

IDEAS

Simulation solutions for pipelines



The challenge: To reduce the risk to your people, your equipment — and your investment



The solution: Measure. Simulate. And profit.

In every industry, in every business, there is risk—to your people, your equipment, and your investment. Setting your operation free of these risks is what IDEAS is all about. IDEAS is a leading dynamic

simulator for industrial operations, helping customers to save time, money, and resources.

IDEAS is more than just a cutting-edge simulation tool. It is supported by a team of development engineers and process experts who

have years of hands-on experience at operations around the world. We bring the power of IDEAS right to your site, no matter where it is in the world. Our global, industry-specific experience means we understand your issues and can provide you with solutions efficiently.

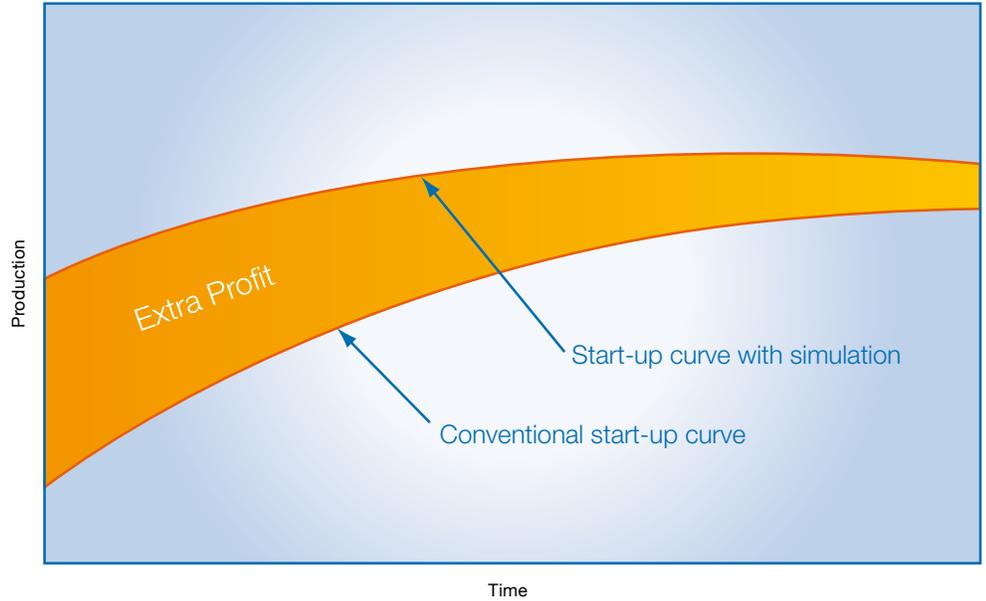
IDEAS is an industry-leader in the pipeline industry, providing hydraulic transient analysis for:

- Concentrate pipelines
- Tailings pipelines
- Freshwater pipelines

We are dedicated to working with you to help you harness the power of IDEAS. With your vision and our technology, the possibilities are limitless.

How IDEAS is implemented to help your project:

- We build process models of the facility based on P&IDs, pump curves, and other key components of the process.
- We connect these models to an offline version of the actual control logic.
- We then run a simulated start-up and verify and correct control logic against this “virtual plant,” months before start-up.
- The models are then used for operator training.



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Benefits

- Test and verify design concepts, quickly and at low cost and low risk
- Stage, test, and validate control logic to achieve faster start-up and increase return on investment
- Train operators without risking their safety or plant equipment



The challenge: To design a process that you know will work before you commit capital

The solution: IDEAS transient pipeline

During the process design phase of a project, IDEAS is a quick and powerful tool that enables users to dynamically model a pipeline project.

IDEAS helps you create a “virtual process” environment in which designs, modifications, and retrofits can be fine-tuned and verified, faster than in real time, before you commit to any capital costs.

IDEAS transient pipeline provides accurate and flexible modeling of hydraulic transient events in liquid pipeline systems. Within the simulation, pipeline sections calculate wave propagation based on fundamental momentum/conservation equations, with pressure waves propagating either upstream or downstream.

Combined with the traditional capabilities of other IDEAS products, which can simulate typical pressure and flow phenomena in tanks, pumps, pipes, and valves, users have the ability to model a pipeline with complete



functionality. The advantage is that users can model and explore different scenarios, such as how different pressure control configurations reduce the occurrence of transient pressure waves.

