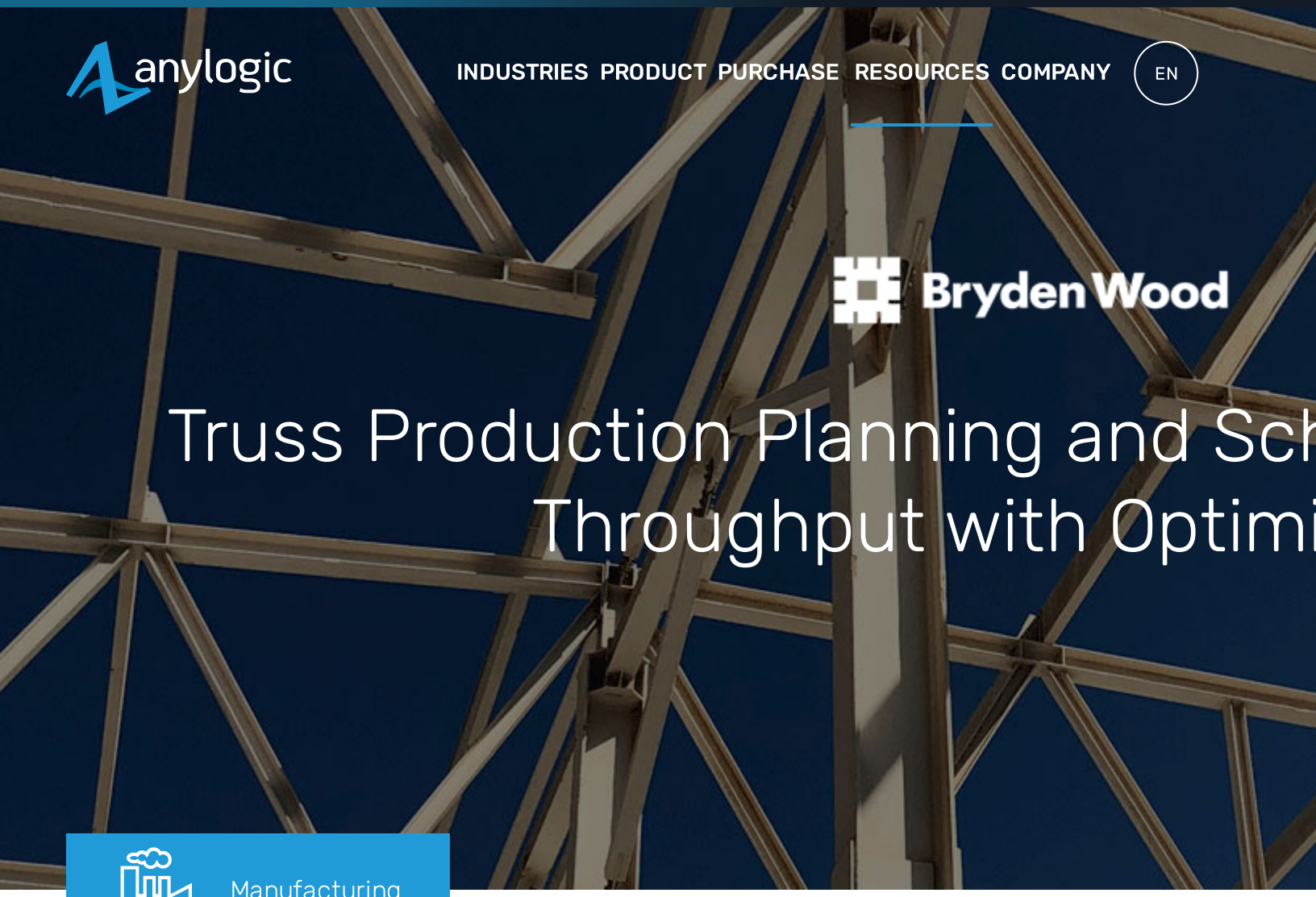


Bryden Wood

Truss Production Planning and Sch
Throughput with Optimi

Manufacturing

Bryden Wood is a global company of creative technologists, designers, architects, engineers, and analysts. They have integrated expertise in the theory and practice of Modern Methods of Construction, the Platform approach to Design for Manufacture and Assembly, and automation in construction.

