

Development of Technology in Turkey through Tree Graph

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1. ABSTRACT

It was long ago that Königsberg's Seven Bridges, a historical mathematics problem's solution was refuted by Euler (1735). His approach to solve the problem contributed to the development of Graph Theory. This theory can be implemented to various technology fields like password hashing, data structures, indexing and network typologies.

This study shows how graph theory works and advantages you would gain while using it on instructional material design. It would be daunting to write about Turkey's Technological Progress in Agriculture, Industry, Economy and Education from the inception of the Republic till today. Therefore, we found a better way of presenting Turkey's technology history by implementing graph theory to make it more intelligible. Tree graph not only allows learning as permanent but also assists to categorize complex data. As a result, this study is an interdisciplinary study with graph theory of math and chronological order of history. The aim of this study is to make learning complex data more intelligible.

Keywords: graph theory, material design, tree graph, Euler, History of Turkey's Technology

2. INTRODUCTION

Today, technology is an irrevocable standard of living. Everything in our daily life, from gadgets that we cannot leave to medical instruments, from defence systems of countries to diversity on transportation, is affected by the bountiful technology today. It is definite that this change didn't happen in a trice. On the other hand it is noted that big change occurred over the last century.

A typical example on the speed of this change is Gordon E. Moore's Law which was written in 1965 at Electronics Journal. According to Moore's Law, every 18 months (was revised to 24 months) the number of transistors on a microchip will be doubled. This law is still operative. Only in 2014, the number of transistors that were manufactured is equal to the transistors that manufactured from the beginning of manufacturing till 2011.

So, how has humanity reached this technology age? What breakpoints occurred in history and what was invented until now? One of the major breakpoints was the intervention of the steam engine, the Industrial Revolution brought innovation that we had never imagined before. Technology raised the standards of communication, transportation, education, agriculture and many other fields.

Our country was also affected by this change. Turkey imports some technologies as well as produces. But as a charter member of OECD countries, Turkey is at the rear of countries that make profits from technology. According to a report from TUIK (Turkish Statistic Institution), technological products are divided into four categories and a graph was made from those product groups that Turkey manufactured (TUIK, 2014). (Figure 1)

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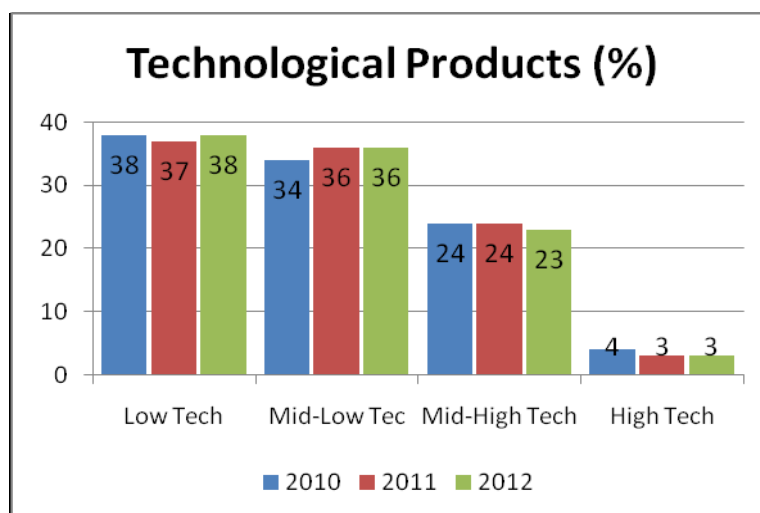


Figure 1. Four categories of technological products that Turkey manufactures

The aim of this study is to display Turkey's achievements in technological and scientific areas by using a tree graph. To shape the tree graph, subjects are divided into seven categories and each category has its sub-categories.

2.1. Universities

Ataturk, the founder of the Turkish Republic, foresaw that the country could only progress via education which is why he gave an order to reform the universities. Within two years of study, in 1933 the university reform was announced (Avcı, 2015: 288). Today's universities were shaped by institutes and schools at that time.

To look at universities in chronological order, in 1926 an Institute of Education was founded which was then converted to Gazi University with an act in 1982 (Gazi Üniversitesi, 2015). Darulfunun which was founded in 1453 with the conquering of Istanbul closed down and converted to Istanbul University with the University Reformation. At that time Istanbul University was the one and only university of the Turkish Republic (İstanbul Üniversitesi, 2011). Istanbul Technical University (ITU), which was established to raise engineers with modern techniques in 1773, gained its name in 1944 (Istanbul Technical University, 2015). The Law School, established in 1925 and Agriculture Institute, established in 1933 were gathered in Ankara under the roof of Ankara University in 1946 (Ankara Üniversitesi, 2015).

