Dealing with uncertainty—The key to success

Kindred spirits: Deep Learning and Qualicision

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PSImetals Release 5.15— out-of-the-box interaction Let the experts solve it together!	**PSIpenta provides end-to-end mapping of industry-typical project management processes** HOLZ automation relies on a modern ERP system	**Online optician Mister Spex relies on the PSIwms warehouse management system** Multi-channel and production supply

PSI

EDITORIAL

Dear readers,

Deep learning and Convolutional Neuronal Networks (CNN), both currently almost equated with the broad field of artificial intelligence (AI), have long ago reached the consumer. Whenever you search for example the Internet for pictures and themes the techniques mentioned are usually active in the background. Even in special applications of pattern and speech recognition these methods are successfully used, e.g. in language assistance systems. Alexa, Siri or Cortana are keywords here.
How about the usage of these techniques in complex industrial processes? When you search the Internet for pictures of cats then it does not matter whether you can find seven to eight images of hamsters out of a hundred search results. In an industrial quality control with image processing, however, a recognition rate of 92 percent is unacceptable.
Nevertheless, artificial intelligence is a fascinating field and conquers industrial processes. At PSI artificial intelligence is used in various forms. Extended Fuzzy Logic, Monte Carlo methods, optimization heuristics and neural networks are components of PSI products. How Deep Neural Networks compare to Extended Fuzzy Logic in terms of the PSI FLS product Qualicision please find out in the main article.

Sincerely yours

Dr. Rudolf Felix
Managing Director
PSI FLS
Fuzzy Logik & Neuro Systeme GmbH

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Dealing with uncertainty—The key to success

Kindred spirits: Deep Learning and Qualicision

Artificial intelligence methods are an integral part of PSI products. Neural networks are used in the field of load forecast in energy transmission networks. Monte Carlo methods are employed in gas and oil pipeline management, while solutions for the metal industry use optimization heuristics such as simulated annealing. In the chemical and pharmaceutical sectors of the process industry combinatory search techniques take centre stage. Extended Fuzzy Logic is applied in complex sequencing and regulatory tasks and in industrial image data processing.

For complex applications in production control the automobile industry relies on Artificial Intelligence in terms of Qualicision technology in over 120 production lines worldwide to calculate production sequences. Due to the enormous combinatorial complexity of the questions to be solved here, it is indispensable that these solutions handle the process-related combinatorial uncertainty. Here, the relation to Deep Learning is strong. As with Qualicision, Deep Learning also requires controlled handling of combinatorial complexity, and hence dealing with the combinatorial uncertainty.

Deep Learning solves highly complex combinatorial problem

The following comparison shows that both technologies are related. Examples are none other than the two widely noticed solutions AlphaGO and AlphaGO Zero. Both methods have solved the very complex combinatorial problem of mastering with algorithms the Asian game Go in an impressive way. Obviously, the complexity of the game Go with a combinatorial dimension of two to the power of one thousand two hundred excludes a complete search. For comparison, the problem of machine chess already solved earlier has a complexity

of two to the power of four hundred. How does AlphaGO manage to solve this? Roughly speaking, Go is understood and modelled as a sequence of moves in the sense of a Markov decision-making process. The speed of computing systems, which has increased enormously in recent years, has been combined with a very intelligent combination of a Monte Carlo Tree Search (MCTS) merged with two Deep Neural Networks into one architecture, with training duration extending several weeks and supported by massive parallel computing. In the end AlphaGO ran on forty so-called search threads on 1202 CPUs and 176 GPUs in a parallel architecture.

Learnt probability distribution

Algorithmically, the MCTS method in the breadth-first search, i.e. in the selection of the next possible move, was limited by the so-called Policy Neural Network. The policy network outputs a learnt probability distribu-

tion in the search for the best possible moves, starting from a given position. For limiting the search space, in the depth search the so-called value network is used, storing estimates in order to best evaluate the feasibility of a node without having to go through the underlying sub-depth explicitly. In an initialization phase AlphaGO's policy network was trained with approximately thirty million human-played positions of the KGS Go server available on the Internet.

The Value Network learned evaluations of position nodes by playing

This fascinating process converges and works brilliantly. In the later version AlphaGO Zero, the system only played against itself with one single interconnected neural network covering both purposes. Thus, the input of the human-played games was no longer required.

However, AlphaGO and AlphaGO Zero take advantage of the fact that the rules of the game Go are clearly defined and the set of rules is fixed by definition. Thus, the search space of the game positions is enormous but finite the Japanese Rules of Go consist

and, in combination with large, impressive computing power, the means of probability calculation as a method for dealing with uncertainty may be applied.[1]

Sequencing in production

Now let us compare the game Go with the task of sequencing orders in an assembly line. Not infrequently a car factory produces in a day two thousand vehicles from an astronomically large number of order variants, which are to be sequenced in a way that meets the technical restrictions of the

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The main object of the game Go is to use your stones to form territories by surrounding vacant areas of the board, thus occupying larger territories than your opponent. The Go board consists of a grid of 19 horizontal and 19 vertical lines, with 361 intersections. The empty points which are horizontally and vertically adjacent to a stone are known as liberties (green squares).

In the upper diagrams, the white stone has four liberties and the black string has 6 liberties.
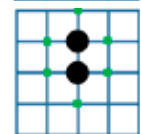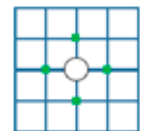
No isolated stone or solidly connected string of stones without liberties (horizontally or vertically adjacent empty points) can persist on the board. All stones without liberties (called prisoners) are removed from the board.

The lower diagram shows that white playing can set a stone on the liberty (green dot), thus capturing the black string.

You will find more Go rules and strategies at[2].

The so-called game tree complexity can be estimated at about $2^{1,200}$.

