

Automotive and transportation

ŠKODA AUTO

Use of Tecnomatix tools helps spur ŠKODA's automotive market growth

Product

Tecnomatix

Business challenges

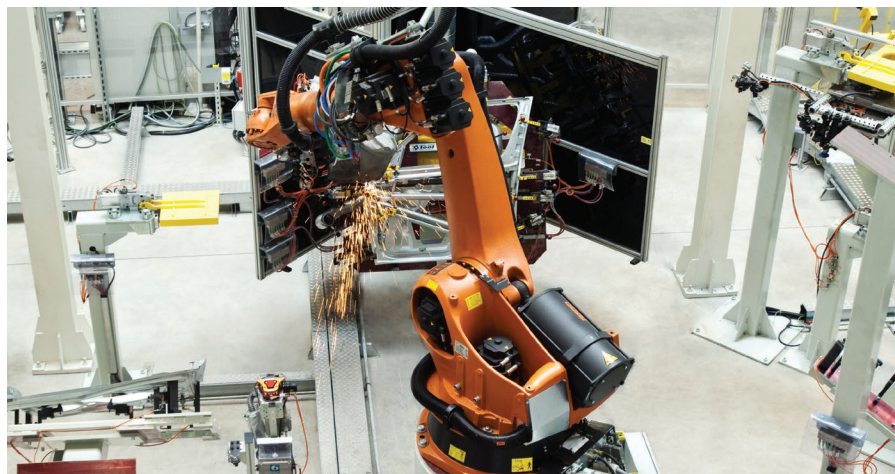
- Launch new car models earlier
- Support company growth
- Add new production lines quickly
- Reduce costly rework

Keys to Success

- Identify and fix process deficiencies early
- Communicate manufacturing process plans
- Shorten commissioning time of new production lines
- Improve engineering collaboration for BIW production lines
- Protect employee health by providing a safe work environment

Results

- Reduced risk at commissioning of production lines
- Greater engineering transparency
- Safer work environment
- Overcame a 5-week delay in the delivery of robots
- Highly accurate simulation analysis using motion capture



A ŠKODA BIW line.

ŠKODA uses virtual commissioning to reduce risks with time saving potential and ergonomic simulations to enhance worker safety

Rapidly growing Czech automaker expands global reach

ŠKODA AUTO (ŠKODA) is one of the world's oldest automobile manufacturers, dating back to 1895, when Václav Laurin and Václav Klement formed a partnership that laid the foundation for more than 100 years of Czech expertise in automotive engineering.

ŠKODA has become a key brand in the Volkswagen portfolio, employing more than 26,500 people worldwide. The company manufactures seven car models –

Citigo, Fabia, Roomster, Octavia, Yeti, Superb and Rapid – producing 879,000 cars in 2011. Thanks to the Volkswagen group's substantial investments in development and production, ŠKODA automobiles now stand for exemplary quality, reliability, practicality and value.

Digital factory team supports strategic growth initiatives

ŠKODA management has defined ten strategic initiatives to support business growth, several of which will be led or supported by the manufacturing engineering group, including sharing and re-using modules among multiple car models, continuously improving manufacturing, shortening production time per unit, optimizing return-on-tools investment and establishing new plants and production lines overseas. The manufacturing engineering

A ŠKODA
BIW line.



“Unlike some engineering software tools, the use of Tecnomatix really has a strong impact on how we deliver a project, all the way up to the organizational level. In the past, mechanical simulation engineers and control engineers were practically disconnected. Now they have a common language, which is Process Simulate Virtual Commissioning.”

Radek Fáborský
Tooling Department
Virtual Commissioning
Project Leader
ŠKODA AUTO

group decided that many of these initiatives would best be answered by broadening the scope of its digital factory project.

The digital factory project at ŠKODA is a comprehensive engineering approach, covering a range of methods, procedures and tools intended to support industrial production. This includes using cutting-edge software technologies to create a digital factory that becomes an exact virtual image of physical production.

The digital factory team’s tasks include creating the methodology for using digital manufacturing tools, implementing long-term plans and setting the objectives for this initiative, assisting in project planning and optimization of product development, providing ergonomic simulations with motion capture systems, communicating with the Volkswagen group, jointly

developing and applying group standards, and raising internal awareness of this initiative.

