Real-Time Production Intelligence

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The boardrooms of companies around the world are abuzz with terms like 'productivity improvement' and 'cost reduction'. Targets vary, of course, and a goal like doubling your productivity factor might seem a tall order, but strategies for achieving just that *do* exist. More often than not, though, they require significant changes in organizational behavior.

Many methodologies, including TPM (Total Productive Maintenance) and Six Sigma, aim at productivity improvement. These methodologies all rely on a strategy of continuous measurement of the actual situation, analysis of the information, and then action based on it. Real-Time Production Intelligence (Real-TPI) – a dedicated software solution for the measurement and analysis of equipment effectiveness – is ABB's Industrial[IT] solution in support of these processes.

Many manufacturing companies still collect production and downtime information manually, using paper log sheets or spreadsheet-based collection systems. Not only is this methodology outdated and labor-intensive, inaccurate recording means that the data are unreliable, too.

What are production managers to do with information that is not only incorrect but also often inconsistent with information from other sources, such as ERP[1] and CMMS[2]? The delays in transcribing and generating reports result in the loss of valuable production time, as action is taken long after the fact.

In today's world, brand loyalty can no longer be relied on to provide a strong

consumer base. Now consumers tend to purchase from the vendor offering the best price or best customer service. To compete successfully in the marketplace, manufacturers have to adapt quickly to fluctuations in demand, availability or the price of raw materials, adopt new maintenance strategies and install new equipment. 'Constant change' best sums up this situation.

What all this means is that plants may waste more than 40% of their production capacity as a result of equipment downtime, slower throughput, quality issues, and a whole host of internal and external influences.

Factory tuning
To successfully tune a factory, a new solution is needed – one that increases throughput, reduces bottlenecks, speeds up lines and reduces waste and break-

Real-TPI supports companies in their efforts to improve factory performance for a higher return on assets (ROA) and on investment (ROI).

[1] Enterprise Resources Planning
[2] Computerized Maintenance Management Systems

KPI and OEE
Key performance indicators (KPIs) are compared with reliable benchmarks to allow quantitative evaluations of potential improvement. Armed with this information, manufacturers can tackle potential problems considerably earlier.

One such KPI is Overall Equipment Effectiveness (see figure on this page). This is an indicator of how machines, production lines and processes perform in terms of availability, production rate and quality. OEE is the best yardstick for understanding current performance and locating areas for potential improvement in a manufacturing environment.
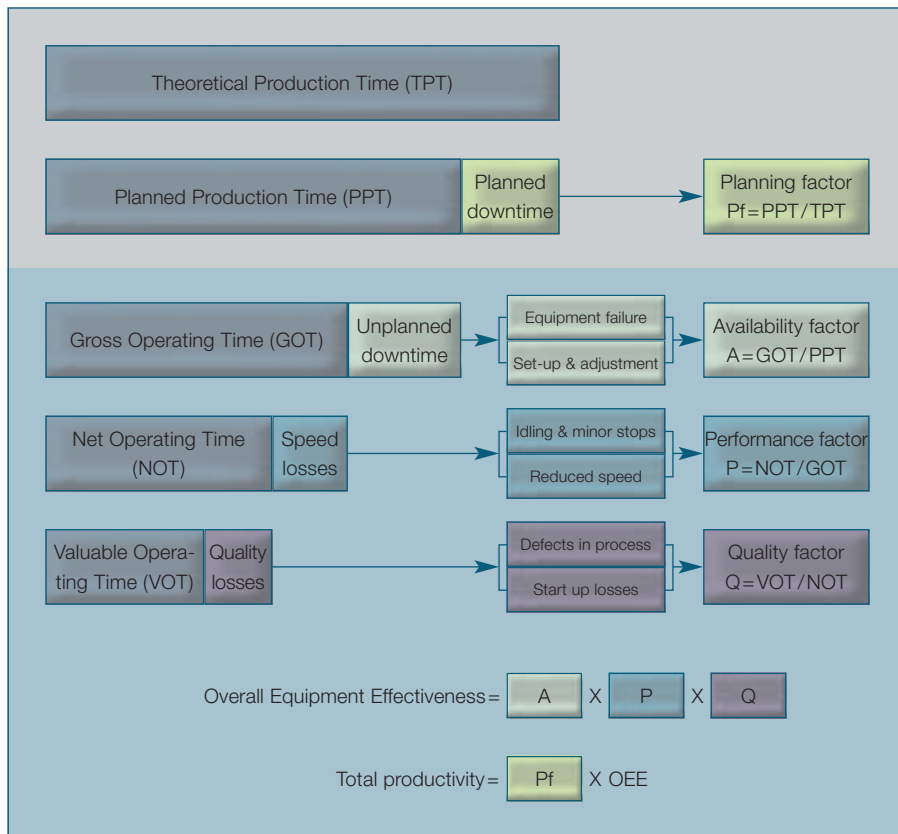
The factors Availability (A), Performance (P) and Quality (Q) provide a single measure of overall performance. This figure shows how well a resource is being utilized, with equipment, labor and the ability to satisfy quality requirements all taken into account.

