



Nissan North America, Inc.

Designed for Success

Results

- Meet daily manufacturing achievement numbers and keep production fluid
- Ensure system quality and uptime that is approaching Six Sigma
- Excel at implementation and production with an expert engineering team that is 25% of the size of competitors' engineering resources
- Decrease training time by 70% on maintenance alone
- Reduce engineering training time at least 50%
- Reduce scrap for improved environmental friendliness
- Meet tight environmental and safety standards for automotive manufacturing and documentation
- Collect data for improved warranty, recall, defect and hold management
- Decrease integration costs by as much as 80% for additional projects through a larger network of providers, improving the competitive bid processes

Smooth Ride

Nissan Revs Up Its First Full-Size Vehicles with New Plant in Canton, Award-Winning Productivity Model and Automated Manufacturing Systems from GE Fanuc

With the most productive automotive plant in North America for the last 8 out of 9 years according to The Harbour Report, Nissan North America, Inc., knows how to drive manufacturing. The team has developed the "Nissan Production Way" – which has set the standard for many other manufacturers, including those well beyond the automotive industry. And, when it came time to launch the company's first line of full-size vehicles, Nissan looked to follow its proven and successful model at its award-winning plant in Smyrna, Tennessee – which includes cell-, machine- and plant-wide automation from GE Fanuc, a unit of GE Infrastructure – at a new plant in Canton, Mississippi. Today, Nissan's assembly plant in Canton covers 3.5 million square feet, represents an investment of \$1.4 billion, and is designed to produce 400,000 vehicles per year at full capacity. With strong demand for Nissan products in North America, the team at the plant is using proven automation technology to put the pedal to the metal in Canton's production – monitoring and controlling processes from the highly flexible paint shop and carefully tracked production to environmentally friendly incineration systems and cost-effective energy management.



imagination at work



Reving Up at Canton

The Canton plant took Nissan just two-and-a-half years to go from conception to production. With market demand high for its products, Nissan launched six new models in 14 months at the plant – including the Quest minivan, Armada full-size sport utility vehicle, Titan full-size pickup truck and the Altima sedan. Additionally, the plant makes the QX56, luxury brand Infiniti's first full-size sport utility vehicle and the first North American-built Infiniti. The Canton plant plays a large role in Nissan's growth strategy.

Nissan now has a complete line of full-size vehicles – which are unique to North America – and require full-size production to match. By using the Nissan Production Way, the plant's engineers can take advantage of their expertise in sequenced and simultaneous manufacturing to bring more new vehicles to the marketplace, faster.



The Nissan team uses Proficy Tracker and HMI/SCADA CIMPLICITY®* software from GE Fanuc in Smyrna and Canton at the heart of its Production Management Control System (PMCS) to add as much intelligence to the manufacturing floor as possible. The Canton plant's PMCS is a critical component of Nissan's integrated manufacturing strategy that requires a collaborative effort with the company's supply chain, providing a foundation for a Just-In-Time (JIT) environment. Other major plant systems, connected to CIMPLICITY, include the Nissan Energy Management and Control (NEMAC) and the Paint Control Room (PCR).

* Part of Proficy Intelligent Production Solutions from GE Fanuc.

CIMPLICITY controls all of the data transfer, and the system's flexibility allows the team to connect to and span the entire operation. The plant starts with metal for white body assembly, through the paint shop and to Trim & Chassis for final assembly. Nissan is controlling operations within the Canton plant and also connecting to other Nissan plants as well as the enterprise systems and supply chain.

With more than 1.2 million I/O points, the PMCS at Canton:

- Tracks and routes vehicles and parts through the entire manufacturing process;
- Delivers information to over 150 shop floor devices;
- Moves vehicles from the body shop, to paint shop, to final assembly;
- Broadcasts messages to suppliers to notify them to deliver required commodities at the necessary time, in just the right quantity, and in the correct sequence; and
- Provides a comprehensive, easy to use, real time and web-based interface for system analysts to keep production fluid.

The GE Fanuc team designed the PMCS application and integrated Nissan's ordering processes, tight supplier clustering requirements, and flexible manufacturing processes. The team implemented the system on High Availability components from EMC, Dell, Microsoft®, and GE – including supervisory, production management and HMI software as well as VersaMax Programmable Logic Controllers (PLCs), Proficy Machine Edition software and more than 300 different plant-floor operator stations. The team built the solution to tightly integrate the HMI and production tracking and routing software, Proficy Tracker, with Microsoft's DNA and .NET technology. GE also supplied the floor-level integration and installation of PLCs, sensors, workstations, and associated cabinets and wiring.

