cpmPlus Expert Optimizer
Advanced optimization for your industry

Power and productivity
for a better world™

ABB

Improve production, energy efficiency and profitability

Advanced process optimization
Modern industry works hard to achieve efficient production. With ABB's cpm Plus Expert Optimizer users can implement advanced process optimization to improve productivity, energy efficiency and profitability by stabilizing and optimizing the process. cpmPlus Expert Optimizer effectively manages process complexity to help achieve the best possible performance.

When do you need cpmPlus Expert Optimizer?
Most control systems offer the possibility to implement PID loop controllers. These controllers can regulate one variable by manipulating one actuator, for example valve opening regulates one flow rate. But what do you do if moving one actuator influences several process variables so that you have conflicting objectives? For example, what if increasing the air flow has a positive influence on the flame oxygen, but a negative one on the temperatures of your preheater tower? What if increasing the rate of a chemical additive improves quality but decreases production? Or if opening one valve reduces pressure on one pressure header but increases it in another? In these cases you need to coordinate the

moves of your manipulated variables and find trade offs in a systematic manner. You would be using multivariable control and this is where cpmPlus Expert Optimizer will provide you with the most benefits.

cpmPlus Expert Optimizer extends the capabilities of your control system by coordinating actions on the process, such as rotational speed, fuels, valves or chemical additives. It maximizes efficiency by looking at the interactions among variables and deciding according to the plant goals. It collects real-time data, processes it with mathematical algorithms, and coordinates the plant actuators for optimal performance.

cpmPlus Expert Optimizer provides the following features
– Advanced process optimization techniques, such as model predictive control, fuzzy logic and neural networks
– Flexibility to handle the process requirements of different industries with different business objectives
– User friendly modeling environment which shields the mathematical complexity from the process engineer, allowing its use by non mathematicians
– A modular, reusable and scalable design to reduce deployment time

Making the intelligent manufacturing choice
cpmPlus Expert Optimizer achieves continuous process optimization, improving overall performance, stability, profitability and sustainability. These real-time tools and algorithms can be deployed to implement optimization solutions to processes such as:

– water, energy or steam supply systems.
– combustion and chemical processes like boilers, calciners and kilns.
– crushing and grinding processes.
– chemical processes such as flotation circuits or distillation columns.
– plant scheduling problems like optimal automatic charge and discharge of batch reactors.

cpmPlus Expert Optimizer is a core component of ABB's cpmPlus platform. Process engineers that use cpmPlus Expert Optimizer have successfully achieved more than 4 million hours run time in closed loop control. With over 400 installations worldwide, providing savings in excess of $100 million for our customers, cpmPlus Expert Optimizer implements the most advanced algorithms available for process optimization using easy to use graphical design tools.
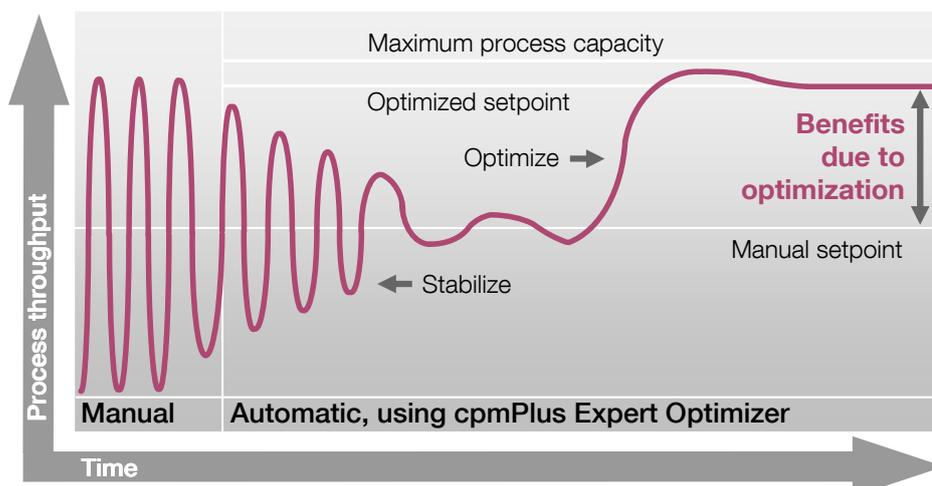
A comprehensive approach to a challenging problem

cpmPlus Expert Optimizer consists of variable gain, multivariable Fuzzy Logic operators, Neural Network blocks and Model Predictive Control engines in linear and nonlinear fashions.