Production losses are, by definition, unplanned. Planned activities like scheduled maintenance have to be included, and this is done through the planning factor (Pf). Multiplying this factor by the OEE yields the total productivity of a plant or production unit.

downs. Importantly, such a solution must be based on accurate, real-time data. Correct and objective measurement of the actual production efficiencies and losses is absolutely essential for this.

Working closely with several industries, ABB has developed Real Time Production Intelligence (Real-TPI) as the solution to this problem. As its name implies, Real-TPI is a software solution designed especially to measure and analyze equipment effectiveness in real time. Real-TPI supports companies in their efforts to improve factory performance for a higher return on assets (ROA) and on investment (ROI). An increase of 1% OEE can improve profit dramatically, with an increase of several thousand dollars per machine to millions of dollars per plant or production unit[3] possible.

Intuitive presentation and configuration
Everyone involved in manufacturing, from the operators to senior manage-

ment, has a need for specific production and performance information. Typically, an operator will be interested in his machine and work orders for the shift; supervisors will need an overview of the equipment for which they are responsible; and the production manager will wish to compare targets with the actual production figures. Failure frequencies, detailed machine histories and waiting times after breakdowns are invaluable information for maintenance crews and their supervisors. Finally, the plant's managers will want to evaluate KPIs to support strategic decisions for improvement. One such KPI, the OEE, is used in different forms at all levels of the manufacturing organization.

Having the right information is only one improvement factor. An improvement or reliability team, with a mandate to initiate change, is also essential. This team must follow up on performance issues, present findings to all organizational levels and areas (production and maintenance), and propose improvements, whichever methodology an organization has chosen.