With the system providing as much intelligence as possible about the factory floor, Nissan has been able to increase line speeds, handle varying model mixes, and decrease equipment downtime.

Getting into Gear

Nissan deployed more than 80 plant floor and control room systems in a fast rollout. The plant achieved a highly available and sophisticated hardware/software architecture without having to spend large sums of money and without hiring large teams of engineers to maintain the system. The key was to plan the infrastructure and implement it using a high degree of automation. This reduced errors and accelerated the roll-out process immensely.

With the plant-wide system in place, the team at Nissan has been able to:

- Meet daily manufacturing achievement numbers and keep production fluid;
- Ensure system quality and uptime that is approaching Six Sigma;
- Excel at implementation and production with an expert engineering team that is 25% of the size of competitors' engineering resources;
- Decrease training time by 70% on maintenance alone;
- Reduce engineering training time at least 50%;
- Reduce scrap for improved environmental friendliness;
- Meet tight environmental and safety standards for automotive manufacturing and documentation;

- Collect data for improved warranty, recall, defect and hold management; and
- Decrease integration costs by as much as 80% for additional projects through a larger network of providers, improving the competitive bid processes.

“The most important aspect of the technology is that Nissan can achieve flexible manufacturing,” explains Rich Breuning, automotive marketing manager for GE Fanuc Automation. “The team can constantly change routing rules, refining processes to restore sequence and minimize costs. This truly is a technology environment that enables continuous improvement.”

For example, if the team needs to pull a unit for minor repairs, the vehicle or component gets out of sequence, which can impact the plant’s Color Blocking and Trim-Content Blending production schedule. Color blocking ensures that the plant minimizes raw material, speeds processes and decreases the number of paint changes by having all components of the same color together in production. In the case of the repaired part, the system implements rules to get the unit back into sequence without disrupting overall production. This fluidity is critical to successful automotive production.



The plant’s 133 manufacturing rules – or Routing Control Objects (RCOs) – are the foundation for Nissan’s production management system. “Nissan’s schedule is based on color blocks and trim content,” Breuning says. “In setting up the routing rules, the team revised nearly every RCO in a major way during implementation, configuring and testing each one over a four-six month period. Now, with thousands of factors that come into play, they are focusing on key areas and improve the system constantly for even greater return.”

Technology Behind the Wheel

The plant’s PMCS consists of four levels: system, site, cell and floor (See Figure 1, PMCS Overview). The **system level** comprises the Storage Area Network (SAN), plant-wide system security and policy, system installation management, and system development management. The SAN provides a flexible, networked storage infrastructure for 16 PMCS servers at Canton. The integrated SAN solution strengthens the PMCS performance, reliability and failure proof capability. The team can automatically perform secure, non-intrusive backups while production continues. Business Continuance Volumes – which are point-in-time snapshots of the entire system – provide disaster recovery for faster startup, as needed.



Figure 1, PMCS Overview

For security, the PMCS is fully integrated with Microsoft Active Directory and Group Policy. The system authenticates users based on domain accounts to allow PMCS and CIMPLICITY applications. Role-based permissions control users’ application access with predefined business roles, while allowing the Canton domain administrator to have multiple organizational units that represent different logical groupings of users.

The Canton PMCS **site level** entails the business host data integration, manufacturing system integration, production data repository and manipulation, web user interfaces and reports, and broadcast and JIT. These combined system and site components provide the vital link for the Canton facility – located on 1,400 acres – to entirely be part of the Nissan flexible manufacturing process.

The site level is the main interface layer between the Nissan enterprise wide scheduling and inventory systems (Business Host) and the Canton manufacturing systems. The site-level automation relays production schedules from the Business Host to the manufacturing systems – keeping the Nissan enterprise and Canton production always in synch. The system processes complete vehicle identification data from the Business Host to support more than 1000 vehicle schedules a day. Additionally, it serves production start data to more than 15 OEM equipment locations through the cell level and manages vehicle build sequence information, providing it to the manufacturing systems upon request.

