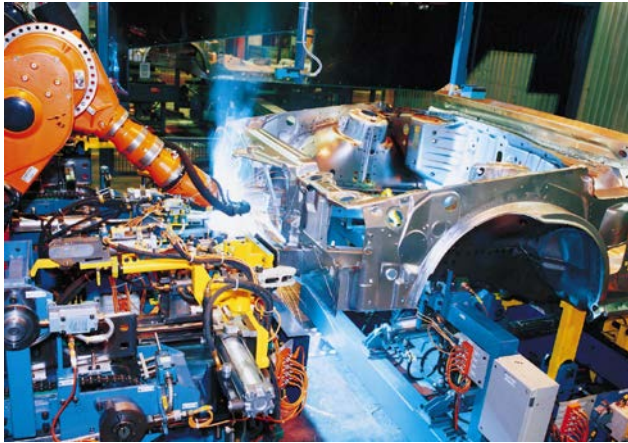






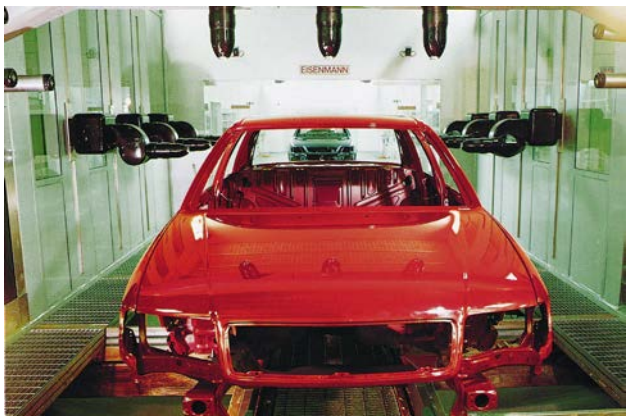
welding of sensitive points and points that were hard to reach. After that, the application was expanded to assembling of major connections and final assembling of a car body. At the present time, mainly the whole lines for car body assembling are robotized. For points with laser welding, robots were applied even earlier. There is a constant request for the reduction of these welding points. Even for car bodies assembled in this way, additional finishing is necessary, which is still manual. Production without errors is still only a goal.



*Fig.10 Application of robots in car body assembling*



*Fig.11 Laser control of car body on line*



*Fig.12 Robotized painting of a car body*

In recent times, structural adhesives are increasingly more used for connecting of car body parts. For initiation of such a method for connecting of car body parts, it is necessary to change the existing connecting technology completely, with obligatory preservation of very strict production conditions. Regarding the improvement of production quality, the conditions for control of finished car body and for introduction of laser control on the car body assembly line itself were enhanced, see fig. 11. This control is more important from the aspect of parts installation in the assembling process in which robots are used. Painting of a car body is being given more

and more attention with the purpose of getting as good appearance as possible and reducing errors to zero. Painting of a car body is mainly robotized, see fig. 12.

The process of vehicles assembling can be organized in various ways, depending on the producer. Fig. 13 shows the typical assembly line, where the process has been improved in the sense of better logistics and application of modern manual assembling tools. Introduction of new technologies, such as glass bonding, requires the change of assembling process which is realized on that work place. The application of a manipulator is frequent and the same ones are used for assembling of large and heavy sets (instrument panels, doors...). Robots are also used in the assembling process, for more complex operations and in large batches.



*Fig.13 Assembly line*

#### **4. Virtual designing**

Car industry had a plan to eliminate the manufacture of prototypes batch by using virtual designing and to go to production directly after the computer. What were the reasons for such optimistic expectations? The application of powerful computers, softwares for various purposes in the designing process as well as behaviour simulations were the causes for such expectations. The advantages of virtual designing are that the weak points on the construction are easily detected, e.g. contact points, see fig. 14. The detected point is either eliminated by modifying the construction or the conditions for undisturbed functioning are created.



*Fig.14 Modelling of the surrounding (car body)*

Big producers are leaving aggregates designing to collaborators nowadays. Conditions for installing are defined by the finalist. A collaborator is responsible for the success of his/her construction, such as fulfilment of valid regulations, elimination of all the errors in the batch and a guarantee period. The goal of each collaborator is to have his/her construction used in the first installing by which he/she acquires a reference, secure income and profit from the spare part. Along with the construction, calculations, i.e. simulations of certain processes, important for good operating of the vehicle, are realized, fig. 15. All technology departments are directly included in

the development process (manufacture of parts, safety, assembling, installing, quality, lifetime). Fig. 16 shows the simulation of the installation process, i.e. ergonomic studies at this work place.



