Making improvements with AI and data science

Tofaş, winner of the Improvement System category at the 2019 International Quality Awards, was praised by the awards' judges for its outstanding example of a quality 4.0 case study. Dina Patel finds out how the Turkish car manufacturer has used artificial intelligence (AI) and data science to show how the effective use of information can lead to significant improvements, including lower defects and higher customer satisfaction

Photos: Tofaş

Photo: CQI

Established in 1968 in Bursa, Turkey, car manufacturer Tofaş produces Fiat Egea Sedan, hatchback and station wagon models, at its Bursa plant. With an annual production capacity of nearly 450,000 vehicles, Tofaş is also a distributor, handling the domestic sales of six brands (Fiat, Fiat Professional, Alfa Romeo Jeep, Maserati, and Ferrari) in Turkey.

In recent years, the company has made improvements in quality KPIs. In 2019, the International Quality Awards presented Tofaş with the Improvement System award, which celebrates a team that has moved its organisation forward by establishing and delivering an effective improvement system. Hakan Ersoy, Quality Method and Planning Specialist at Tofaş, speaks to *QW* about why the organisation chose to adopt artificial intelligence and data science to specifically reduce the number of defects.

QW: **What is your role at Tofaş?**
Hakan Ersoy: My role is that of a method and planning specialist at Tofaş. My responsibilities include implementing world class manufacturing methods and tools, implementing the ISO 9001:2015 - Quality management systems standard, and developing defect management systems. I also work on projects relating to new data science, digitalisation of current processes, and robotic process automation.

QW: **How is quality structured at the organisation?**
HE: Quality consists of four departments at Tofaş. The first is Production Quality, which controls all quality-related processes and organises planned and urgent process audits. The second is Product Quality. This department controls our products from a customer's perspective by using special control methods such as the customer product audit. Model Quality is the third department which is responsible for organising improvement activities to achieve our targets. It also manages external key process indicators such as customer quality surveys and warranty costs. Finally, the fourth

What are your **three top tips** for developing a successful improvement strategy in an organisation?

1. Interpersonal communication and cooperation are very important in organisations. This will not be a difficult issue for a team that gives each other support.

2. Organisations that adapt to the modular and variable structure of today's conditions will be more successful. We find higher chances of success for organisations that can produce the fastest and most effective solutions such as customer demands and market variations.

3. Predict and plan the medium- and long-term future, not just the present. Business planning should support all employees, and this will ensure success.

department is Quality Engineering. They research, develop, and implement new quality methodologies and tools.

QW: **How has quality helped to steer the organisation towards continuous improvement?**
HE: We provide a competitive advantage with our understanding of quality, which is central to perceiving customer satisfaction. Quality control has helped to detect and prioritise errors, particularly where there is opportunity for improvement. Quality control also provides diagnostic support to help clarify the root causes for any issues we might encounter.

In addition, Tofaş has introduced a standard method for managing errors with the e-LUA Integrated Quality Management Platform. Through this platform, we ensure that the solutions for errors are commissioned in accordance with the methodologies presented in the World Class Manufacturing model. This model, according to Fiat Group Automobiles, is a structured and integrated production system that encompasses all the processes of the plant, the security environment, from maintenance to logistics and quality. World Class Manufacturers are those that demonstrate industry best practice. The prime goal for Tofaş is to continuously improve production performance.

QW: **What challenge did Tofaş hope to solve when it began using artificial intelligence (AI) and data science?**
HE: We wanted to analyse the cost of warranty repairs and analyse our data on the number of defects. This would help us predict future costs. However, our use of traditional tools and techniques meant that we were unable to manage and maintain all the data.

At this stage, we discovered that we could use integrated business intelligence and machine learning to increase data-driven decision-making in a variety of processes in the organisation, by using the relevant technologies and thus creating value from data. We can now estimate the cost of errors by using machine learning from big data.

QW: **Why did you begin using AI?**
HE: AI was used to predict what the future error rate and warranty cost would be by analysing data based on the current warranty cost data. Since the data we had was insufficient to make estimates, we tried to increase the quality of our data. Although we were not facing a high rate of defects or low satisfaction among customers, the

Tofaş and the International Quality Awards

Tofaş won the Improvement System category at the 2019 International Quality Awards. *Quality World* finds out what winning has meant to the organisation and how it will help them in the future.

Why did you enter the International Quality Awards?
In 2018, we entered the International Quality Awards for the 'Innovation through Quality Method' category and became a finalist. Using this experience, we applied for the 2019 awards to demonstrate and share our capability for creating new methodology and tools.

How did you find the application process?
It was very successful. Although I was in a different country, we encountered

extremely facilitating solutions in the application and presentation processes.

What does winning the award mean to Tofaş?
Our company has shown how much investment has been made in Tofaş and how we have advanced not only in vehicle production, but also in the field of system development. Industry 4.0 and digitalisation has moved to the top of the agenda for our company. The award is an honour for all of us.

