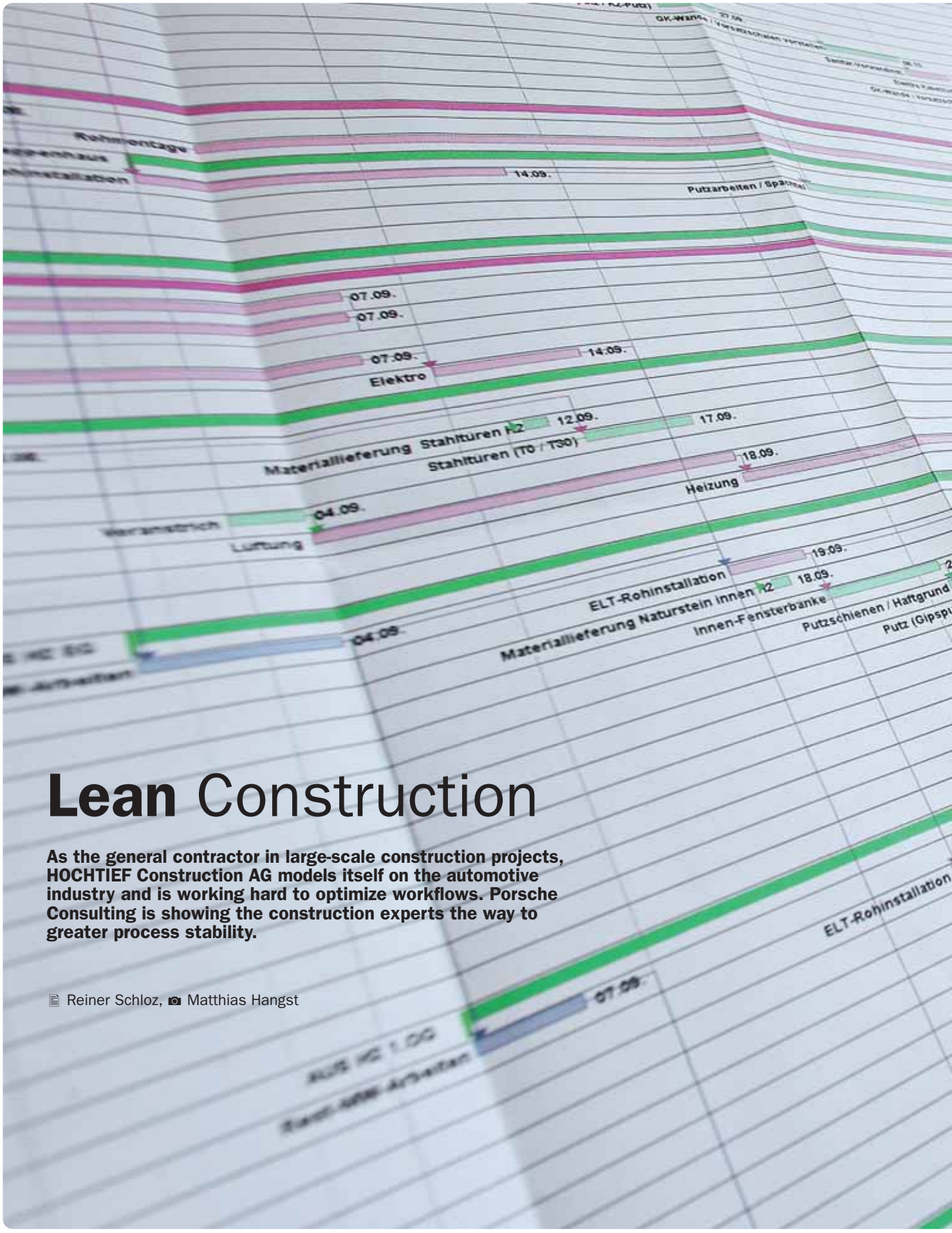
