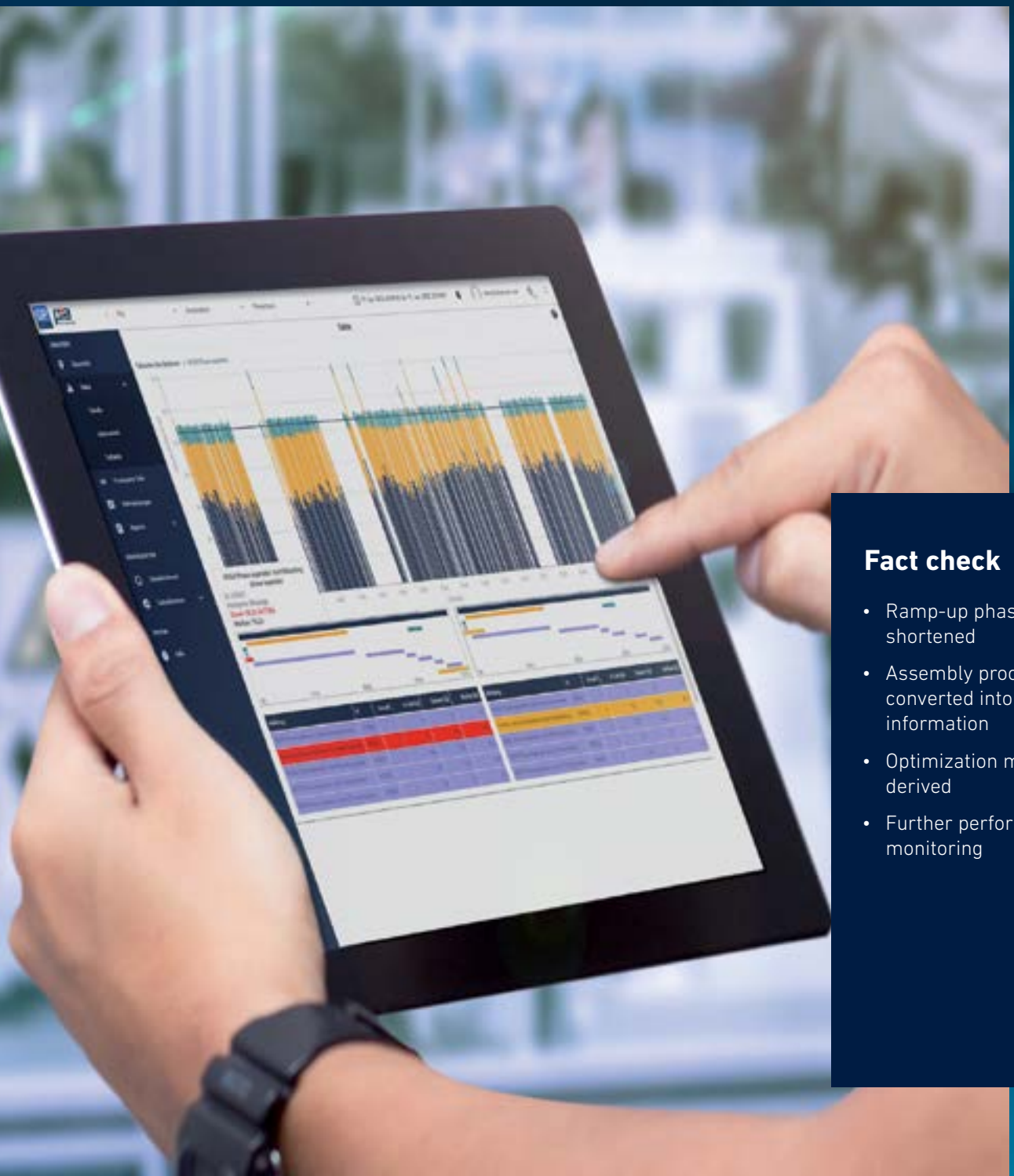
EN

CASE STUDY ZF SCHWEINFURT

SIGNIFICANTLY BOOST THE OEE IN THE RAMP-UP PHASE WITH piaOPTIMUM



Fact check

- Ramp-up phase significantly shortened
- Assembly process data converted into relevant information
- Optimization measures derived
- Further performance monitoring

DETECTING SOURCES OF ERROR AND RECTIFYING THEM SUSTAINABLY

THE RAMP-UP PHASE FOR NEW ASSEMBLY LINES IS ALWAYS AN EXCITING PROCESS:

Is the system working as planned, are the stations well coordinated, is the material supply right, are the employees well prepared for their activities? Experience has shown that start-up difficulties arise in each ramp-up phase, such as excessively high scrap rates or unstable cycle times. Technology and logistics, as well as the processes between man and machine, have yet to get used to it. The aim is to work out the desired Overall Equipment Effectiveness (OEE) piece by piece. It's good if inefficiencies can be quickly identified, analyzed, and eliminated during this sensitive phase. In the case of complex lines with many stations, it is often difficult to determine the exact source of interference in a targeted manner to remedy the situation.