Real-TPI gathers run-time information from control systems, and stand-alone equipment. It collects product and order information from higher-level systems
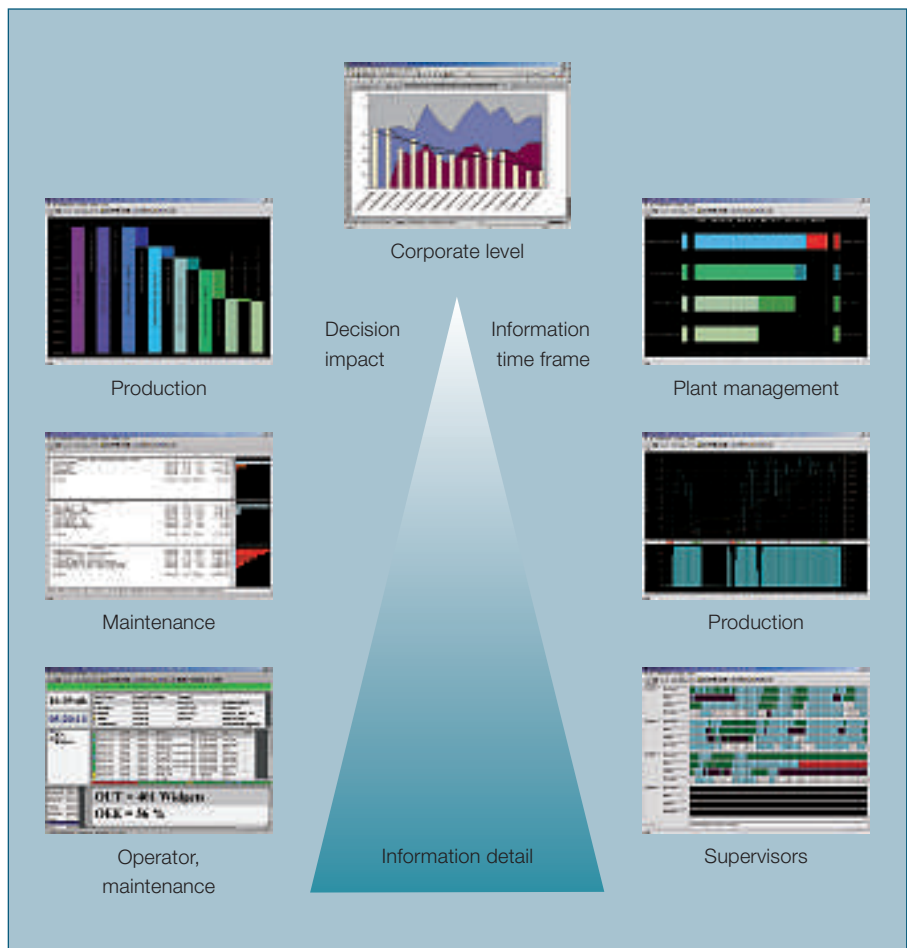
Real-TPI is a dedicated software solution for measurement and analysis of equipment effectiveness, for use at all levels of an organization.
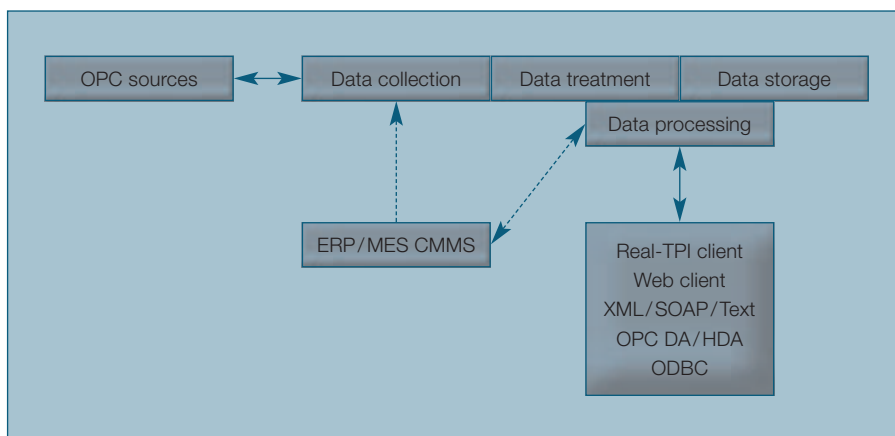
Standard interfaces enables Real-TPI to be easily integrated in new or installed control and information systems.

like Collaborative Production Management (CPM) or ERP. Other information, such as maintenance, operator identification or raw material shortages can be collected by barcode readers, RFID tags or other intelligent sources, stored in a database along with all the other information, and utilized such that Real-TPI can report KPIs and perform a root cause analysis.

Data collection and storage
Today, OPC Data Access (OPC DA) is the main protocol used for real-time data exchange with PLC, DCSs and other platforms. In addition to OPC, Real-TPI supports data collection from a variety of conventional mechanisms, in-

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[3] A McKinsey and Co. study has shown that a 1% improvement in volume results in a 2.8% improvement in profits.

cluding text files, ODBC (Open Data-Base Connectivity) and DDE (Dynamic Data Exchange) connections.