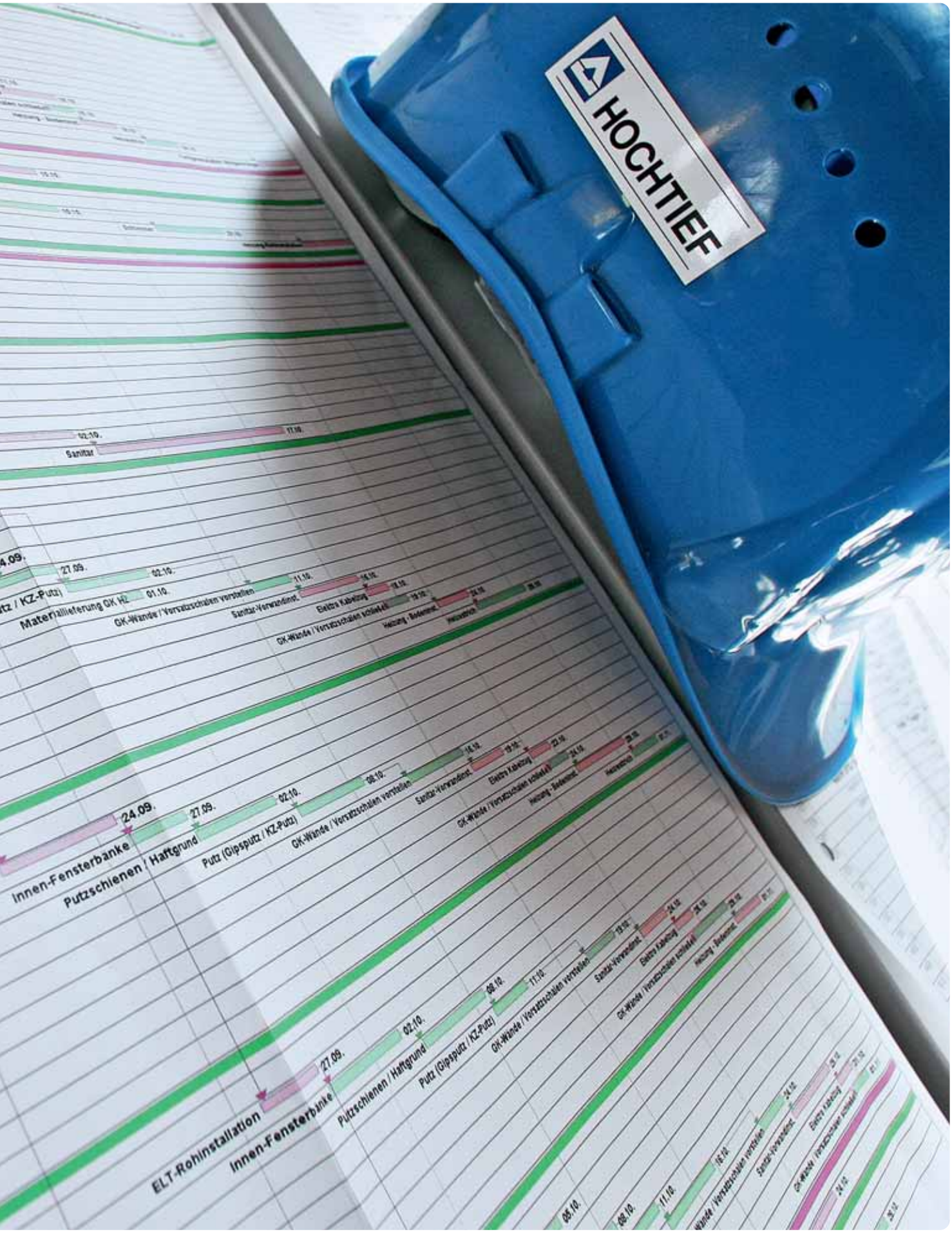