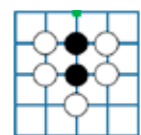**Moves and liberties**

Capturing

Figure 1: Excerpt of the Japanese Go Rules.

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against itself over and over again. In this manner AlphaGo distinguished more promising nodes from less promising nodes, improving that distinction by playing millions of games against itself. In this way, a so-called Reinforcement Learning Architecture emerged, with MCTS as a search method and two Deep Neural Networks: the move selection network (Policy Network) and the sub-depth limitation network (Value Network).

of fourteen articles and about twenty rules with related interpretive comments (see Figure 1). In particular, the number of stone types is manageable: There are only two of them, white and black stones. Therefore, the resulting combinatorics is the uncertainty-giving element of the game due to its by enumeration de facto untreatable size. In the end this kind of uncertainty bears the advantage that the law of large numbers can be assumed as valid

assembly lines. Compared to the game Go these are the rules of the game in this context (see Figure 2). An example of such rule is that after two orders with a rear view camera at least two orders that do not include a rear view camera have to follow. A further example is that a white car in the sequence has to be followed at least by five more white cars. If a number of white cars have rear view cameras the result for the mentioned distance rule

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[1] Cf. www.heise.de/newsticker/meldung/Kuenstliche-Intelligenz-AlphaGo-Zero-uebertrumpft-AlphaGo-ohne-menschliches-Vorwissen-3865120.html

[2] Cf. www.cs.cmu.edu/~wjh/go/rules/Japanese.html

- 20,000 basic model variants

- 10,000 parts and components per vehicle

- 200 extra equipment components

- The number of all theoretically possible car variants of all German car makers is 2^{83}, that is about 10,000,000,000,000,000,000,000,000

- Given a sequence length of 2,000 positions the result is almost beyond imagination: approximately $2^{20,000}$ possible sequences. For comparison: The number of atoms in the universe is about 2^{240} and the combinatorics of Go is $2^{1,200}$.

Figure 2: Dimensions of sequencing assembly orders in car factories.

results in a puzzle problem similar to that of a Go game.

Certainly, the difference is that in a car assembly great many of such rules are to be considered, in most cases sixty to seventy, sometimes even over a hundred with interpretation tolerances. In addition, the number of orders and their composition (number of rear view cameras, leather seats yes/no, different colours, etc.) dramatically increases the complexity of sequencing. Applied to the comparison with the game Go, here the type of the stones is not only not set as in the game Go to two but the number of stone types is open. It may differ from day to day, because the orders in their composition can vary from day to day, which means that there is a different number of order types on a daily basis.

Qualicision goal conflict analysis

The Qualicision sequencing solutions work with the so-called Qualicision goal conflict analysis instead of probability distributions as a method for dealing with uncertainty. This is used to estimate the search space both in width and in depth for positive and negative relevance in the process of calculating the sequence. The-

oretically it may also be considered as a Markov process. The underlying methodology of the estimation is based on Fuzzy Logic and the so-called Fuzzy goal functions (impact curves). This solution works even if the rules of the game and the types of stone vary from game to game. As stated earlier the type of orders used in sequencing varies from day to day. Therefore, applying the law of large numbers in daily sequencing cannot be applied for learning. What has been learnt yesterday can already be invalid today or at least differ.

Combinatorial complexity of sequencing

Considering the combinatorial complexity of sequencing, for a sequence of two thousand order positions it can be estimated at approximately two to the power of twenty thousand. By comparison, as stated for the game Go with two to the power of one thousand two hundred and for chess with two to the power of four hundred.

The combinatorial complexity of sequencing in an automobile factory is thus ten times greater in the exponent than that of the game Go, and in the end by two to the power of eighteen

thousand astronomically much larger. In comparison, the famous number of atoms in the universe seems very small with two to the power of two hundred and forty. Even though the "sequencing moves" that are actually permitted in sequencing reduce the combinatorics due to the restrictions of the assembly line, the uncertainty to be treated during sequencing is not treated with probabilities and Monte Carlo methods as in the case of the game Go but via fuzziness. Nevertheless, the intelligence of both methods is ultimately due to the intelligent management of uncertainty to limit the search space.

In this sense, the methods used at AlphaGO and Qualicision are kindred spirits, as both accept that the explicit handling of uncertainty is the key to success. Projects that combine both methods in the future are already ongoing. It will be an exciting future. ◉

Product review: PSImetals Release 5.15—Interaction Out-of-the-Box

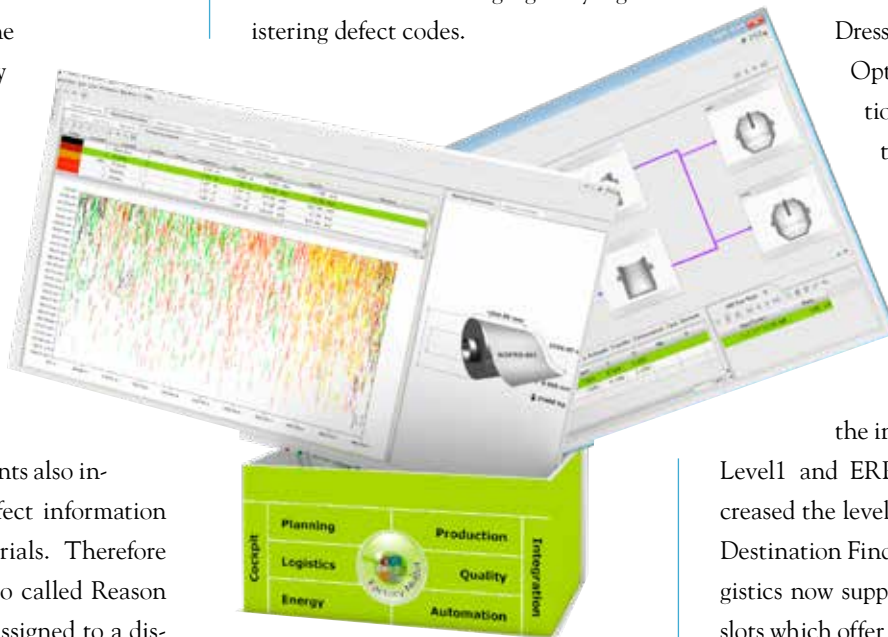# Let the experts solve it together!