Data can come directly from a control system platform like ABB's 800xA, other vendors' control systems, external database systems or the equipment itself.

Ideally, all information would come from a single source, such as the 800xA, but the reality is that most manufacturing companies have a variety of systems and equipment that may not be completely integrated. Every process, production line or machine is different. Each has its particular data, typically with its own format and definition. The issue of how to manage these multiple formats can be resolved with additional programming, but often changes in proprietary systems can be complex, sometimes impossible. Regulatory compliance or warranty issues may prohibit modifications. With Real-TPI, incoming production data can be normalized to a common format with a scripting language. This allows the handling of different machines and processes in any

Example of a stand-alone, single PC Real-Time Production Intelligence application
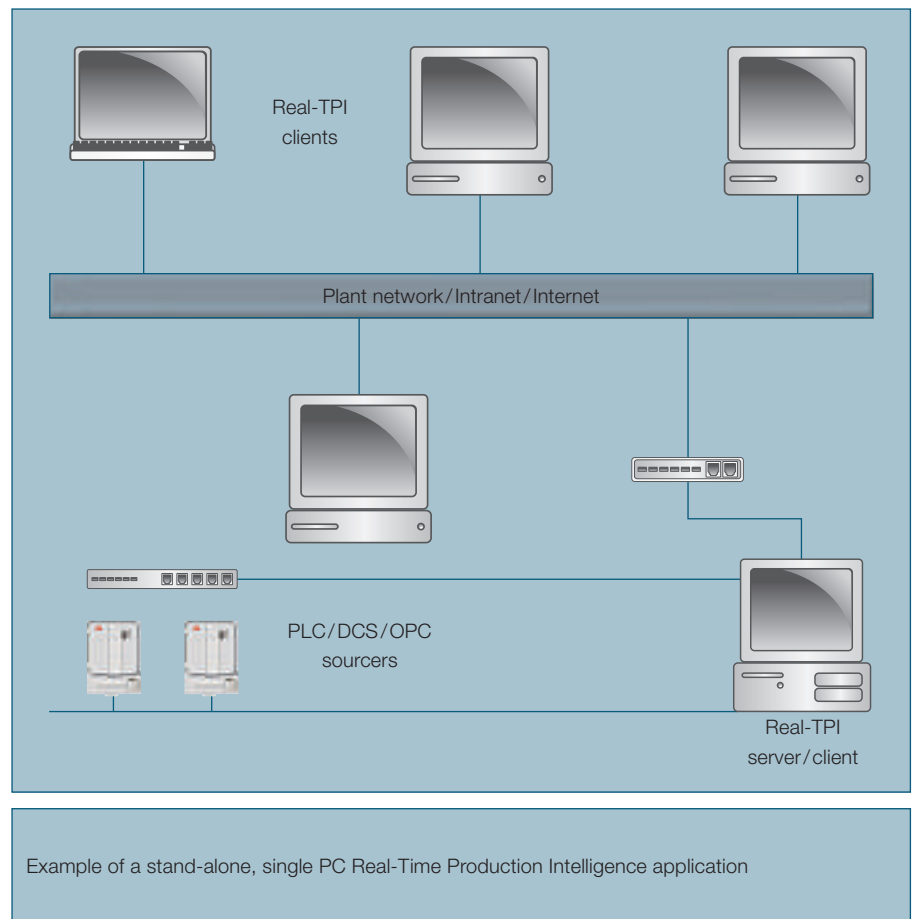
combination of continuous, batch or discrete manufacturing.

In order to accommodate the differences in production machinery or processes, Real-TPI provides a flexible, configurable structure for the storage of information. In addition to production events such as downtime or product changes, Real-TPI is able to store other relevant information such as process values, operator information, production order or batch information, production values and comments. Based on this information, Real-TPI is able to report KPIs and perform root cause analyses.

