Lean Manufacturing: Performance, OEE and Downtime Analysis
“Having full access to real-time production data enables you to detect and anticipate weak spots in the production system and to make the right decisions to increase productivity and efficiency.”
To enable Overall Equipment Effectiveness (OEE) you need simple but effective tools that can ensure data acquisition, aggregation and transparent analysis with rapid returns (ROI). In today’s increasingly competitive world, production plants need to adopt the philosophy of “Lean Manufacturing” to improve their production processes, be more efficient and produce quality goods. The automation systems that manage production processes can only be optimized if the right information is provided. This can be realized by using “lean” tools that are easy to apply with minimum impact to achieve maximum return. The Movicon Pro.Lean module offers maximum efficiency using Progea’s twenty years of experience in the industrial automation software sector. The production lines are normally subject to various causes that weaken performance efficiency with respect to the effective performance potential: Malfunction, downtime, scrap and rejects reduce production efficiency causing economic losses to the company. Losses that companies are usually inadequately equipped to remedy.

The automatic real-time knowledge of the performance indicators (KPI) enables Overall Equipment Effectiveness (OEE) values to be calculated to indicate the real plant production efficiency rate. On average, a well-established manufacturing company performs at up to 60% of its full potential performance capacity. This means that in an ideal situation for every 100 approved goods produced, only 60 are produced. Considering that the 100% value is purely theoretical, an ‘excellent’ value of a true lean production would be around 85%. It is easy to imagine how improved production efficiency and an increase in the OEE value would signify a noticeable increase in business for any company without investing large amounts. For example, it is quite easy to imagine how a mass production manufacturing company can increase profits and reduce loss by improving and increasing their performances by a small percentage.

Efficiently managing real-time production process information flow enterprise-wide from production plant system sensors through to the managerial offices is the “real” solution for improving productivity efficiency, reducing loss and increasing profits.
Key Performance Indicator (KPI) knowledge of the production process is crucial for eliminating weak spots and increasing performance.

Pro.Lean® is a simple and effective solution based on reliable, open and flexible technology.

Pro.Lean® is the best solution to aid in decision making. It is a Movicon functional module designed to measure global efficiency values in real-time. It collects and aggregates production process data deriving from the different data sources at the production level (PLC, HMI, SCADA) and analyzing real-time situations with benchmarks to show the production level indicators independently from the deriving data source. Production managers can use this data to aid decision-making and promptly act to eliminate inefficiencies. Movicon and Pro.Lean® together offer secure and efficient connectivity tools for collecting real-time information directly from the source or origin. A configuration wizard helps users associate data and create databases automatically and safely with the aim of producing an OEE project with immediate results in only a few hours.

This solution is also open to customization of field communications, dashboard displays and analytical reports. Predisposed Open Database Connectivity (ODBC) connectors enable bidirectional connections with managerial systems that allow simple Manufacturing Execution Systems (MES) solutions to be created. These include solutions such as managing and launching orders or production batches or synchronizing and co-ordinating processes and resources. Pro.Lean® enables the availability of immediate KPI and OEE value calculations, to record the causes of downtime events and to present productivity dashboards according to the criteria defined by the standards with the option to customize. The KPI and OEE indicators can be displayed in web architecture using common Internet browsers.
Real-time Information to Detect and Eliminate Inefficiencies to Improve Productivity

Pro.Lean® will make your production plant more efficient by highlighting those key indicators that will enable you to reduce loss and increase profits.

The KPI indexes, OEE value and downtime production analysis calculated by Pro.Lean®, will enable your company to maximize production by increasing productivity in the three main parameters: availability, performances and quality.

Increase Efficiency
Improving local and global production efficiency will enable you to make better use of existing production equipment and reduce rejects and downtimes. As a result, plant running costs will be reduced to satisfy your production plans without needing to rely on overtime work and the threat of delayed delivery deadlines.