Lean Construction

As the general contractor in large-scale construction projects, HOCHTIEF Construction AG models itself on the automotive industry and is working hard to optimize workflows. Porsche Consulting is showing the construction experts the way to greater process stability.

Reiner Schloz, Matthias Hangst


HOCHTIEF
Innen-Fensterbanke
Putzschienen / Haftgrund
Putz (Gipsputz / KZ-Putz)
GK-Wände / Versatzschalen verstellen
ELT-Rohinstallation
Innen-Fensterbanke
Putzschienen / Haftgrund
Putz (Gipsputz / KZ-Putz)
GK-Wände / Versatzschalen verstellen

Open spaces: The building site in Bingen is very neat and tidy

Life is pleasant in the garden city of Bingen am Rhein—or will be once it's finished. A small, high-quality neighborhood with a hotel is being built here; it will almost seem like a holiday village. An artificially constructed park lies just in front of the balcony, and behind that flow the waters of the Rhine. On the opposite bank, the Rüdesheim vineyards rise gently upwards, serving as a solid background for the Niederwald monument. To the left, you can see as far as the Mäuseturm, a former customs tower on an island in the river. If you appreciate visual attractions, you will get your money's worth here.

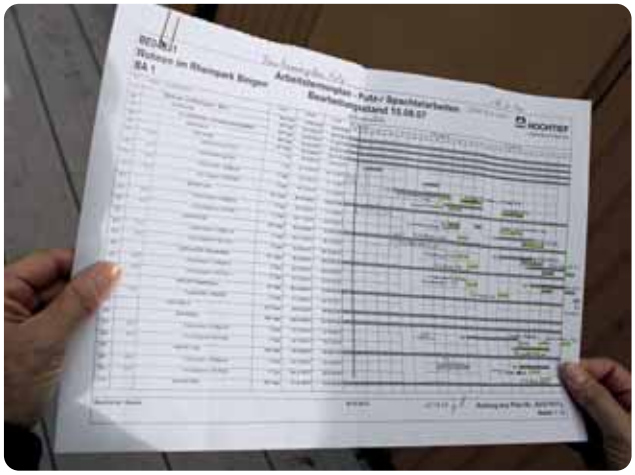
The building site already provides an unusual view. Essen-based HOCHTIEF Construction AG is currently building the first four residential buildings, featuring 26 owner-occupied flats with areas of between 80 and 180 square meters. The construction volume is €4.9 million net. At present, an average of just under forty builders from around twelve subcontractors are working here every day on sanitary installations: plaster and screed are being applied. An ordinary day's building work, apart from one thing: there is enough space on the building site to play football. Nothing is lying around. The stocks present are piled up neatly on spaces marked by colored lines, which look like parking bays. "Anything delivered here is used within two days," says site manager Helmut Grell. At the recent topping-out ceremony, even the mayor of Bingen, Birgit Collin-Langen, was amazed by so much "order and cleanliness." However, this is far from being the full picture. Eberhard Rau, who is re-

sponsible for the Continuous Improvement Process (CIP) at several HOCHTIEF Construction AG building sites, has to smile when he thinks of one particular baffled worker. In Rau's words, "When he started plastering, we had to stop him. According to the schedule, he was too early."

The sudden insights are increasing. After all, Bingen, along with projects in Cologne, Hamburg, Düsseldorf, and Berlin, is currently one of five pilot building sites run by HOCHTIEF Construction AG. With the assistance of Porsche Consulting, the construction there is taking place in accordance with the same type of lean principles as those used in the automotive industry. Things which at first glance appear out of the ordinary are already producing noticeable results. For Dr. Reiner Pamp, the company's lean construction manager, this is the result of consistent implementation of the methods used in automotive production in order to focus on activities that create value and to reduce work that is wasteful. "Because it uses series production at a fixed location, the automotive industry has it a bit easier than we do in the construction industry," believes Pamp, "but the fundamental problems are the same. That's why we can learn a few things from automotive production."

The new approach is regarded as the best way to move into the future. In 2006, HOCHTIEF Construction AG, which had 4,860 employees worldwide, achieved a result of €1.96 billion. Currently, the contractor is working on around 100 building sites in Germany in building construction alone. However, it is working under the conditions prevailing in the construction industry—which are very risky for general contractors in particular. Its own in-house production depth (and thus its value creation) amounts to only around 20 percent—as in the automotive industry. In large projects, the general contractor takes on the role of manager and is responsible for costs, quality, and meeting deadlines, but is at the same time very dependent on the subcontractors. As a rule, quality is not defined by performance figures; it therefore very much depends on the people involved, and this can result in a high level of reworking. In order to complete building projects on time, a disproportionately large amount of energy and activity must be expended and carried out in the final phase of a project. At times, management is still involved with a project for up to three months after completion.