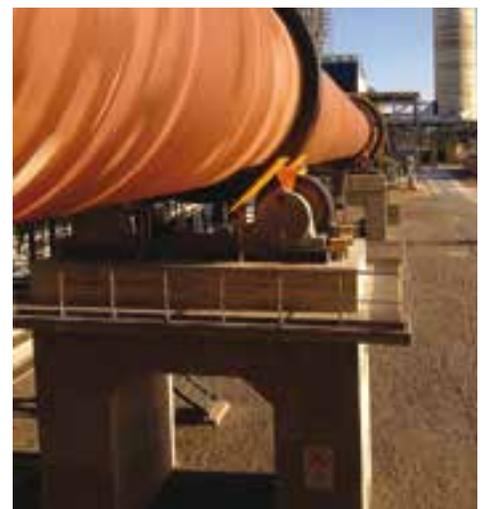
Essentially, IDEAS acts as a superior tool for “what-if?” analysis of production and optimization. Steady-state models can link to operating costs, complex production logic, discrete simulation of discontinuous events, and to spreadsheets for dynamic exchange of data. In addition, as the complexity of the project advances, steady-state models created in IDEAS can be easily converted to a dynamic environment to include detailed

dynamic specifications and process control logic.

Customers in the pipeline industry have used IDEAS to certify the performance of new or existing control valves, thereby ensuring responsive and robust line pressure control and reducing line shutdowns. IDEAS also enables the correct sizing of new control valves and actuator installations. The hydraulic transient capabilities in IDEAS allow evaluation of safe control valve stroking speeds and start-up procedures when operating close to maximum allowable operating pressure.

Benefits

- Create live process flow sheets
- Quickly determine flows and temperatures
- Help verify the selection of process equipment
- Make economical design decisions



Typical project results: transient simulation

Because pipelines run over great distances and variable terrain, they have always presented significant operational challenges. The risk of spills leading to loss of product, environmental damage, and human injury means that your operators require in-depth understanding of this critical part of your plant.

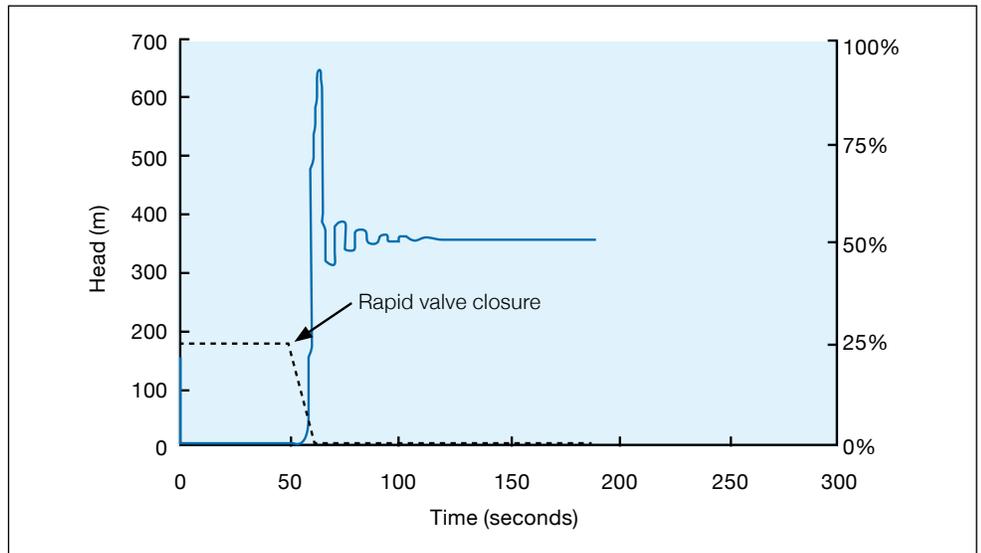
That's why ANDRITZ AUTOMATION developed IDEAS transient pipeline. This simulation tool solves transient equations and is able to predict the pressure and flow throughout a pipeline to provide real-time responses to operational changes such as choke valve opening or water batching. Slurry properties, such as viscosity and frictional resistance, are also incorporated in the model.

