AUTOMOTIVE MAIN INDUSTRY
DETERMINATION OF TECHNOLOGICAL SITUATION

EXECUTIVE SUMMARY[(*)]

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In this study; it was intended to set up required policies and strategies, by determining the dynamic technological situation in Automotive Main Industry, which has intensity in RTD (Research and Technology Development), together with relevant actors to reveal our "assets" that are present, or to be possibly present in future and seize the desired future. In the study, "Dynamic Technological Situation Evaluation Model" was used as a tool, which has been developed in TUBITAK-TIDEB. In accordance with this model, two meetings were arranged until now and as output of these meetings two detailed reports were prepared. One of the important results derived from these reports is that Automotive main industry is a production centre mainly possessed by foreign partners in line with their strategies and will keep its today's situation also in future, as a sector going towards a better position by developing and using technology in a way that enables to get a national know-how acquisition. The basic goal of this study is to define and put into practice

a. National policies,
b. Structures, and
c. Mechanisms.

In the reports mentioned above, there are important proposals relating to these matters.

Being the last phase of the model, the agenda of the last meeting, which is to be held with the participation of managers and decision makers, is to adopt the steps to be taken around a common, national policy by evaluating the results and proposals stated in preceding reports, to make automotive main industry get to a more competitive position worldwide by increasing its capability in technology.

[(*)] The study was designed and coordinated by TUBITAK-TIDEB based on the Sectoral Model developed by Tülay **Akarsoy Altay**.

Model

The followings are the aim of determination of the technological situation of the sector in a base of fundamental and critical technologies:

a. Design (DE) and design verification (DV) capability,
b. Mastery of technology,
c. Capacity of deploying and triggering technology.

The concept "dynamism" in the model includes technological tendencies of near future, complex relations among technological parameters and interactions in process, and flexible strategies for alternatives arisen from change.

Combined Data Tables

Four companies from automotive main industry participated in the study: BMC, Ford Otomotiv, Tofaş and Toyota. Having a higher RTD intensity, it was assumed that these companies represent the whole sector in technological development. The first output of the study is data tables. The companies were asked to fill in the data tables to collect data about their capabilities in design and design verification, mastery in technology, capacity to deploy and trigger technologies to determine their technological tendencies in the next ten years (processing the Data Tables, Combined Data Tables were obtained for the sector).

Meetings

Data tables were handed to the academicians participated in the study and asked to prepare a pre-report by interpreting the data. A meeting was realised with academicians, who had handed their pre-reports to TIDEB beforehand. According to the methodology, the output of the previous phase is the input of the next phase. Therefore, it was tried to make the participants reveal their implicit data within the limits of Combined Data Tables. The opinions resulted from the meeting were explained in "**Academicians Report**".

After Academicians Report prepared, the data tables, academicians report and guiding questions were sent for preparation to the technocrats who continue their R&D studies in automotive main industry. Afterwards, a meeting was realised with these participants (Companies Meeting) and the opinions arisen in the meeting were explained in "**Companies Report**".

The meetings were organised in an environment that keeps the participants away from their daily works. Before the meetings, two types of questions were prepared to direct the meeting. One type of questions were prepared to verify, complete and correct the written information and the other type of questions were prepared to help revealing implicit information. Both of the meetings were carried out with "controlled meeting management technique".

Report I: Academicians Report

In the first meeting, the academicians revealed their own implicit information in the limits of combined data tables.

The opinions summarised below were explained in Report I.

It is understood that Turkish Automotive Main Industry:

a. Has an important acquisition of knowledge and experience in manufacturing area and makes an effort to master the basic subjects such as classic mechanical system and sub-systems in design and design verification,
b. Does not have an activity, however, in areas such as electric, electronic, optic, etc. and in systems / products comprising technologies facing future such as telematic. The subject of vehicle dynamics has been left completely to the licensor and a knowledge deficiency in this area still continue.
c. Has a nationwide acquisition of certain knowledge and experience in prototype area
d. Has an institutional acquisition in fatigue
e. Has an important potential in application of alternative fuels.

