

NX • Teamcenter

NPO Saturn

NPO Saturn achieves record-breaking development time for the SaM146 engine using Siemens PLM Software technologies

Industry

Aircraft engines

Business challenges

Expand into the international jet engines market

Create a new family of products

Develop engines faster and cheaper

Keys to success

Deploy NX CAD/CAE/CAM and Teamcenter PDM

Establish efficient business processes

Introduce concurrent engineering

Replace experimental studies with engineering analysis via supercomputer

Results

Cut engine development time in half

Eliminated prototype testing, saving significant program costs

Gained valuable international experience



Prototype testing stages eliminated and program costs significantly trimmed as engine development time is cut by 50 percent

Gas turbine engine specialist

NPO Saturn Research and Production Company (NPO Saturn) develops and manufactures gas turbine engines for commercial and military jets, navy ships, power plants, and gas transfer stations. The company was established in 1916. Now it is a part of United Engine Corporation (UEC).

One of the company's most significant achievements is the development of the SaM146 engine. The engine is designed in partnership with Snecma, located in France, for the Sukhoi Superjet 100 family

of regional and long-haul jet liners. NPO Saturn is the only Russian company holding a Production Approval Organization certificate awarded by the European Aviation Safety Agency.

NPO Saturn's primary design office and production site are in Rybinsk, the Yaroslavl Region of Russia. There are business divisions in Moscow; sites include the famous Lyulka Research and Engineering Center, St. Petersburg, Perm and Lytkarino.

Advanced, new solutions support science-driven aerospace projects

For the past decade, NPO Saturn has been evolving and advancing its capabilities and portfolio. The company once housed a plant that produces a single product, the D30 KU/KP engine for the Tupolev 154.

Results (continued)

Developed and certified the SaM146 engine; other large-scale projects well under way

Established a smooth-running, virtual development environment

Enabled efficient collaboration with international partner: Snecma in France

“With Siemens PLM Software’s solutions, we have significantly reduced the engine development time and have established business processes that match modern international best practices. As a result, the company is an equal partner in large international projects like the SaM146 program.”

Yuri Zelenkov
IT Director
NPO Saturn



More of these aircraft engines were produced than any other like product in Russia. The engines support the Ilyshin 62 commercial jets, which are coming to the end of service life, and the Ilyshin 76 military cargo jet.

Today, NPO Saturn is concurrently developing more than ten new jet engines and supports the entire lifecycle of its products – from manufacturing to after-sales customer service. The company has transformed into an innovation pioneer with extensive design and engineering capabilities and a high-capacity, modern manufacturing site.

The catalyst behind a highly successful technology transformation

“At the turn of the millennium, the company faced some tough challenges: to become Russia’s largest jet engines developer, to enter the world market, and to introduce new business areas like after-sales service,” says Yuri Zelenkov, IT (information technology) director, at NPO Saturn. “So we had to develop a new family of products. The company’s management realized that the development and engineering data management system had to be drastically changed through the extensive application of advanced IT. The reason was not just to evolve with the fashion and the spirit of the times, but rather to address the company’s real needs. When competing in a highly aggressive market, we could not afford spending 15 years on an engine development, as was the case back in Soviet times.”

A jet engine is one of the most complicated and engineering-driven products made. Its development takes in-depth analysis and experimental research in thermodynamics, aerodynamics, strength, acoustics, materials science, etc. It’s no wonder that, prior to the wide-scale introduction of advanced information technologies, a new engine’s development cycle lasted 12 to 15 years. Most of the time was spent on experimental performance refinement: dozens of prototypes were tested to destruction in order to check the specifications and adjust the design parameters.

At the turn of new millennium, it became obvious that successfully competing in the global aircraft engines market required faster and less costly development, which was impossible without a large-scale computer-aided design (CAD) and product lifecycle management (PLM) systems deployment. NPO Saturn analyzed all of the major CAD and PLM offerings and chose Siemens PLM Software solutions to advance its plans and goals.