Transient pipeline simulation

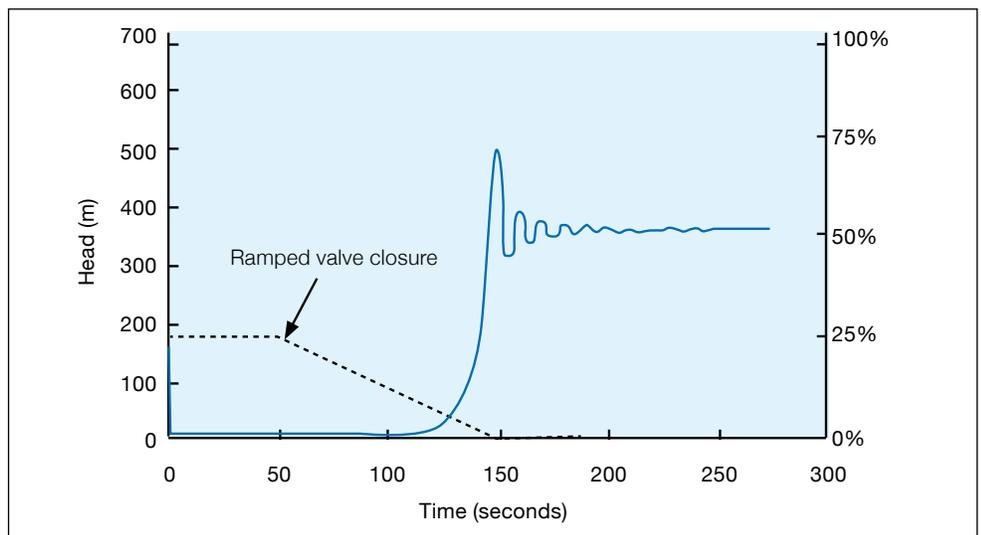
The pipe object within IDEAS solves the transient form of the Navier-Stokes equations using the 'method of characteristics.' Each transient pipe object is discretized into zones such that the volumetric flow rate (Q) and head (H) are calculated in each zone. Therefore, there is a variation in pressure, flow, and properties of the fluid throughout the pipe. The number of zones is set so that the length of each zone satisfies the stability criterion of the transient equations. In each zone, the pipe performs mass and energy balance calculations, as well as property estimation to determine properties such as density and viscosity. The friction factor is calculated using the Colebrook equation.

Water hammer phenomenon

The figures illustrate an example of a downhill pipeline that is 4 in. diameter, 2.5 km long on 1.5° incline, and is transporting slurry with a specific gravity of 1.4. In Diagram 1, the pres-



▲ Diagram 1: Pressure response to valve closure of downhill pipeline



▲ Diagram 2: Pressure response to ramped valve closure of downhill pipeline

sure response (at the end of the pipeline) to valve closure is shown. When the downhill valve is closed, there is an increase in the pressure at the valve. This pressure increase causes a pressure wave that travels back and forth between the ends of the pipe until dissipating due to friction losses. This surge in pressure can rupture the pipeline if it exceeds the maximum allowable operating pressure of the pipeline. In Diagram 2, the same pipeline

experiences a different pressure response due to a ramped closure of the valve. In this case, valve closure is ramped down over 100 s and the resulting pressure surge is lower (500 m head versus 650 m head) and the response is also delayed. Thus, the use of transient pipeline simulation illustrates how the operator can reduce the risk of high pressure rupture by operating the same control valve differently.

The challenge: To verify that your complicated control scheme will run your plant correctly

The solution: IDEAS dynamic simulation

IDEAS is an effective tool for control logic verification, helping to stage and test control systems quickly and accurately, reducing the steep curve to start-up.

Implementation of control logic is a difficult task, since the performance of the plant is not only dependent upon the electrical and mechanical components, but also on the control logic and the design concept used to control those components.

That's where IDEAS enters the picture. If the control logic cannot start a simulation, it will not be able to start the actual equipment. By using IDEAS for control logic verification, you will reduce costly design errors that could otherwise delay start-up.

Studies have shown that using simulation to help with start-up can correct up to 82% of control logic problems before field implementation. The cost savings are enormous. Control logic verification translates into immediate savings through a smoother start-up and can easily realize a 200% or more return on investment.



IDEAS communicates with all major PLC or DCS equipment. Using our OPC server, OPC client, or one of our custom communication drivers, IDEAS makes the task of control system logic verification more manageable and consistent. In addition, new control logic can be tested and verified on the IDEAS simulator while the actual plant continues to run without interruption.

The biggest benefit of using IDEAS for your control logic verification is that our team works with you every step of the way. Our experts travel directly to your plant site, anywhere in the world, and work directly with the

equipment vendors, control company, and plant personnel during commissioning.



