does not play a significant role. A holistic view, quick preparation of alternative work plans and their comparison are rather key topics. It is important to settle in the first place whether a manually prepared draft fits the IT-generated working plan, i.e. to analyse where severe deviations occur in the determined target times. In this way, students are offered concrete indications in order to check their calculation basis and –processes.

Generating alternative work plan variants achieves high learning effects

Students are able to write a minor thesis during the semester by using the knowledge they gained in lectures and trainings. The thesis is a typical plan from the manufacturing technology branch, which usually serves as profound input for the shop floor. Such a minor thesis serves the purpose of determining an effective economic production variant for a given component or work piece, including the preparation of a detailed work schedule. In order to calculate the planning times for the respective part, students first of all identify all individual work steps and their sequence order. Adding the times determined for the necessary work steps sums up to the whole planned time for the production of a part. First of all, this is done in a "classic" way without IT-support, i.e. on "paper level". This manually prepared work plan serves as a basis for the comparison with the work plans quickly generated by HSplan. Students shall develop a consciousness for variant production, in order to come up with realistic alternatives for one preferred variant.

Changing certain parameters has effects on target times, work steps and work schedules. Thus, modifications are easier to assess and can be used more precisely in the determination of suitable alternatives. Among other things, it becomes apparent that even the selection of a manufacturing process shall be reassessed: "In the scope of this exercise, we consider it highly important that students already get acquainted with software-tools, such as HSplan, and learn which potential of effectiveness but also which limits lie in these tools. Users have

to define a reasonable sequence order of the individual work steps for a respective manufacturing process. As a first step, students have to cut out a blank, for instance. Only afterwards do further work steps, such as roughing and smoothing, occur in the planning, no matter whether the respective parts are milled or turned. Thereon, drilling and thread-cutting are put into practice. If one wanted to transfer such basic knowledge to the software, it would become significantly more complex, time-consuming with respect to maintenance and too expensive, in the end. The software rather serves the purpose of supporting users efficiently in the fulfilling of routine tasks than transferring additional knowledge with numerous plausibility tests and support sensitive to context issues", comments Prof. Dr. Hentschel and adds: "Nevertheless, we highly appreciate the provided tutorial, although the intuitive operating interface of the software is self-explanatory."

"The integration of HSplan into our curriculum was a step towards the right direction. This is clearly resembled by the achieved study effects of our students. In addition, high functionality, transparency and traceability as well as a comfortable handling and assessment clearly contribute to this success,"states Prof. Dr. Hentschel. "Our next step will be to closely deal with HSi-Technologiebasis®,especially with the calculation basis and the sets of rules, in order to assess their influence on manufacturing technologies more precisely. Such an insight into this field gives interested students the chance to find topic suitable for their theses. Moreover, we will be able to add the latest processing methods, machines and tools to our virtual machine park." Dr. Geipel adds: "By coupling HSplan directly to the manufacturing control system of the shop floor, we are aiming for another goal: Work plan variants to be analysed could be transferred as alternative solutions in the manufacturing process into graphs. By following this approach, we have the aim of making manufacturing processes more transparent in order to assess them with regard to their effectiveness in the workflow, starting with the preparation of work plans up to shop floor control systems."