To optimize performance, the automotive supplier ZF used the piaOptimum software application on the entire system at its Schweinfurt site during the ramp-up phase for a production line for electric motors. The analysis tool was developed by PIA Automation and is a good complement to the analysis tools already in place.

Individual pieces, such as the rotor and stator, the gearbox, and the power electronics, are assembled into an electric drive for automobiles on the production line. In the start-up phase there are more than 30 stations and a cycle time of three minutes. The line has a high degree of automation with several robot cells and numerous automatic stations. In addition, however, many manual activities are also carried out, work preparation and logistics are added, as well as maintenance. All processes between man and machine should be optimally coordinated and adapted.

> Thanks to piaOptimum, we were able to significantly increase overall plant efficiency after the first optimization phase. In performance runs under optimum conditions, the OEE was just under 90 percent - a great value. We will now optimize the plant and the processes even further.
>
> Sebastian Krause, Manager Manufacturing and Engineering at ZF

SIGNIFICANT INCREASE IN OEE

The OEE (Overall Equipment Effectiveness) value, which is made up of the three sub-factors quality, availability, and efficiency, is always the key metric for assessing line performance. During the ZF ramp-up phase, there were difficulties in every OEE sub-area, but they were identified, analyzed, and evaluated using piaOptimum. As a result, the ramp-up phase was significantly reduced and the OEE was greatly increased.

The primary focus was on the minor process disturbances that occurred in partial cycles within the stations but were difficult to detect. The piaOptimum analysis tool, on average, reduces the ramp-up time for customer systems by several weeks while also saving personnel resources

During the service assignment for plant analysis and optimization, a joint team of experts from PIA Automation Austria and customer specialists (from logistics, maintenance, quality assurance, work preparation, process optimization departments) was formed, which was then divided into working groups.

Michael Juwan, Global Expert PIA4.0 at PIA Automation Austria, describes the procedure: "With piaOptimum, which takes the most important data from the line and processes it transparently and comprehensibly, errors could be clearly detected. We then evaluated them: Where are the problems and bottlenecks? When and why do they occur? What losses do they cause? This made it easier to prioritize them and assign them to the right work team. For example: Is the topic more relevant for maintenance or work preparation? In this way, we were able to generate work packages and have them implemented by the individual teams according to assigned priority. In retrospect, a further evaluation was important in order to check whether the measures taken were successful. In this way, it could be ruled out that the supposed improvements would cause other problems. "

On one hand, the collisions clearly lead to increased cycle times (intervention required), but, on the other hand, they also lead to a higher NIO probability. The figure shows only simulated system data.

Blue: *Cycle time of a single component*
Green: *Collision during the tightening process*
Red: *NIO component*

STATUS BEFORE THE START OF THE PROJECT

At the beginning of the project, some stations were not stable at cycle time. The assembly line had a considerable amount of scrap and the logistics and feeding processes were not yet properly coordinated, so material availability was not optimal.

As a result, the assembly requirements for the operators were not yet a perfect fit. For example, rejects – i.e., NIO components (non-in-order components) – mean disadvantages and costs in several respects. A rejected component would need to be dismantled and reassembled, costing time and resources because it requires an employee and an assembly station. However, not every component can always be adequately dismantled because, for example, pressing processes cannot be repeated. In this case, it would be disposed of completely.

The ultimate task of piaOptimum is finding the cause of the error. This can be accomplished on a minuscule scale; with the program capable of recording every side process at a station down to the partial cycle level and detecting fluctuations and anomalies.

TRANSFORMING DATA INTO RELEVANT INFORMATION

Using its years of experience in specialized machine construction, PIA Automation has developed piaOptimum- a tool that converts specific data of the assembly process into information, calculates it and presents it in a way that is visually easy to comprehend. Being a bottom-up process, piaOptimum records comprehensive data at the process level and continues to simplify the presentation as it moves upward. In this way, the problem can be detected at the highest level and analyzed downwards, with the ability to check in increased detail until the root cause of the performance problem is determined. Systematic problems, faulty processes and incorrect use of stations are revealed.

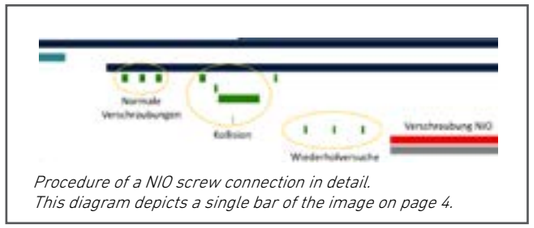
piaOPTIMUM FOR FURTHER PERFORMANCE MONITORING

Even with the completion of the ramp-up phase and the transition to stable production, piaOptimum continues to be used as a valuable tool to detect possible minor malfunctions and deviations from the target performance. In this way, process optimizations can continue being carried out and the cycle time can be further reduced.

