



Direct Part Marking and Rolls-Royce: Enabling the Future of Aero Engine Manufacturing

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~Nat Russhard,
Team Leader, Rolls-
Royce Direct Part
Marking

Despite the iconic name, Nat Russhard is quick to point out that Rolls-Royce has nothing to do with automobiles. The car making division of the company was sold years ago to a different owner, while the core of Rolls-Royce has steadily retained its place as a leading aero engine manufacturer. Its success is due in part to the company’s active pursuit of new technology solutions that allow it to offer a competitive range of products in the global civil aerospace, defense aerospace, marine and energy markets. One such solution that is helping Rolls-Royce keep its competitive edge is direct part marking.

Direct part marking is conceptually related to the U.S. Department of Defense’s Item Unique Identification (IUID) Policy, but operates on an even larger scope. It employs the same technology, standards, and data matrix identification as IUID, but it does not assign a unique identification number. As Russhard, leader of Rolls-Royce’s Direct Part Marking team, explains, “Today, we uniquely identify about 15% of the aero engine. Rolls-Royce has a policy to identify the entire engine via machine readable methods. Rolls-Royce is in a fairly unique position because of that.” By making the entire engine machine readable, Rolls-Royce has significantly reduced the number of read errors associated with identification, which has subsequently led to fewer mistakes during the manufacturing process. As Russhard notes, “Although look-alike parts may well fit in different aero engines, that doesn’t mean they’ll function in quite the same way. The materials may perform differently according to temperature or any number of variables. With direct part marking, we can capture both the as-is-built condition and check it against the should-be-built condition. Have I put the right parts in the right engine? Direct part marking enables us to answer this question with greater accuracy. There have been many secondary benefits, but this – the improvement in accuracy and quality – has been the primary aim and payoff.”



*Dot-peen marking a 2D
Data Matrix code onto
an aero engine part*

Russhard credits Airbus’s request for machine readable identification on line replacement units for the Trent500 engine as the catalyst for Rolls-Royce’s part marking implementation. Though implementation started as an external requirement, it didn’t take long for Rolls-Royce to realize the widespread potential for the technology: “We recognized very quickly that this standard was the only way to go on future projects. The Trent 900 for Airbus’s ‘hotel in the sky,’ the Trent 1000 for the Boeing 787, the TB400 joint European engine – all of these point to exactly the same requirements, so we ended up with a transformation program across the whole of the company.” Once the benefits of implementation became evident, Rolls-Royce proactively pursued adoption of the technology, not only to comply with external standards but also to realize internal enhancements. “There is a policy and culture throughout Rolls-Royce to meet machine readable requirements because of the clear benefits and unmistakable advantages,” observes Russhard. “The U.S. requirements only supplement what we’ve already been doing for 5 years. We’ve had to make adjustments to the data format and quality standards to comply with international standards, but we’ve always seen this as an opportunity to reduce quality failures associated with identification. A ‘5’ and an ‘S’ will never be confused again because it is being read by a machine.”

Once Rolls-Royce recognized the potential for the technology, the next major challenge was determining a process plan for implementation. As Russhard explains, “What is holding back the majority of suppliers is the fear factor – how do we do this on existing parts? That’s the task Rolls-Royce was left with.” Yet, according to Russhard, the task remained manageable as long as the business rules were kept simple. One area where this approach was crucial was in determining the rules and parameters for part marking. “Rather than change every one of thousands of drawings, we made sure the standards were instructed from the drawings. We didn’t change the definitions or drawings which the parts are made from. Instead, we changed the standards which instructed the drawings. Changing each definition would have been a momentous undertaking, and fortunately, that hasn’t been a requirement. Instead, we were able to engineer change through quality standards in a highly efficient and successful manner. By keeping our business rules simple, we made implementation fairly easy.”