As for design matter, it is necessary to have “input conditions” to design. However, this is the data that is the most difficult to obtain in designing. These are the kind of data that can vary in every design. Main industry obtains input conditions from the licensor for its design studies. Therefore, design capability is incomplete. On the other hand, design verification being performed in accordance with the licensor companies’ standards is a capability that can be easily lost. The real design verification capability is dependent on setting the own standards for the own products developed by the company itself.

Another important point determined is that the companies are not capable of removing their deficiency in design, design verification and technology by themselves. They remove their deficiencies in these areas by working with

a. The licensor companies that they are dependent on
b. Other independent and generally foreign companies
c. Other suppliers (generally foreign).

This situation causes decrease in value added in our country.

Examining the ways of acquiring design, design verification and technology that the companies prefer, it is seen that vertical technology and/or data transfer is more common than horizontal transfer. The most common choice is to solve the problem by the company itself without any inland or outland contact. If this is not possible, “information transfer from abroad” becomes a preferred alternative. The last alternative is to work with a counsellor or found a partnership in R&D with other

local companies. Collaboration with university is the least preferred choice, which indicates the existence of an important problem in university-industry relations.

Based on the data collected, it is possible to say that main industry and suppliers considerably work together in product design. Similarly, main industry wishes suppliers to participate in R&D studies. But it is clear that basic design capabilities of suppliers are limited. Although suppliers wish seriously to have modern design devices, it is a fact that they have limited engineering staff that can use these means sufficiently and effectively and do not have adequate laboratories for design verification. As a result, the role of suppliers relating to design phase is minimum. Ideal situation; given the input conditions by the main industry, the supplier designs the product, verifies the design using its own possibilities and hands the product to the main industry. But it is clear that existing situation is too far from the ideal.

It is known that suppliers have some deficiencies in management, design, product development, design verification etc. It is also seen from the data in hand that the suppliers have some knowledge and possibilities relating to technology, management, design and manufacturing that they cannot fully utilise. By sharing their possibilities and supporting the others, the suppliers should contribute to form an industry that is more reliable and capable of producing, designing, verifying design, in high quality and standards. Possibility of working with suppliers as well, in a base of sub-systems, in solving problems regarding technology will help widening university-industry relations and reaching solutions faster.

To build a real supplier industry, the base for Main Industry-Supplier-University relations should be strengthened by deploying works as much as possible and making possible these three knowledge sources to be used jointly. Only in this way suppliers will be able to develop their R&D projects and take over the important part of the load on main industry.

Mechanisms offered for Main Industry-Supplier-University cooperation and deployment of knowledge and workload:

a. Umbrella projects with participation of more than one companies from main industry,
b. Constitution of accredited, independent and central laboratories,
c. Constitution of laboratories in various companies, universities and centres,
d. Constitution of R&D agent institutions.

These offers were dealt with in Report II.

Report II: Companies Report

In the second meeting, the participants revealed their implicit information within the limits of data tables and Academicians Report (Report I). These are given below as a summary of second report.

The companies' design and design verification capabilities in product and sub-products examined in detail in Report II, together with their mastery in technology. It was determined that Turkish Automotive Industry is passing from production phase to product development phase; besides systems such as painted steel sheet bodies, chassis, etc, there is a potential of improvement in near future in prototype and prototype technologies, which are basic technology areas. It is understood that there is no adequate infrastructure yet for modern time's communication and telematic systems and also there is no project planned for near future for this.

Regarding input conditions mentioned in academicians report, different opinions take place in companies report. To reflect expectations systematically to designs for local customers, input conditions are determined without help of licensor. Also there are some completed projects on this subject, for which benefited from R&D incentives. For this reason, thesis such as

- "Companies are not capable of determining input conditions."
- "Deficiency of knowledge in input conditions is among the weaknesses of the sector."
- "Production knowledge is not necessary if geometric characteristics, kinematics and system dynamics are in question."

are not completely true, because, material, production knowledge and production methods are important and sometimes the most effective input conditions in design.

Benefiting from the answers given to the guiding questions in the meeting, speculative scenarios for future and the matching strategic point of views of the participants were tried to be compiled. As a result, it was tried to determine the common and different sectoral strategic approaches peculiar to the sector. The aim was not to choose one of these approaches but to see the existing alternatives that can maximise national value.