COLLISION OF A SCREW WITH A COMPONENT AS A CAUSE OF NIO PART

In the following, an example of a quality problem based on the process data from piaOptimum will be presented: A screwdriving station caused excessive scrap rates. Since the screw did not appear to meet the tolerance, it was initially suspected that the quality of the screw was the reason for the high proportion of rejects. In fact, piaOptimum was able to show that it was not the screw itself that caused the problems, but a collision of the screw with the component. As a result, a small amount of chips got into the thread, making the screw more difficult to screw which led to the components being defined as rejects.

According to piaOptimum, the NIO part was usually preceded by a collision. As an improvement measure, the feeding of the screws could be optimized in such a way that the screw, even when inaccurate in terms of dimensions, hits the drill hole exactly. Such problems can occur during the ramp-up phase, Michael Juwan knows: "If an incorrect tolerance of the screws is assumed and the machine is designed for it, the process cannot function smoothly. This only becomes apparent later in the ramp-up phase. With our software tool, we were able to uncover this small cause detail and thus reduce the NIO content at this station to a minimum. There are many little things that, when taken together, have a decisive effect. The final percentage points, which transform the line into a well-functioning production, are always the heaviest. piaOptimum works to make these crucial details visible. "
It was also important to support the employees on the line in their tasks and to optimize the processes in terms of feasibility for the operator. If a manual activity fails often, then it is likely the process is not well-designed for humans. In this case, assembly supports were found, e.g., that components could be threaded in better or lifted or positioned more easily.

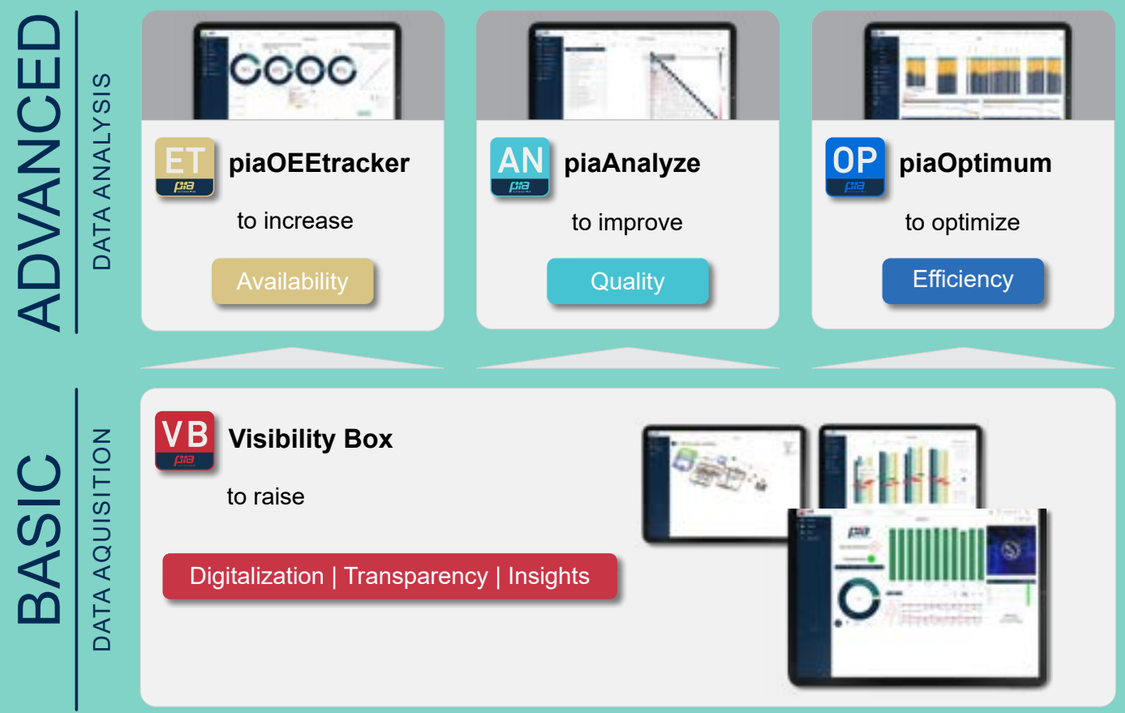


Procedure of a NIO screw connection in detail.
This diagram depicts a single bar of the image on page 4.

LESSONS LEARNED: TRAINING CELLS, ASSEMBLY AIDS AND OUTSOURCED LOGISTICS

Overall, a large number of small but decisive optimzation measures could be derived and implemented in the project. The processes could be stabilized and cycle times shortened with the help of assembly support, process optimization, mechanical extensions, parameter optimization, outsourcing of logistics processes from the line, and employee training. In a very efficient method of training new employees, the project team set up training cells in which the most difficult processes are simulated to train new employees before they proceed to work on the assembly line. The consistent definition of logistics processes and responsibilities also had significant effects on improving assembly times. Responsibilities and work instructions were clearly defined once again, so that it was clear at each station which processes and actions had to be carried out and by whom.

> Our piaOptimum analysis tool collects the data direcly from the plant and prepares it transparently and comprehensibly. Sources of error can thus be quickly identified.
>
> Michael Juwan, Global Expert PIA4.0



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