Analyzing the information
Real-TPI includes a wide variety of standard production efficiency reports, in-

> With Real-TPI, incoming production data can be normalized to a common format for any combination of continuous, batch or discrete manufacturing.

cluding a detailed machine overview, chronogram, customizable equations results, Pareto, OEE graphs, penalties (bottlenecks), production and waterfall diagrams.

Other reports, such as machine state, shift, product, batch or production order, operator, shift and comments list, are also accessible. All data and calculations stored in the database can be accessed through end-user definable export files in the export analysis.
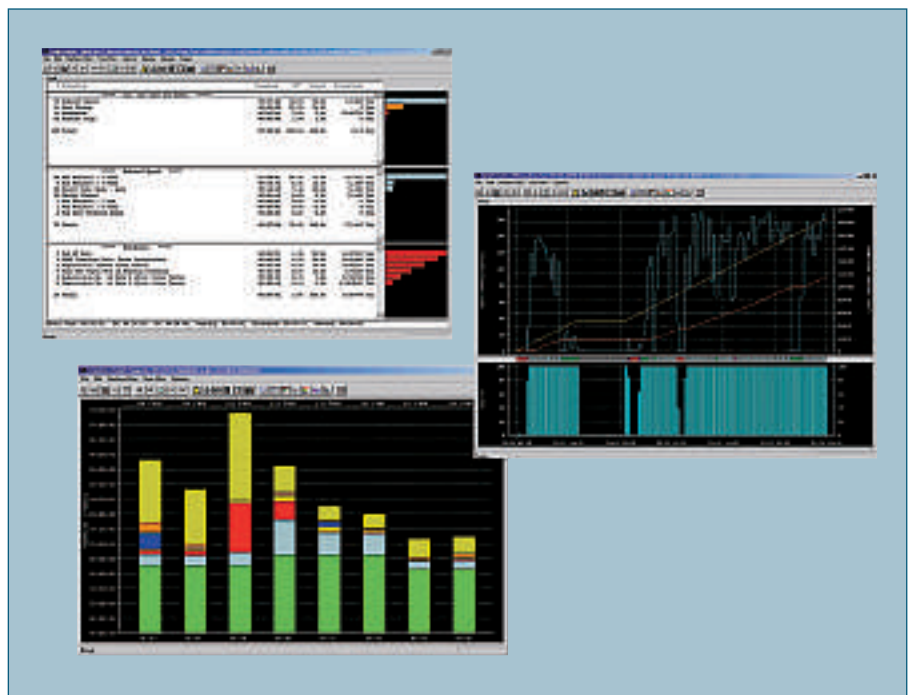
The flexible reporting system allows dynamic selection of parameters such as machinery or time periods. It can provide reports showing up-to-the-minute, real-time information. A uniform set of

icons on the analysis displays provides a simple way for the user to navigate through automatically generated time periods like shifts, production runs, batches, days and weeks, as well as pre-configured machine selections. All of

Real-TPI is already operational in the life sciences, chemical, consumer, manufacturing, process, oil and mining industries.

these fully customizable settings can be saved for later re-use. Since they are accessible in every analysis display, the user can use the same selection in multiple analysis reports. For example, Pareto, OEE and chronogram results can be concurrently displayed for the same machine selection over the same period of time.

Data in Real-TPI can be exported in HTML, as an XML document, or as a text-based report. The Real-TPI web module supports browser accessible graphical reports and an XML/SOAP interface to standard or customized web pages or external systems.

Standard analysis screens from a Real-Time Production Intelligence application: chronogram, production and penalty (cycle time) diagram

Time series data and calculated results can also be shown as OPC Historical Data Access (OPC HDA-tags), making it possible for OPC HDA client software to produce trending reports and correlation analysis.

