PINpoint INFORMATION SYSTEMS WHITE PAPER

<u>New Supercar Engine Assembly Perfected by Manufacturing Execution System</u>

Introduction / Summary

This document summarizes the manufacturing execution system (MES), or manufacturing operations management (MOM) solution implemented by a leading Automotive manufacturer to manage the complex assembly of the engine for their new Supercar. <u>The MES/MOM was integral to ensure each and every single of the nearly two-thousand (2,000) process steps involved to build the engine were completed to the set specifications or tolerances without fail</u>.

MES/MOM ensured zero-defects during the assembly of the engines since it monitored and controlled all operations; all tools and devices, and the line workers themselves since the MES/MOM directed them from job start to end. The MES/MOM verified worker credentials, provided work instructions, and confirmed that the materials and tools were properly selected for the exact task at hand.

Destined for the Automotive manufacturer's highest-performance GT sports car (*see Figure 1*), the twin-turbo charged V6 "*EcoBoost*" engine is vital to the success of the final product. **Given the intricacy of the engine and the number of steps needed to assemble it, and its high tolerances, the MES/MOM proved indispensable.**

Background / Problems

Considering the Supercar is not mass-produced, or is production limited, i.e. these cars are produced in low volumes and are of very high complexity; **this low-volume or high-complexity production established the need for an extremely flexible manufacturing system to maximize quality and time-to-market speed while keeping costs down**. A flexible MES/MOM solution was an absolute necessity due to the bespoke nature of every engine.

Figure 1: Ford GT Supercar.

Of particular significance was the error-proofing of the crankshaft and the main housing bore, two (2) parts which are manufactured to extremely tight tolerances in order to fit together precisely. **The method or sequence of the assembly of these matching parts to the engine creates an inimitable scenario whereas both parts become separated early on in production**. It was critical that these unique parts always married together at the respective assembly station without fail.

The other complexity was that the engine was comprised of various parts with varying bolt sizes, and therefore different tools would be needed, as well as different sized sockets. Error-proofing was essential to ensure the correct fastening tool and socket were always selected for the task at hand.

Solution

By implementing a MES/MOM to manage every manufacturing operation the customer was enabled to achieve the highest level of error-proofing to produce a quality product while keeping costs down. The engine assembly starts with the creation of an '*Engine Birth History Report*' which is unique to each and every engine or serial number. The engine birth history report follows every engine (*Figure 2)* throughout the life of its assembly, and identifies all of the captured process steps or assembly data into a central database (*SQL server*).

Every single detail is important, right down to verifying the worker and their timing, what tools they select, which socket, and what part. In the case of the crank shaft each part is identified by matrix barcode which must be scanned into the MES/MOM; once the first part's unique specification is input, the second matching part must be matched by another worker at a different station later on. If the parts do not match an alert is raised actioning the next steps to remedy the situation.

Figure 2: 'EcoBoost' engine.

The MES/MOM's feature of "*cross station investigation*" highlights the 'feature based' or made-to-order (MTO) capabilities, or flexibility inherent in the manufacturing operations management solution. The engine birth history report in this case mapped out exactly all parts, tools to be used, matching sockets, fastening tolerances, and thousands of process steps unique to the assembly of each and every engine.

By verifying and tracking which crankshaft serial number was selected in the first station, the cross station examination could be performed in the subsequent station, i.e. verifying the specific diameter crankshaft selected in the first workstation, which directly correlated to the main bore housing diameter in the second station. The MES/MOM performed the cross station examination to ensure the married parts always met, any deviation from this stopped the process, locked the assembly tool, and raised an Andon alert.


Figure 3: Socket verification system.

The other crucial error-proofing technique needed involved the tracking of fastening tools and sockets required to complete any given assembly process step. This **"*multiple tool coordination*" was accomplished by introducing a MES/MOM '*Socket Tray*' socket verification system** (*Figure 3*). The Socket Tray features separate 'trays' or slots in which the sockets seat and are presence detected via proximity sensors. The MES/MOM instructs and then tracks and verifies the line worker's actions as she/he proceed in the fastening operation; firstly, verifying the correct '*nutrunner*' assembly tool was selected, and then by verifying the correct socket was removed from the tray. The line worker next fastened the appropriate bolt as directed by the MES/MOM until the set fastening tolerances of input torque and angle were met.

Further to the accomplishment of managing the bespoke manufacturing of each "*EcoBoost*" engine, MES/MOM provided the manufacturer with indispensable recorded process data which served to further improve all aspects of production including cycle time. As data was gathered and analyzed the manufacturer was able to optimize and improve assembly timing by identifying bottle necks and being able to re-configure processes by re-allocating time or tasks.

MES/MOM Software

The MES/MOM software has been developed since 1997 and it continues to be evolved and pushed-forward by leading manufactures. Thoroughly proven it is in use daily around the world in multiple languages by leading automotive, aerospace, heavy machinery, agricultural, and power sports vehicle manufacturers. The software is meticulously designed and tested to '*Information Technology Infrastructure Library*' (ITIL) standards before any official version release.

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Conclusion

The MES/MOM was integral to monitoring and ensuring control of the nearly two-thousand process steps involved to build the engine. These tasks had to be completed to the set specifications or tolerances without fail, including the challenge of cross station parts coordination. Error-proofing was required at a high-level to ensure zero-defects during the assembly of the engines. **By using MES/MOM to monitor and control all process steps, including all tools, devices, and the management of the line workers themselves, the opportunity for a failed or cheated process step to occur was eliminated.**

MES/MOM played an integral role in guiding the line worker to successfully accomplish each process step, right down to verifying that they selected the correct tool and socket, and materials; and by confirming the operation happened to within predetermined tolerances in a predetermined time.

Given the intricacy of the engine and the number of steps needed to assemble it, and its high tolerances, the MES/MOM proved indispensable. For low volume or high-complexity production, MES/MOM proves to be the most flexible and thorough manufacturing execution system; it proved to maximize quality and time-to-market speed while keeping costs down.

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