How will the award help Tofaş in the future?
It will provide motivation for us to be a candidate for new awards. It also contributes the positive awareness for our company's quality approach.

reason we started using AI was to offer more opportunities for improvement. Our main purpose was to predict internal and external errors that may occur within the vehicle's guarantee period.

A forecasting model considered many effects such as trend, seasonality, and quality improvements of the components by taking insights from the warranty data from Qlikview (a business intelligence platform), that we had collected. We realised that we need to use AI to incorporate errors into our calculations to increase our accuracy before it was nearly 70 per cent and it was human based manual prediction. After we implemented AI, we have seen our accuracy rate increase to 95 per cent.

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effects such as trend, seasonality, and quality improvements of the components by taking insights from the warranty data from Qlikview (a business intelligence platform), that we had collected. We realised that we need to use AI to incorporate errors into our calculations to increase our accuracy. Before we implemented AI, our accuracy rate was nearly 70 per cent and it was human based manual prediction. With AI, our accuracy increased to 95 per cent.

QW: **What training did the team have and how did they adapt to using AI?**
HE: Our project team consisted of members from the ICT data science department, business expert users from the quality department and other supporting members ▶

How has Covid-19 affected the automotive industry?

Rob Brown, Global Head of Automotive at BSI, speaks to QW about how Covid-19 has affected the automotive industry. There is no doubt that the coronavirus pandemic, and consequently the unprecedented closure of manufacturing plants across the world, has had a far-reaching impact on the automotive industry.

Furlough, closure, consolidation and downward forecasts are sadly all common words and phrases used in conjunction with today's global automotive sector. In the wake of the coronavirus pandemic, production has slowed or stalled completely, and original equipment manufacturers (OEMs) have had to rethink and reschedule new vehicle introductions as new vehicle demand almost halts.

It is expected that global light vehicle production will fall more than 20 per cent to around 71 million units in 2020 (Automotive News, April). This prediction is of course dependent on how quickly global economies can recover and whether there are further outbreaks of the virus, resulting in full lockdown measures being reintroduced down the line. Either way, the pandemic has hit the sector hard and the recovery could take years.

Switching focus to the automotive aftermarket, this segment of the sector has tended to fair reasonably well in previous economic downturns, with consumers opting to retain their existing vehicles rather than make a new purchase. However, the Covid-19 lockdowns imposed worldwide have impacted here [in the UK] too, with vehicle miles travelled and the number of collisions reduced as a result. However, if China's example holds true for the rest of the world, where consumers' car usage levels have returned to pre-Covid-19 levels (McKinsey, May), and in a climate where public transport is reduced or avoided, the easing of lockdown restrictions and reopening of garages may conceivably result in a small upturn for the aftermarket, provided parts are readily available.

The broader automotive sector, including manufacturing, face the same challenges. In the very early stages of recovery they will be focusing on how to make facilities Covid-proof and how to safely return its workforce back into the manufacturing environment. Many manufacturers, including Ford, have developed comprehensive manuals which detail new guidelines and practices relating to the cleaning and disinfecting of workstations and common areas, measures for increasing handwashing, the placement of hand sanitisers, temperature-scanning on arrival, social distancing, the use of Personal Protective Equipment (PPE) including masks and face shields, and ramped up cleaning schedules.

With regard to supply chain disruption, we may see further parts shortages but also opportunities to rethink supply chain models, which will put the sourcing of raw and assembled materials under the spotlight. This includes reassessing the geographical diversity of supply chains to spread the risk away from a single region in case of further lockdown to minimise disruption to supply, reducing reliance on a single supplier. And setting up early warning inventory systems to help anticipate and mitigate material shortages, and perhaps rethinking 'just in time' lean methodologies.

There is much discussion in the media of a new reality following the devastating impact of Covid-19. It is unclear how long the recovery of the sector will take, but what is certain is that the impacts will be long-lasting and far-reaching. Health and safety, resilient supply chains, business continuity practices, sustainability frameworks and, of course, innovation, will all come under increasing focus and play a crucial role in rebuilding this great industry.