Even early attempts with Artificial Intelligence were called Expert Systems. Experts are important – they are able to solve specific problems others can't. But what if the problem or task is not limited to a specific topic or region? With the new release PSImetals 5.15 PSI counts on Interaction between modules and components.

On the quality side, findings from Surface Inspection Systems (SIS) can be stored directly in the factory model and visualised at any location using PSI Click Design. The information is linked directly to the material genealogy and can be analysed further in graphical form. Improvements have been made to rework management on the basis of customer suggestions.

Increased Quality inspection requirements also influenced the way defect information is assigned to materials. Therefore PSI introduced the so called Reason Code that could be assigned to a dispositioning task like rework, degrading or scrapping. Following user requirements in addition to this Reason Code, it is now also possible to assign a Defect Code instead to a re-work management operation within the deviation management process. This reduces configuration time and increases reporting capabilities. A context filtered list of defects will assist the user in his operation. For additional transparency PSImetals provides an improved configuration to indicate failed tests by extended defect descriptions. These case specific defect codes allow a quick overview of the related problem.

Additional deviation management capabilities can be configured by triggering rework tasks automatically in case of material de-charging or by registering defect codes.

Transparency and efficiency

Tracking auxiliary or packing materials offers a further dimension of cost optimization. With the new Packing PDA screen the operator is now able to track the consumption of packing materials like pallets and films in a very comfortable way. At other production lines, operations such as bundling/unbundling and material movements from/to the production line can be triggered.

Sometimes autonomy is more important than interaction. The order fulfilment model in the Automotive Business is typically driven by so-called Schedule Agreements. These orders previously required many data transfers between the ERP or Order Dressing System and the MES, despite the fact that most of the data was static. PSImetals is now able to store the static part in a Production Order Template to create an operative Production Order without further communication with the Order Dressing system.

Optimised communication mechanisms for the PSIintegration Framework have resulted in improved efficiency in the transfer of huge data packages. Improvements to the interfaces with Level2/Level1 and ERP/SAP have also increased the level of transparency.

Destination Finding in PSImetals Logistics now supports dynamic storage slots which offer valuable potential for optimisation, especially where space is limited. Long product manufacturers are delighted with the inclusion in the standard product of an option for relocating bulk parts by splitting/merging bulk material.

Plan for increased complexity

Many customers are keen to make optimal use of high-quality coils and deliver final products on schedule. The PSImetals Coil Combiner has been given a general facelift and made more user-friendly. The option "Slit Groups" can now be used to man-

Interaction between modules and components in the PSImetals Release 5.15.

age groups of small slits conveniently, assign scrap parts within a cutting pattern via a graphical interface and implement an infinite number of complex cutting patterns on the basis of pre-slit calculations. The new fixed slitting patterns offer huge potential for increased throughput by automatic assignment.

Customers that have a good demand for orders of specific widths might want to have their slitters set to determined patterns to avoid downtimes caused by machine configuration.

For improved forecast management the Demand Manager has a new screen giving an overview about the forecast and its consumption. Data from third-party applications can now be incorporated more easily, either by input in the new forecast screen or as direct import from a CSV file.

Coil production from A to Z

The daily life of metals production is a complex one and it depends on the seamless interaction between the different functional areas of an organiza-tion. Integrated solutions provide vital assistance.

Example: "Narrow coils"
These orders must be combined into larger coils that can then be slit and/or cut. PSImetals supports this process across multiple components. "Narrow orders" are firstly elaborated as produc-tion orders using Order Dressing. The Coil Combiner then takes over to find the optimum combination and gener-ates cutting plans. These cutting plans are then elaborated again by Order Dressing with combined orders/cutting plans as results. Finally the combined orders and the cutting plans are ex-ecuted by PSImetals Production and visualized within Material Genealogy.

Example: "Hot metal handling"
Comprehensive support is provided for the scheduling and tracking of heats after blast furnace tapping on torpedo ladles, including treatment practices. Users have access at all times to an overview of consumption and heat stock in the Online Heat

Scheduler. The operator can man-age deviations by adding rework steps and reassigning actual heats to differ-ent orders directly in the Gantt-chart. As such decisions can have huge im-pact on heat timing, this new function is also supported in scenario mode to check unwanted effects first. Besides the direct manipulation the user can freeze an amount of upcoming heats on an aggregate. Those heats won't be considered by Online Heat Scheduler in its next optimization round. This guarantees a stable planning situation for the near future.

PSImetals 5.15 offers a wide range of new features, enhancements and performance improvements. The fully integrated, cross-modular processes supported out-of-the-box provide par-ticular added value. ◉

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manager

Product report: PSIpenta provides end-to-end mapping of industry-typical project management processes

HOLZ automation relies on a modern ERP system

Specialised machines of every size are the stock-in-trade of HOLZ automation. The owner-managed company from the Swabian town of Backnang is able to meet almost any special customer request. The planning and production processes required for this purpose are sophisticated and complex. The necessary level of flexibility, agility and efficiency can only be achieved with cutting-edge methodologies and technologies. A modern ERP allowing end-to-end mapping of industry-typical project management processes plays a central role in this process.

