

# Telescope technologies

Business



Company: Autodesk Customer: Telescope Technologies Submitted by: The WhiteOaks Consultancy What does La Palma in the Canaries have in common with Merseyside? The answer is - telescopes! For La Palma is the home of the international Roque de los Muchachos observatory site, the location for The Liverpool Telescope, the first telescope designed, manufactured and assembled by Telescope Technologies Limited, of Birkenhead.

Completely robotically controlled from the Astrophysics Research Institute adjacent to Telescope Technologies' factory at Twelve Quays, Birkenhead, this remarkable telescope needs no on-site operator. To give an idea of the scale of the engineering involved, The Liverpool Telescope weighs in at 20,000 kg., has a 2 metre diameter primary mirror, and stands some 8 metres high when vertical. That's higher than an average house! And there are plans in place to design and manufacture even larger instruments, up to 8 metres diameter with a monolithic main mirror, and up to 50 metres diameter with a segmented main mirror. All this would not be possible without Telescope Technologies' 3D design system from Autodesk. Thanks to this system, the telescope has been brought from concept to completion significantly faster than would have been previously possible, significantly lighter in weight, and at a significantly lower cost.

Anthony Mansfield, Chief Designer of Telescope Technologies Limited (TTL) comments, " Without our 3D design system we would not be in business. With it, we are leading the world in the medium and large research telescope business". This approach has made TTL so successful that it has already won two further orders for similar instruments. One telescope is destined for the Inter-Universities Centre for Astronomy and Astrophysics in Pune, India,

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whilst the other is destined for the University of Hawaii's Institute for Astronomy's Haleakala Observatory on Maui. More orders are in the pipeline and the company has recently entered a reciprocal agreement with Carl Zeiss Jena. The astronomical heritage of Merseyside extends back to the mid-seventeenth century, when Jeremiah Horrocks of Toxteth successfully predicted that a transit of Venus would be observable on the 24th November 1639.

His seminal work "Venus in Sole Visa" became the cornerstone of the "New Astronomy" and Horrocks was seen as one of the inspirations for the creation of the Royal Greenwich Observatory. The links between astronomy and Merseyside continued through the pioneering work of William Lassell in the nineteenth century, right up to the present day with this, the New Generation Astronomical Telescope. NGAT is the brainchild of Professor Mike Bode from the Liverpool John Moore University and will be used by him and his research staff at the University's Astrophysics Research Institute. Through this project, TTL has created 220 jobs and Managing Director Mike Daly expects to recruit another 10 specialist technicians to cope with the growing pipeline of orders. TTL was founded three years ago as a result of a grant from the European Regional Development Fund under the Objective One programme to re-establish the UK's ability to manufacture large astronomical telescopes.

The overall 'New Generation Astronomical Telescopes Project' was a joint initiative between Liverpool John Moores University (JMU), PPARC and the National Museums and Galleries on Merseyside (NMGM). The idea was that design work would be carried out largely by the then Royal Greenwich

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Observatory (RGO), assembly and testing by JMU, while NMGM would assist with the associated public understanding of science activities. Despite the recent restructuring of the Royal Observatories, the University, TTL and PPARC have worked together to help to ensure the survival of the core telescope design team, and all key individuals are now directly employed by TTL or are retained as consultants. TTL retains the intellectual property rights to telescope design and in return each new telescope provides a royalty to the Research Council which it is free to re-invest in science. TTL now has new purpose-built offices, and an assembly and test facility on Twelve Quays, Birkenhead. The TTL building is unique in that there are four 'pods' on which four telescopes (in the 2-to-3-metre class) can be built simultaneously.

Each pod sits under a shutter which can roll back to allow the fully constructed telescope to be tested on the sky, before dismantling and shipping. Objective One provides money from Europe to help Merseyside catch up with the prosperity of other regions. In order to achieve this aim it must draw private sector investment as well as other public expenditure. The programme is supported by two European Structural Funds, the European Regional Development Fund (ERDF) and the European Social Fund (ESF). ERDF funds capital building works and some other economic development projects, whereas ESF funds vocational training and other human resource development activities. The programme is run by a local partnership of representatives from the public, private and voluntary sectors, further and higher education, TECs and statutory agencies.

