

## Nissan – The LEAF battery production



### APPLICATION:

New facility design

### BRANCH:

Automotive

### SECTOR:

Vehicle Manufacturer

### BENEFIT:

Nissan used simulation to validate production levels at their new LEAF battery facility at its Sunderland, UK plant. The new facility design, having been optimised using WITNESS by Lanner, will deliver a €10 million cost saving, when compared to the original plant in Japan.

### About the company

In 2010 Nissan launched the world's first mass produced electric car available from a major manufacturer, the LEAF (*Leading,*

*Environmentally friendly, Affordable, Family car*). Launched in Japan and the US initially, it is now available in the UK and forms part of the government's £43 million subsidy scheme for electric vehicles, which provides buyers with a discount of up to £5000 on any one of nine eligible electric cars.

Production is so far being undertaken in Japan, but from 2013, Nissan Motor Manufacturing (UK) in Sunderland is expected to manufacture 50,000 LEAF cars per annum. A plant to produce lithium-ion batteries for the LEAF is currently under construction at the Sunderland site and is due to go into production in January 2012. The building of additional battery plants in Portugal, France and the US will follow over the next two years.

### Uncharted territory

The LEAF electric car represented relatively uncharted territory for the automotive manufacturer so investment in a new plant for production of the batteries was required. Before building the UK plant however, Nissan's team of engineers in Sunderland had to demonstrate that the throughput volumes currently delivered in Japan could be matched.

The task was far from straightforward as battery production is hugely complex. The project team had to plot operational efficiency and scrap rates against the three key stages of production involved in the creation of the required volumes. These included the manufacture of just under 12 million cells to create modules required for each of the 60,000 battery packs needed per year; the linking and charging of

anodes, cathodes and electrolytes to form the battery's structure; and battery pack assembly.

Environmental conditions were also a major consideration, as in battery production, humidity levels must be maintained at less than 1% (against average conditions which are 75%) and clean room standards adhered to in order to avoid particle contamination.

### Challenging assumptions

Having observed battery production at the pilot plant in Japan, the project team felt confident, not only that they could build a new plant in Sunderland which would cope with the throughput demand, but that they could achieve this against a lower cost base. The reason for this assumption was that the pilot plant was not purpose built meaning constraints existed around the layout of production processes.

Given that the building design and plant layout was integral to optimising production and supporting the overall profitability of the LEAF, the team set about creating a business case to demonstrate that the facility could cope with the expected volumes, at greater levels of efficiency. However while Nissan's team of engineers could articulate their assumptions anecdotally, they needed to be able to prove beyond doubt that substantial investment cost savings would be possible. As part of the process, the team concluded that the level of complexity involved in scoping out the best layout for battery production was impossible to harness and optimise without sophisticated modelling software to test and validate their thinking.

### Proving the business case

Various teams within Nissan had used Lanner's WITNESS simulation software in previous projects, and as it was proven, robust, cost effective and familiar, Nissan chose WITNESS to construct the complex battery production model.

Once the WITNESS model was created, it mapped and analysed the entire spectrum of production variables, facilitated an understanding of the complex relationship between processes at multiple stages, and tested different layouts to find the best one. Having processed a number of scenarios, WITNESS demonstrated the optimum plant layout to achieve the required throughput.

### €10 million savings

Exceeding expectations, the model also showed that through using this layout, the throughput could be achieved with an investment cost saving of €2.5 million for the Sunderland plant alone, when compared with the pilot plant.

It also highlighted that if the optimised layout was extended to the additional three battery plants planned, it would increase savings to over €10 million. In addition to testing and validating some of the ideas for cost savings, WITNESS also highlighted problems and bottlenecks which would have incurred costs and disruption at a later stage of the manufacturing process. These issues were therefore mitigated against at the outset, potentially adding to the savings highlighted above.

*“Having this model means that the team could not only provide a watertight assurance that our Sunderland plant could cope with the volumes, but that it could do so at a substantially reduced cost base – one which was far greater than we’d hoped,”*

comments Bob Scurr, lead engineer at Nissan Motor Manufacturing (UK) Ltd.

*“Simulation was the only way to provide a scientific risk free business case which would optimise the layout and identify the most efficient and productive layout for battery production.”*

#### **Next steps**

Having built the Sunderland plant according to the layout designed through WITNESS, the team is now undertaking further testing and validation in preparation for the production phase.

Once this stage is complete, pilot production will commence in order to test the quality and assess the lifecycle of the batteries before full production commences in January 2012.

The additional battery plants in France, Portugal and Tennessee in the US will be built against a phased schedule over the next two years, with support from Lanner’s WITNESS model.

*“Lanner’s WITNESS solution has been integral to optimising battery production for the LEAF and its derivatives. Without it, changes and modifications to the production process would have had to have been*

*tested in the real world, which is prohibitively risky and costly,”*

Bob concludes.

*“From our investment in WITNESS software we have seen an ROI of over €10 million and have absolute confidence that our production is as lean and efficient as it can be.”*