Automation of additive manufacturing

Increased productivity through automation along the process chain in 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. In order to implement the advantages of these new degrees of freedom in a meaningful way, particularly in terms of cost-effectiveness, manual process steps need to be automated and interlinked. This can greatly increase productivity and take additive manufacturing to a new, industrial level. Automation has also played an important role at Protiq since the online platform went live in December 2016 and forms the foundation of the digital business model

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Complete and intelligent linking at both digital and analog levels: with Protiq, automation starts on the digital platform and continues along the entire process chain.

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

Even before it was spun off as a subsidiary of Phoenix Contact GmbH & Co. KG, the toolmaking unit formerly known as "Rapid Solutions" was able to follow the full automation of conventional production at close quarters. Phoenix Contact's internal tool shop is one of the best in its field and one of the best in the German-speaking world. 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. These awards were achieved not least thanks to the consistent implementation of Industry 4.0. This is particularly evident in a fully interlinked, automated production cell

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

This spirit with regard to technological progress and the continuous drive for innovation should also become part of the corporate DNA of the spin-off subsidiary from the very beginning. Accordingly, the automation of manual process steps was already taken into account when Protiq was founded.
Both the digital side based on the continuously growing platform at www.protiq.com and the analog side in the form of intelligent interlinking in production are essential factors of equal importance. These flow together on the store floor and interlock until the customer order is delivered.

The digital platform offers the customer complete flexibility

At the digital level, Protiq maps manual process steps such as quotation preparation, the ordering process, production planning, material handling and the end-to-end traceability of orders in an automated process chain. This allows the great advantage of speed to be maintained and exploited in additive manufacturing in particular.
The customer can flexibly upload their individual CAD data set to the website at any time, analyze it and even have it repaired automatically. In addition to visual feedback on their model, they then receive immediate information on the basic manufacturability, the costs for all available materials and the associated delivery time. Once the configuration process is complete, an order can be placed immediately via the shopping cart or shared as a project.

Once the order has been placed by the customer, it is entered into the ERP system, the manufacturability is checked again in detail and included in order management and production planning. At the same time, the delivery date is communicated and the customer is continuously informed about the current production status. The production planning system (PPS) is used to digitally track the customer order from the time the order is placed through to delivery and enrich it with additional information at every step of the process. This creates a digital component file parallel to the production process, which contains all the necessary information, such as route cards, measurement reports, job layout and design.

This ensures identical production long after the order has been completed. This factor is particularly important in the area of series production, as reliable reproducibility must be ensured.

Analog production on the store floor follows the goal of intelligent full interlinking

Parallel to PPS, Protiq's analog production is also pursuing the goal of full automation and is already partially automated in many areas. In 2019, for example, the entire powder handling process in the area of plastic laser sintering was successfully automated, from powder feeding to powder transport and powder supply. The entire powder handling process is implemented via a fixed pipe system. The individually developed control system synchronizes new, old and build powder silos, unpacking stations as well as sieving and mixing units with each other, evaluates requirements and ensures the automatic provision of processable build powder at the laser sintering machines so that continuous production can be realized

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Automated powder handling ensures that the plastic laser sintering systems are continuously supplied with building powder.

Automatic component recognition as decision support in reworking

Protiq also uses a decision-support system to partially automate post-processing. This specially developed technology makes it possible to automatically assign the correct order from a large number of components after the construction process. This is particularly advantageous for plastic laser sintering, as this manufacturing process makes it possible to produce not just one component, but any number of different components in one build space. These are nested three-dimensionally in the space and must be separated and sorted again after the manufacturing process. The automated component allocation is based on autonomous deep learning algorithms - often referred to as artificial intelligence - and was developed specifically for this application.

This support system can drastically reduce the time required for sorting, as the operator can spread out several components on a scanning surface, start the software and then move on to another task.

Once the sorting process is complete, the desired job can be selected.

The corresponding components are then marked in color using a projector and can be sorted. In addition to reducing manual effort, this also reduces the potential for errors.

In automated component recognition, industrial camera technology is used to visually capture a wide variety of geometries. By interacting with a touch display, the correct components for each order can be color-coded and sorted using a projector

Transparency for the customer as an inspiring feature

According to the guiding principles "Precise. Fast. Reliable.", Protiq's focus is on the customer and their component - in the age of digitalization, it is particularly important to offer the greatest possible transparency. In addition to the marketplace function on the Protiq platform, the customer should participate as closely as possible in the production process.
Protiq's end-to-end automation at the digital level makes this possible. In the target state, the customer should know exactly which process step their components are currently in at all times.

Semi-automated production line for series production in the automotive industry

Similar to the major automation steps in the field of 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 SLM process chain is being analyzed. This holistic view of the entire value creation process covers all sub-areas from the idea of the component and the design based on it, through simulation, optimization and definition of requirements, to production and post-processing, including full quality assurance.
The basis of this joint project is initially the loose linking of individual process steps for metal laser melting. On this basis, an end-to-end process chain for hybrid series production is then to be created, in which a combination of additive and conventional production is realized on both the hardware and software side.

Further information:
www.protiq.com