Reduce Machine Downtime
The downtime analysis will allow you to eliminate anticipated and repetitive problems relating to production. This will enable a reduction in plant downtime events, a significant reduction in costs and a better way to reallocate human resources.

Increase Production
Increasing efficiency and decreasing downtime events caused by production inactivity or malfunctions will enable you to increase the effective production rate of plant capacity value.

Quality Improvement
Analyzing data for defective productivity will allow you to detect the causes and eliminate them. This will enable you to reduce production waste and rejects and thus increase product quality and client satisfaction.
The OEE is an essential parameter, a reference indicator for analyzing production processes by calculating the overall performance of the production plant and classifying the different production losses according to the following three factors:

- Availability
- Efficiency
- Quality

These factors influence overall company efficiency and productivity. The accuracy of the OEE values depends on consistency of automatic real-time production data collection. Without accurate measurements and access to punctual extraction of production data it will be impossible to ascertain the interventions needed to improve and render the production process more efficiently. This is why Progea has designed Pro.Lean® the most simple and cost effective solution. Production line information flows can be managed by being aggregated and placed at the disposal of company managers with clarity and simplicity. This tool is essential for closing the gap often created among the field production, company management and teams. Pro.Lean® is based on industrial connectivity and data collection technology and Progea has tested it with Movicon for many years. The Pro. Lean® module provides automatic and intuitive management of the “Historian” component for collecting and recording data, the “Dashboard” component for displaying the key indicators KPI, OEE) in real time and Reports for analyzing data collected and archived by date, shift, operator, machine, product and batch. With the Pro.Lean® solution each manufacturing company will be able to discover the real production capacity of its systems, production lines and machinery. Pro.Lean® facilitates the task of detecting critical weak spots and defects by providing the information needed to eliminate them and improve overall efficiency. This will allow production plants the opportunity to increase their value, improve productivity and increase profits while reducing investment recovery time and strengthening the entire company’s competitive presence at home and overseas. It goes without saying that in today’s competitive world influenced by the effect of globalization, manufacturing companies cannot risk becoming inefficient and non-competitive. It is strategically logical to reduce production costs, improve production line and machine use and improve flexibility to not only product quality but also services. Pro. Lean® offers cost contained tools to collect real time information from production flows and analyze the coefficients of efficiency using tables and graphs in an open and integrated web-enabled architecture that also enables direct connection to the company IT tools (ERP, SAP).

How can the OEE be increased?

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Dashboard Performances and Reports with Quick, Reliable and Clear Information

Pro.Lean© offers efficient, complete, fast and transparent performance value visualization.

Pro.Lean© has been designed to guarantee perfect visualization of all the performance parameters and indicators collected by the production system using the real-time data dashboard displays and analytical reports. These tools offer transparent and accurate data containing all the information needed to achieve reduced production loss and increased business activity. By using the Movicon technology combined with the Pro.Lean© module, you will be able to view your company’s performance indicators on local monitors with dashboard displays and over the Internet using a simple browser. This will drastically cut management, maintenance and licensing costs more than any other OEE system on the market allowing you to minimize company investments.

Dashboard Data
The collected data are represented by the Pro.Lean© module in real-time using attractive graphic dashboards to display indicators and operating statuses with greater clarity. Operators will be able to supervise and control all productivity processes from wherever and whenever through the web interface graphics. The dashboard interface has been designed with the latest ergonomic requirements in mind and is equipped with the option to customize. The integrated advanced supervision and control functionalities enable the module to function as a supervisor.
OEE and Downtime Analysis Values

OEE indicators (Overall Equipment Effectiveness) are recognized as the most effective key indicators with which to measure overall plant system efficiency. OEE is aims to assist companies to maximize market output by increasing productivity in the three key areas: availability, performances and quality.