They work through a Monitoring Committee, two Technical Panels - one for Industrial Development and one for the people of Merseyside - supported by a secretariat. The secretariat is based in the Government Office for Merseyside. The Programme started in January 1994 and ran until the end of 1999. European funding to Merseyside is likely to continue, but the form of the new programme is not yet known. The Liverpool Telescope project itself started some 2 years ago, and the order was won against very stiff competition from Germany and Japan.

Performance, cost and timescale parameters were very tight. The company had to be certain it could design and manufacture the telescope on time, within budget, and working. A way had to be found to ensure that the design was viable and could be manufactured without prototypes. It was also vital to save material, and therefore cost, without compromising the integrity and performance of the telescope. It became clear early on that the only viable approach was through a fully-integrated 3D design system, one that enabled TTL to model the telescope, and to analyse the structure to make it as light as possible, as strong as possible, and as easily manufacturable as possible. The chosen system had to play an integral part in TTL's operation.

It had to be solid-modelling based. It had to be parametric. It had to have powerful table-driven design functions. It had to have a fully-integrated analysis application and it had to have high-performance static and dynamic visualisation capabilities. The CAD system needed all these attributes because the company needed to be able to create a full working model of the telescope electronically, before committing to high and irreversible

expenditure on actually manufacturing the instrument. Any errors at the manufacturing stage threatened the whole viability of the project.

Fortunately, Mansfield's experience with Autodesk products when he was at the Royal Greenwich Observatory stood him in good stead. He knew that Autodesk had the solution. As he says, " It's the standard in this business, it's the standard in research, so you are sure of compatibility". The system is based around Mechanical Desktop® 4 Power Pack (MDT) 3D solid modelling, surface modelling, and engineering design software from Autodesk. In addition to the 3D modelling capability, the system has more than 800, 000 reusable 2D and 3D parts, holes, features, and structural steel profiles in 18 different standards and takes advantage of the intelligence built into the 2D and 3D content with intelligent placement capabilities.

The system also allows the generation of common machinery components such as standard shafts, cams, springs, belts and chain-drive systems and can easily perform the everyday engineering calculations needed to create, edit and test designs. For TTL, the value of such a system goes beyond being able to model the system in 3D. This in itself gives them very great benefits in terms of the speed and accuracy of design, and the time saved by the automatic creation of working drawings from the computer model. There is also great benefit in being able to analyse the static and dynamic performance of the telescope because the strength and integrity of the structure and the range of motion of any mechanisms can be checked before any parts of the telescope are manufactured. This approach has enabled TTL to prove the design of the instrument before it spends high and usually non-returnable amounts of money on materials and manufacturing set-up. And <https://assignbuster.com/telescope-technologies/>

because TTL can show its prospective customers how the finished telescope will appear, through the use of 3D visualisation software, TTL can eliminate the cost and time involved in creating physical prototypes, and customers can see in advance what they are getting.

This can save a significant amount of time and money by eliminating unnecessary journeys to TTL's premises. And since this is a global business, such journeys can be very time consuming, very expensive, very stressful, and in this age of air traffic congestion, very unpredictable. To achieve all this, TTL make active use of MSC Working Model FEA® and MSC Working Model Motion® to provide first-cut static and motion analysis of the telescope. These two software packages are fully integrated into TTLs design system. They operate on the actual 3D model, without translation and without data exchange. MSC Working Model FEA provides TTL's engineers with the capability to analyse the static performance of their designs under load conditions.

Working Model FEA allows the engineers to optimise designs before passing them into Ansys® for detailed and exhaustive final analysis. This speeds up the analysis process because it reduces the number of times that a full analysis has to be carried out. Whilst a full analysis is very exhaustive, and the only real way to fully analyse the design, it is also relatively complex and time-consuming and requires appropriate expertise. Working Model FEA is intended for use by design engineers as part of the everyday design process. MSC Working Model Motion allows TTL's design engineers to analyse the action and range of motion of various parts of the model, thus ensuring that

all the parts and assemblies fit together properly, and move in the way they are intended to move, before the telescope is manufactured and assembled.

