

# METHOD OF UNIFICATION OF THE COMMERCIAL VEHICLES AND BUSES

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The automobile is possibly the most massively manufactured sophisticated product among those produced in mechanical engineering. More than 60 million of automobiles are produced every year. The automobiles consume the enormous material and human resources necessary for their production and during their life cycle. That is why we need to seek and find the methods how to reduce the consumption of these resources. For the solution of this problem we propose the method of the modularization and unification while designing and manufacturing the automobiles.

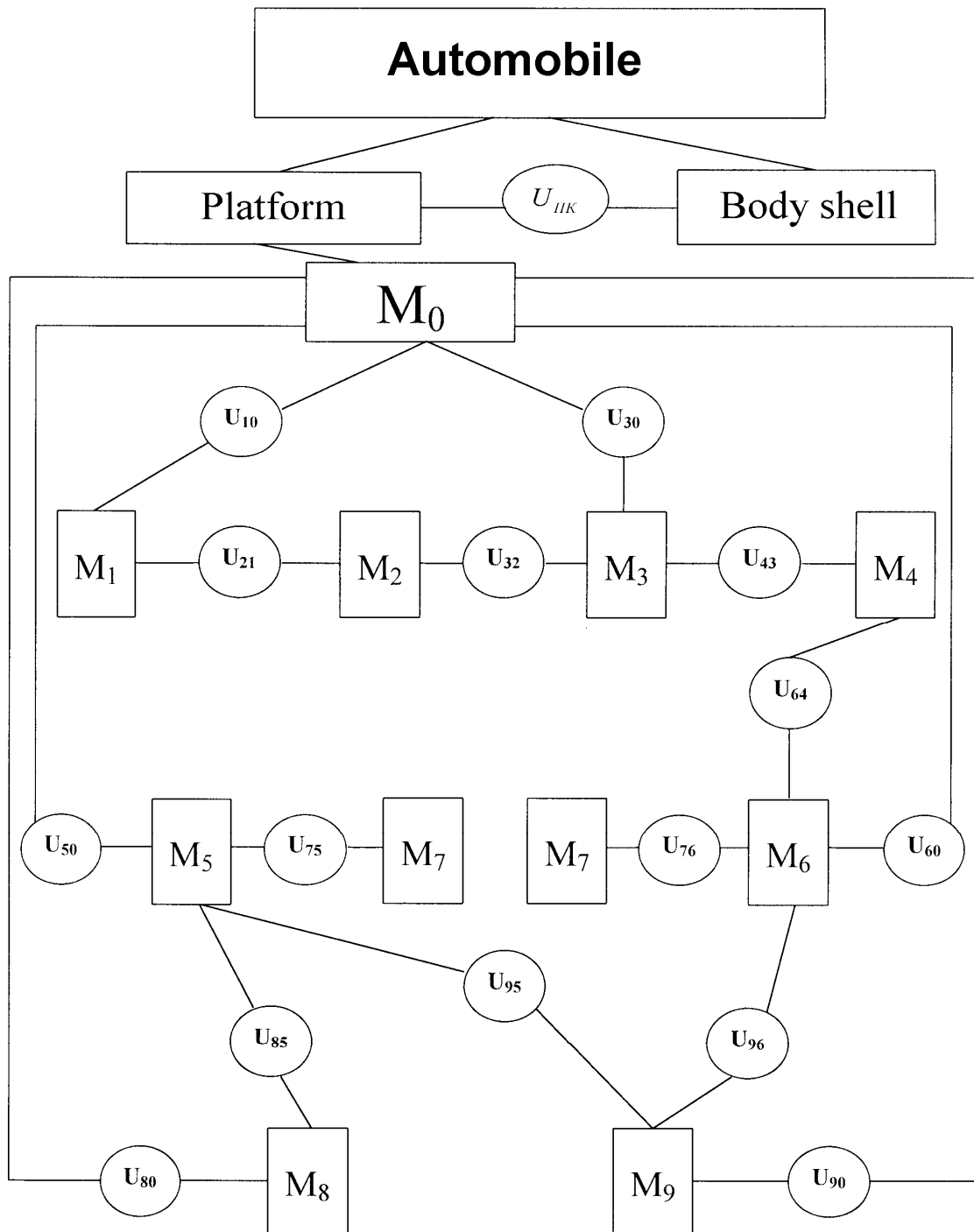
Modularization is the decomposition of the whole product into its components – modules – without their destruction. The decomposition of the automobile into modules is naturally produced according to the standards accepted in automotive engineering. Platform and body shell are the two main components of any automobile. The platform module consists of functional modules. The basis of the platform is the frame module. The frame could be a separate module of the automobile. In this case the body module can be installed on the frame. The platform includes the engine module, the transmission module, the steering wheel module, and the braking system module. These modules are separate aggregates. These modules are coupled together by the joining and coupling units. This level of the platform modularization is taken in this paper for us to discuss the problem of the unification of the automobile structures below.

Every module can be described and identified by means of a set of its parameters. We divide the set of every module parameter into two subsets. The parameters determining the module joining with the rest of the platform modules are included in the first subset. We call these parameters as external ones. The other parameters are included into its second subset. These module parameters we call internal ones. The external parameters of the module are the main for the solution the problem of the unification of the automobile structures.

The body shell is the main second module of the automobile.