Real time data acquisition combined with the OEE analysis make the Pro.Lean© model an essential tool for any manufacturing company business manager. Aided by this module managers will be able to develop a deeper understanding of the production area performances and identify the factors restricting opportunities to improve efficiency. Pro.Lean© does this by offering a vision-wide perspective correlating the productive and functional aspects, production rates and quality using common metrics to provide unique calculated performance measurements.

The OEE calculations consider three factors:

1. **Availability** - takes down time loss into account and is calculated based on the percentage of effective operating time with respect to planned or ideal production time.

2. **Performance** - takes speed loss into account and is calculated by the percentage of pieces effectively produced with respect to programmed target totals and ideal run time.

3. **Quality** - takes quality loss into account and is calculated on good pieces produced and total number of pieces produced.

These indicators are applicable using Time Range, Production Line, Machine, Shift, Batch and Operator filters.

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OEE = \text{Availability} \times \text{Performance} \times \text{Quality}
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This crucial information enables managers to establish means of improving production assets and machine efficiency, optimize production time and reduce waste. A calculated low OEE value will inevitably cause an increase in unitary production costs and consequently a reduction in profits and opportunities. This would mean that a production line running 24/7 would lose 4% of its productivity potential for every hour lost in a production downtime event.

Analyzing production data to detect the bottlenecks and downtime events will enable the company to take immediate action to reduce loss. For instance, recovering just 2 percent loss means that the weekly production rate will regain 3.5 hours of productivity time, an additional 168 hours of productivity on an annual basis. A simple 2% production recovery translates into a significant increase in profits.

Today, based on a theoretical OEE value of 100%, the most efficient and highly productive company will generally reach
an OEE value equal to 80-85%. Without control methods most companies operate on average at an OEE value of around 60 percent. It is therefore paramount to take into account the opportunities offered by the OEE indicators to reduce loss and increase profits.

**The Downtime Analysis**

The performance indicators alone are not enough to detect the causes of inefficiencies. Data collection systems need to be evaluated for their capacities to provide the right information that enables detection of the macro causes that determine productivity loss and diminishes performance. This information is essential to ascertain the causes of inefficiency in order to eliminate them. This requires the full cooperation of the operators to not only control alarm events, automatically triggered by the system, but also to establish the reasons production downtime events occur in the actual machinery being used (e.g. format change, setup, raw material shortage, scheduled maintenance, meetings and work breaks).

Pro.Lean© includes analysis modules for the causes of downtime events to generate a statistical analysis based on various and configurable options. Production managers can refer to this analysis to obtain the vital information they need to recover efficiency, implement corrective intervention and improve production management.

**The Statistical Analysis**

The downtime Analysis Module is used to visualize statistical data relating to production downtimes. This is done by graphically representing data in classification of date order, total duration or event frequency. The values displayed in these classifications are extracted from diverse historicals and represented in graphs that offer a selection of different data filters that include time range, batch, shift or operator. The graphs can be displayed and printed as histograms or with statistical data represented by overlapping curves. In addition to the statistical calculations and graphics the system also provides data summary tables as detailed reports to represent all filtered data.

**Pocket Analysis for Mobile Systems**

The integrated Web and Web client technology will enable you access to your performance indicators using any smartphone and tablet from wherever you might be!
Communicating quickly and securely is essential to enable MES systems to provide all the necessary realtime data where needed. Movicon Pro.Lean® is able to represent the gathering point of process data as a crossroad of the company production system information flow. As the strategic role of communication is essential, Pro.Lean® provides all necessary tools to ensure that the flow of information is smooth, fast and transparent.

**I/O Drivers**
The I/O driver library contains a vast selection of native and integrated I/O drivers to communicate with control systems (PLC, CNC, instrumentation, Fieldbus).