This means that assembly times are reduced because errors are reduced to a minimum. All part of the benefits of “ getting it right, first time, on time”. Having a complete electronic model of the telescope is key to TTLs objective of eliminating prototypes. This “ virtual prototyping” is completed through the use of another Autodesk product - 3D Studio MAX®. TTL transfers the electronic model of the telescope into 3D Studio MAX so that it can be photo-realistically rendered and animated.

So realistic are the images produced that one prospective customer visiting TTL’s factory fully expected to see the finished result in the workshop. The assumption was made that the images were photographs of the real thing. One practical example of the benefits of the 3D design approach taken by the company can be seen in the design and manufacturing of the telescope yoke. This complex design, comprising a series of tubes of different diameters welded together to make an extremely rigid yet lightweight fabrication, normally represents quite a problem for the fabricators. The yoke tube intersections are highly complex curves and must fit exactly if the structure is to meet its performance criteria.

This fitting process is expensive and time-consuming. On this occasion, TTL delivered the electronic design data to it’s fabricators in IGES format. The fabricators used this data to cut the tubes, and no additional fitting was required. The welded structure was completed in just 6 weeks, down from the normal 10 weeks. Overall, some 2 to 3 months was saved compared with



using 2D CAD. Following the success of this electronic communication with one of its subcontractors, TTL is now communicating electronically with more and more of its customers and suppliers.

The benefits are clear: faster, more accurate, more trusted and more effective exchange of knowledge and information. Of course, the benefits of TTL's approach have been available for many years. Indeed, the aerospace and automotive industries have been pioneering users of such systems. But with investment levels of £500 million or more to create a new car model, the high cost of older-generation systems has not been too much of a problem. What is new is that PC-based systems from companies such as Autodesk and its partners have taken the lead in price-performance, in ease-of-use, in functionality and in actual software technology.

Economy-of-scale really does apply here: as the volume of PCs made and sold increases, so does the money that is available for hardware manufactures to invest in advanced technology. . And because the market is so big, the investment is amortised against high volume. The same applies to the software too. In the last decade, the price-performance ratio of such systems has improved more than 10-fold.

One of today's systems costing less than £6, 000 is faster, far more capable, and far more easy-to-use than systems costing more than £40, 000 just 6 short years ago. For TTL this has meant that their operation actually became viable. Without the low cost and high performance of the 3D design system, they would not have had the competitive edge that has enabled them to run such a successful business. Now the company is looking to develop the

system further, to make the workshops' task easier and faster. Having seen what the system has done for his colleagues, Nick Ferneyhough, Works Manager adds: " I need to be able to look at the working drawings on the shop floor, electronically, and red line them if necessary, so the designers can make any changes quickly and easily".

In fact, TTL can implement this very quickly and at virtually no cost.

Configuration management is also an area for development. In the future TTL will look at the options in this area, including Motiva, the Autodesk invested partner in this application area. But how did TTL ensure that they got the right solution? Most systems of this size, for companies of TTL's nature, are supplied through value-added resellers. Autodesk may supply the right software, but it takes solution and systems integration skills to implement and support such a system.

TTL's CAD system is looked after and supported by Tech Solutions of Blackburn, Lancashire. Mansfield says, " it's very much a personal thing. Dealing with Tech Solutions we are dealing with people: people who know their business, people who understand our business and its needs, people who work as part of the team". All in all, as well as increasing the competitive position of the UK's only remaining manufacturer of telescopes, the Autodesk solution is helping TTL to create high-quality sales proposals and quotations faster and better, so helping it win more and better business. Managing director Mike Daly, head-hunted in Singapore where he was Hanson's Asia-Pacific manager, wants to source as many of the fabrication components locally as possible- for good social as well as commercial reasons - but his experience so far has not been encouraging. The machined

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items, four metres across and weighing 2-3 tons, are too large for Merseyside's engineering workshops to handle.

" It's surprised us given the shipbuilding tradition of the area," says Daly. Daly adds " We are one of the first of a new breed of truly original high-tech companies to be established on Merseyside. We are widely regarded as a classic model of the " knowledge-driven" companies the Government is keen to promote. We are very pleased with the part that Autodesk has played in this".