This is a scale of wastefulness that Porsche long ago reduced with the help of lean manufacturing processes; as a result, it set itself back on course for success years ago, and thus acquired the experience that Porsche Consulting today passes on to customers in a wide range of sectors. The first hurdle was to adapt the methods used on the factory floor to the building site. Jörg Kaiser, principal at Porsche Consulting, and his team first of all turned their knowledge upside down: "In automotive production, the product passes horizontally through the individual working steps. In the construction industry, the subsections pass vertically through the product. If you have internalized this, it is easy to derive the methods." ▸



Building to a time plan: Great transparency increases punctuality

Naturally, this learning process required a thorough introduction to the world of lean production, which was provided to those responsible at the pilot building sites in a tried-and-tested way at the Porsche Akademie. In various workshops, the consultants familiarized site management, work preparation, planning, logistics, purchasing, and quality control employees with the changes. Target processes were defined and standards were laid down. For example, the takt, which is the heartbeat of all automotive production, is more of an elastic term on building sites. For the garden city, for example, the scheduling sequence for much of the subsections was planned in accordance with lean principles on the basis of the contractual deadlines and basic time limits.

Things are underway: Shoptalk about sanitary installations

All pulling in the same direction: From left, Rau, Pamp, Kaiser, and Grell

Detailed planning of the work contents and the associated capacity of a cycle make it possible to recognize at an early stage whether a worker will actually be able to complete his subsection within the agreed time or whether additional workers will be required in an early phase. In the words of site manager Grell, "It is true that we have to make checks more frequently, but in return we can gain a considerably better overview. CIP manager Rau sees an additional benefit: "If we meet the takt time, we can thus ensure that only one trade is working at one particular location. This brings about a clear improvement in quality."

The introduction of just-in-time principles forms part of the operation on the pilot building sites. The subcontractors must ensure that they comply with the five R's: the right part must be present in the right quality and the right quantity at the right time in the right place. Even though at the beginning of the pilot project it was still very unusual for suppliers to have to deliver smaller quantities of material several times, in the meantime they have discovered the benefits of planning reliability for themselves. According to Rau, "Some of the subcontractors have already joined together and identified interfaces."

Quality control has also had to be rethought by everyone involved in construction. "Defects are no longer acceptable," says Kaiser. "People need to get this into their heads. Anything that can be rectified immediately will not cause additional problems later, and will not give rise to any additional costs." ▸

“The construction industry needs process innovation.”

Dr. Reiner Pamp, lean construction manager at HOCHTIEF Construction AG, talks about the reasons for and objectives of collaborating with Porsche Consulting.

Dr. Pamp, how modern is the German construction industry?
Dr. Reiner Pamp: In the last few years, the construction industry—like the automotive industry—has optimized its manufacturing processes and repeatedly developed innovations. From this point of view, the construction industry is very modern.

So how can Porsche Consulting provide support for you?
Pamp: Like the automotive industry, the construction industry is extremely competitive, and there is great time and cost pressures. Anyone who wants to hold their ground in the market in the future has to pursue new avenues. And we believe that there is great potential for improvement in the very way in which construction is carried out.

Where are the challenges?
Pamp: Nowadays, the principal task of a general contractor is essentially to manage the construction processes. We coordinate the use of the subcontractors, deal with the costs, the quality, and adherence to the schedule. In short, despite the fact that we are very dependent on others, we carry a high level of risk, and our margins are small. In order to become even more efficient and to attain even better quality as well as aim for controllable risk, the construction industry needs detailed, planned, and stabilized processes as well as further process innovations. I believe that there is a great deal of potential where costs, quality, and deadlines are concerned.