800xA – Industrial IT platform
ABB's 800xA platform provides a flexible way to combine, structure and exchange information from different sources. The Real-TPI Aspect System is designed to be an Aspect inside the 800xA workplace, which allows easy access to charts and reports, including custom reports, from within the Process Portal environment. This 'Aspect' can also be linked and dedicated to other objects in the functional structure.

Scalability
The Real-TPI solution can be implemented on one machine, a production line or a whole plant. It can be integrated in the 800xA system, act as either an isolated or networked stand-alone
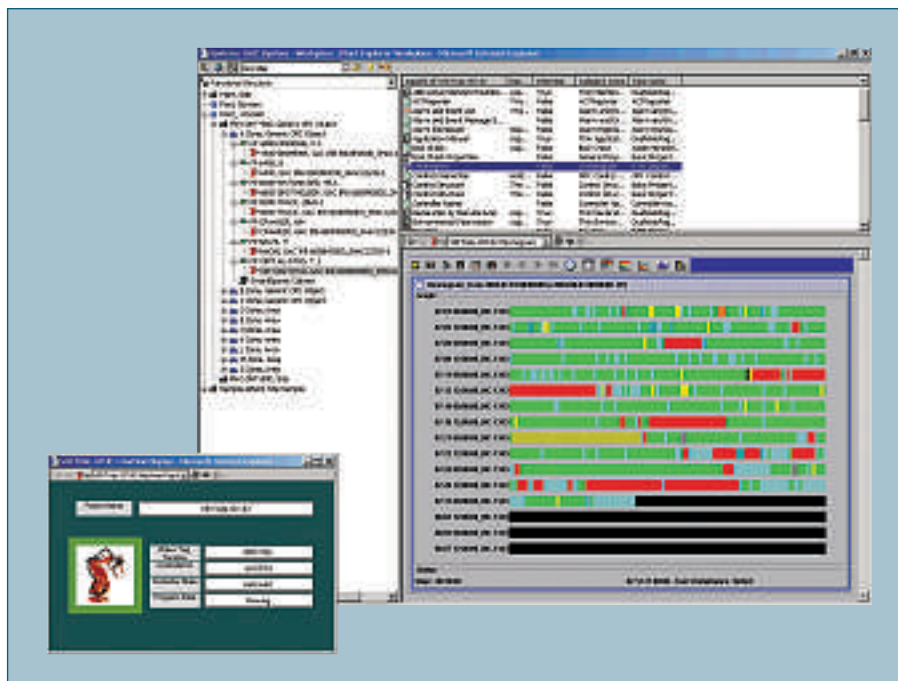
Real-TPI Aspect associated with an asset, here a robot
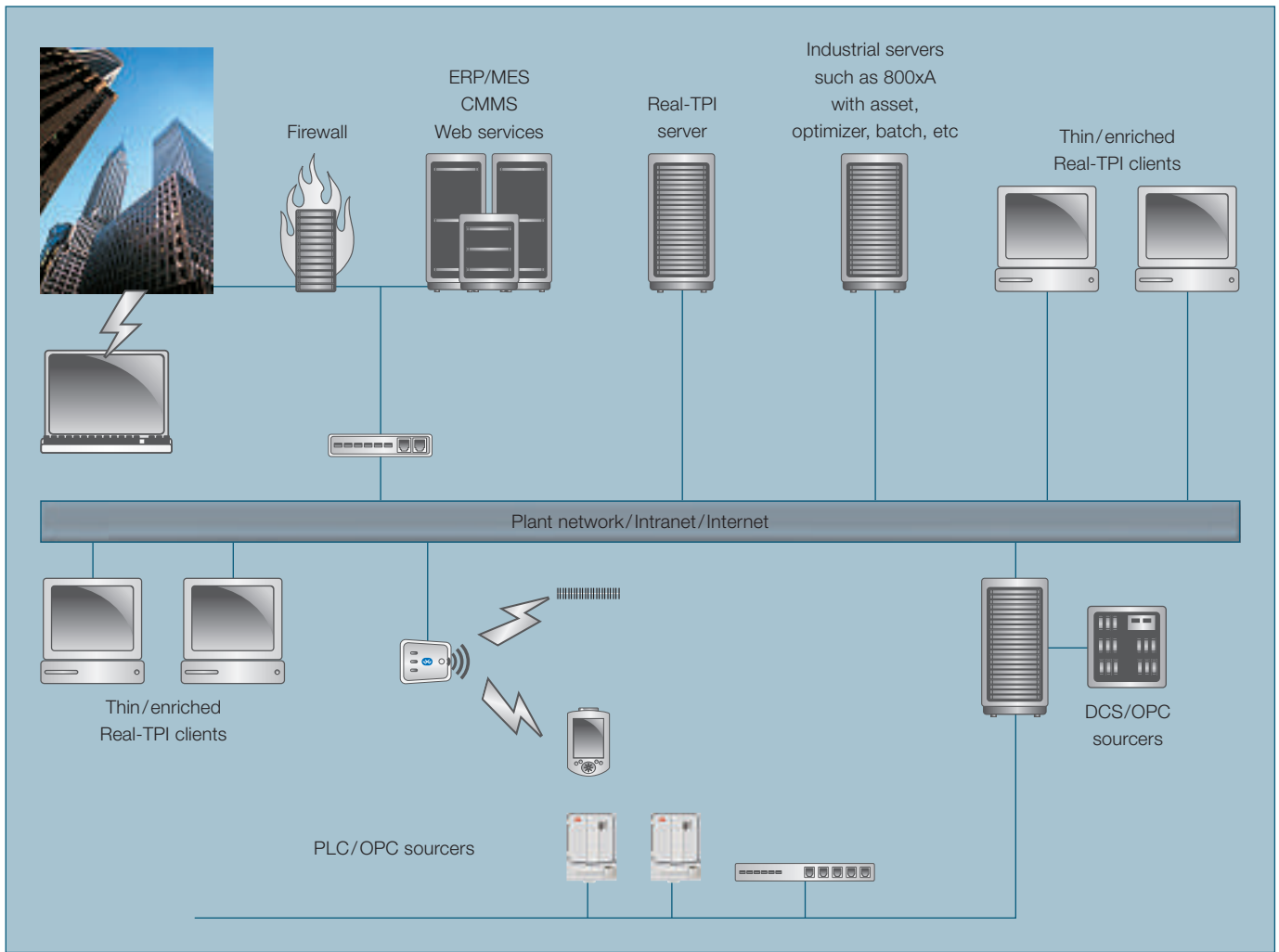
Real-TPI integrated in a large-scale information system, such as 800xA, and combined with business systems at corporate level

application, or be used in a multi-plant environment.

The database of Real-TPI is automatically scaled to match the configuration, and can handle an infinite number of breakdown codes, process data or other events.

A tool for asset optimization

Very often, a company installing a new piece of equipment will experience significant 'growing pains' before the equipment reaches the production output for which it was designed. In some cases, it may never achieve the anticipated output. Acceptance of a new installation can be delayed if the customer's requirements are not met, possibly resulting in

penalties for the supplier and production losses for the customer. Even after acceptance, new machinery is seldom consistently run at full capacity during the first year of operation. Real-TPI is designed to positively influence ROI by facilitating the tuning process and helping service people to eliminate failures in the early stages. It also supplies maintenance departments with critical information regarding equipment behavior, accelerating the transition to preventive maintenance.

Once a machine is installed, operational and tuned, it will degrade for a number of reasons, including mechanical wear, limited maintenance or wrong operational usage. Real-TPI provides the tools needed to continue achieving optimal

production capacity through continuous follow-up and improvement. Whatever type of production equipment is involved, in whatever industry, it provides the information and visualization customers require to optimally manage their assets and increase their return on investment.

Real-TPI is already operational in over 100 installations in the life sciences, chemical, consumer, manufacturing, process, oil and mining industries.

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