Fuzzy logic & neural networks
Fuzzy logic incorporates human knowledge to make and implement effective decisions in a process, while neuro-fuzzy networks are used to learn relationships between key process variables.

Model Predictive Control (MPC)
One of the leading technologies in cpmPlus Expert Optimizer applications is Model Predictive Control (MPC). MPC is based on the predictive capabilities of a mathematical model, where an optimization procedure selects a sequence of future control actions. These sequences of moves are applied to the process and when new information becomes available, a new sequence is determined. Each sequence is computed by means of an optimization procedure, which follows two goals:
– Optimize the performance
– Protect the system from constraint violations

For processes featuring strong interaction among different sections, MPC offers substantial performance improvements compared with traditional single-input single-output control strategies.

MPC plus Mixed Logic Dynamics (MLD)
cpmPlus Expert Optimizer allows the user to formulate linear and nonlinear process models. It also allows models that contain Boolean variables as needed for plant scheduling applications. Finally, cost functions are designed with the same tools available for modeling. The ability to mix logical and dynamic inputs provides unbeatable freedom for customization of the application to the customer needs.

Build the model graphically
The modeling technology used in cpmPlus Expert Optimizer enables development of mathematical models that include batch, continuous and hybrid processes. Typical examples would include oil & gas facilities, cement grinding plants, food and beverage facilities, pulp and paper mills, and industrial power plants where decisions are to be made on how much power and steam must be produced or purchased at any given moment of time.

cpmPlus Expert Optimizer greatly simplifies the creation of complex control strategies: it reduces overall complexity by breaking the overall process into smaller easier to manage components. For example, a hydro-electric power plant is split into the reservoir, dam, turbine, generator and grid. Each part is modeled independently of the others.

The complete process model is then obtained by graphically connecting the sections. The modularity of the approach simplifies the modeling phase and makes it easier to engineer, modify and maintain the models. Furthermore, it allows the creation of libraries containing standard blocks that can be reused in different processes simply by dragging and dropping them.

Benefits
Combining the complementary techniques allows the engineering of powerful robust solutions, which provide substantial financial benefits to the factory over time.

Depending on the customer's challenges cpmPlus Expert Optimizer combines technologies to provide:
– online process optimization.
– decision support in real-time.
– visualization of capacity limitations of process sections.
– soft sensor functionality to infer non-measured values.
– bottleneck analysis.
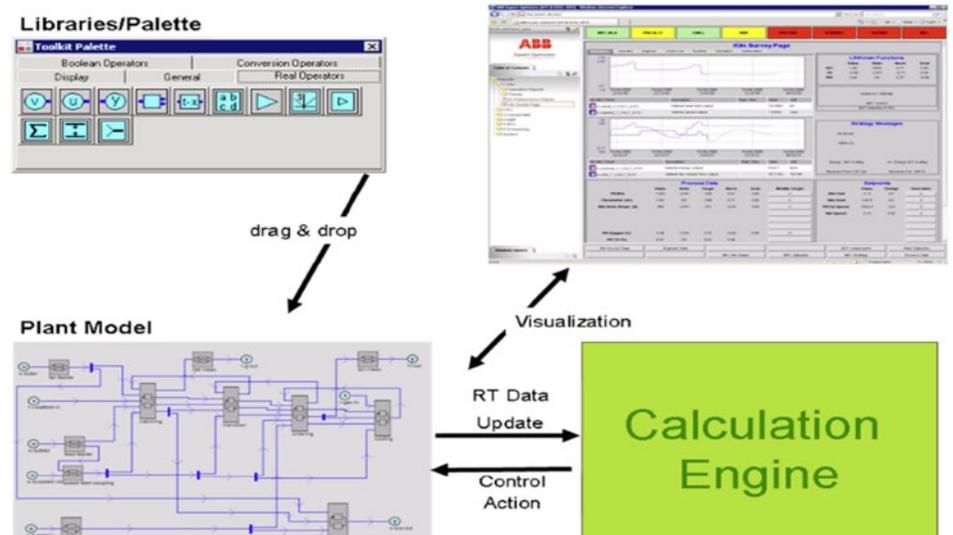
Applications for every industry

cpmPlus Expert Optimizer's model-based and advanced process optimization capabilities have been installed and are running successfully in many different domains. The most significant examples are in:
– closed-loop process optimization in flotation, grinding circuits, blending, calcination and clinkerization.
– environmental protection, for example alternative fuels combustion management.
– industrial steam and power plant optimization.
– pulp and paper production.
– production planning and scheduling, for grinding plants, titanium dioxide production and water distribution.