Most activities of the digital factory based on Tecnomatix digital manufacturing tools

Detecting process deficiencies (after production begins) leads to time-demanding and costly changes. The manufacturing engineering challenge is to identify, analyze and resolve these issues before they are encountered on the shop floor. Various departments at ŠKODA, such as body in white (BIW) planning and tooling and logistics planning, use a range of digital manufacturing tools from the Siemens PLM Software Tecnomatix® portfolio. Tecnomatix is used for process planning, simulation, validation and optimization. Its tools support the analysis and validation of the planned production concept in

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an early stage of the production process before physical equipment is built. This enables any manufacturing engineer involved in development to visualize the future process and propose improvements. As a result, key proposals based on deep analysis can be evaluated and approved on time, so that superfluous corrective actions can be reduced.

The digital factory includes an integrated network of digital models, methods, simulations and 3D visualizations intended for comprehensive planning, implementation, management and continuous improvement of all manufacturing processes. The digital factory provides an up-to-date digital image of the planned or existing production to enable transparent and instant communication regarding feasibility, progress and costs of new processes and products.

ŠKODA deploys several aspects of the Tecnomatix portfolio, including robotics and automation planning tools for the BIW lines, human simulation tools for the analysis and evaluation of shopfloor workers' workload and optimization of ergonomics (based on recorded moves from

motion capture), and logistics planning tools for optimizing internal logistics.

Digital factory BIW vision divided into separate projects

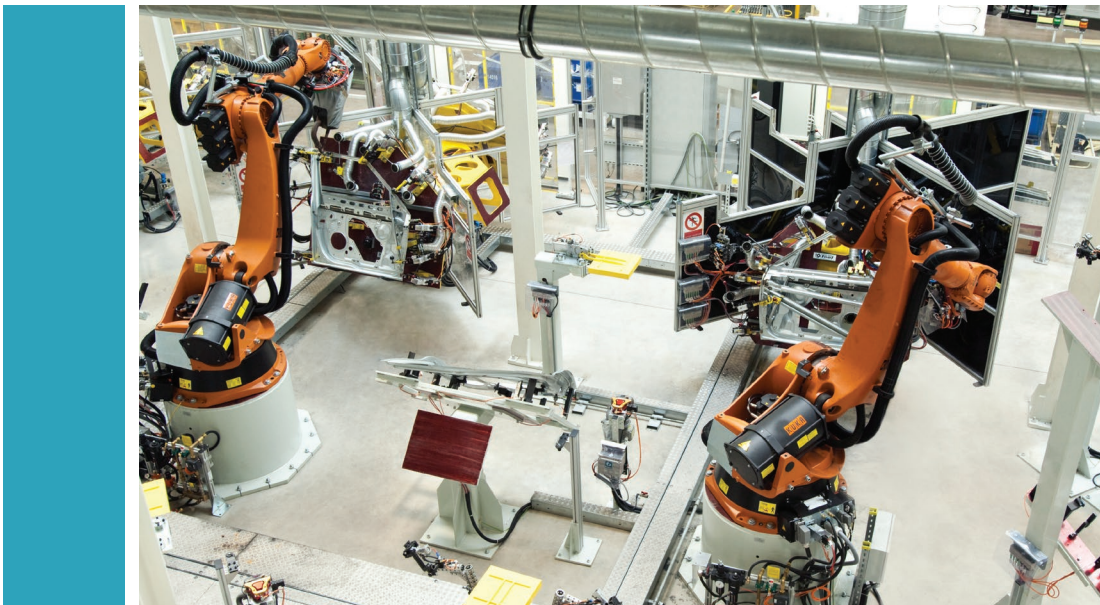
The ŠKODA digital factory team defined four BIW projects for the years 2012 and 2013, including acquiring product data, establishing tool and process libraries, adopting the Volkswagen Group's workflow and data model (which uses Process Designer), and adopting Process Simulate for 3D robotics simulation and offline programming. Both Process Designer and Process Simulate are in the Tecnomatix portfolio.

The projects reflect a strategic shift from a BIW digital factory initiative, which was previously based only on using Robcad™ software in the Tecnomatix portfolio for 3D simulation of single robotics work cells. Now the team has a much broader scope of responsibility – virtually planning and simulating an entire BIW production line – and will use Process Designer and Process Simulate to address these duties.

The Volkswagen group, which has been deploying Process Designer for several

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A ŠKODA
BIW line.

“The value of using Tecnomatix to connect to a real physical controller, run the simulation and test different production scenarios by sending signals from the controller is outstanding.”