Zelenkov explains, “Siemens PLM Software’s products featured several benefits. First, we needed extensive design functionality, and in many aspects the NX product development solution was a perfect fit. Second, it was important to integrate Siemens PLM Software’s products with the products of other vendors. For example, at the time, Snecma was already a prospective partner for the SaM 146 engine development, and Snecma used other software. Finally, Siemens PLM Software’s technologies were very cost-competitive.”





In 2001, at the Moscow Air Show, NPO Saturn executed its first substantial contract with Siemens PLM Software. It covered two solutions: NX™ software in two basic configurations intended for designers and manufacturing engineers, and Teamcenter® software for complete PLM across the organization. The software was supplied through ZAO Innovation Technologies and Solutions, a Siemens PLM Software's partner. ZAO remains NPO Saturn's go-to source for PLM licensing and implementation.

"It was clear that 3D modeling was not enough; there was a need for some kind of data exchange and process support," says Zelenkov. "Therefore, we decided to implement both the CAD and PDM systems at essentially the same time." He explains, "The Teamcenter deployment slightly trailed the NX implementation, because we knew that a new PDM system would require some changes to the established workflows. Initially, we purchased several dozen Teamcenter licenses, and then we evaluated the product and its capabilities. The large-scale deployment and mastering came later."

Incorporating business processes that reflect international expertise

In 2003, NPO Saturn and Snecma jointly began the development of the new SaM146 turbofan mixed flow engine, which was intended for the Sukhoi Superjet 100 family. For NPO Saturn, the partnership with one of the leading industrial manufacturers proved to be an extremely valuable experience, especially in applying and utilizing advanced business practices.

Today, NPO Saturn's computer-aided technologies (CAx) are finely tuned, with the company using NX extensively for the engine's digital mockup development and Teamcenter for comprehensive PDM. NPO Saturn's virtual product development operation supports an end-to-end lifecycle: 3D modeling, product configuration management, and numerical control (NC) programming. In fact, the company has several hundred NC machine tools. Siemens PLM Software's technologies are used at every stage.

"We had to establish business processes that would be appropriate for two geographically dispersed companies, and that would meet the European aviation authorities' requirements," notes Zelenkov. "From the onset, we knew that Teamcenter was the right choice for collaborative development, streamlined processes and concurrent engineering."

However, because NPO Saturn's partner Snecma used different CAD and PLM systems, integration was an issue, albeit quickly solved by using the XML language and the STEP format. Effective communication was essential as the engineers in Russia and France exchanged critical data on a daily basis.

While the business processes created during the SaM-146 engine development vary somewhat from those common in the Russian aircraft engine industry, NPO Saturn is considering the application of these processes to its domestic projects as well. "The collaboration processes that we

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Yuri Zelenkov
IT Director
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established with Teamcenter are close to the international model," says Zelenkov. "We see a lot of benefits in this fact."

Record-breaking development time

The SaM146 engine received its European certification in 2010. The engine's development took about seven years, half of the time that was needed prior to using Siemens PLM Software's solutions. The faster development time is based on using the advanced functionality of NX and Teamcenter, as well as in the company's use of supercomputers. The company introduced its first supercomputer in 2005. It performs parametric analyses, which replaces numerous actual tests. The technologies from Siemens PLM Software are used at the first stage of engineering analysis, before the supercomputer is applied.

"The changes in our processes are very significant," says Zelenkov. "While we were developing the SaM146, we did not make a single prototype. Before using NX and Teamcenter, we used to build dozens of them. For example, when we developed the AL 31F engine for the Sukhoi 27 fighter in the 1970s and 1980s, 50 full-size prototypes were made and destroyed, not counting individual parts and components. With the new SaM 146 engine, all parameters have been optimized using PLM technologies and the supercomputer. The digital technologies have helped to greatly reduce development costs, because physical prototypes are no longer required."

Only certification tests required by the airworthiness codes are mandatory for a commercial jet engine. Eight SaM146 prototypes were built and used in various tests: bird strike, ice ingestion, blade separation, etc. The engine passed all the certification tests on the first try, thanks to the highly accurate, digital engineering analysis performed upfront.