HOLZ automation chose the ERP system PSIpenta from PSI Automotive & Industry for several reasons. On the one hand, company representatives were favourably impressed by visits to other customers working on similar processes and already using the software for production purposes. On the other hand, the high level of investment security and the prospect of joining the established PSIpenta user community (IPA), which engages in lively exchanges on

square metres in new premises opened in 2014.

In order to ensure that the necessary conditions for further growth were in place, internal processes were reviewed in 2013. In technical terms, the company had long been in a position to implement complex projects.

> *PSIpenta is an ERP system which allows us to look to the future with confidence, and which even gives us room for potential further growth.*
>
> **Andreas Holz**
> company officer at HOLZ automation

panding steadily for many years. The merger with the design office of his son, Jürgen Holz, was completed in 2000. The company now employs 60

However, it became clear that an ERP system offering end-to-end mapping of all processes and scheduling plans was required for logistical implementation of these projects.

"It became clear relatively early on that we needed a new ERP system with end-to-end mapping of the processes required, including scheduling plans", remembers Andreas Holz, who is in charge of purchasing, quality management and ERP as well as acting as company officer. "It would otherwise have been impossible to implement large projects, particularly if we wanted to remain true to our vision of developing and building high-quality machines on schedule".

The new factory premises in Backnang.

the web portal and in working groups, were also vital factors in the decision. Founded by Manfred Holz in 1970, HOLZ automation has been ex-

people. Specialised machines are produced and an annual turnover of approximately EUR 15 million is generated over an area of more than 2000

Faster processes thanks to digitisation

Particular goals included reducing the administrative burden, achieving faster processes thanks to digitisation and providing comprehensive support for

all processes from order acceptance, costing and fully integrated material planning, shop-floor data collection and access control all the way through to dunning.

At HOLZ automation, PSIpenta maps the typical processes of a specialist machine manufacturer. The commercial data are created in the ERP system upon receipt of the order. The Technology Department designs component, E-plans and software on this basis. An interface with the mechanical CAD system transfers the finished BOMs back into the ERP system. The work order structure is then created and expanded here as the basis for all material planning processes.

of current development work or finished BOM data and refined in ever increasing detail. This early documentation, as well as the constant updating of production data through exchanges of information with the Technology Department, ensures maximum transparency in respect of the progress of the project and its costs. Project managers can intervene in processes at any time, and reschedule if necessary. This means that the company is able to respond extremely quickly to changes, which has a positive impact on mean lead times and compliance with delivery deadlines.

Improved data quality

The specialist machine manufacturer took advantage of the intro-

PSIpenta Production Cockpit at HOLZ automation.

At a very early stage in the project, the project managers develop a rough schedule known as a milestone plan, which is constantly updated on the basis

duction of the new system not only to optimise its operations, but also to achieve its goal of improving data quality in order to fully exploit the

PSI modules in use at HOLZ automation

- Order management
- Shop-floor data collection
- Workflow
- Backlog processing / dynamic production adjustment (from PSIpenta adaptive)
- Contact management
- Financial accounting
- Time and attendance
- Access control

possibilities of the ERP system. Employees created new copies of all product data and price information for this purpose. Only three months after the appointment of a project manager, the system successfully went live.

HOLZ automation's investment in the future has already paid off. The previous order volume of around EUR 500 000 has now increased to EUR 7 million. This corresponds to an approximate increase in BOM size from around 2000 items or 50 assemblies to around 8000 items or 300 assemblies at present. "We would never have been able to implement such complex projects without PSIpenta", sums up Andreas Holz. HOLZ automation is particularly pleased with the high level of transparency and compliance with delivery deadlines achieved with PSIpenta. The connection of a PDM system is also planned in the medium term. ◉

User report: Online optician Mister Spex relies on the PSIwms warehouse management system

Multi-channel and production supply

Europe's leading online optician, Mister Spex, relies on the PSIwms warehouse management system for optimising the logistics processes behind its web shops. The standard product from the PSI Logistics Suite controls all intralogistics and production supply processes at the new central logistics centre in the Berlin district of Siemensstadt.

Javier Carvajal Vargas, Chief Operations Officer of the online optician Mister Spex GmbH, analyses the situation as follows; "The move into the new logistics centre was an important step toward achievement of our growth objectives. "As well as expanding capacity, our primary aim was to accelerate shipping processes and optimise process control overall". The contract for the warehouse management system necessary for this purpose was awarded to PSIwms.

The modules and features of this system allow it to coordinate not only intralogistics processes for rapid order completion and punctual production supply, but also the multi-channel strategy including returns processing, meaning that it will also cover future developments within the com-

Sample "Order" dialogue screen from PSIwms.

ment with widely differing levels of performance", says Vargas as justification for the company's choice. "The upgrade and integration capabilities, as well as the broad range of functions which PSIwms already features in its standard product, were decisive factors".

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>
> **Javier Carvajal Vargas**
> Chief Operation Officer, Mister Spex GmbH

pany as a whole and its intralogistics processes. "During the selection procedure, PSI Logistics impressed us with its superior assessments, references and solutions in an environ-

The online optician stores most of its raw materials and articles in the warehouse in Berlin Siemensstadt which it moved into in 2016. Every day, the employees there process up

to 12 000 orders from all over Europe. More than two million customers are served from the Logistics Centre. In the web shop, customers can choose their preferred frame, colours

and materials from more than 43 000 branded models of glasses. The warehouse also stocks branded sunglasses, contact lenses and spectacle lenses as well as various care products.