With an act, The Black Sea Technical University was established in Trabzon in 1955 (Karadeniz Teknik Üniversitesi, 2015). Ataturk gave a speech at the Turkish Grand National Assembly in 1937 that cited to establish a university in the east. A long time after that speech, in 1957 Ataturk University started education in Erzurum (Atatürk Üniversitesi, 2015). In Izmir, The Aegean University was established in 1955 (Ege Üniversitesi, 2015). In 1956, Middle East Technical University (METU, 2014) and in 1967, Hacettepe University were founded with related acts in Ankara (Hacettepe Üniversitesi, 2015). In 1971, Robert High School South Campus, which had been operating for more than hundred years, converted to Boğaziçi University (Boğaziçi Üniversitesi, 2015).

Turkey took its toll from student incidents spread to world in 1973 and enacted two laws. One of them was the National Education Law and the other was the University Law. Until the military coup in 1980, universities were founded in different cities like Adana, Sivas, Malatya and Kayseri. With the 1982 Constitution, all universities started to operate under the High Education Institution (Korkut, 2003). Currently, 193 universities are operating in Turkey (Yüksek Öğretim Kurulu, 2015).

2.2. Research and Development Institutions

It is not only universities that research and develop new technology in Turkey. On many fields like space, defence or chemistry institutions were established. These institutions contribute to national technology and science. These institutions and the purpose of their establishment are explained briefly below.

2.2.1. Turkish State Meteorological Service (MGM)

It started to operate in 1925 with the modern approach to forecasting. Its duty is to support the marine and aviation sectors with meteorological information and to give early warnings when harsh meteorological

conditions are expected (Meteoroloji Genel Müdürlüğü, 2015). Currently, The Meteorology Institution operates within 15 Regional Directorships.

2.2.2. General Directorate of Mineral Research and Exploration (MTA)

General Directorate of Mineral Research and Exploration came into operation with an act (issue number of 2804) in 1935. Underground sources, petrol surveys and operations, geologic researches are the fields of study of this institution (Maden Tetkik Arama Kurumu, 2015).

2.2.3. Machinery & Chemistry Industry Institution (MKEK)

The history of MKEK stretches far into the past, but in 1950, it gathered factories spread all over the country under one roof. Its current subject is weapon manufacturing and defence industry; however, it manufactures some side products as well. Today it operates with two management headquarters and 10 factories (Makina ve Kimya Endüstri Kurumu, 2013).

2.2.4. Turkish Atomic Energy Authority (TAEK)

TAEK was established in 1956 by a decision made in Ankara (Türkiye Atom Enerjisi Kurumu, 2009). TAEK's duty contains all kinds of amicable nuclear research. Currently, it operates with 3 training & research centers and 5 management directorships.

2.2.5. Turkish Scientific and Technical Research Institution (TUBITAK)

TUBITAK was founded in 1963 with 4 research groups (today it has 10 research groups). Its main objective is to support fundamental & applied academic research especially on natural sciences and to encourage young researchers (Türkiye Bilimsel ve Teknolojik Araştırma Kurumu, 2015). In this respect, it supplies financial support to many projects mainly collaborated with universities.

2.2.6. TUSAŞ Aviation and Space Industry Company (TAI)

Turkish Aircraft Industry Company (TUSAŞ) was founded under the Industry and Technology Ministry to reduce foreign-dependency of Turkish defense industry on 28 June 1973. In 1984, the company was reshaped under the name of TUSAŞ Aviation and Space Industry (TAI) (TUSAŞ-Türk Havacılık ve Uzay Sanayii A.Ş., 2015). TAI manufactured many local products of national aviation. In 2012, Gökürk-2 designed and manufactured by only Turkish engineers, put into orbit and sent its first signals to the Ankara ground station.

2.2.7. Kandilli Observatory

Kandilli facility was constructed in 1868 and was given to Boğaziçi University by the passing of a new law in 1983 (Kandilli Rasathanesi ve Deprem Araştırma Enstitüsü, 2014). It now has 3 departments, 4 centers and 3 laboratories. Earthquake, tsunami, geodesy, geophysics and calendar arrangement are the fields of its study.

Agriculture, communication, transportation, computer and internet experience of Turkey is given below with their corresponding titles. Change and industrial progress of Turkey of these fields started at Izmir Economy Congress in 1923 (Avcı, 2015).