Benefits

- Detect and correct up to 82% of control logic errors before field implementation
- Achieve quicker and smoother start-up, resulting in 200% return on investment

	DCS loop back	IDEAS model
I/O and loop test	✓	✓
Process-wide logic test	x	✓
Tuning constants known before start-up	x	✓
Realistic process models	x	✓✓
Remove control logic errors	x	✓✓
Remove process intent errors	x	✓✓
Verify advanced control logic	x	✓

Success story

Customer: Enbridge Pipelines

Simulation objective:

- Simulation for pipeline control and engineering

Enbridge Pipelines, one of North America's largest batch transporters of liquid petroleum products, has come to rely on IDEAS technology to help select and engineer its entire control valve system.

Pressure control valves comprise 90% of the final control elements in Enbridge's 15,000 km liquid petroleum pipeline network in North America.

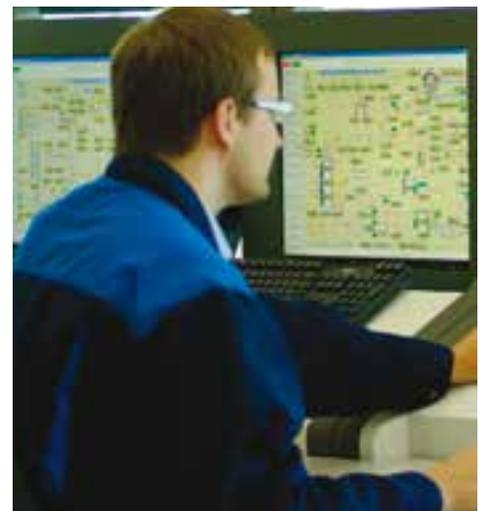
Enbridge, along with R.W. Shirt Consulting, have developed a unique technology for evaluating control valve performance in the pipeline system. "IDEAS' flexible interface and embedded ISA control valve standards provide the ideal engineering tool for our work," says Roger Shirt, Ph.D. "IDEAS has helped Enbridge achieve significant equipment cost savings, increase line stability, and reduce energy pumping expenses."



A challenge on the line involved the replacement of a 25-year-old control valve installation that Enbridge operators had found extremely unresponsive. An IDEAS simulation model of the pipeline showed the existing control valve installation to be greatly oversized for the current service conditions. Several candidate replacement valves were evaluated from competitive vendor bids, including alternatives for adjacent piping geometry.

This process enabled selection of the most effective solution—excellent pressure control loop performance with low pressure drop across the installation.

"Annual savings of 20,000 USD in pumping energy costs over alternative solutions were realized," Shirt says.



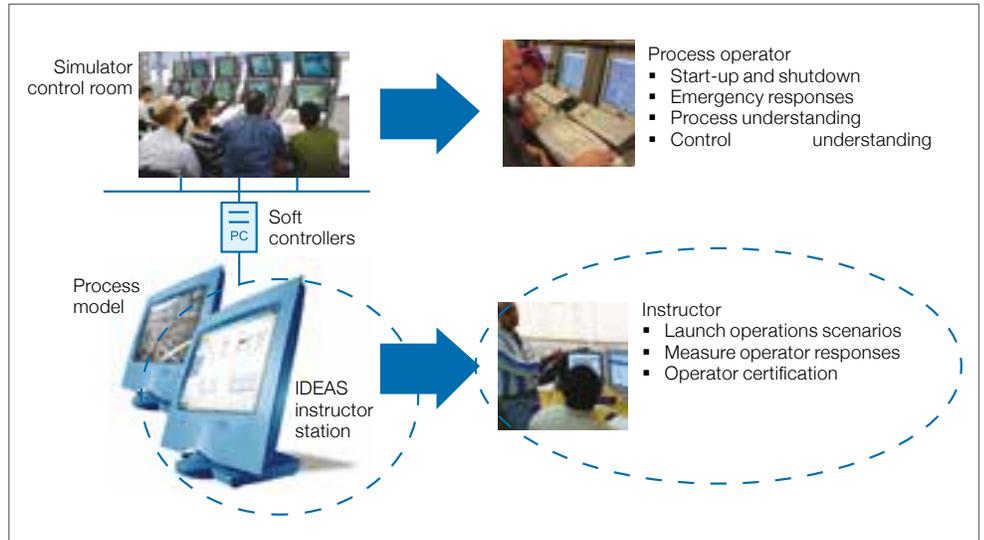
The challenge: To train your operators on a process—and meet your start-up schedule

The solution: IDEAS instructor

IDEAS is an essential tool for operator training; it works like a flight simulator, allowing trainees to gain realistic, hands-on experience without inflicting harm to themselves, the environment, or the plant.