In addition to the technical difficulties of incorporating a new technology into an existing process, Russhard notes that communication was a continuing challenge. In order to ensure common understand-

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A Rolls-Royce T500 blade labeled with direct part marking technology

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ing of requirements, it was vital to establish and communicate expectations clearly. “One of the greatest obstacles to overcome was making sure everyone was aware of the changes. Effective communication is 80% of the challenge. If people know the exam question, then the answer is fairly easy. But if they don’t understand the question, they’ll never get the correct answer. That’s why it’s imperative to have clear requirements and clear communication about those requirements.” As significant as communication is, however, it is only a small step toward the much larger goal of overall process capability. As Russhard explains, “Process capability is a massive thing for industry. If you don’t have the capability, you don’t have the process. If there’s an inconsistent variable, then you can’t rely on it. Manufacturers need reliable, robust processes, and the repeatability of results is essential. At Rolls-Royce, we work toward clear communication, clear requirements, providing points of contact, implementation plans, process monitors, and making sure everyone understands the exam question...until finally we arrive at an equation that equals process capability. So it’s extremely important to put all the glossy promotions to one side and talk factually about requirement capabilities or else you put the end objective, process capability, at risk.”

Despite these challenges, Rolls-Royce has come a long way since it first began looking at the technology in the late 1990s. The company has implemented direct part marking throughout its community and in all of its manufacturing sites worldwide. This includes more than 600 suppliers who operate across the commercial/civil, military, marine and industrial sectors. Implementation is being instructed and closely monitored throughout the component supply chain, and the Trent 900 on the Airbus 380 marks the first aero engine for Rolls-Royce to roll out with each of its more than 20,000 parts machine readable identified. Though it is too early to articulate specific Return on Investment (ROI), Russhard says the benefits of implementation have been manifold. The greatest gain has been in quality control. “The real reason we did it is because it significantly reduces quality failures that are associated with identification. Is it a ‘1’ or a ‘7’? This removes legibility issues because the legibility is now confined to the reader, and the reader won’t make mistakes. Either it will read the data or it won’t. It won’t record the wrong information.”

In addition to the quality gains, however, Russhard says that time savings have been a subsidiary benefit. “Take for example the traditional method of data capture for fan blades. Fan blades are very finely balanced. You can spin the whole of the fan with your index finger. To do that, we have to collect data from the manufacturer to balance each fan accordingly. There are typically 26 fan blades and it used to take 90 minutes to gather the information manually. Now it takes around 3 minutes. So there is definitely a cycle time benefit.” In addition to the speed and accuracy of the system, Russhard continues, it is also an enabler to a paperless system. “Once the data is gathered, it then goes to a certification group, who will create the as-build conditions. They have to re-type and re-format the data, but with machine readable data, it can go straight into the system. And that’s only for one of about 20,000 parts. Now this obviously doesn’t equate across all parts, and the main goal when we went forward was always quality. The time benefits are a spin off to quality.”

Given the successes at Rolls-Royce, Russhard offers the following lessons-learned to companies just beginning implementation. First, understand the requirements. “It’s vital to obtain clear requirements from the customers from the beginning,” says Russhard. Second, he recommends establishing acceptable process capabilities: “If your machine isn’t up to the task, it will never meet the requirements, so bear in mind the effective use of equipment.” Third, minimize the engineering effort for drawing changes. Fourth, share practices with colleagues and, at times, even competitors. As Russhard observes, “Boeing, Airbus, Rolls-Royce...we all have a common goal. Their failure is of no consolation to me, because eventually we will want to share data from the same big database in the sky. Accuracy of data benefits everyone.” Lastly, he notes, use implementation as an opportunity for internal improvement: “Machine readable identification is an enabler, it doesn’t do anything in its own right. It has the ability to give all sorts of benefits in terms of data tracking, cycle time for data capture, traceability, and quality control. But you have to look at this as a transformation or you won’t get the benefits. Sure, it’s easy to take the shortest route just to be compliant and put a check in the proper box. But if you take the next step and leverage it is as a life cycle management technique, and transform your data capture process, then it will have much more value than just a compliance requirement.”

For Russhard, however, the goal of implementation has always been very straightforward: “We’re doing it because the customer demands it and it makes good business sense. That’s the very simple reason why we’re doing it.”

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