And you get this from the automotive industry experts?
Pamp: By introducing lean principles, the automotive industry has made enormous advances in productivity while also considerably improving its delivery service and quality. Specifically, I think that Porsche is exemplary in this area. I am convinced that, after a certain amount of transfer, it will be possible to apply all of the lean principles in the construction industry, and that they will result in significant improvements in our production processes as well. I do not believe that either the standard building contract terms or the product will prevent this from happening. The initial success in implementing our pilot projects provides a reason to continue down this road. It is becoming apparent that everyone involved in construction profits, particularly the customer, the planners, and the subcontractors.

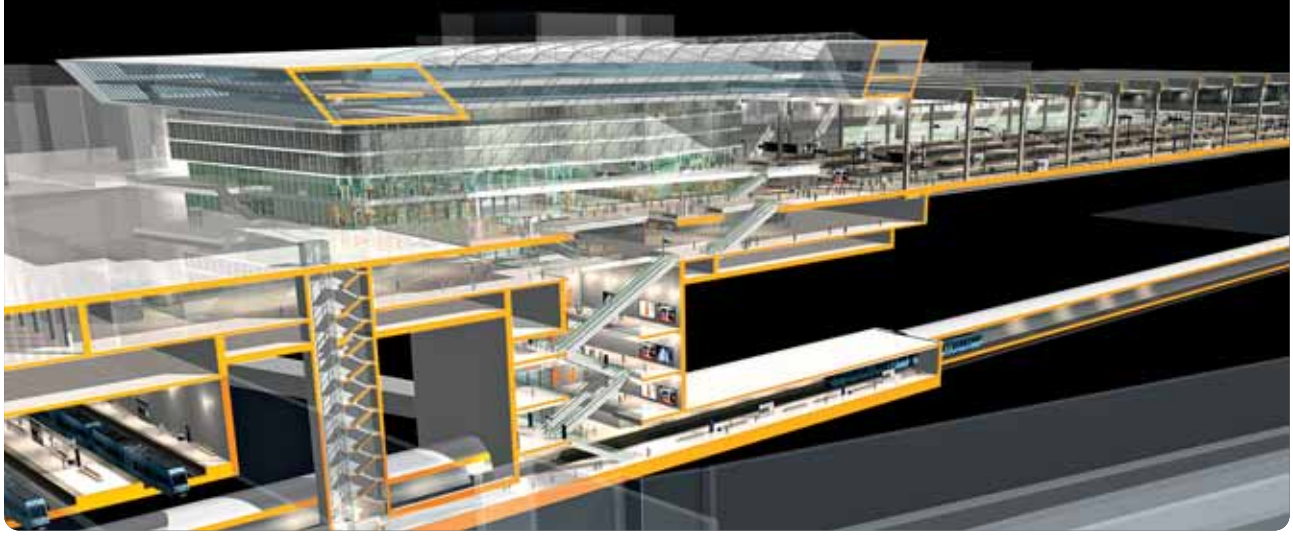
In defiance of all human habits, the new methods are being carried out consistently at building sites such as Bingen. The workers are operating in accordance not only with building plans but also with time schedules, using all the relevant Quality Gates, which strongly resemble the map for a Product Creation Process. The introduction of visualization tables provides the necessary transparency. This makes it possible for deadlines to be checked consistently and to be met on a very regular basis. Within HOCHTIEF Construction AG itself, there is increasing interest in the pilot building sites. There have now been queries about pilot building sites from other branches. CIP manager Rau also wants to involve the subcontractors to an even greater extent as early as in the run-up to a project. "We need to strengthen the team spirit further."

In Bingen, meanwhile, everything is progressing as usual. The four buildings should be completed in March 2008. The new residents will then enjoy the view that evokes a holiday mood: the park, the Rhine, and the beautiful vineyards on the other side of the river. ◂

A parking bay on the building site: In Bingen, manageable stocks have their own fixed, marked location

ViCon: The Virtual World of Construction

Something which long ago became an everyday part of development work in the automotive industry is also becoming increasingly important in the construction industry: virtual construction by means of computer-controlled 3D models and simulations. HOCHTIEF has developed the ViCon service concept from the technologies that are already available. Virtual Design and Construction (ViCon) is based on a 3D computer model which can be expanded to include any information of relevance to the building work (4D model). The objective is to save time and money when building and to identify possible defects or critical phases at an early point in time. In the words of Dirk Schaper, managing director of ViCon GmbH, "We use software, hardware, and services to form products which create added value for everyone involved in the construction. Our objective is to integrate ViCon into lean construction processes with the ▸



help of Porsche Consulting. We will then finally enter a new world of construction."