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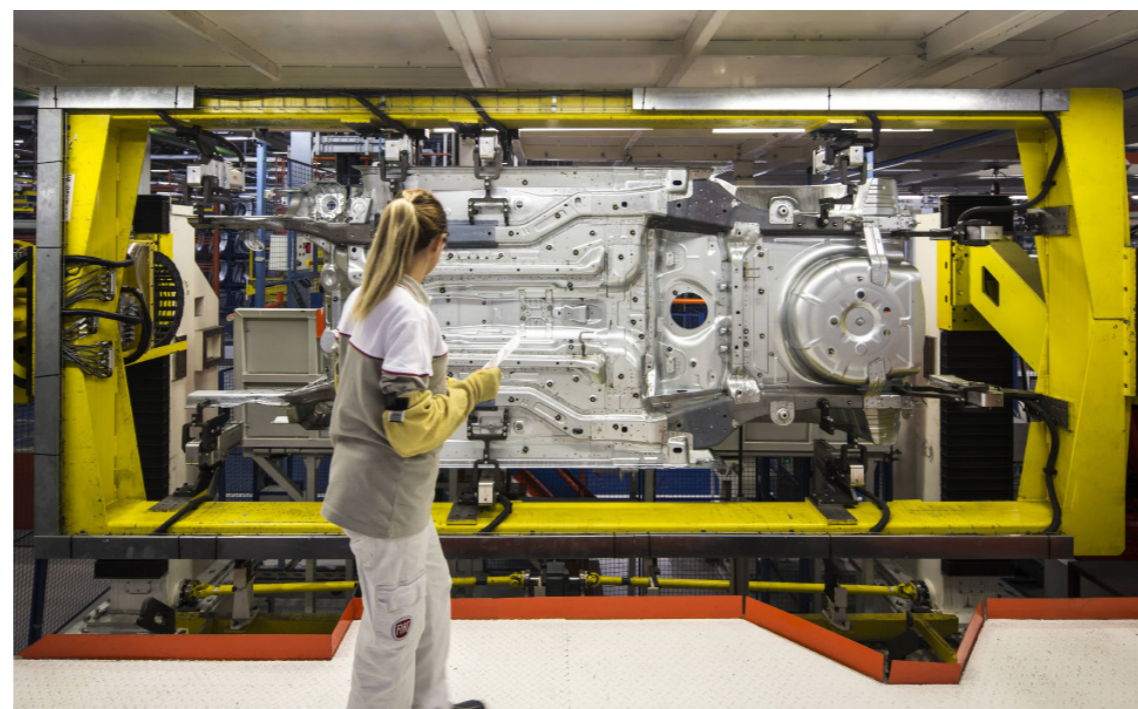
from business departments. Each team member had to undergo different types of training. For this reason, we chose our team members from people with the relevant skills. These skills included Fiat Chrysler Automobiles software usage, data science, and data crunching – when data is processed, sorted and structured to run algorithms and programme sequences on it. Skills also included software programming and R – a widely used statistical programming language – business intelligence reporting, and knowledge of visualisation environments such as Qlik Sense, a modular platform for developing and integrating business and AI solutions.

QW: How has Tofaş used AI and data science to reduce car defects?

HE: We have done this by making more accurate predictions about the potential errors that could occur in the future. This is so that we can be informed about the quality errors on the vehicle in advance. We already know about future issues that may arise and how to take precautions for them. This allows us to develop more effective solutions for them earlier in the production process.

AI has allowed us to understand how vehicles behave throughout their warranty life by analysing the defect realisation conditions from historical data, and this has given us the opportunity to take precautions and ensure our customers do not have to take their car in to be repaired as often. This has led to an increase in customer satisfaction.

QW: What were some of the challenges Tofaş faced when utilising AI and data science?

HE: It was not easy to collect all the data we needed to carry out machine learning, which uses statistics to find patterns in massive amounts of data. We also did not have enough data to conduct the data science side that would allow us to create algorithms and predictive models. We overcame this challenge by working with Fiat Chrysler Automobiles and have made improvements by using the business intelligence that was created from using the data analytics platform Qlik Sense.

We then went through a long process to build the data model based on the information we had collected. We analysed all data sources in detail and carried out data enrichment studies to identify defect characteristics and definitions, and vehicle characteristics, to make the data more meaningful and appropriate. We also worked closely with consultants from external firms and data scientists, as a group, to learn and teach each other.

QW: How has customer satisfaction improved since Tofaş began adopting AI and data science?

HE: We have predicted the mistakes that will occur in the coming years and started improvement activities for them; for example, the number of anomalies you might find in certain vehicle components. By doing this, we have already observed a 10 per cent improvement in our error and cost rates. This benefit rate will increase even more over the next few years.

Previously, we did not intervene with regard to some of our errors, since the frequency rate at which they occurred was low and so was the cost. However, we realised these errors were triggering other errors. Now when we see situations where some errors may lead to problems in the future, we run early measures.

QW: Prior to these improvements, what quality system did you have in place and how was it improved?

HE: Before this project, we used traditional warranty management systems. This included tracking and e-Sigi ++ Fiat, a system used to manage all Fiat vehicle updates and warranties, to monitor the data. These systems are very manual, and they provide very limited data. Analysing data from the old systems is very difficult. These old systems have been developed into a new business intelligence model called QlikView, which has a more compact design.

QW: What is the next big challenge for Tofaş and what role will quality play in meeting this challenge?

HE: Customer demands and expectations are increasing on a day by day basis. The systems we are developing are always being developed to ensure our customers are happy and satisfied. Our sole interest is to have a share in the automotive market and to manage our economy with high efficiency. The quality department tries to contribute to this by identifying development opportunities.

Our objectives are to further improve our quality management system and to match all internal quality indicators and activities at the design stage. I want to be able to construct a proactive, quality management structure. ∎