Optimizing the processes in the cement and minerals industries
Advanced process optimization is the work horse of the cement and minerals industry. Applications such as
– kiln optimization
– alternative fuel management
– grinding circuit optimization
– blending of raw materials
– flotation circuit optimization
are state-of-the-art solutions. ABB's cpmPlus Expert Optimizer is the only advanced optimization solution that offers all of these applications using MPC.

Benefits
– Increased production
– Improved energy efficiency
– Reduced emissions

Achieving increased industrial steam and power plant performance
The main goal of the industrial power plant is to serve steam at varying levels of pressure, temperature and quantity to processes such as paper mills, oil refineries, metal refineries, etc. Due to the intrinsic uncertainty of the steam demand and energy supply, these plants have high variability and pose higher requirements on their control schemes.

Here MPC offers superior performance over traditional single-input/single-output control strategies by utilizing dynamic process models to account for the strong coupling among process variables. The algorithms provide smooth transitions by opening pressure reduction valves, closing vent valves, or tightly controlling the steam balance among low pressure and high pressure boilers. For instance, in case of large disturbances, the controller will sacrifice steam parameters for the sake of avoiding boiler trips, while introducing optimal correcting actions in a coordinated way across the network of boilers, pressure header, steam accumulators and steam turbines.

Benefits
– Provide increased, stable and reliable steam and power supply
– Reduce operating costs
– Minimize disturbances to the steam users

Increased productivity in pulp & paper plants

Pulp and paper plants are ideal environments for process improvements for nonlinear MPC in cpmPlus Expert Optimizer. The process used in these plants is challenging in that the right mix of chemical additives must be applied at the right time and under the right conditions in order to meet stringent quality requirements.

Using the nonlinear models and real-time data from the plant floor, as well as taking into consideration events such as the maintenance of key equipment, cpmPlus Expert Optimizer provides predictions of all key process variables, often for several days into the future. These models are tailored to predict process variables that cannot be measured directly.

In many cases, optimal scheduling necessitates a variety of models to describe the process; for example, the sodium and sulfur chemistry as well as the fiber balance. Very often, more detailed models for fiber lines are developed to describe other quality specifications such as kappa number and brightness.

Benefits
– Increases energy efficiency at consistent product quality
– In case of disturbances, automatically reschedules operations for maximum throughput under the new conditions
– Saves energy costs by permitting individual sub-systems to be throttled during peak energy price times

Achieve consistent, reliable & safe lime mud kiln operations

Controlling a lime mud kiln is a challenging task. The process has long time delays and large perturbations acting on it. Only a perfect mix of experience, process knowledge, mathematical techniques and state-of-the-art software can achieve optimal behavior over long periods of time. The control strategy deployed in cpmPlus Expert Optimizer stabilizes and optimizes this complex chemical process by combining modern control technology with deep process knowledge and experience.

Benefits
– Consistent control of the process, eliminating shift-to-shift variations
– Enhancement of kiln-specific knowledge
– Control strategy focused on business objectives
– Lower plant maintenance costs through improved run times

Achieving improved production and stability in complex oil and gas applications

In the oil and gas industries, where small productivity improvements have strong effects on the bottom line, advanced process optimization applications have tremendous value. ABB has a long track record of successful applications in this industry, implementing solutions in LPG, butane, polymers, styrene, ammonia stripping and many other distillation units.

In addition to numerous process optimization projects both upstream and downstream, ABB has also delivered successful projects in integrated gasification combined cycle plants with production improvement of up to 25%. Here ABB has successfully delivered not only in the process master controller but also in partial processes such as acid gas removal and solvent regeneration.