The old world is more akin to the following scenario: On the building site of a complex €150 million building construction project, every day 30 to 50 plans arrive (36 months of construction time, this makes around 40,000 plans); they relate to a wide range of problems, and must be taken into account. It is not easy to maintain an overview, and defects often are not discovered until very late on, which may result in time delays and additional costs. In contrast, ViCon combines all the information, which can be retrieved at the touch of a button and can be understood very clearly in the 4D model. Thus, ViCon enables reconciliation of the actual and target schedules so that it is possible to react at an early point in time. Additionally, exact quantities of materials—ranging from steel and concrete to the sloping ceiling area—can be calculated. A 3D module testing for building services conflicts provides protection against unwelcome surprises, for spatial conflicts between the building services subsections (heating, air conditioning, electrics, sanitary fittings) can be identified and thus corrected early on. According to Schaper, "It is very difficult to identify such problems on 2D plans." ViCon is also already in use on the pilot lean building sites, such as the one in Bingen.

The possibilities are practically limitless. Currently, ViCon has 45 "i-rooms" in use. With the aid of interactive whiteboards, a user can set off on a virtual walk through the building on two large screens, stop at critical points, directly enter his remarks, create a photo, and e-mail it to those concerned. Since April 2004, ViCon has been used worldwide on more than 300 construction projects, and has so far been in particular demand in the United States. For Jörg Kaiser, principal at Porsche Consulting, one thing is clear: "We will define the process regarding when and how ViCon can be used meaningfully. Ultimately, this service is also an excellent tool to control the subcontractors even better."

Incidentally, even if construction work is running to plan, ViCon has not exhausted its possibilities. The building information system provides the operator with details of the maintenance cycles and other important data and facts. Even the people who subsequently live in the building can gain great benefit from ViCon at an early stage. In a similar way to Porsche's Car Configurator—which anyone interested can use on the Internet to put together the color and fittings of his vehicle visually, with the costs included—the Building Configurator provides clear proportions: the right color for the bathroom tiles, the kitchen fittings—everything can be displayed beforehand in 3D format on the computer. And you know immediately what it costs. ◂

Working with the "i-room": Everything can be simulated

Cartier

HORLOGERIE

IN LA CHAUX-DE-FONDS, BIRTHPLACE OF THE SWISS WATCH-MAKING TRADITION, CARTIER BRINGS TOGETHER ON ONE SITE ALL THE ELEMENTS OF CREATION LEADING FROM THE DRAWING TO THE FINISHED PRODUCT.



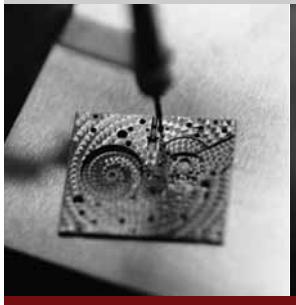


Meeting the point of technology and tradition, the factory allows creativity, precision and innovation to explore boundless new territories for invention. This audacity imprinted in the DNA of Cartier guarantees watches with exceptional character.

Cartier Horlogerie is nowadays one of the few important factories in Switzerland to integrate all the watch-making crafts and industrial processes.

Three main strategic axis of evolution keep on asserting Cartier's special position: the reunion in one tailor-made building of all the development skills to speed the time to market of tomorrow's watches; reactive tools to control and drive the entire supply chain; and an unwavering commitment to provide the absolute best quality to its clients.

A MAJOR ACTOR IN THE LUXURY INDUSTRY, CARTIER DEVELOPS, PRODUCES AND INSURES THE LONGEVITY OF EXCEPTIONAL WATCHES.





CARTIER HORLOGERIE • Chemin des Alisiers 10 • 2300 La Chaux-de-Fonds • Switzerland