The FASTtruss project highlighted in this case study was developed by Bryden Wood in collaboration with Tata Steel and the Advanced Manufacturing Research

and optimization in the construction industry

> A lattice truss is an infrastructural design component used in construction applications. It consists of interlaced chords that are cross-linked horizontally and diagonally to provide stability and support to a structure. Source: Corrosionpedia.

Lattice trusses are often bespoke and manufactured with intensive labor input, manual handling of materials, and are limited in repeatability.

The construction industry is typically slow to adopt new processes and technologies. Thus, it has had little improvement for decades, whereas other sectors have increased productivity. Traditionally, everything is focused on-site using bespoke elements and processes. This means poor efficiency and an inability to repeat and scale.

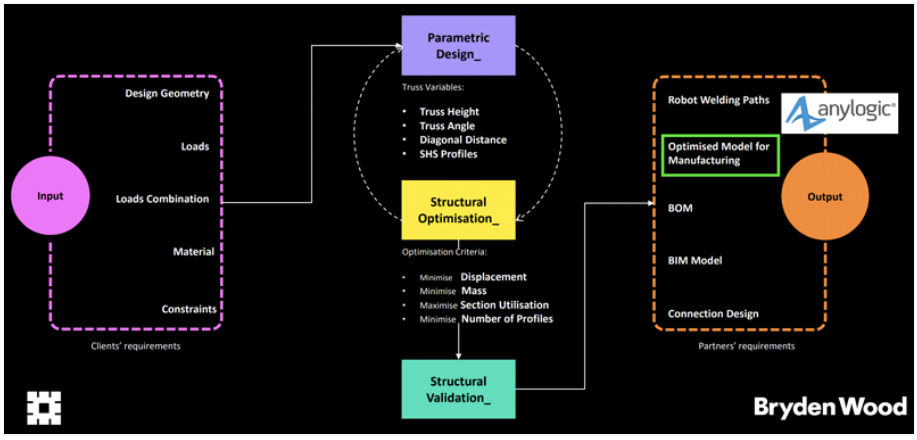
Truss production and assembly can be done in an off-site factory with high levels of automation, including robotic cells. Storage, shipping, and on-site installation are faster and more efficient, with reduced working at height improving safety, when using automation. As a part of the digital workflows, simulation could play a vital role in these projects to make them faster and smarter.

Solution: Creating a simulation to support production planning

considered only core process timings with no constraints on the availability of resources (e.g., people, additional equipment) and no equipment breakdowns or maintenance. Also, no changeover times were considered between truss types in each welding stream. Brace and chord grinding areas as well as painting bays were assumed to have unlimited capacity without bottlenecks.

Then Bryden Wood decided to create an optimized model. AnyLogic was chosen for the simulation because of its built-in libraries, which provide a fast and flexible platform for development. Production simulation software enables stakeholders to analyze manufacturing systems, evaluate the impact of system changes, and make informed decisions. As the simulation is built using knowledge from existing mathematical models, it allows further dynamic analysis.

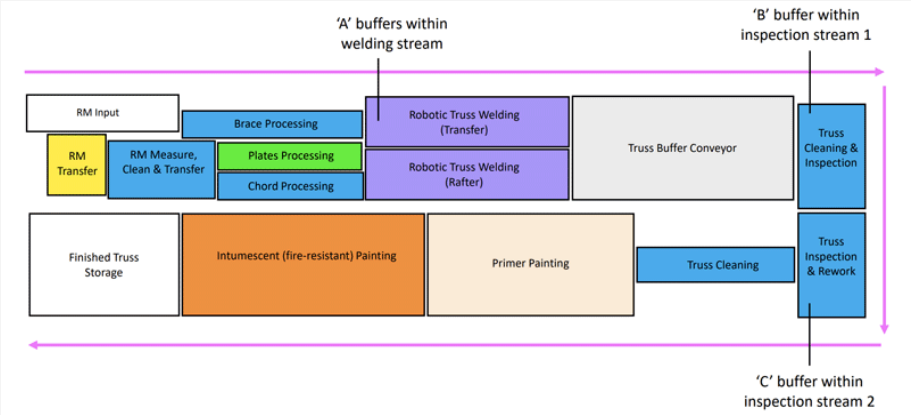
In the picture below, you can see the optimized production model that was a part of the automated design workflow.



Automated design workflow for the production planning and

consist of chords, braces, and connections. These trusses can be assembled in 2 different ways: rafter or transfer.

