SIEMENS

CPI-ENG

Mechanical design specialists develop a Stirling engine from scratch in few months with NX

Product
NX

Business challenges
Develop models of large assemblies with many parts

Allocate design resources with great flexibility

Keys to success
Implement NX design software to turn concepts into reality

Utilize part linking to enable concurrent work on assemblies

Results
Efficient management of interaction between different files and geometries

Solid and reliable relationships among all parts of a large assembly

Direct integration of production and machining data into 3D models with PMI

## Dividing the model into three segments enabled CPI-ENG engineers to work concurrently on one large assembly

Top-notch mechanical design

CPI-ENG Srl was established to deliver high-quality, targeted engineering solutions in the mechanical design domain, providing customers with all-round service from feasibility study, through all design and development stages, up to project definition and, in some cases, prototyping. The qualified staff of the company, based in Trieste, Italy, presents a spectrum of ad-hoc solutions and options to each customer, taking into account all design aspects, from product-related costs to ease of assembly.

The company was founded in 1998 as a specialist in mechanical design and business consulting, identifying its core business in engines. "Today, our major customer is Wärtsilä, a leading manufacturer of big engines for the naval and energy industries," says Christian Bracich, CEO of CPR-ENG. "But we also have projects in defense, where we develop drones and self-guided airplanes, and in heavy equipment, where we are supporting a customer for the construction of a structure for the ITER toroid, the nuclear fusion power station that is being built in France."

In the early years, CPI-ENG also designed several mechanical transmissions for heavy equipment and earthworks machinery. The company currently employs about thirty designers, guided by Bracich himself, who succeeded his father in management and has been the main driver for business growth in recent years. Besides the Trieste office, CPI-ENG has added a subsidiary in Moldova, employing twelve mechanical designers to provide further added value to customers.
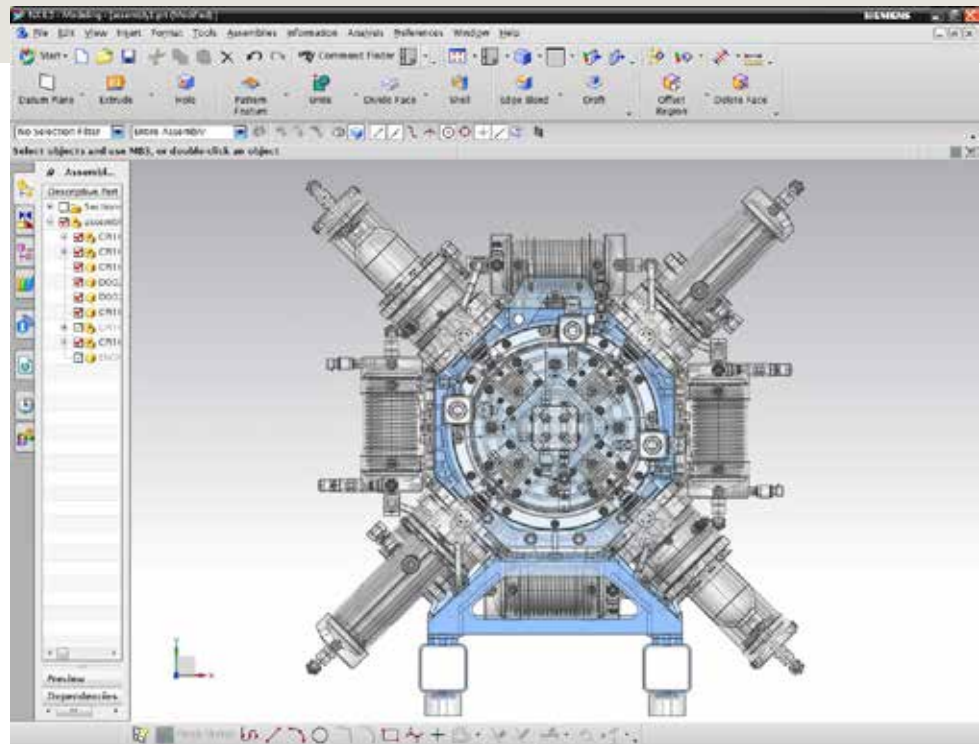
All-round design expertise

When a customer knocks on CPI-ENG's door, a meeting is organized to identify the project's real needs and collect information about resources, tools and deadlines to develop a specific offer. When the customer accepts the offer, the design process is launched, sometimes executing a pilot project to test possible suppliers and align them to customer needs. "In Trieste, we are the only company offering this level of service, with a full package including work scheduling, resource allocation and complete execution, from design to calculations, up to the prototype when required," says Bracich.

Among its most innovative projects in recent years, CPI-ENG collaborated with FBK for the DiGeSPo (Distributed combined heat and power Generation from small-scale concentrated Solar Power) project, which aims to build an energy supply plant based on micro solar panels connected to a new concept: a dual-effect Stirling motor. This system was designed to supply eco-sustainable electric power, heating and cooling to single or multiple residential sites, small retail businesses and

industrial and public buildings, achieving 60 to 70 percent global efficiency compared to incident solar radiation.