Optimum coverage of specific order structures and production

On the basis of a multi-channel strategy, Mister Spex also cooperates with more than 550 local opticians in the DACH region and the Netherlands. In parallel, the company operates its own stores in Berlin, Oberhausen and Bremen, as well as in Bochum and Dortmund. All segments—internal and external production, direct customers and shops—are supplied from the Mister Spex Logistics Centre. "In addition to warehouse management, the new WMS was intended in particular to provide optimum coverage

for the various B2B, B2C and production order structures", says Vargas. "PSIwms already meets the majority of our requirements with its standard modules and features. That also means that we are working to a well-established industry standard, without spending a substantial amount of time on lengthy programming tasks".

Since November 2016, PSIwms has controlled the intralogistics processes of a Mister Spex warehouse running at full capacity. An automatic carousel picking system from Kardex has been installed as an automation component storing 7400 pairs of glasses. The other rack systems in the manual picking areas provide storage capacity for more than 700 000 articles. "Given the range of articles and the level of customisation of the end products, extensive automation is not currently a cost-effective option", explains Vargas. "With PSIwms, however, we feel equipped for further progress in terms of the automation of intralogistics processes".

Route-optimised transport orders

The warehouse management system determines storage locations using various strategies, priorities and article rankings, which are continuously adjusted on the basis of sales and throughput figures. PSIwms generates transport orders for put-aways as well as for picking processes on a route-optimised basis. For the purpose of picking processes, orders are split into production orders and B2C shipping of merchandise, sample frames and customised glasses manufactured to order and supplied directly to the customer or picked up at shops, and accessories and samples supplied to retail shops.

Coordinated processes

Production is divided into in-house production processes, which include grinding lenses, producing frames and assembling the finished article, and "insertion", which involves mounting pre-manufactured and supplied lenses in standard frames which are stored at the warehouse. The ERP system separates the orders from the web shop into manufacturing and pure shipping/picking orders and transfers

A small insight into the Mister Spex warehouse.

them to PSIwms. For order production, the system coordinates picking and material merging as well as the timely supply of order information to the grinding and assembly workstations.

For shipping-only orders, the WMS controls the flows of material from picking, merging of the order items for shop deliveries and handover to shipping. In order to do so, the software implements manual multi-order picking with up to 100 different orders per picking operation.

A further highlight is returns processing, which involves quality control and assignment to subsequent process steps such as put-away, repair and order checking. In parallel, PSIwms combines the order data from returns and generates them for intralogistics purposes. "This has allowed us to implement a high-performance warehouse management system which ensures maximum efficiency and optimally coordinated processes for warehouse management, production supply and order production, independently of ERP resources", summarises Vargas. "The upgrade capabilities mean that we are also optimally positioned for future developments. In all, PSIwms has been a cost-effective and future-proof investment".

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News: PSImetals Academy "Configuration"

Adaptation of dialogue boxes and interfaces

This new development for PSImetals Academy comes in response to requests by our customers for customised training courses for the PSImetals standard system. Participants in the basic training course "Configuration" will learn how to adapt dialogue boxes and interfaces.

For the past two years, our in-house academy has offered project methodology training which focuses on concrete applications of the system. The new courses of the PSImetals Academy enable customers who are already using the applications to deepen their knowledge in the wide range of system configuration. On the basis of structured learning units, the fundamentals are taught in a methodical manner in order to support independent use of the many pos-

The "Configuration" training module.

sibilities offered by the standard system.

The basic training course "PSImetals Configuration" offers a thorough introduction to the creation, custom-

isation and embedding of SDC and office dialogue boxes. Practical exercises teach learners how to use the data dictionary and how to edit L2 and SAP messages without Java programming.

Training can be delivered on-site at your company and customised to your needs thanks to the modular structure. Advanced courses building on the basic training will also be offered in the future. ◉

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News: 20 years of the PSImetals Line Scheduler at SSAB Finland

Software products have birthdays too

Software is essentially a very abstract concept, which boils down to rows of ones and zeros. Software as used by customers means something very specific: on the one hand features, menus and algorithms, and on the other hand people—both those who work on the software and those who work with it. 20 years of working together is a good excuse for a celebration.

And so let's wish the PSImetals Line Scheduler at SSAB in Raahe, Finland a very happy birthday! Forty million tonnes of coils have been scheduled on the hot strip mill using the Line Scheduler over these 20 years. Back in 1997, both the product and the customer had different names; the BetaPlanner was in use at RautaRuuki. However, the problems addressed back then were

A birthday party with birthday cake for all the users.

the same—finding the best possible sequence for the individual hot strip mill equipment programmes.

Software that keeps up with the times and changing requirements

If you are very lucky, or if you develop particularly good software, customers will still be able to use it after 20 years. And they will be happy to do so, because the software keeps up with the time and changing requirements. Today's users at the Raahe plant make very active use of the software, configure it themselves and independently adapt many aspects of the Line Scheduler to meet their needs. For example, a student trainee at SSAB recently developed a separate model to simulate concrete prob-

Satisfied project managers reunited at the PSImetals Usergroup 2017: Pierre Beghin (PSI), Marti Finnila (SSAB), Luc Van Nerom (PSI).

lems and equipment restrictions even more effectively.

This model now supplies the Line Scheduler with Raahe-specific planning requirements on a daily basis. Such a high level of interest and confidence on the part of a customer is what a supplier loves to see, and forms a basis for the best possible leveraging of the software's huge potential for optimisation. We'd like to say thank you, and all the best for the next 20 years! ⊙

Event: Follow-up to ABM Week 2017 in Brazil

From global trends to local strategies

From 3 to 6 October, representatives from the metal and mining industries met in São Paulo to discuss strategic issues and future trends for Brazilian companies. The main topic of the presentations and debates was the potential of Industry 4.0 for business development.

When the Brazilian steel association ABM hosts its annual event, visitors know what to expect: exciting and versatile presentations from industry leaders on the topics that move the steel industry. The focus of the event was on the digitisation of the metal industry.