Common Approaches

a. Depending on foreign companies' strategies, Turkey has become a production centre in automotive. Since it is necessary to reach a certain level in product development to decrease cost, the capabilities in also this area have been improved. But there are some problems arisen from technology and production scale to keep being a production centre. In case of not solving these problems, the advantages in question may be lost.
b. The roles taken over from the licensor should be increased.

Different Approaches

A. The world is in the way of unification. It is expected that, four or five main automotive companies will remain in long period. To create a new brand with available resource and possibilities in hand is impossible.

A1. Conditions for manufacturing passenger cars in Turkey can be continued. Basic requirements for this are to develop and spread production and management technologies and to develop suppliers' design, design verification and production capabilities and management technologies.

A2. Also in line with the targets of licensor, it is possible to produce passenger and/or commercial vehicles in Turkey and increase the production gradually. In some technological areas, it is possible to acquire capability of developing design/technology competitive in international area and then constitute centres of excellence in determined areas.

It is necessary to continue R&D activities to make vehicle production lasts in Turkey and be effective.

A3. Passenger cars require a higher quality, more costly investments and larger markets. It is possible to give up these and tend to commercial vehicles with technology intensive production. Real competition power of Turkey is in engineering services. Centres maybe constructed to continue high value added engineering activities in. Besides, it is necessary to construct test centres as well.

B. The companies in Turkey can create their brand. With today's possibilities, this is true for heavy commercial vehicles. In local market there is not much demand for high technology. The demand can be met with lorries powered with engines of 600-700 hp.

If the companies do not tend toward production of simple models such as commercial vehicles and collective transportation vehicles, the production in Turkey will be possible only as a subcontractor.

Attaching importance to flexibility in production, it is possible to develop various vehicles in a low quantity. This situation will be an advantage for Turkey.
It is possible that Turkey will have its own brand in 10 years by tending toward low cost commercial vehicles and dominating narrower regional markets.

Areas with Precedence

In the meeting, different prior areas based on different strategies were determined. While determining these areas, it was not looked for an agreement. The prior areas determined during the discussions are presented below. Arrangement in the order is from the common precedence for requirements of the same group to the extremes.

Materials

Plastics (internal / external plastic coverings)
Metals (parts made of iron sheet)
Alternative fuels (CNG, LPG, H2, etc.)

Products / Sub-products

Painted body and chassis made of steel sheet
Indication systems (indicator panel)
Electric distribution systems
Seats
Active suspension systems
Vehicle and Engine Control Systems
Preventive Systems for Exhaust Emissions
Fuel Injection Systems
Fuel Cell
Hybrid Engines – Electric and ICE
Diesel Engines

Technologies

Fatigue
Vehicle Dynamics
Acoustic and Vibration
Design Technologies
Safety
Electronic and Telematic
Management Technologies
Recycling
Rapid Prototype Technology
Manufacturing Technologies
Thermodynamics

Tests (physical or virtual) and Engineering Centres

Acoustic and Vibration (NHV) Tests
Fatigue Tests
Road Tests
Emission Tests
Component Tests (material, coating, function, life, corrosion, etc.)
Homologation Tests
Vehicle and Engine Tests

FEA (Finite Element Analysis)
CFD (Computer Fluid Dynamics)
Simulation Analysis

Software

Hardware/Software for Engine

Beside these prior areas, subjects such as technologies for cars working with boron based fuel batteries; cars working with electric energy and fuel economy were brought forward.

To determine the common technological requirements and capability areas integrating each other, the priorities were revised and grouped and new organisation suggestions based on these were developed. In the areas with precedence, the conditions for knowledge acquisition in Turkey and doing joint works were examined.