"CPI-ENG was in charge of developing the structural and functional mechanical design of the Stirling machine, invented by Robert Stirling back in 1816, a type of engine that leverages temperature and pressure differences to generate clean energy with no incoming fuel and no harmful emissions," says Michele Alessio, engineering department manager at CPI-ENG. The purpose of the DiGeSPo project is to build fully-independent, eco-sustainable systems to generate heat and power with no grid connections. For this purpose, the Bruno Kessler Foundation in Trento devised an innovative system of high-concentration solar panels, with efficiency levels suitable to generate heat/cold differences big enough to drive the Stirling engine, which in turn feeds a power supply unit. The key feature of this design is that it absorbs only 30 percent of the energy collected by panels, while the remaining 70 percent is available to produce hot water, heating and other services.

From idea to design

CPI-ENG executed all design and calculations, as well as handled the production and assembly of the Stirling engine components. The engine was installed in Malta with excellent results: 80 percent yield compared to original plans. For this innovative project, the Trieste-based team relied on NX™ software from product lifecycle management (PLM) specialist Siemens PLM Software, starting from a simple Excel® spreadsheet where the customer had listed the key engine parameters: bore size, stroke, fluid and not much more.

"The initial study with NX helped CPI-ENG engineers understand whether the Stirling machine had to be designed as a boxer, inline or V engine," Alessio says. "Based on the analysis and calculation of friction-related consumption for each configuration, we came up with an X engine, a variant of a boxer engine with a slightly different sequence of cylinders to fully leverage power with lower mechanical losses." In the following steps, the entire engine was developed using NX, dividing the model into three different segments: cylinder, base and cooling/heating. Three designers coordinated by Alessio developed the assembly in-sync by working inside the same "skeleton," managing the assembly concurrently and sharing the basic structure with the corresponding dimensions and axes.

"In our office, we use all major CAD packages as requested by the end customer," explains Bracich. "In this case, we were free to choose, and we had no doubt: we opted for NX. Since early training, we could appreciate how fast and intuitive NX is, enabling designers to execute any idea very easily. NX is easy to learn if you have used any other CAD software, so it is ideal for a company like CPI-ENG, where staff members have diversified experience. Last but not least, NX is very fast and more stable than other solutions."

"The Stirling engine project required us to work with specific constraints, and the design approach with other software packages is more difficult," notes Alessio. "With NX, it's much easier to navigate within assemblies, as our experience with Wärtsilä proves. Two years ago, the Swedish company turned to us to design a new engine layout for a new product line. To finalize the project within four months as requested, we recommended using NX, which they had already adopted in their engineering department. What I like most about NX is the interaction between files or geometries. Right now, we are developing a casting for a German customer and the part linking function ensures very stable associative links between raw part, machined part and finished part. Even on very large assemblies with many parts, all links remain solid."

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Michele Alessio
Engineering Department Manager
CPI-ENG Srl

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Solutions/Services

NX
www.siemens.com/nx

Customer's primary business

CPI-ENG Srl is a mechanical engineering company specializing in mechanical design and business consulting, with a team of 30 design engineers.
www.cpi-eng.it

Customer location

Trieste
Italy

Towards data management

The partnership with Wärtsilä started in 2004 and developed quickly from the very beginning. After only one year, CPI-ENG had already dedicated 12 individuals to the ship engine manufacturer. "Today, half of our designers work for Wärtsilä, and we manage all their engines with NX, from design to modifications, including all upgrades, across five product families," says Bracich.

A few months ago, CPI-ENG implemented product and manufacturing information (PMI), a comprehensive 3D annotation environment of NX that enables the design team to capture and associate component manufacturing requirements directly with the 3D model. "Through our subsidiary in Moldova, we have acquired a German customer who was looking for a partner to carry out a project in English and Russian," Bracich says. "This company, another manufacturer of engines, expressly asked to use NX and to develop the entire job with PMI."
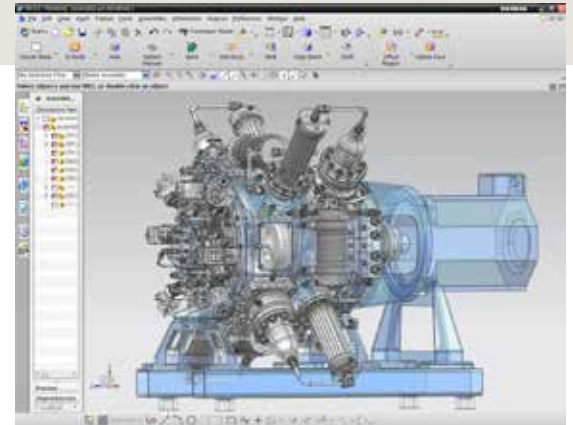
PMI is a tool for 3D model documentation that enables designers to associate all dimensions with a 3D component, so that they can be easily transferred automatically to 2D drawings downstream. "Using the PMI method, it takes five minutes to generate a drawing instead of two hours," Bracich says. "The benefits are tangible. The 3D model virtually incorporates all 2D information. A senior designer can develop a 3D model with preset values and then transfer it to a junior engineer with all the necessary constraints and annotations."

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