The keynote speech was given by Flavio Almeida, CIO of our customer ArcelorMittal Flat Brazil, who presented the company's "digital strategy".

During a panel discussion led by Leonardo Zenóbio (Usiminias), representatives of steel companies, the transport industry and government officials debated the logistical challenges faced in Brazil. Primetals Technologies and ArcelorMittal Tubarao also gave first-hand insights into the successful projects they had completed using PSImetals solutions.

The event was very well-attended, and impressed visitors once again as the number-one opportunity for South American steel manufacturers to network and share experiences. ⊙

Fernando Guerra (PSI), Ivo Abrahao (AM Tubarao) and Pierre Beghin (PSI) discuss the digitisation of the metal industry.

Interview: Dr. Herbert Hadler, Managing Director of PSI Automotive & Industry GmbH

Market trends for ERP and MES in 2018

The last few weeks of the year is traditionally a time for heated debates on the trends that will be most important in the year to come. The Production Manager asked Dr. Herbert Hadler, Managing Director of PSI Automotive & Industry, about the key developments he expected to see in 2018 in the areas of Enterprise Resource Planning (ERP) and Manufacturing Execution System (MES).

ness models are now gradually being developed. We will see a lot more solutions which genuinely deserve the title of Industry 4.0. This is naturally a great opportunity for us, since we have already proven with customers such as

What major trends do you expect to dominate in these areas in 2018?

Dr. Hadler: Artificial intelligence (AI) will certainly play a prominent role. Digitisation means the generation of increasing volumes of data. It is important to make the links between the data recognisable using automated methods. Artificial Research and Artificial Intelligence will therefore become even more important in this area. We want to deploy these technologies to offer even more than the analytical techniques currently used to optimise processes. We want to support decision-making and highlight links which go beyond simple correlations—something which is still impossible with today's software.

At the same time, smart solutions are gaining in importance. Smart factory, predictive maintenance, digital twins and self-optimising processes are the catchphrases we will be hearing more often in 2018. Our vision is AI-optimised production.

Turning to more practical matters, what about production?

Dr. Hadler: RFIDs and IoT solutions will increasingly be integrated into processes and become visible in our day-to-day work in 2018. Connected

Dr. Herbert Hadler has been Managing Director of PSI Automotive & Industry since 1/1/2016.

machines will become a must, because this is the only way that data can be collected and processes can be controlled directly. Event-based algorithms are also gaining in importance and allowing advances to be made in the field of agility.

Let's talk about agility. What is happening in relation to the most popular topic of recent years? What is the future for Industry 4.0?

Dr. Hadler: Industry 4.0 will gather speed. So far, many of the solutions available on the market were really manifestations of Industry 3.5. Busi-

e.GO Mobile, StreetScooter or Mosca that we are able to implement forward-looking solutions in practice.

What do all these developments entail for the future of the ERP and MES market?

Dr. Hadler: Existing production systems will become increasingly dispersed. The software solutions developed to date must follow in their footsteps, and morph into service-oriented architectures. As an experienced integration specialist, PSI can play a leading role in this respect. We have already made a good start by pre-

senting solutions for the implementation of swarm production.

How does the current version, PSIpenta 9, fit in with these developments?

Dr. Hadler: Version 9 was a release which changed everything. On the one hand, we incorporated all of our customary strengths. That means we have a product which is tailored exactly to the needs of manufacturing SMEs, and draws its lifeblood from being as close as possible to our customers' problems. The human user is always the centre of our attention. On the other hand, the fact that we have completely converted our technology to Java, with a user-customisable PSI Click Design interface and industrial apps for mobile working, means that we now offer software that is fully in tune with the times. We go even further, in fact, because the overall experience represents a completely new way of managing process control.

What exactly do you mean by that?

Dr. Hadler: We regard PSIpenta Version 9 and the associated MES and Industry 4.0 solutions as a whole new kind of ERP. Taking our lead from mobile apps and the huge opportunities for adapting to the user's needs, all the time and everywhere, we are working on answers to the question of how we will work and handle business processes in future. The ease of use we all know and love from the consumer market is now also available in the world of ERP—and yet we have also retained functional depth. This is the message. This is what sets us apart from the competition. PSI stands out because of its holistic solutions.

What can we expect in 2018?

Dr. Hadler: We will see comprehensive expert solutions for mapping the entire value creation chain. Our concept for making our customers' lives easier depends on broad and deep application-based functionality in the form of a platform for value-creation processes. We want to allow companies to work without disruptive changes in media format. The coupling of PSIpenta with PSIwms, a solution currently being introduced at our customer e.GO Mobile, or our scenario for coupling PSIpenta with PSIcommand for efficient service processing in the field, are just two examples of many.

Which highlights of 2018 are you personally looking forward to already?

Dr. Hadler: The Hannover trade fair and our international customer conference, IPA, are always enjoyable events. It's great to be able to talk to customers in person. We are currently working on our concept for the Hanover trade fair. I can't reveal any details yet, but I can say this much; you're in for a treat! The IPA 2018 will take place in Hamburg, which is a truly great location. We always want to offer our customers something very special.

However there's something else I'm looking forward to even more. We've redesigned many aspects of this year's PSI Automotive & Industry, involved young colleagues with fresh ideas and challenged our assumptions with an open mind. I can hardly wait to see how all these innovations, both small and large, will be received by customers in 2018.

Thank you very much for such an interesting interview. ◉

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User report: Shendong issues final acceptance for PSImining

Increase in the efficiency of mining operations

Shendong is a wholly owned subsidiary of Shenhua Group Corporation Limited. The Shenhua Group, with an annual production of more than 440 million tonnes, is one of the largest coal producers in China. In June 2017, Shendong issued a final acceptance for the process management and control system PSImining supplied by PSI Mines&Roads GmbH.