Petr Hynek
BIW Planning Team Manager
ŠKODA AUTO

years now, has developed the Dikab concept (Dikab is a German acronym for digital BIW). Dikab represents a data model, workflow and methodology that enable improved internal communication within the group and external communication with manufacturing engineering suppliers, based on managing data using Process Designer.

The Dikab concept includes a customized data scheme that defines the data model and specific production line modeling hierarchy. Volkswagen has already released a second version of Dikab, which incorporates modifications that were requested by the users. Part of this concept is an interface between Process Designer and Teamcenter® software from Siemens PLM Software. Use of Teamcenter will support the frequent updating of product data (geometry and metadata) from the product design environment to the manufacturing engineering environment.

Process Designer is used in ŠKODA according to the Volkswagen Dikab concept for every car project. Nevertheless, there are some unique aspects of using Process Designer within ŠKODA. For example, there are customized visualized work instructions for the human operations in the BIW production line, which enable changing and optimizing the production sequence, not only before the start of production (SOP), but also after SOP. Another

example would be the basic duration calculations for the manual operations, based on ŠKODA’s time measurement standard.

ŠKODA doesn’t limit the use of Process Designer to the line concept planning phase. ŠKODA engineers also use it during production. Using a special customized interface of Process Designer to Techedit (the backbone system at ŠKODA for calculation and parts ordering for every production department) helps ensure the right part is delivered to the right point of use on the production line. Process Designer includes the entire bill of materials (BOM), along with the production process (operations, manufacturing processes and times). ŠKODA calls this combination the “Technological BOM.”

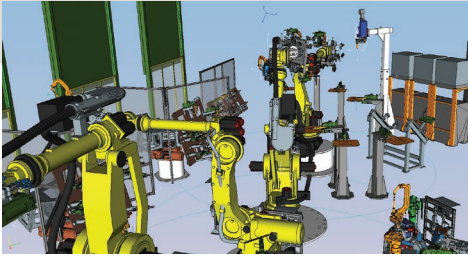
Additionally, this project includes the development of a methodology for insertion of effectivity into the product data and relevant manufacturing operations and for the use of the variants, based on Process Designer functionality.

Faster production ramp-up requires virtual commissioning

ŠKODA defined the target of the virtual commissioning project simply as shortening the time needed for the productive commissioning of a BIW line. This is especially important when introducing a new model to an existing, running line. The company wants to minimize the downtime

ŠKODA Yeti.





A ŠKODA BIW line simulated with Process Simulate Virtual Commissioning.

of the running production line by assimilating new or modified production equipment to that existing line.

“Process Simulate Virtual Commissioning enables us to optimize and troubleshoot both the mechanical and control aspects of a robotics work cell,” says Petr Hynek, BIW planning team manager at ŠKODA. “The value of using Tecnomatix to connect to a real physical controller, run the simulation and test different production scenarios by sending signals from the controller is outstanding. It allows for a very thorough validation of the planned robotics work cell interlocks, safety and cycle time optimization.

“As this entire concept is rather new for us and for the entire Volkswagen Group, we used a stepped approach to implement it. The first project in which we used Process Simulate Virtual Commissioning was the side panel welding of the Yeti

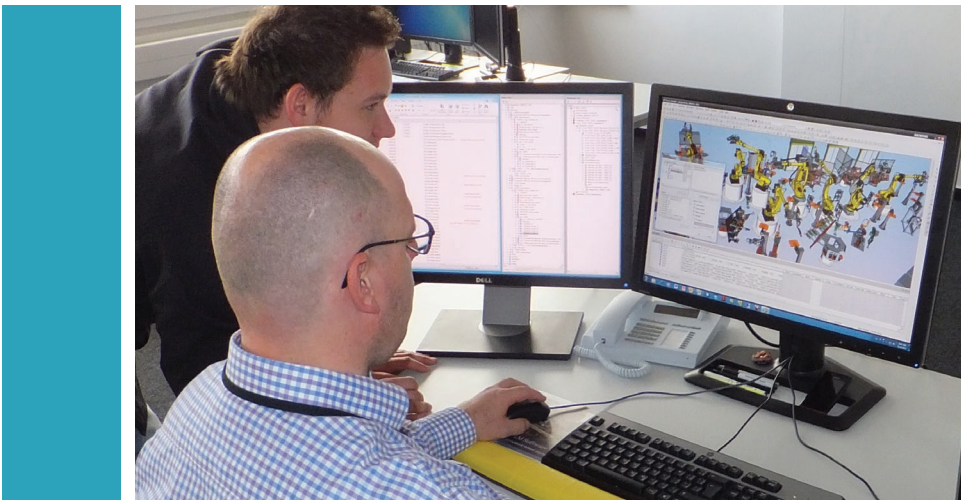
model. We had to introduce its production into an existing line to increase the production capacity.”