Common Requirement Areas

There is a good infrastructure in Turkey in areas of body (chassis, painted body made of steel sheet, suspension system, steering wheel system, brake system, etc.) and body equipment (internal finishing parts, external finishing parts, etc.) and the sector would like to improve its existing capabilities in these areas. Besides, the sector would like to increase its knowledge acquisition in technological arena of vehicle dynamics, acoustics, vibration, safety and fatigue. Painted steel sheet body, especially the parts made of steel sheet, have an important portion in total cost of a vehicle. Constitution and improvement of engineering services in this area will highly contribute. Production of internal plastic finishing parts and preparation of prototypes are important and costly phases of product development process. Related sectors' capability in Turkey is insufficient in this area and cooperation maybe useful to improve engineering acquisition and situation of suppliers in plastic parts development process. Vehicle dynamics and suspension systems are the areas that are very important for Turkey, have future in the sector and have related suppliers in Turkey. Also in these areas cooperation, especially in test systems and road tests, between suppliers and main industry is possible. Vibration and acoustics are very important parts of product development process. Also cooperation in this subject is possible in test systems, runway and anechoic chamber.

Encouraging Horizontal Structuring

Here, horizontal structures among three or more companies should be encouraged / supported in common requirement areas without looking for an R&D profundity. Cooperation to be done in the subjects of plastic parts, indicator systems and electric distribution systems or in the areas of production technologies and management technologies could be based on such an organisational network.

Encouraging Integrated Projects / Structures

During the meetings, it was concluded that extreme requirements and the results of the efforts done for these requirements would be effective only in a very long term. Various projects having profundity in research maybe formed in the areas such as vehicle and engine management systems and electronics, alternative fuels, recycling engine emission systems and injection systems, technology for cars running with boron based fuel cell. That kind of projects should be evaluated as the projects that need the academic knowledge in universities and R&D institutions that are to be realised only combining the resources and hence require the partnership of two or more companies. These activities, which are called as R&D studies before competition, are far more long lasting and costly than product development projects. Having far heavier and selective evaluation criteria, that kind of projects should be encouraged by supporting comprehensively and for longer periods. Before determining the subjects of that kind of projects, technological foresight should be

done and critical subjects that will keep their importance also in future should be chosen.

Besides, an autonomous technology institute or company having an integrated structure maybe established, which can provide both the required engineering manpower according to the requirements of product development projects and the hi-tech equipment / software that is expensive and can be effective only if it is used collectively. For example, under the partnership of TAYSAD, TTGV and OSD, a company may be formed to provide technology and engineering services.

Excellence and/or capability centres may be constructed especially for rapid prototype, seat and suspension systems. Although the topics here (seat and suspension systems) are not extreme samples, the target is important. These centres should have an extremely netted and integrated structure and be able to produce extremely important integrated projects. While constructing such centres with participation of companies, suppliers, universities, institutions and expert engineering companies, Turkey's priorities should be examined carefully. However, way of supporting that kind of centres should be different.

Encouraging Integrating Areas

It was thought about two kind of organisation to improve suppliers' design, design verification, manufacturing and management capabilities:

a. To develop a common project, gathering together more than one supplier around a main company
b. To direct a supplier in developing products that fit standards of main companies and improve its capabilities, choosing a supplier by more than one main company

It is an important advantage to construct test centres in integrating areas for tests such as

a. Vehicle dynamics, vehicle integration, calibration, noise and vibration, safety, emission, developing sensor, acoustics, fatigue, road tests, etc. (virtual and/or visual)
b. Component tests (virtual and/or visual)
c. Type approval (homologation) tests, which collect the possibilities and equipment in one place in Turkey. This also may help to direct R&D studies to Turkey.

Encouraging Relations with Universities

Dealing with development of a vehicle within a time limited program that is to be produced in high volumes in international standards and can be compete in international markets, it easy to understand -considering the problems regarding time, confidence and purposes- why universities are not preferred to get the same kind of information. Moreover, academicians have to spend extra time to solve the problems out of their interest areas since the information package demanded from the university includes also engineering knowledge beside academic knowledge. However,

a. Engineering knowledge has been acquired for years by licensor. Industry in Turkey is in the phase of getting this knowledge. In later phases, e.g. in phase of developing or constructing excellence centres, it is more appropriate to get this information from universities.

b. Engineering knowledge is in the interest area of engineering companies. That kind of companies maybe used as an interface in relations between universities and companies. Expert engineering companies having the characteristics to be an interface maybe encouraged.

c. Another solution to utilise university's knowledge acquisition is the research institutions working in these areas.