Shendong operates several mines in the region of Daliuta in Inner Mongolia, China. The underground area where systems are monitored and controlled and miners' movements are recorded extends over more than 600 square kilometres, including all extraction areas and underground main and branch lines for material transport and supply of all four mines.

Four mines integrated into a higher-level control system

The project order covered the integration of all lower-level control, automation and security systems of the four mines into a higher-level control system based on PSImining. The mines which are now managed from a single control room jointly produce 100 million tonnes of coal per year. A total of 31 different subsystems were connected to PSImining.

In addition to the traditional mining systems of shearer control, belt control and shield control, the infrastructure sub-systems for electrical power supply, water supply, ventilation (including sensors for carbon monoxide, carbon dioxide and methane) and underground person and vehicle localisation were also integrated. All of these sub-systems are represented with geographic precision on automatically transferred maps from the Graphical Information System (GIS) operated at Shendong.

The video cameras installed underground can also be operated via the integrated control system, and provide full-HD live streams (H264-encoded). Direct communications from the control system were also implemented using a VoIP telephone system.

In order to allow all these different sub-systems to interact meaningfully within a single control system, a common data model was created for them on the basis of IEC62264. Integration of the sub-systems has allowed a significant increase in efficiency for mine operation and the control room personnel. Comprehensive fault analysis is only possible when all sub-systems are connected to each other.

Fault analysis in just five clicks of a mouse

A shearer comes to a standstill (reported by the shearer control sub-system) due to inadequate sprinkling (information available in the shield control sub-system), because pressure is no longer generated in the water network (water sub-system), since the water pump is no longer receiving power (power sub-system), because a circuit breaker above ground has tripped due to overloading; analysis of this incident in separate systems would take a long time and many man-hours. The combination of all objects and their online states in PSImining allows the above fault analysis to be carried out by a single person with five clicks of a mouse. Video streams can also be assigned to specific objects, meaning that the situation on the ground can be inspected with a single click in the event of a fault.

In addition to these traditional SCADA-based functions, PSImining also features maintenance functions.

One minute of production = EUR 27 000 profit

During the introduction of PSImining, the over-arching project objective was to improve the "Overall Equipment Efficiency" (OEE) of the managed mines. The OEE determines the productive time of all technical equipment as a percentage of the theoretically available operating time. An increase in the OEE has a direct impact on the economic efficiency of mines; Chinese mines usually work with a fixed maintenance shift of 4 hours, and record an OEE of around 50% for the remaining 20 hours. In the aforesaid four mines, an improvement in the OEE of one minute per day results in an increase in production of 456 tonnes of coal per day. Based on a market price of EUR 52 per tonne (as of 20/10/2017), this means an increase in revenues of EUR 27 300 per day, or EUR 8.6 million per year. Faster localisation of the real cause of faults therefore represents a huge potential source of improvements. Other benefits result from a reduction in repair times or greater efficiency of maintenance

The PSImining control room at Shendong.

shifts thanks to improved mainte-nance planning and execution.

Having observed these benefits, Shendong now uses PSImining to control a further mine. In March 2018, Shendong intends to open a new extraction area with a coal seam thickness of 8.8 metres. This height alone will deliver 18 million tonnes of coal per year. PSImining provides the tools required to make this possible. ◉

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Event: Four trade fairs on the agenda for PSI Logistics in spring 2018

In dialogue with customers

Customer dialogue and comprehensive information about innovations and new functions will be the order of the day when PSI Logistics presents the latest releases of standard products from the PSI Logistics suite at four events in spring 2018.

At the **16th Hamburg Logistics Days** to be held on 21 and 22 February 2018, PSI Logistics will present its complete range of solutions for the strategic design and operational control of logistics networks and processes.

At the **4th PSI Logistics Day** to be held on 12 March 2018 in the Wöllhaf Conference and Banqueting Centre at Stuttgart Airport, the focus will again be on the exchange of experience between users, prospective customers

In keeping with the concept of "Digital logistics networking", we extend a cordial invitation to this year's PSI Logistics Day.

and PSI's software developers. The latest innovations and application options are traditionally examined

in more depth in parallel sessions aimed at specific target groups.

From 13 to 15 March, visitors to the **LogiMAT** in Stuttgart will have the opportunity to find out more about the scope of PSI's standard products during highly practical presentations. At the **Passenger Terminal EXPO** in Stockholm between 20 and 22 March, PSI Logistics will focus in particular on the PSIairport solutions. ◉

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News: PSIpenta controls processes and connects sites in Germany and Poland

AGTOS GmbH implements new ERP system

PSI subsidiary PSI Automotive & Industry GmbH has been contracted by the Emsdetten based AGTOS "Gesellschaft für technische Oberflächensysteme mbH" with the implementation of the new ERP system PSIpenta version 9. PSIpenta will replace a system developed internally that the company has used since its founding.

In the future, PSIpenta will connect two corporate sites in Germany and Poland with one another, control and support cross-company logistic processes in distribution, production and service of shot blasting machines.

Along with PSIpenta, the scope of delivery includes the modules shipping and cost calculation, PSIfinance as well as the operating data and personnel time-tracking components from the manufacturing execution system (MES) palette.