Concurrent engineering optimized

In 2010, NPO Saturn joined together with a number of other UEC companies on the advanced and highly fuel-efficient PD 14 jet engine development project, which was driven by JSC Aviadvigatel in Perm. The engine is designed for the MS21 long-haul airliner. NX and Teamcenter were chosen as the foundation PLM technologies for the project. The experience gained by NPO Saturn on the SaM146 development served to facilitate the establishment of a unified project infrastructure, as well as tight management over the collaboration between designers and engineers at the Perm and Rybinsk sites.

Similar to the SaM146 development, the approach optimized concurrent engineering tasks. "All the engine development stages – engineering analysis, production planning, NC programming, manufacturing and tests – are performed in a concurrent or synchronized manner, not one after one," says Zelenkov. "For example, when the design of certain parts is locked, the manufacturing begins prior to the final approval. As a result, the total development time is reduced."

Zelenkov notes that NX and Teamcenter fully support concurrent engineering, providing structured access to the product's 3D master models and parts. As the primary master model is changed, the associativity tools track the impact, identify the dependent entities, and enable the necessary adjustments.

Solutions/Services

NX

siemens.com/nx

Teamcenter

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Customer's primary business

NPO Saturn Research and Production Company develops and makes gas turbine engines for commercial and military jets, navy ships, power plants, and gas transfer stations. Established in 1916, it is now part of United Engine Corporation (UEC).
www.npo-saturn.ru

Customer location

Russia

Partner

ZAO Innovation Technologies and Solutions

"The advanced technologies from Siemens PLM Software enable NPO Saturn to make competitive and regulatory-compliant products fast. With Siemens' PLM, development and manufacturing costs are reduced, knowledge and expertise are gained, and supply chain management is efficient."

Dmitry Kremenskov
Vice Director General
ZAO Innovation Technologies and Solutions

Besides faster design turnaround at NPO Saturn, concurrent engineering has enabled streamlined interaction with contractors and suppliers. The relationships between the value chain stakeholders (both within and outside the company) are handled in such a way that the impact of any change on the product lifecycle can be readily tracked and managed.

Launching the PAK FA ahead of time

The T-50 fifth generation multirole fighter is a milestone project for the Russian aerospace industry. NPO Saturn is participating along with other companies of United Engine Corporation. The primary developer is the Lyulka Engineering Center's Moscow office. "Product 117" is the in-house name of the engine intended for the advanced front-line stealth aircraft, the PAK FA.

According to Zelenkov, Siemens PLM Software's technologies have helped NPO Saturn to significantly reduce engine development time. "Military developments are more science-driven than commercial ones," he says. "For example, materials science plays an important role. That is why it takes more time. Still, Product 117 has been developed ahead of time thanks to digital modeling and early engineering analysis."

Significantly reduced costs, improved knowledge and increased efficiency

Today, Siemens PLM Software's solutions are used throughout the entire company, with hundreds of engineers employing them. According to Zelenkov, the added value is substantial: "With Siemens PLM Software's solutions, we have significantly reduced the engine development time and have established business processes that match modern international best practices. As a result, the company is an equal partner in large international projects like the

SaM146 program." He notes, "Today, NPO Saturn has completely paperless production. Sometimes drawings are printed out for manufacturing purposes, but doing so is a convenient by-product of using a 3D model."

Dmitry Kremenskov, vice director general at ZAO Innovation Technologies and Solutions, adds, "The advanced technologies from Siemens PLM Software enable NPO Saturn to make competitive and regulatory-compliant products fast. With Siemens' PLM, development and manufacturing costs are reduced, knowledge and expertise are gained, and supply chain management is efficient."

According to Kremenskov, whose company both deploys Siemens PLM Software's solutions and provides consulting services at NPO Saturn, the success of a PLM implementation depends on the agility and skills of the experts within a company. He points out, "At NPO Saturn, a team of professionals deals with product lifecycle management. They know their goals and the scope of the tasks to be solved. The fact that the company's top management pays due attention to PLM demonstrates its commitment to technological excellence."

Future plans

Zelenkov concludes, "NPO Saturn has extensive plans for further cooperation with Siemens PLM Software and its partner, Innovation Technologies and Solutions. Such an efficient partnership must go on. We will use the solutions from this team in the future; we will switch to new releases and master new capabilities. Advanced new product development would be impossible without this."

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