

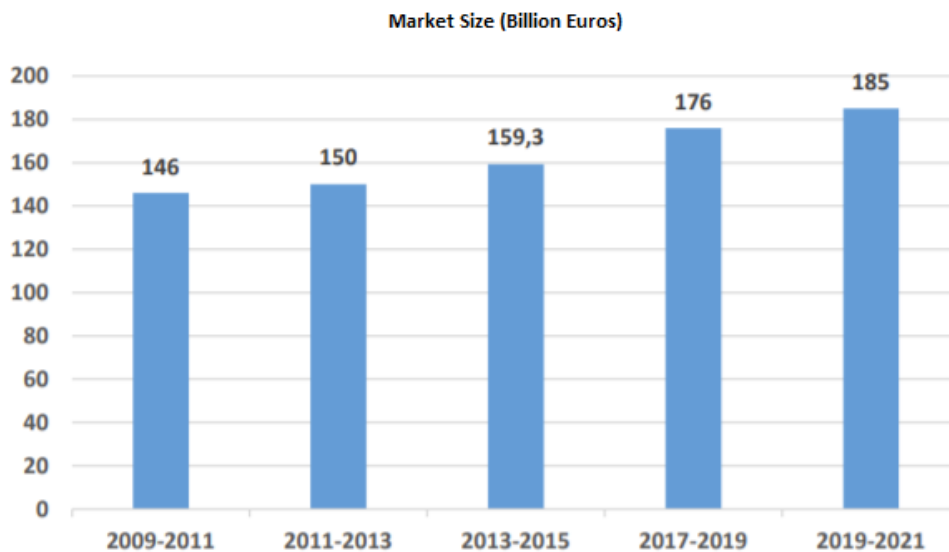


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## Railway industry

### Market structure, Performance, Key players

The railway market size is 185 billion Euros totally between 2019-2021 and a growth ratio of %2,8 is expected every year as a trend.



Source: www.statista.com

According to the "Global Land Transport Infrastructure Need" report, which is a joint study of the OECD and the International Energy Agency (IEA), an investment of USD 45 trillion was planned for new infrastructures for road and rail transport between 2010-2050. With these investments, the global road and rail infrastructure is expected to grow by 60% between 2010-2050. According to the analysis of the IEA, it is predicted that the total passenger and freight transport using road and rail will double by 2050.

Amid European railways, Turkish railways are a relatively small railway system in a large country resulting in a low network density.

Investment projects are prepared and managed by TCDD and the Ministry of Transport. The long-term development plan is mostly done by TCDD. The ambition, according to the 2023 objective, would be to finance a network comprising 10.000 km of high-speed rail lines and additional 5000 km of track for conventional lines. Although this plan seems highly challenging in the present economic context but also in terms of schedule, it provides the current political vision towards a significant development of Railway in Turkey so to be within the top countries in this field.



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Source: TCDD, investment targets until 2023.

The government plans for 2030 adding 26.000 km of railway line to the infrastructure network besides upgrade works for signalling and electrification. As of today, only 28% of the total network is signaled only which limits the operation capacity.



Source: Anatolian Railway System Cluster, investment targets until 2023.



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Another ambitious target is to manufacture or purchase rolling stock in all kinds to renew the rolling stock fleet of Turkish railways until 2030 as a government plan. As the SMEs in Eskişehir are mostly dealing with rolling stock manufacturing this could be also a direction for investment by EDIC.

Also, in the light rail sector, the market shows increasing development since the last 10 years. Many industrialization zones are established for railway specific production sites and clusters are built. Global companies such as Siemens, Alstom, CAF, CRRC and Bombardier invested and transferred their production sites partially to Turkey. Compared to other cities Eskişehir has a small amount of railway investment for Skoda and Bombardier by TÜLOMSAŞ (recently TÜRASAŞ).

Figure 1. Global companies production sites (own illustration)