Benefits
– Optimal trade-off between feed rate, preheater temperature and riser temperature in fluid catalytic cracking units
– Better process stability due to tight control according to consideration of interaction among variables
– Higher throughput due to systematic handling of capacity constraints

Economic Process Optimization

Reduce costs, optimize investment

Continuous operating performance and improved profitability are major concerns in industry today. Implementation of advanced process optimization systems like cpmPlus Expert Optimizer can reduce costs and optimize investment by processing the information available and suggesting decisions. Production efficiency is reached via integration of process, production, market and quality information into one decision support tool that processes this data in optimization algorithms to suggest or directly implement optimal decisions. Examples could be, which fuel to burn, or which product to produce, or when to schedule maintenance on a particular day or week?

Plant management support tool

cpmPlus Expert Optimizer is ideally suited to provide the following functions:
– Immediate detection and remedial action to changes in process or energy market conditions, for example by reassigning production to different equipment in case of a failure
– Consistent economic process optimization, for instance, by providing optimal plant scheduling according to real time data on the energy supply conditions and the production plan of the plant. A typical example would be to assign production to periods of lower energy costs, and make sure the plant is prepared to produce optimally during those periods

Application example

Most benefits are achieved in a continuous process plant where production schedules should be coordinated with the availability and properties of raw materials and products, changing market conditions or boundary conditions specified in contracts with the energy suppliers. cpmPlus Expert Optimizer computes which equipment should produce which product type and at which time, in order to minimize energy costs and off specification product.

In one scenario, an industrial steam and power plant is prepared to produce maximum power during market price spikes, and lowest possible power when purchased energy is cheaper than the customer's own produced power. The system is also able to enforce priorities on the steam consumers, and to minimize the effect on the network of rapid changes in the steam consumption. cpmPlus Expert Optimizer drives the plant optimally between these transients resulting in the following benefits:
– Higher profitability
– Lower energy costs
– Throughput as dictated by the market

Market responsiveness

Bringing a combination of supply chain, market conditions and plant constraints into the actual process optimization brings extended benefit by immediately reacting to these constraints. This means your production can react proactively to market demand.

For example, in a cement plant with a product portfolio of several cement types, changing product demands and limited storage capacity it is difficult to decide when to produce one cement type or another. The result might be that product changes are made too often with a detrimental effect on quality, throughput and energy consumption.

cpmPlus Expert Optimizer uses real-time data on the expected product demand, the electrical power price and availability, plant storage capability, and mills availability to calculate online when the product change should actually happen so that product demand is satisfied, while minimizing the number of product switches and the energy cost.

Benefits
– Lower energy consumption
– Lower energy costs
– Less off specification material
– More production

Achieving business goals through advanced optimization

Accurate and consistent
Optimization goals are achieved through technologies that enable the knowledge of the best process expert to be applied accurately, and consistently. Expected benefits are often exceeded as a result of the additional process expertise from ABB application engineers and because of the interaction between these engineers and the client's specialists.

Benefits
– Increased production up to 10%
– Less energy consumption up to 7%
– Improve product quality up to 20%
– Reduced operating costs up to 5%
– Reduced process variability up to 50%
– Improved operational consistency

Fast implementation
The cpmPlus Expert Optimizer toolkit provides a comprehensive variety of advanced control techniques for appropriate strategy development. Coupled to the graphical engineering environment, this ensures fast development and implementation and simplified long term maintenance of a system. The cpmPlus Expert Optimizer toolkit is used to build and display the control strategy required to achieve process and business objectives.

Tap the vast experience of ABB's process engineers
In addition to their own process knowledge, customers can tap the vast experience of ABB's process engineers to develop the strategy best suited to optimize their dynamic process. ABB offers comprehensive training and application support for cpmPlus Expert Optimizer end users.

Customer care – ABB is never far away
ABB's technology and application experts work side-by-side with your plant personnel to develop solutions that are directly linked to business objectives and the critical capabilities required to support them.

Performance Services
The Performance Services team provides a range of value-enhancing services including process optimization consultancy, upgrading CPM systems, on-site workshops, site audits and more. All dedicated to accelerating your return on investment by reducing cost and increasing asset effectiveness.

Service agreements
An ABB service contract agreement is tailored to compliment your in-house expertise and provide the additional capabilities needed to maintain site asset performance at the required level.

SupportLine
At any time of the day, throughout the year, SupportLine lets you reach centrally located system specialists and development engineers from ABB, for technical assistance. Included is free access to the case tracking tool allowing you to follow the resolution progress.

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