As the Yeti became popular, ŠKODA decided to commission an additional production line. ŠKODA engineers had therefore selected a second project for use of Process Simulate Virtual Commissioning: the Yeti underbody welding cell, which includes five robots and a failsafe. ŠKODA experienced a delay of five weeks in the delivery of the robots, but by using Process Simulate Virtual Commissioning, they were able to overcome this delay, catch up and launch the production on time.

“We have selected a project to further deploy Process Simulate Virtual Commissioning, in which we had a real schedule challenge,” says Hynek. “We connected it to the SIMATIC S7 PLC (Programmable Logic Controller) over Siemens’ SIMIT and SimbaBox. Using Tecnomatix, we validated all the robotics operations and the cell control logic, including safety aspects in a virtual environment, so ramp-up of the physical line was much faster and we could actually compensate for a significant delay in hardware delivery and start production on time.”

“One of the next essential activities was comparison of the digital motion results (recorded using the motion capture suite integrated with Tecnomatix) with the conventional evaluation of the physical motion. We found the digital motion results to be almost the same as the physical motion results, which is impressive.”

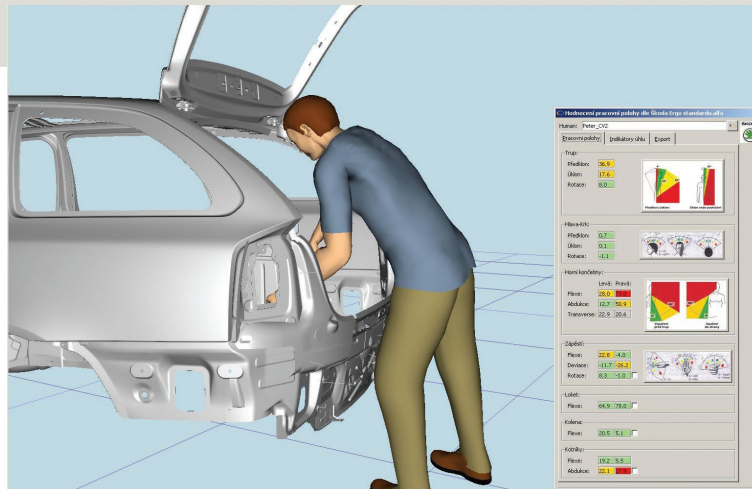
Andrej Bednár
Digital Factory Team Manager
ŠKODA AUTO



Radek Fáborský and his team using Process Simulate Virtual Commissioning.

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ŠKODA's unique ergonomics standards embedded in Jack™ human simulation software.

“We also initiated a third project in which we used Process Simulate Virtual Commissioning to simulate welding of the rear doors of the new Rapid Liftback model,” says Andrej Bednár, digital factory team manager at ŠKODA. “Based on our positive experience, we are certain that by using Tecnomatix we will significantly reduce the risks and the troubleshooting of a BIW line commissioning. With more than 3,000 units produced daily – representing different lines with different

capacities – this is a huge benefit in earning additional production days. We have decided that our tooling department will further deploy Process Simulate Virtual Commissioning and gain the needed expertise.”

The tooling department is an internal line builder within ŠKODA, which competes with other line builders on projects for ŠKODA and within the Volkswagen Group. The tooling department phases-in a car project after the line concept planning phase and, naturally, is more focused on simulation, where the users shift from using Process Designer to Robcad and Process Simulate.

“A car manufacturer always has a pressure to shorten the duration of a new car project,” says Radek Fáborský, virtual commissioning project leader in the tooling department. “The virtual commissioning

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Virtual Commissioning Project Leader
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ŠKODA Rapid.