The IDEAS instructor module can help train operators months before the actual plant is up and running. It helps produce better trained operators—operators who will start up new processes faster, react more wisely to plant upsets, and be more productive.

IDEAS instructor contains preconfigured scenarios that teach, train, and challenge trainees on process upsets, including two of the most intensive and complex procedures—start-up and shutdown. We can all imagine this scenario: a relatively new operator is on shift when suddenly a tailings line starts to sand-out. In most cases, such a scenario would have significant safety, environmental, or production consequences—but your new operator, who has practiced start-up and shutdown on the IDEAS simulator, immediately makes the cor-



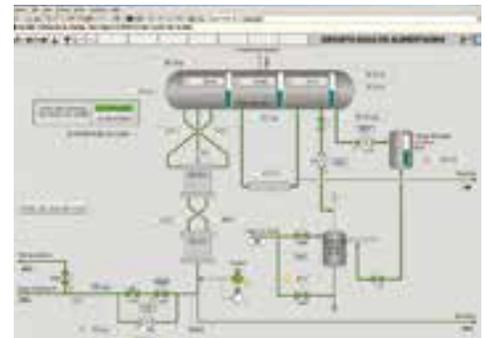
▲ Where IDEAS instructor fits into an operator training system

rect decisions and your operation continues without incident.

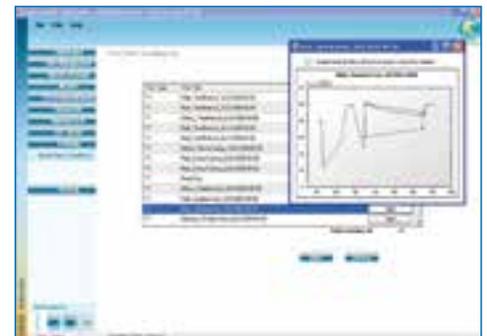
Operator interface

The simulator allows the actual plant configuration to be loaded into the training system, so that operators will be trained using the same interface (including the same logic, keyboard, and graphics) as the actual plant. The simulator enhances the learning process by actively involving the operators and providing immediate feedback without risk to production.

The view from the simulator is identical to the actual DCS screen. ▼



A screen shot from IDEAS instructor demonstrates the easy-to-use interface. ▼



Instructor interface

IDEAS instructor software enables you to track individual employee performance, including login and fault scenario management. The operators' performance in executing start-up, shutdown and normal operating procedures is assessed by tracking selected process variables (for example, temperature, pressure, and flow).

Benefits

- Teach plant operators safely and reliably
- Have personnel practice intensive and complex procedures
- Monitor trainee progress and assess performance
- Standardize and create consistent training

Success story

Customer: Antofagasta PLC

Training objective:

- Train operators in critical process scenarios including pipeline leaking, pipeline plugging, and equipment failure

After experiencing an operational incident at its Los Pelambres mine in Chile, Antofagasta contracted ANDRITZ AUTOMATION to design and build a training system for their concentrate and tailings pipeline operators.

The pipelines needed to be simulated in enough detail for rigorous operator training. The model was built using IDEAS transient pipeline and was verified and tuned using the expertise of a third party, PSI, who actually designed the pipeline. The steady-state and transient results realized by the IDEAS model were verified first against PSI design tools and then against actual plant data.

As a result, ANDRITZ AUTOMATION was able to deliver a one-of-a-kind transient simulation tool that can quickly manage changes in concentration and emulate mineral pulp



batches. The IDEAS model can also be easily converted to a fully dynamic simulation tool.

Some typical scenarios programmed into the training package included pipeline leaking, pipeline plugging, and equipment failure.

In order to deliver the product, ANDRITZ AUTOMATION built a state-of-the-art operations support center in Santiago, where Los Pelambres operators could attend an entire training program.

This operations support center consisted of:

- IDEAS models of the pipeline and other remaining equipment
- “Soft” version of the mine’s Emerson control system (DeltaV) connected to IDEAS via OPC
- “Soft” version of the Emerson operator stations
- IDEAS instructor software for managing and delivering the training

- Third-party technical school instructors delivering the actual training to each operator

The results were very good for the first batch of operators that was trained; not only did the models comply with the PSI verification, but the operators gained valuable experience on a system that accurately represented the “look and feel” of the mine’s actual pipelines.

Due to natural instrument noise, the leak detectors installed in the piping system had difficulties in finding small leaks. Nevertheless, the trained operators are now able to react more quickly, with confidence and accuracy.



The challenge: To realize the best net present value on your capital project

The solution: IDEAS simulation

IDEAS is the leading simulator for the mining, oil sands, and pulp and paper industries and is becoming the standard for pipeline projects.