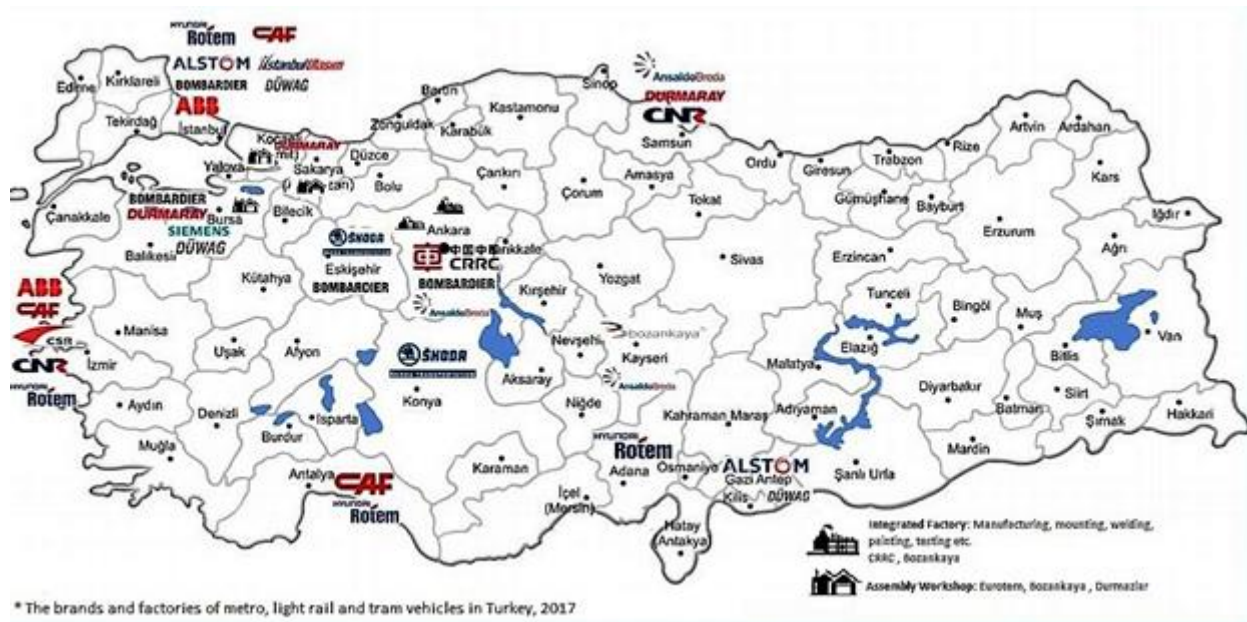


Figure 2. Expansion of new light rail lines until 2023

Turkish Cities planning to open light rail lines by 2023	
Trabzon	Mersin
Malatya	Afyon
Denizli	Aydın
Kahramanmaraş	Hatay
Sakarya	Rize
Şanlıurfa	Elazığ
Isparta	Erzurum
Diyarbakır	Çanakkale
Karabük	Balıkesir



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As a result of high investment in rolling stock such as locomotive, high speed trains, freight wagons and light rail vehicles and signalization/electrification infrastructure systems, the companies working in rail systems are closely following these activities in the sector and continues to work for support and project opportunities for the development of the sector and in Eskişehir.

Eskişehir is in the middle of road and railway crossings between the high industrialized cities such as İstanbul, Bursa and Ankara. It has also an important meaning for railways as TÜLOMSAŞ (now – TÜRASAŞ) is producing here since over 100 years. Railway departments of Eskişehir Technical University and investment in realization of URAYSIM (Railway Test Centre) Project converts the city into a railway attraction centre. Many global railway companies such as Skoda, Bombardier, Aselsan, Savronik, TÜLOMSAŞ (TÜRASAŞ), Epsilon Vagon, Esray are also located in Eskişehir Organized Industrial Zone. The average experience of the companies in Eskişehir are more than 10 years in railway system environment. The sector has improved itself and has made a great progress in terms of production capacity and efficiency. Most of the companies in the sector have obtained ISO quality certificates and increased their production for foreign markets and are aware of the market changes and global requirements. The recent investments of the companies are tending into more automated (such as welding robots) and technology based project management and production systems. Companies focus on more specific railway products rather covered by complex international technical requirements than regular and usual ones to open to the global market, to avoid high competition and to provide high value added products.

Eskişehir's railway production performance is low among other cities such as Ankara, Bursa and Sivas and in general the R&D investment is not high as it should be. However, it continues to develop its services through new investment projects.

## Technical support and technological development tools required by SMEs

According to the information gathered by the SMEs in Eskişehir; as the number of projects and demands increase, specific specifications are changing for each project. In particular, customer-specific expectations are different. In such cases, a redesign is needed for every change request.

In general, an increase is expected for the industrial design and in average 2-4 engineers are needed for the future for each SME. Tools needed for the future for engineering works is such as “Solid” and “Siemens NX” programs. 3D modelling is effecting the sales, which would be good to have for future works. A need for the future for engineering works is especially softwares such as simulation, digital twining softwares and 3D scanners/metal printers.

For validation process, there is no expectation in growing in the future, but in average 2 engineers will be needed in the future for both certification and validation issues for each SME.

Under analysis; the SMEs estimate that they would need ANSYS or SOLID – Analysis programs and to employ ca. 1 engineer to use those programs.

For test process, the tests will be increasing in parallel with the increasing number of projects. For tests, such as railway vehicles and signalization issues TS EN ISO/IEC 17025 test labs and a test track is required which is covered under the ongoing URAYSIM project. In average, 2 extra persons could be employed in the future for tests.

The project management it is expected to increase in the future. For project management tools such as SAP business one and 2 extra people.



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Prototype business is expected to grow in the future, whereas the number of licenses for each software has to increase and a 3D printer and scanner is needed for fast prototyping whereas in average 1-3 technicians are required for prototype processes.

## Placing industrial SMEs in Eskişehir's innovation eco-system

The strong attributes of the SMEs in Eskişehir are;

1. Fast reaction to enquiries and changing environment,
2. The number of high qualified engineers,
3. Experience and competence.

The weak points of the SMEs in Eskişehir are described as follows;

1. Difficulty finding clients in Turkey to sell the state of art technology such as cloud solutions, robots and digital transformation and integration projects etc.