**OPC**
Both client and Server OPC DA, OPC DA XML technology has been integrated. OPC UA is also available as an option.

**Networking**
Vast network connectivity in distributed workstation networks includes WinCE HMI panels as well.

**DB Connectors**
Special input and output DB connectors to any database, application or company system use simple shared tables to connect to any managerial system (ERP) or company SAP systems. This makes Movicon Pro.Lean® the best system for connecting managerial levels with production levels creating enterprise-wide connectivity to make production data easily accessible to top company levels in real-time.

**Historian**
Process data archived in SQL Server™ relational database.

All process data collected by Movicon Pro.Lean® is recorded and archived for subsequent analysis using the Data Logger objects which are created automatically by the Pro.Lean® configuration wizard.

The configurator enables simple data aggregation and defines the recording and archiving modes. This important task guarantees the simplicity, reliability and openness concepts. It is not necessary to have a Microsoft SQL Server™ license for Pro.Lean® to work in simple architecture. The data tables are structured automatically and the calculation database provides all the information needed for quick and effective analysis in the dashboard and analytical report viewers. Moreover the simple object-based configuration enables real-time data to be custom managed, displayed and recorded due to the Movicon platform architecture design of which Pro.Lean® is a functional module.

**Data Collection Openness**
The collection of alarm data, a machine downtime event, may require HMI interface on the local production monitor if not already available as digital information from the PLC. The Pro.Lean® architecture is ideal for connecting remote workstation terminals, whether beb-based or local HMI on operator panels based on Windows CE at a low cost. The Pro.Lean® system has powerful and integrated tools to enable collection points of data containing information on downtime events when required. In cases in which operator workstations are already equipped with an HMI system, the Movicon Pro.Lean® Web interface can easily be installed internally to protect investments without needing any complicated interventions permitting you to reduce investment costs.

**Data Redundancy**
Movicon Pro.Lean® offers application of a data redundancy function for automatic synchronization of historical data in PC systems with redundant hardware and communications in “Mission Critical” data collection systems.
Open and Flexible Architecture

Pro.Lean® uses the consolidated Movicon architecture for communications and data collection

Thanks to Movicon Pro.Lean® you can implement your MES system directly into your business by connecting it to your production lines without having to worry about which connection modalities to use. Pro.Lean® has a variety of integrated solutions to enable connectivity toward production process systems by way of I/O drivers designed for connecting PLCs, CNCs and Remote I/O directly. In addition, the option to use OPC Client or Server connectivity towards HMI or production line pre-installed SCADA systems is available. This will enable data collection without incurring heavy investments and additional installations on the production side. Data are aggregated and stored on Microsoft’s SQL Server™ Relational DB tables. The OEE and KPI performance indicators can be displayed locally or by remote control made possible by the Movicon Pro. Lean® Web architecture. Moreover this system enables full bidirectional connectivity with ERP or SAP systems for total information flow control from the shop floor to the director’s office for complete enterprise-wide top to bottom coverage.

An extremely simple and easy to implement cost efficient solution with the use of consolidated technology and all the components needed for:
1. Field communication
2. Historian and Data Collection
3. Realtime Dashboard
4. Analytical OEE and Downtime Reports
5. Operator terminal downtime event entries
6. Web accessibility from tablet and smartphone as well
Application Examples

Pro.Lean© can be applied anywhere in any production process and existing automation infrastructures at a low cost.

Pro.Lean© is a "standard" solution that can be used in all production data and analysis applications. It can be applied as an onboard machine module or as a production line supervisory module combined with the Movicon Scada/HMI supervision projects, or in independent or stand-alone architectures applied in existing systems.

Pro.Lean© can connect to existing PLCs or Scada/HMI by collecting production information and storing it in its databases. The local machine operator can use existing PCs to track downtime event entries using a simple Web browser (without modifying the local application) if the PC is connected to a network simple low cost operator panels connectable to Pro.Lean© are also available. Pro.Lean© offers a solution for those without a main supervisor as well, where display screens can be integrated to manage all production line information.

