

INCREASED PRODUCTIVITY THROUGH AUTOMATION ALONG THE PROCESS CHAIN IN ADDITIVE MANUFACTURING

Automation of Additive Manufacturing

(A technical article from 2020, author: Stefan de Groot, Technology Manager and Project Manager for Additive Manufacturing, Protiq GmbH, Blomberg)

Additive manufacturing offers enormous potential for industrial applications thanks to a significant increase in design freedom compared to conventional manufacturing processes. To be able to put the advantages of these new degrees of freedom to good use, especially from the standpoint of cost-effectiveness, manual process steps need to be automated and linked. In this way, productivity can be increased considerably and additive manufacturing can be taken to a new, industrial level. At Protiq, too, automation has played an important role since the online platform went live in December 2016 and forms the foundation of the digital business model.

Automation was already practiced by the parent company before the spin-off

Even before it was spun off as a subsidiary of Phoenix Contact GmbH & Co. KG, the tool-making unit formerly known as “Rapid Solutions” was able to follow full automation in conventional manufacturing at close quarters. Phoenix Contact’s in-house tool shop is among the top performers in its field and one of the best in the German-speaking region. As a participant in the prestigious “Excellence in Production” competition, the tool shop has already been named overall winner and “Tool Shop of the Year” twice. Not least, these awards were achieved through the consistent implementation of Industry 4.0. This is particularly evident in a fully linked, automated production cell.

This spirit with regard to technological progress and the continuous drive for innovation was intended to be part of the corporate DNA of the spun-off subsidiary from the very beginning. Accordingly, the automation of



▼ Complete and intelligent linking on both the digital and the analog level: at Protiq, automation already starts on the digital platform and continues along the entire process chain

manual process steps was already taken into account when Protiq was founded.

Here, both the digital side, based on the continuously growing platform at www.protiq.com, and the analog side, in the form of intelligent linking in production, are essential factors of equal weight. They come together on the shop floor and interlock all the way to the delivery of the customer order.

The digital platform offers customers complete flexibility

On the digital level, Protiq maps manual process steps such as quotation, the ordering process, production planning as well as material handling and the end-to-end traceability of orders in an automated process chain. In this way, the great advantage of speed in additive manufacturing in particular can be retained and exploited.

Customers can flexibly upload their individual CAD data set to the website at any time. They then receive visual feedback on their model along with immediate information on the costs for all available materials and the corresponding delivery time. Once the configuration



Fully linked, automated production cell in the in-house tool shop of Phoenix Contact GmbH & Co. KG as an example of the consistent implementation of Industry 4.0.

process is complete, an order can be placed immediately via the shopping cart or shared as a project.

Once the customer has placed the order, it is imported into the ERP system, manufacturability is checked in detail, and the order is entered into order management and production planning. At the same time, the delivery date is communicated, and the customer is also kept continuously informed about the current production status. Via the production planning system (PPS), the customer order is accompanied digitally from the time of ordering through to delivery and enriched with further information at every process step. This creates a digital component file parallel to the production process that contains all the necessary information, such as the routing card, measurement reports, build job layout and design.

In this way, identical production can be ensured even long after the order has been completed. This factor is of great importance especially in series production, since reliable reproducibility must be ensured.

Analog production on the shop floor pursues the goal of intelligent full linking

In parallel with the PPS, analog production at ProtIQ is also pursuing the goal of full automation and is already partially automated in many areas. In 2019, for example, the entire powder handling in plastic laser sintering, from powder feeding and powder transport through to

powder supply, was successfully automated. The entire powder handling is implemented via a fixed piping system. The custom-developed control system synchronizes new, used and build powder silos, unpacking stations as well as sieving and mixing units, evaluates requirements and ensures the automatic supply of processable build powder to the laser sintering machines, so that continuous production can be achieved.



Thanks to automated powder handling, the systems in plastic laser sintering are continuously supplied with build powder

Automatic part recognition as decision support in post-processing

In post-processing, too, partial automation is possible through the use of a decision support system. This technology enables parts to be automatically assigned from a large number of components to the correct order after the build process. This is a great advantage, especially for plastic laser sintering, since this manufacturing process makes it possible to produce not just one part but any number of different parts in a single build

space. These are nested three-dimensionally in space and must be separated and sorted again after the manufacturing process. The automated part assignment is based on autonomously operating deep learning algorithms – often also referred to as artificial intelligence – and can be developed specifically for this application.

This support system drastically reduces the time required for sorting, as the operator can spread several parts out on a scanning surface, start the software and then turn to another task. As soon as the assignment process is complete, the desired order can be selected. The corresponding parts are then highlighted in color with the aid of a projector and can be sorted accordingly. In addition to reducing manual effort, this also lowers the potential for errors.

Transparency for the customer as a delight factor

In line with the guiding principles “Precise. Fast. Reliable.”, ProtIQ focuses on the customer and their part – in the age of digitalization, it is particularly important to offer the highest possible transparency. In addition to the marketplace function on the ProtIQ platform, customers should be able to participate in the manufacturing process as closely as possible.

End-to-end automation at ProtIQ on the digital level makes this possible. In the target state, customers



▼ Automated part recognition uses industrial camera technology for the visual capture of a wide variety of geometries. By interacting with a touch display, the correct parts for each order can be highlighted in color via a projector and sorted

should know exactly at any time which process step their parts are currently in.

Further information:

www.protiq.com

Partially automated production line for series production

Analogous to the major automation steps in plastic laser sintering, ProtIQ is currently developing a partially automated production line for metal laser melting (SLM). Together with a large number of industrial partners, the entire process chain of the SLM process is being analyzed for this purpose. This holistic view of the entire value creation process covers all sub-areas, from the idea for the part and the design based on it, through simulation, optimization and the defini-

tion of requirements, to manufacturing and post-processing including comprehensive quality assurance.

The basis of this joint project is initially the loose linking of individual process steps for metal laser melting. On this basis, a continuous process chain for hybrid series production is then to be created, in which a combination of additive and conventional manufacturing is implemented in both hardware and software.