Due to high added value services/products and long term research and development the SMEs in Eskişehir are trying to be unique in their fields. They have many rivals as the business in railway vehicle production and signalization are trending topics in the global arena. As the business is not related to the product, the project base activities don't allow to estimate any market share or rival share ratios. The main competition runs on product conceptions.

The main differences of the SMEs in Eskişehir against the rivals are;

1. Cost advantage due to being domestic,
2. The responses and solutions of the SMEs are much faster than foreign companies,
3. To stand behind the product for service and parts commitment and non-contractual problems.

The market is dynamic and even in classic automation and mechanic markets intends to increase new production concepts based on technological solutions. That's why there is a big change in the technology and concepts.

There is an increase in demands on the global and domestic levels. However, domestic implementation rate (due to currency fluctuations and economic situation) is very low. The lowest labor costs compared to European countries are in Turkey. For that reason various railway productions are in shift to Turkey. The industry does not invest in digital transformation nor in robots, although investment return in robots decreases to 6-7 years. The reason for that is that the investment planning is 3 years in railways due to uncertainties in economic situation and cancelation of domestic railway tenders. However, it is expected in the near future, that global companies will not subcontract companies that do not produce with robotics.

SMEs have various dialogues with different university engineering departments. Consulting support in state of art literature research is received from time to time. Student projects and graduate subjects are created.

In terms of international collaboration; there are many joint projects with Siemens and GE due to the low labor cost and good manufacturing qualities in Eskişehir.

The future of rail systems is positively evaluated by the SMEs and they are interested in continuing work in the railway market. Especially URAYSIM investments are considered to be accelerated. Another expectation was for the localization rates to be increased from 50% up to 85%, which could contribute



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in addition to the rail sector. It is expected to invest in the railways about 35 billion USD until 2035 in Turkey.

## Difficulties experienced by SMEs in R&D and Innovation

The opportunities for further improvement of the SMEs in Eskişehir are described as follows:

1. Difficulty in placing the products into the market,
2. Export strategies,
3. Understanding the requirements for international certifications,
4. Turkish test laboratories limited test services whereas most of them are not accredited test labs.

There are many railway engineering departments and divisions at Eskişehir Technical University and at Osmangazi University. But, most of the new graduated staff are leaving Eskişehir after searching a job for a certain amount of time. A model that will create employment needs has to be developed.

Subcontracting of industrial design was seen as low. The problems encountered were;

1. Slow reaction to changes due to external dependence,
2. High costs for changes or errors (remote communication problems).

Analysis subcontracting problems encountered were; finding the right and competent company, understanding the price balance and mutual agreement of the correct requirements.

External laboratories (prototype tests) are mostly used such as TSE / TÜRKAK approved labs in scope of measurement on the paddle boxes, determination of energy classes, metallurgical tests etc. The problems in outsourcing of tests are as follows:

1. There are very few laboratories,
2. For some tests, the company have to send it to labs abroad which cannot be made in Turkey (e.g. regarding fire resistance). At domestic applied tests; there are long return time regarding the tests.

## Summary of Insights and Conclusions

The following areas are where technology in high standard is necessary to be applied in railways: design drawings such as CAD programs, FEM analysis to detect the strength of units, computer based simulators for locomotive drivers, driverless operated trains, robotic arc welding machines, communication system hardware and software production between trains and command centres, signalling software to control and command the railway traffic and sensors to detect failures on wayside systems, non-destructive testing to detect cracks on rails and wheelsets, 3D printer and scanners for fast prototyping. In Eskişehir companies like ASELSAN, SAVRONİK, ESRA, ANOT, ALBAYRAK, EPSİLON and TULOMSAŞ (now TÜRASAŞ) are delivering novel products such as first national loco driver simulator, locomotive traction units and first national signalling equipment etc. However, the industry 4.0 transformation actions still have not started yet in Turkish railways and SMEs.

The European railways research trending topics resulting from past problems are:

Digital continuity from design to operation  
Digitisation at railways – SmartRail 4.0



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Building Information Modelling (BIM)  
Wayside Train Monitoring Systems (WTMS)  
Driverless operation  
Cybersecurity for security-critical infrastructure

Large amounts of fees are paid abroad for test processes and certifications, which greatly affect the production costs and sales volume of companies. Therefore, EDP support to the sector to reach the standards and international certification is of high demand for businesses in the sector.

It is necessary to create an ecosystem that can be followed more easily about the global trends in product making and production concepts, and the trainings should be systematized and easily accessible by SMEs. It is necessary to describe a new approach for university and industry relations to do joint business as well as the cooperation ratio between SMEs and universities or techno parks are considered as very low.

After the effects of COVID-19 epidemic, the importance of Turkish railway suppliers is increased especially for EU markets due to location and reliability of supply compared to China. So innovative projects for industry have become more important.

SMEs products should be mostly technologic based and high value-added products whereas specific production market segments should be analyzed to provide a unique product. This could bring also a great potential in competing with European companies.



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