The versatility of the body shells give us no possibility to decompose the body shells into unified modules as we can do it with the platform. The platform requires more careful sophisticated technical service and repair than the body shell.

The structural scheme of the automobile decomposition is shown on figure1. This is an example of the vehicle decomposition into body shell and platform.



**Figure1: The example of the structure decomposition of the vehicle with FR layout (front-engine, rear-wheel drive layout) into separate modules and joining units of the modules**

This decomposition can be applied to the passenger vehicles, commercial vehicles, and buses having FR layout (front – engine, rear – wheel drive layout). The platform is decomposed into modules, which are unified according to the subset of the external parameters. The units of joining and coupling are shown on figure1 as circular figures. They are determined by the external parameters of the modules. These units are unified according to the subset of their external geometrical, technological, and functional parameters. The functional modules, shown on figure1 as rectangles, are determined by internal parameters of modules. They may differ with different automobile and automobile platform modules makers.

Modules:  $M_0$  – frame module,  $M_1$  – engine module,  $M_2$  – clutch module,  $M_3$  – gearbox module,  $M_4$  – driving shaft module,  $M_5$  – front axle module,  $M_6$  – rear axle module,  $M_7$  – wheel module,  $M_8$  – steering wheel module,  $M_9$  – braking system module.

The automotive platforms are much better adapted for modularization and unification in comparison to body shells of the automobiles. The platforms can be nearly completely decomposed into unified, homogeneous modules of the same kind. These decompositions are determined by external parameters of the platform modules. The unification of the platform could be implemented by means of the choice of the equal external parameters of the platform modules of the of the same kind. We call this a unification method [1]. This method is based on the unification according to the subset of the external parameters of the platform modules.

There is no doubt, the unification according to the subset of the platform external modules parameters can be done for the automobiles of the same type and class. The automobiles of various types and classes could be designed and manufactured on the same platform. The difference between such vehicles is determined by the characteristics of their body shells. Consequently such unification of the platform will broaden the types and classes of the vehicles which will have the platform unified according to that method.

The examples of unification can be found in automobiles as well. The passenger cars have four wheels. The road wheel disks parameters for tire mounting have got the unified standard range. The automotive tire industries produce various tires according to the accepted parameters. The other parameters, excluding standard parameters for road wheel discs, can vary, depending on manufacturers. The octane numbers of the gasoline are unified too. The parameters of the engine compression ratio are unified according to those numbers. We can enlist more examples of such unification.

The production of the automobiles with unified modules could give us possibility to gain certain advantages and benefits compared with nowadays situation.

The design and development of the automobiles can be simplified. The structures of the modules may be fitted into the automotive structures of the automobiles being designed without their modules development. It will save time and reduce cost for their development.

The module production in automotive industry is a well known fact. Separate modules are produced on specialized plants manufacturing engines, transmission modules, steering systems modules, braking systems modules. The specialized production can be organized more economically and the products can have better quality than at automotive plants where all components are produced at one spot.

The production of the automobiles and the business involved are becoming transnational. The automobiles influence politics in relations between countries. Modularization and unification in the automobile design and structures could be very helpful under modern level of the global automobilization.

The usage of the unified functional modules could change the structure of the automotive plants. They could organize automotive production near the consumers. The unified modules for the platforms could be transported from the specialized manufacturing plants. These modules do not occupy much space and more easy to transport.

The replacement of the unified functional modules by the more advanced ones will broaden the possibility for the modernization of automobiles being used nowadays. It could be one of the new directions of the activities connected with automobiles.

It is quite known that technical service and repair of the vehicles consume several times more resources compared to their production. The unification simplifies the assembly and disassembly of the structures if they consist of the unified functional modules. The unification enables production and usage of the unified tools and equipment for automobiles manufacture. It could also simplify the personnel training.

A lot of automobile manufacturers try to adapt their technical service facilities according to the automobiles of their own brands. But we should not forget that it will put limits to the automotive market of their automobiles in areas without the facilities for the repair and service of their automotive brands.

At present we have got no unified standards for technical service and repair. The unification of the automotive structures could support the development and implementation of the new global standards for technical service and repair of the automobiles of various companies and these standards will be obligatory for every automakers.

Modularization and unification could be useful for the production of the electric and hybrid vehicles. The production of these vehicles uses the modules of different industry branches. The modules must be unified.

The problem of module technology realization involving the usage of the unified functional modules can be divided into technological, organizational, and legal problems. This problems should not be complicated from the technological point of view. The platform modules with different parameters of the units of joining and coupling of modules are manufactured by automobile and automotive platforms modules makers. The unification of the manufactured automotive designs is not a serious technological problem. Much more effort needs the solution of legal and organizational problems. Automakers of the world should find a compromise. The governments find agreements with difficulty. The numerous examples of fruitful and beneficial cooperation between automakers are well known. The alliances of automakers are organized by automotive companies of various countries. The production of automobiles of various firms have been organized in various countries. Versatile agreements and technological regulations are adopted and observed by automakers of various firms. The agreement on the modularization and unification while designing and manufacturing automobiles could be reached at the level of the automakers.

### **Conclusion**

The external parameters of modules must be globalized. At least, the unification can be done for the same type and classe of vehicles and a family concept vehicles produced by various automarkers. The problems of modularization and unification is necessary to develop at the level of the world automotive community. The modularization and unification can optimize the global development of motorization in a lot of directions. The pioneers could gain a certain advantages and benefits.

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