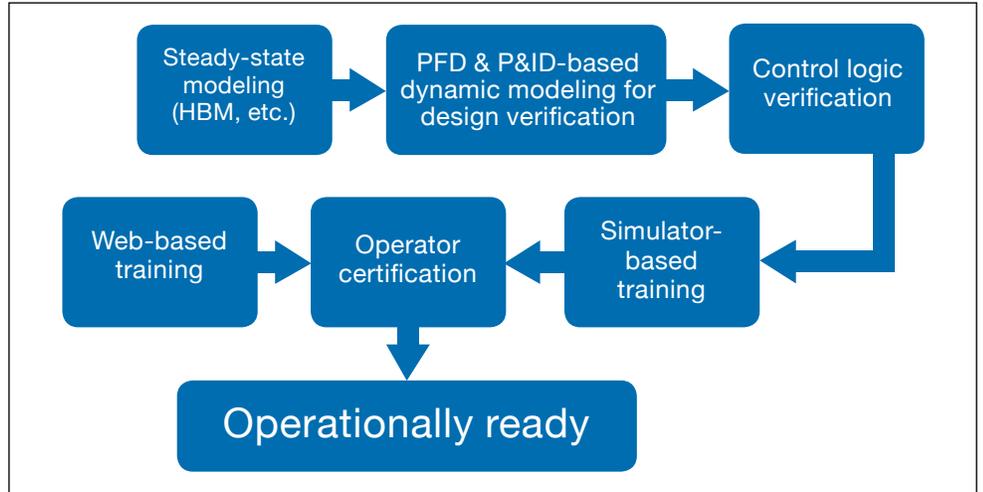
IDEAS has been used to help mining operations in North and South America achieve start-ups that are faster, smoother, safer—and more economical. By using IDEAS, mining operations have realized significant savings.

Simulation experts

We can model any vendor equipment and are able to communicate with every DCS supplier, so your operators train on the same graphics and logic that they will use in the actual plant.

Realistic process models

IDEAS has realistic models to accurately represent your process, based on first principles of chemistry and physics. IDEAS allows you to model your plant or process at a micro or macro level of fidelity, depending on your need.



▲ How simulation makes your pipeline project operationally ready

Smooth start-up

IDEAS catches hundreds of errors in control logic before start-up, which means your plant achieves products on—or ahead of—schedule.

On-site implementation

Our personnel include experienced mining project managers who understand your industry. We travel directly to your site to work with vendors and control suppliers during commissioning.

Risk-free training

The IDEAS instructor module allows staging and operator training to take place in complete safety, without risk to your employees or the environment.

The data agrees. At one South American plant, operators used the IDEAS simulator to practice start-up, shutdown, and emergency sequences in the months prior to start-up. This allowed the operators to be better prepared when it came to the operation of the actual plant. A standardized test with approximately 300 random questions was de-

veloped to test operator competency. The test questions were given in three intervals, once before any training, once after class training, then once again after IDEAS training. The results clearly showed that the IDEAS training made a remarkable improvement in operator competency.

Student competency	
Before any training	20.3%
After classroom training	26.7%
After IDEAS training	85.0%

Ongoing benefits

Since IDEAS is modular and scalable in design, many plants continue to use the simulator past start-up for a variety of applications, including process design and training of new operators.

Return on investment

The IDEAS simulator acts as a virtual plant that will help pinpoint plant production improvements and shorten projected start-up dates. In many cases, the IDEAS return on investment has been over 200%.

Success story

Customer: BHP Billiton

Simulation objective:

- Process modeling

BHP Billiton is the world's largest diversified resources company, with over 128,800 employees and contractors working at 141 locations in 26 countries. As such, when it came to picking a simulation standard, BHP Billiton wanted the best solution available. That is why the company chose IDEAS as its standard for process modeling for its stainless steel material group.



The decision was made after a rigorous competitive selection process lasting nine months, and in the end BHP Billiton decided that IDEAS presented the best long-term benefit.

The IDEAS simulation package possesses a number of novel advantages over its com-

petitors, coupled with excellent customer service and development teams.

Process simulation is an important aspect of process engineering, which helps BHP Billiton develop process technology, improve operational performance, and advance their world class projects.

Not only did BHP Billiton view IDEAS as the right tool to accomplish these objectives, but they know that ANDRITZ AUTOMATION possesses the depth of resources to respond to current and future simulation requirements.



Automation solutions

Release your full potential



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