The PMCS site level also provides a data management system built on Microsoft SQL Server 2000. Eight databases provide support for millions of data transactions per day – storing detailed vehicle data, vehicle change history, vehicle movement history as well as vehicle component data and built-vehicle inventory. The system includes a flexible web-based interface that allows speedy, reliable and transactional data access and manipulation – even from remote locations around the world. Operators and managers can change the vehicle build sequence, abort and start a unit, change vehicle data such as color and trim type, place units on hold, and create teardown units for testing. Reports from the system range from Scheduled Sequence Achievement Ratio (SSAR) to production data such as counts and inventory.

“At Nissan, detailed and rigorous reporting is standardized across the company,” Breuning notes.

Also at the site level, the plant’s JIT Notification Module notifies key suppliers of vehicle locations, so they can sequence parts into the plant at the right time. The module provides suppliers with a comprehensive data sheet for each vehicle using XML formatting. Each supplier receives documents electronically via Microsoft Message Queuing technology. The trigger for sending this information is the movement of units on the shop floor. At selected points, a JIT notification action is configured at the database to send different messages to different suppliers. Operators can re-notify one or more suppliers in the event that the original notification was lost or wrongly processed.

The Canton **cell-level** components include production data and process equipment integration, plant-wide production tracking, plant-wide vehicle routing control, a real-time user interface, production equipment data logging, production data aggregation and centralization, and local equipment and process control. These cell components make sure that the plant meets its daily achievement numbers and give production analysts the ability to keep production fluid.

The plant's cell level utilizes the open infrastructure and powerful device communications of CIMPLICITY HMI to deliver production data to numerous devices and floor equipment to monitor and control production. The software communicates with 76 PLCs to collect and deliver production start data and commands, collects vehicle and carrier identification data from 72 smart eye readers, 16 RF readers and 13 barcode readers, and delivers real-time production data to five marquees and numerous workstations.

The system's Tracker production module tracks vehicles, parts and carriers through the entire facility, starting from metal start to final buy. Tracked items include: vehicle bodies, carriers, boxes, body sides, doors, seats, frames and fascias. The software manages routing based on a set of rules, user inputs, vehicles and device states – connected directly to the RCOs – and has allowed Nissan to implement numerous decision routing methodologies including its Scheduled Sequence Achievement Ratio (SSAR). While the system handles complex manufacturing processes behind the scenes, operators can easily navigate the graphical screens.

The plant's **floor-level** components and peripherals include production data collection, production data error proofing (Poka Yoke), inventory system integration, floor console user interfaces, floor equipment data logging, devices / equipment installation and integration, and vision system installation and integration. The floor components collect data for warranty, recall, defect and hold management.

The floor-level functionality collects data on 10 major vehicle parts – including engine, transmission, steering gear, fuel tank, and key as well as 13 airbag parts such as the diagnostic module, side impact sensors, belt tension sensor, and front crash zone sensor. This process helps Nissan with warranty, recall and vehicle hold management, and is an integral part of the airbag assembly certification. Integrated vision systems detect spot build defects at three locations: the metal line, frame and box. The PMCS floor level also provides automated error proofing at stations to ensure that the correct part is chosen for the vehicle.

As an example, the key data for trucks on the box line is validated against information stored in the database, and the operator is alerted if a key set is being matched to the wrong truck.

Additionally, the floor-level components enable inventory transfer and facilitate inventory control. The buy-off process identifies missing data and vehicle holds, updates PMCS vehicle tracking, and transfers the vehicle to Distribution and Auto Services, Inc. (DAS) inventory, if appropriate.

The Road to Productivity

With the technology in place at the new plant – and production kicking into high gear – Nissan stands to continue its tradition of driving away with recognition for the most productive plants. The team has implemented a full factory-wide system for a major new facility in record time and helped Nissan build upon its strategy for full-size vehicle production. The scalable PMCS can continue to meet the plant's needs, as demand continues to climb for Nissan vehicles and production stays in the fast lane.



GE Fanuc Automation Information Centers

USA and the Americas:
1- 800-GE FANUC
or (434) 978-5100

Europe, Middle East and Africa:
(352) 727979-1

Asia Pacific:
86-21-3222-4555

Additional Resources

For more information, please visit the
GE Fanuc web site at:

www.gefanuc.com