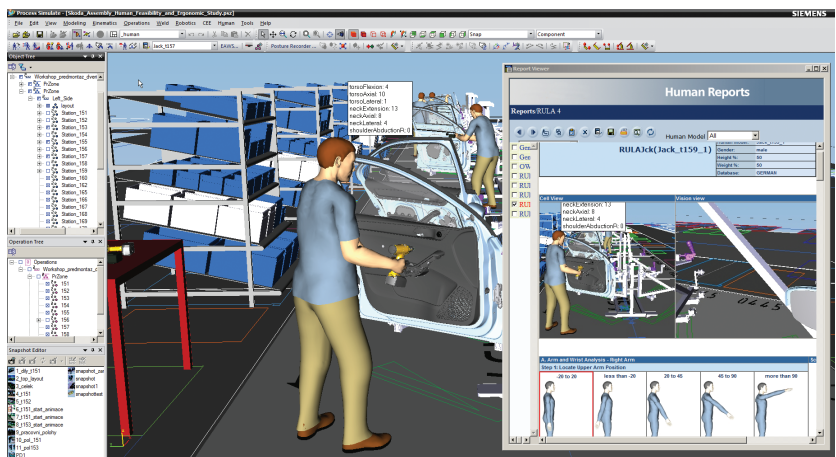
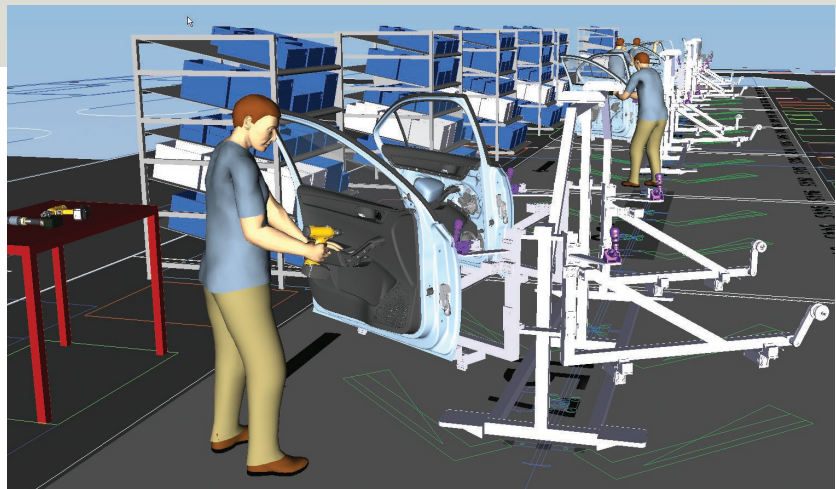
domain is a complex scenario, but Tecnomatix is very user-friendly and using the valuable professional consulting we get from Siemens PLM Software, we feel that we are on the right track to deploy Process Simulate Virtual Commissioning.

“The first pilot project of Process Simulate Virtual Commissioning at the tooling department of ŠKODA was supported by the targeted use of Siemens PLM Software consultants. The consulting methodology used for this complex issue not only gave us the needed know-how, but also left enough room for our own ideas and local process customization in such a way that the result is an enduring, self-sufficient ability to perform and understand the virtual commissioning process. I strongly believe that the use of Tecnomatix will help shorten a car’s project time. Real engineering collaboration is obtained by using Process Simulate through the multi-user capability, which ensures that manufacturing engineers cannot do simultaneous changes on the same data set. It also enables excellent collaboration with the planning department.

“Another new, important aspect is the move from a time-based simulation to an event-based simulation, as it enables a much more realistic analysis of a robotics work cell. We started the virtual commissioning initiative in April 2012, and within a few months we were already running a pilot project within our department, using it for the rear doors welding zone of the Rapid model, which includes nine robots.”

The ŠKODA tooling department implementation team readily accepted Process Simulate Virtual Commissioning. This enabled a smooth continuation of the work done by the BIW planning team and helped ŠKODA perform virtual commissioning and feed the validated data back to the planning environment after the engineering work was completed.

“Process Simulate Virtual Commissioning triggered a small revolution in the conser-



ŠKODA Rapid doors subassembly analysis completed with Process Simulate Human.

“The virtual world of automotive manufacturing engineering,” says Fáborský, “Unlike some engineering software tools, the use of Tecnomatix really has a strong impact on how we deliver a project, all the way up to the organizational level. In the past, mechanical simulation engineers and control engineers were practically disconnected. Now they have a common language, which is Process Simulate Virtual Commissioning.”

Ergonomics analysis increases workers’ health and product quality

Automotive production and assembly include major risk factors for shop floor employees, including unnatural body positions, high levels of work-cycle repetitive-ness (in which each cycle is often less than one minute) and intensely applied forces in the installation of components.

“In also considering the smooth connection of Jack and Process Simulate Human to our motion capture suite, it was clear to us that the Tecnomatix solution was the best for our requirements, compared with the other solution we tested.”