2.3. Agriculture in Turkey

36% of land can be harvest in Turkey. This ratio makes Turkey as a self-sufficient agricultural country. On the other hand most of the lands need irrigation. Thus, the State Water Supply Administration was established in 1954. The South-eastern Anatolia Project (GAP) which covers a vast territory of the country revealed as a roof project in 1977 (GAP Bölge Kalkınma İdaresi Başkanlığı, 2014).

Other developments on agriculture can be as follow. Between 1923 and 1926 sugar factories were established in Usak, Alpullu and Afyon (Avcı, 2015). Carpet factories in Isparta and Kayseri were constructed in between 1926 and 1927. After 1950's with the effect of mechanization some meadow and grass areas were converted to agricultural lands. To quote agricultural goods and support farmers the Soil Product Office (TMO) was established in 1938. Another government office, the General Directorate of Agricultural Corporations (TIGEM) was founded to improve agricultural activities in 1984 (Tarım İşletmeleri Genel Müdürlüğü, 2010).

2.4. Transportation in Turkey

As more interaction between people leads to reduce missing knowledge, more interaction between cities leads to reduce gap between cities. Diversity on transportation does not only develop a country's logistic infrastructure but it also obtains cultural, commercial and educational improvements of a country. We mainly divide transportation on four different categories.

2.4.1. Land

2.4.1.1. Highway

"Approximately 4.000 km of well-conditioned highway and total amount of 18.350 km of ordinary road inherited to the Turkish Republic from the Ottoman Empire in 1923." (Çetin, Barış, & Saroğlu, 2011:124) This number reached to 41.582 km in 1940. With Marshall Aids, some allowance allocated to highway constructions between 1948 and 1952. To construct industrial type of highway the General Directorate of Highways (KGM) was established in 1950. In 1960 country had 60.000 km of highways. One of the biggest symbols of Turkish Republic, the Bosphorus Bridge was constructed in 1973. After that, modern tarmac roads started to construct. A chart of roads in Turkey today is given below.

Table 1. (Retrieved May 5, 2015, from <http://www.kgm.gov.tr/>)

ROADS ACCORDING to SURFACE (KM)							
As From 01.01.2015							
	Tarmac Cement	Surface Treatment	Cobble	Stabilized Road	Soil	Other Roads	TOTAL
Highway	2 155	-	-	-	-	-	2 155
National Highway	13 446	17 415	72	67	29	251	31 280
Provincial Highway	2 476	26 862	201	824	570	1 541	32 474
TOTAL	18 077	44 277	273	891	599	1 792	65 09

2.4.1.2. Automotive Industry

Devrim is the first vehicle designed and manufactured by Turkish engineers. By the order of President Cemal Gürsel it was manufactured in 129 days at the Eskisehir Railway Factory in 1961(Avcı, 2015: 293). But mass production couldn't be done. Anadol was manufactured by Otosan Company in 1966 and sold out amount of 84.000 (Ford Otosan, 2015).

"In 1970's Turkey started to manufacture foreign companies' vehicles like Ford, Fiat and Renault. In 1990's companies from far east like Toyota, Hyundai and Honda started to manufacture their vehicles in Turkey."(TOBB, 2012: 16). In the year of 2012 Turkey had 18 factories related to automotive sector. In the year of 2012 only, manufactured vehicles by Turkish factories reached beyond the number of one million (TOBB, 2012: 77).

2.4.1.3. Railway

First railway laid down to Izmir – Aydin in Anatolia in 1856. Form Ottoman Empire to Turkey 4.136 km of railway inherited. Another 3.764 km was added to current railways till 1950. Between 1950 and 2003 a very short distance (only 945 km) attached to country's railway line because of concentrating on highway constructions. 1.759 km railway laid down in between 2003 and 2014. Marmaray put into service in 2013 and Ankara – Istanbul high speed train (YHT) put into service in 2014 (UDHB, 2014).

2.4.2. Seaway

Despite the fact that Turkey surrounded by seas on three sides and have an inner sea (Marmara), country still can't use its full potential on seaways. According to a law legacy of the Ottoman Empire Naval Corporation conveyed to the Turkish Seyr-i Sefain Corporation in 1925 which then conveyed to the Corporation of the National Seaways and Ports and gathered some other corporations in 1944. Finally, the General Directorship of the Turkish Marine Corporation was established in 1984 (TDİ A.Ş., 2014).