In the picture below, the approximate factory layout is demonstrated.



The truss factory layout used for production planning and scheduling (click to enlarge)

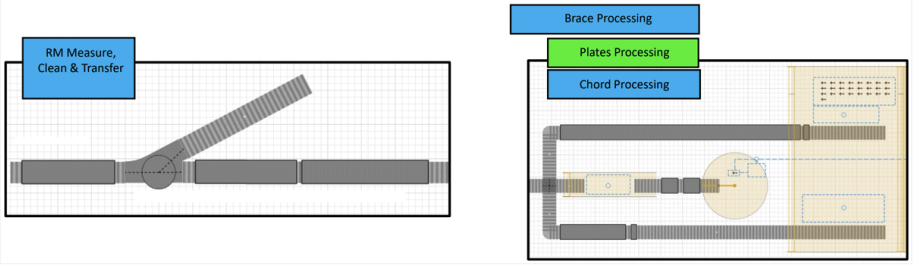
Inputs for the production planning and shedule optimization model included the following:

- Process flow, cycle times and timings
- Truss types, dimensions, and quantities
- Production schedules
- Logistics

Outputs were the following:

- Accumulation and sizing of buffers
- Number of processing stations
- Factory throughput
- Indications of bottlenecks

painting and storage areas, were included in the simulation model. In the AnyLogic model, the developers could easily represent the correct capacities and dimensions.



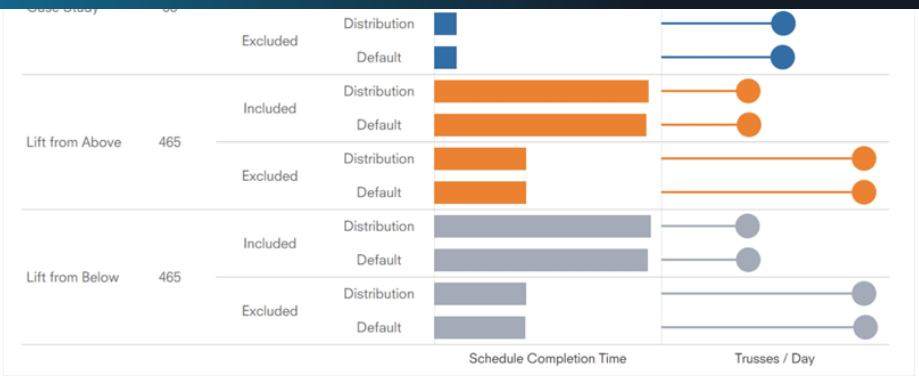
The parts of the factory layout in the AnyLogic production planning and scheduling optimization model

In the process of transferring materials to agents, Bryden Wood decided to simplify the model by batching raw materials and components together. In the real system, a single truss type (including all of the chords, braces, and plates) will be converted in individual batches with the correct parameters and dimensions. It will also be generated in the model based on the production schedule. They will be processed through the different streams depending on the type.

Truss production planning and scheduling results

Using AnyLogic simulation software, Bryden Wood was able to test a few different scenarios to increase the factory throughput and optimize the schedules. They excluded transport times to get a 'best case' boundary output.

Also, depending on the lifting methodology of the final



Schedule completion time and daily throughput (click to enlarge)

As the model developers expected, the inclusion or exclusion of process times made the most difference in the results. One of the other indications was how much of the demand could be fulfilled by one factory such as this.

The variation of 20% in process timings only resulted in slight output variations, indicating the potential acceptable range when considering equipment and process options. The exclusion of process timings provided the largest difference in outputs and highlighted the potential to investigate layouts and transport or transfer methods further.

Bryden Wood also looked at the sizing of the hold, priming, and intumescent painting areas. They found out, at an early stage, that the production schedule had an impact on the sizing of these areas, which was important for facility sizing, resource requirements, and cost.

Some area sizing and throughput figures were similar to what had been predicted by the project team. However, the simulation indicated that other areas

Wood aims to further investigate and optimize production schedules, facility layouts, as well as reliability, downtime, and working time constraints.

The expansion of scope could be done for resource usage, raw material receipt and storage, finished truss storage, packing and dispatch, as well as the wider supply chain.

The case study was presented by David Reader, of Bryden Wood, at the AnyLogic Conference 2022.

The slides are available as a PDF.

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