Andrej Bednár
Digital Factory Team Manager
ŠKODA AUTO

Installation of parts into the vehicle and carrying large, often awkward loads contribute to overloading workers. Czech law requires that employers continually evaluate ergonomic risks and protect the health and safety of their employees. Optimized workplace ergonomics contribute not only to improved work comfort and employee health, but also to improved individual productivity and product quality.

That is why ŠKODA decided to introduce a proactive approach to ergonomics, with the objective of preventing problems instead of dealing with consequences. With no simulation tool in place for ergonomics, ŠKODA implemented a benchmark study to determine its best option. “We conducted a benchmark with two of the leading ergonomics software vendors,” says Bednár. “Using their software, we executed a two-step process.”

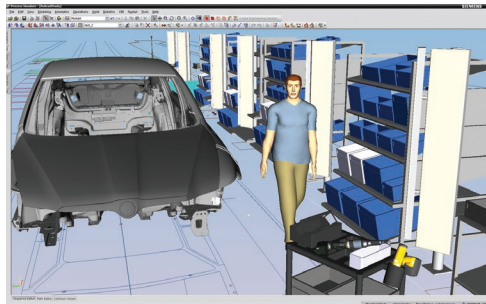
He explains, “In the first step, we simulated one assembly station of the ŠKODA Superb. We didn’t settle with static-posture analysis and decided we needed to

conduct dynamic simulation to obtain the expected benefits. One of the biggest challenges we have identified is that it takes quite some time to create a full, realistic, dynamic simulation, including animation. This is why we have focused on motion capture very much from the beginning, as we believe this will save time in the preparation of the dynamic simulations. The second major issue was Czech law, which includes strict local government occupational health and safety requirements, so the tested solutions needed to support the local standard as well as international ergonomics standards. We wanted to use our existing known standards and not necessarily use the standards delivered with the software, as this way the analysis results would be well accepted, and we could easily find the necessary corrective solutions, whenever needed.”

“The next logical step was verification in a real production, which we made during 2012, when ŠKODA tested an existing doors pre-assembly line. This step verified the robustness and usability of the whole system. ŠKODA has also evaluated ergonomic aspects with dynamic human simulations. During this step, one of the most important tasks was to ensure that the working postures comply with the Czech law.”

Bednár notes, “In also considering the smooth connection of Jack and Process Simulate Human to our motion capture suite, it was clear to us that the

ŠKODA Superb assembly analysis created using Process Simulate Human.



“We found the digital motion results to be almost the same as the physical motion results, which is impressive.”

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Solutions/Services

Tecnomatix
www.siemens.com/tecnomatix
 Jack Human Simulation
 Process Designer
 Process Simulate
 Robcad
 SIMATIC

Customer's primary business

ŠKODA AUTO is one of the world's longest-standing automobile manufacturers. The company, part of the Volkswagen group, is a global player that sells cars in more than 100 markets worldwide. www.skoda-auto.com

Customer location

Mladá Boleslav
 Czech Republic



Tecnomatix solution was the best for our requirements, compared with the other solution we tested. With Tecnomatix, users are able to address the ergonomic aspects of manual operations during the early stages of product design and manufacturing planning."

Therefore, ŠKODA decided to focus solely on deploying the human simulation tools of Tecnomatix. Its engineers attended several workshops to learn how to use the motion-capture tracking suite in an environment with strong magnetic influence, which is typical for industrial production.

"One of the next essential activities was comparison of the digital motion results (recorded using the motion capture suite integrated with Tecnomatix) with the conventional evaluation of the physical motion," says Bednár. "We found the digital motion results to be almost the same as the physical motion results, which is impressive. These results reinforced our intention to establish a virtual-reality ergonomics lab in which two engineers from the digital factory team work with

Jack and Process Simulate Human, supported by the health protection, product design and manufacturing engineering departments."

Within this newly established lab, the digital factory team works with state-of-the-art technology, utilizing production operation tracking based on motion capture integrated with the Tecnomatix applications. This allows the team to analyze the feasibility and acceptability of work operations, especially with regard to the different heights of workers. The experience and outputs obtained in this way can be further used to present best practices and lessons learned, and for training shop floor workers on basic ergonomic principles. Expected objectives include improving working conditions for employees, reducing injury occurrences and associated costs, addressing ergonomics during the preproduction project phases, and digitally verifying the feasibility of assembly operations in compliance with ergonomic standards and laws.

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