PSI's variant manager, with an integrated product configurator, will be used to handle AGTOS's
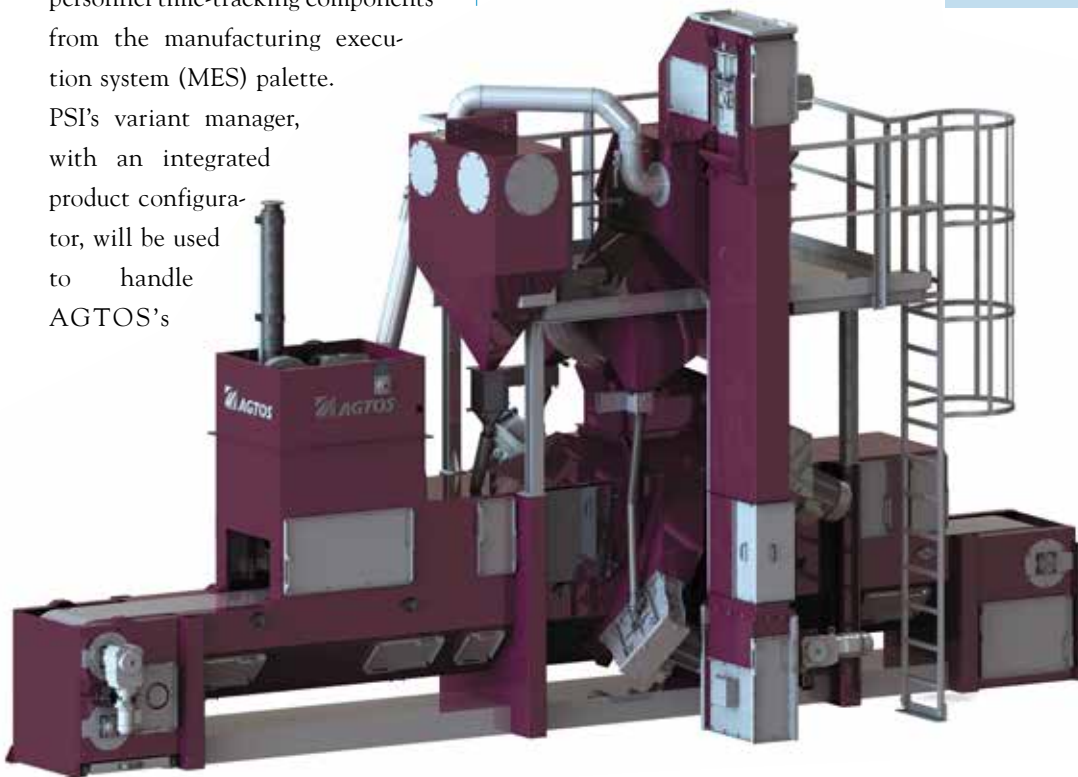
Convincing Multisite functions

In a classical selection process, PSI was able to assert itself with its PSIpenta ERP system as an integrative solution. The deep understanding for the production-typical requirements of a plant manufacturer was decisive. Technologically, PSI was especially convincing with its processes for multisite control. In the future, complex manufacturing

Intuitive design with PSI Click Design

The inclusion of the second site in Poland with the consolidating view

AGTOS Gesellschaft für technische Oberflächensysteme mbH was founded in 2001 and offers shot blasting machines that are tailored to meet the needs of their customers. The company employees a staff of 170, has a modern production site in Poland and an extensive warehouse at its headquarters in Emsdetten.
www.agtos.de

of various, complex procurement, production and logistics processes possessed a high priority right from the start. Along with PSIpenta's classical ERP standard, competence, ability to find solutions and user-friendliness were decisive factors. With the PSI java-based framework with the new PSI Click Design, PSI users can intuitively design and combine the interface themselves. ◉

Wire belt blasting machine from AGTOS.

wide-ranging product business. The integrated solution will be rounded off by the data warehouse/business intelligence (DWH/BI).

processes can be organised with the site in Poland, consolidated in a single view and then compiled with a company-wide cost calculation.

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News: PSI delivers warehouse and ERP management system

e.GO counts on integrated IT infrastructure

e.GO Mobile AG from Aachen has contracted PSI Logistics GmbH with the implementation of the PSIwms warehouse management system. Together with the ERP system PSIpenta implemented by the PSI Automotive & Industry GmbH, the e-vehicle manufacturer will be using an integrated IT infrastructure from PSI for the control of the intra-logistics processes as well as production planning and control of the electrical city car e.Go Life.

First, PSIwms will be implemented in the demo-factory at the RWTH Aachen Campus to support fabrication of the first prototypes. Starting in mid-2018, mass production of the e.GO Life is planned for a new production plant. With the serial production plant, which is currently under construction in the district of Aachen Rothe-Erde, a 16000 square-meter large industry 4.0 showcase factory is being built.

Ultra-modern production of electrical vehicles

The serial production of electrical vehicles will be accomplished with an ultra-modern production plant. The holistic IT backbone for the intra-logistics, supply control and production in the assembly and logistic halls is provided by the PSI software, which is being transferred from the demo-factory to the new plant.

As early as July 2017, PSI Automotive & Industry was awarded the contract with PSIpenta as the ERP partner for the production network to manufacture the e.GO Life. With this contract for the PSIwms as the IT system for the coordinated control of the intra-logistics processes, the e-vehicle manufacturer has decided in favour of an integrated and future-oriented PSI IT infrastructure.

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EVENTS
www.psi.de/en/events

21.–22.02.2018	Hamburger Logistiktage Hamburg, Germany	PSI Logistics
12.03.2018	PSI Logistics Day Stuttgart, Germany	PSI Logistics
13.–15.03.2018	LogiMAT 2018 Stuttgart, Germany	PSI Logistics
20.–22.03.2018	Passenger Terminal EXPO Stockholm, Sweden	PSI Logistics
20.–23.03.2018	Intertraffic Amsterdam, Netherlands	PSI Mines&Roads
23.–27.04.2018	Hannover Messe Hanover, Germany	PSI Group
18.–21.09.2018	InnoTrans 2018 Berlin, Germany	PSI Transcom, PSI Automotive&Industry, PSI Elektrische Energie

PRODUCTION manager

PSI