Fig 15. Simulation of seat frame behaviour

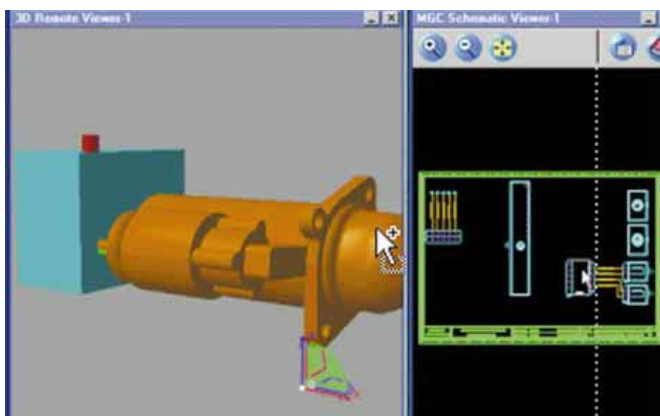


Fig.16 3D model

In this phase of the project, verification of technologic properties of the car part is necessary, as well as the construction of tools needed for manufacture of the car part. In addition to that, conditions of car part manufacture are simulated, especially for plastic parts, i.e. flowing process is simulated. Due to the stimulation of parts manufacture, it is possible to eliminate possible problems in this phase, i.e. to eliminate finishing works on the tool which could consume a lot of time.

Car industry strives to the production without the defective parts. For those reasons, the system of quality is getting increasingly greater attention. Advanced softwares are extremely useful in this process.

Company FIAT, as one of the leading companies worldwide, was the first to introduce a single model into a batch production (vehicle Fiat 500L), without manufacturing a batch of prototypes necessary for developmental investigations and project verification.

By the initiation of the production of model Fiat 500L, the new era in the batch car production began – introduction of the new model into the production without manufacturing a batch of prototypes.

In 2007, company FIAT started the production of model Fiat 500, and in 2012 the production of model Fiat 500L started. In 2013 a new model with seven seats was promoted, Fiat 500L trekking, a partially off-road vehicle.

The mark of both cars (500, 500L) indicates that these are two mutually connected models of vehicle, i.e. that model 500L was developed out of model 500.

For vehicle 500L, a concept of virtual designing was applied. According to information from company FAS site, the cancellation of batch of prototypes was accomplished due to:

- new architecture "Small Wide"
- thousands of hours of virtual simulations
- 200 tests of components and subsystems
- > 100 impact simulations

- > 100 impact tests.

It was not specified which subsystem tests were carried out and which were related to a car body, and in which phase of car body assembling. Over a hundred simulations of impact tests and a good basic vehicle were not sufficient to reduce the number of impact tests, which caused prolongation of the initiation of the production of the vehicle, modifications of the vehicle and increase of costs.

In the applied concept, the main project was handled by the finalist – starting with style, 3D forming, creation of a research, all the way to calculation and process simulation. The entire process was realized on the computer, by application of modern designing packages. The process was simplified by the fact that the data from project Fiat 500 were used (modified platform, developed and tested engine compartment etc.). In addition to all these advantages, over 1000 virtual simulations necessary in this phase of the project were realized. The processes of all simulations were probably shortened considerably, since no major problems were to be expected.

A modern designing process implies a complete responsibility of the finalist for the definition of the vehicle platform.

## 5. Conclusions

A new era began in the designing and development of vehicles – production initiation without a classic vehicle. Vehicle prototype was replaced by a test batch vehicle. Such a procedure probably shortens the time of new model initiation and reduces the development costs. Responsibility of the finalist is partly transferred to other participants in the production process (components producers, equipment producers etc.). In the following period, greater centralization of the development can be expected for some finalists.

## 6. Literature

- [ 1 ] Milovanović M.: Designing of a car body, monograph, Faculty of Engineering, Kragujevac, 2013, ISBN 978-86-86663-993.