This has all been designed with the best technology available for collecting, managing and analyzing production data with the purpose of keeping investments to a minimum without having to modify existing situations unless absolutely required.
Technical Support and Services are our added value

Openness, Integration, Customization, Support. The Progea offers services to satisfy your every need.

Through its network of partners, solution providers and system integrators, Progea offers experts to provide all the support and services necessary and essential to any project’s success. There are many advantages to using a standard product, but setting up the project and tailoring it to specifications of each manufacturing company’s needs requires skill and expert know-how which play crucial roles, if not the main role, in guaranteeing success of the entire project. Progea is highly qualified to provide clients assistance by analyzing client’s their specific needs, putting them into the right perspective and implementing them on a tried and tested basis until fully validated and working to client satisfaction. The OEE (for a machine, production line or entire factory) only indicates the level of production system performance. This alone cannot be used to improve productivity unless combined with the cooperation and willingness of all enterprise-wide personnel, from shop floor to managerial offices, working together to eliminate the causes indicated by the OEE thus enabling success and a secure future for your company.

Progea has been in operation since 1990 producing software platforms for industrial automation. A long tradition attesting to Progea’s matured experience in this sector is based on strongly advocating for innovation boosted by a professional, reliable and enthusiastic team working together in harmony. Progea’s top priority is quality: The company is ISO 9001:2008 certified and its software products undergo severe testing with certification based on the required standards. Its services are provided by a motivated and highly professional team, all of whose members are fully focused on specific client needs and on providing client satisfaction proven by numerous partner references that include Phoenix Contact, ABB, Panasonic, Asem, Vipa, Suetron and many more.
The Key Features

Openness. Pro.Lean© is a Movicon functional model with SQL Server™ and XML-based architecture.

Security. Pro.Lean© guarantees maximum data security based on SQL Server with redundancy management.

Standards. Pro.Lean© is completely based on standard technology to safeguard your investment.

Performances. Pro.Lean© ensures real-time management of your information with the capacity to handle data collection with a frequency up to 10 Ms.

Powerful Data Logging. Collected data can be recorded using the Data Logger objects to record on SQL Server archive tables with automatic data recycling.

Connectivity. Pro.Lean© integrates a library containing a vast selection of communication drivers to connect to all types of automation devices (e.g. Modbus, Siemens, Schneider, Rockwell, Omron, Saia, Mitsubishi, Profibus, Profinet, Ethernet/IP and many others). The drivers include functions for automatically importing tags, remote connectivity via modem and the multi-station concept for point-to-point protocols. In addition to the driver library Pro.Lean© offers full connectivity via OPC with OPC DA, OPC UA and OPC XML DA technology as both client and server.

Configuration Wizard. Pro.Lean© is a Movicon functional module equipped with a configuration wizard to enable easy field variable selection and the automatic creation of data acquisition databases. Real-time Dashboards, calculation databases and analysis reports are created with a few simple step-by-step procedures.

Ready-to-Use and Customizable Reports. Pro.Lean© is already equipped with performance and Downtime Analysis Reports based on the SQL Server Reporting Service. In addition, this solution also offers the use of the Movicon Report Designer or Crystal Report tool for greater integration and customization.

Web-Enabled Architecture. Pro.Lean© offers web-based OEE dashboards, HMI interface and Reports. Data can be access on the Server by using internet browsers. Performances and security ensure reductions in costs and maintenance.

Open and Customizable KPI Analysis Modules. The KPI analysis proposes simple and effective solutions for obtaining straight forward, quick and open OEE and downtime indexes. Reports, tables and graphs enable a thorough analysis of the production process with the option to print and export the data displayed. All the data are managed in customizable architecture.

Integrated Connectivity with Movicon™. In addition to interfacing with any supervisory system, Pro.Lean© also offers users the great advantage to use network connectivity with the Movicon Scada systems and with WinCE HMI panels based on Movicon CE.
A small investment with immediate return to increase performance and reduce loss in any sector of the manufacturing industry.