With the Treaty of Lausanne in 1923, privileges to the foreign ships cancelled. The Act of Cabotage came into operation in 1926. The transportation by seaway in Turkey is done with logistic manner. Civil transportation is still below its potential (Kaya, 2008: 33). 86.3% of the quantity of foreign trade is transported by seaway (Kanalci, 2012: 31).

Below ports and their Regional Directorships are given. Turkey today operates 174 ports. (Ernst & Young, 2011: 16)

Table 2. Total ports operating in Turkey (Ernst & Young: 2011)

Antalya	7 Ports
Çanakkale	24 Ports
İstanbul	78 Ports
İzmir	22 Ports
Mersin	18 Ports
Samsun	16 Ports
Trabzon	9 Ports

2.4.3. Airway

Turkish Aeronautical Association (THK) was founded by Atatürk's order in 1925 (Akdemir, 2005: 63). Same year in Kayseri and in 1926 in Eskişehir two aircraft factories constructed. These two factories and the Akkopru sailplane factory established in Ankara in 1925 are the foundations of Turkey's aviation sector (Hava Kuvvetleri Dergisi, 1988: 74-78). Vecihi Hürkuş, a pilot from the Turkish War of Independence, designed and managed fly in 1925 (THK Uçak İmalat A.Ş., 2013).

Turkish Airways (DHY) established with a decision taken in 1933. DHY carried 1.124 passengers and 6.813 kg of load in 1936, it also carried 609 passengers and 6.900 kg of load in 1937 (Akdemir, 2005). From 1926 to 1928 different types of 160 aircrafts manufactured by the Aeroplane Otomobile and Engine Turk Corporation Factory (TOMTAS). After the World War II, within the Marshall Aids many American aircrafts were bought which then result an end to the Turkish Aviation sector (Selim, 2012).

The Head of Civil Aviation Department was established under the Ministry of Transport in 1954. That department restructured as the Directorate General of Civil Aviation in 1987 (THK Uçak İmalat A.Ş., 2013). In 2012, Turkey had 52 airports. 38 airports were operating both domestic and international flights; the remaining 14 airports were only operating domestic flights. In 2013 total amount of passengers who were flid both domestic and international flights reached to 149.995.868 and total weight of cargo load reached to 731.962 tons. Turkish Airlines which gained its name in 1955 has different types of 274 total aircrafts in its fleet today (THY, 2015).

2.5. Communication in Turkey

Communication has a big role in today's technology. Improvements on technology and science are done via mass communication channels through whole around the world. In this respect many devices were invented. Here, only three of them will be elaborated within historical view.

2.5.1. Radio

The first radio broadcast was done in Turkey in 1927 (Kocabaşoğlu, 1980: 190). There were two radio transmitters in Ankara, one shortwave (20 Kw) and another one longwave (120 Kw) in 1949 (Kocabaşoğlu, 1980: 282-286). In 1964 there were more than 2 million radio receivers in Turkey (Kocabaşoğlu, 1980: 386). In Turkey, supreme board of radio broadcasting was changed hand several times. Finally The Turkish Radio and Television Corporation (TRT) were become responsible for the regulations of the radio broadcasting in 1992 (Kuyucu, 2013: 136).

2.5.2. Telephone

The Postal, Telegraph, And Telephone Service (PTT) took in telephone services as well in 1909. The first automatic switchboard was set up with an order of Atatürk in Ankara in 1926. After that other city centers joined. In a short period of time all city centers were able to communicate. In 1995, Turk Telekom Corporation took responsibility of the telephone services in Turkey (Turk Telekom, 2015). In 2005, privatization of Turk Telekom was carried out.

2.5.3. Television

The first television broadcast was started at Istanbul Technical University in 1952. However, there were no TV's those days thus it was stuck in studio (Tanrıöver, 2011: 11). The Turkish Radio and Television Corporation (TRT) was founded in 1964. In 1968, its first black and white broadcast was done at a basement in Mithatpasa Street, Ankara. The TV programs were telecasted only at Tuesday, Thursday and Saturday evenings (TRT, 2015). TV programs got a great interest and watched on stores' showcases. To raise variety of TV programs; TRT2 (art & culture), TRT3 (GAP & sport) and TRT4 (education) channels were launched in between 1986 and

1990. Star1, the first private TV channel, was launched in 1990 followed by Tele On in 1992. And consecutively Show TV and HBB were launched. In 1993, Samanyolu TV, Cine 5 and Kanal D were launched.

The Radio and Television Supreme Council (RTUK) was founded to supervision of telecasts in 1994. Same year the Turksat 1B was set into orbit and started to broadcast. Today, with only Turksat satellites system, 127 TV channels are being telecast (Türksat A.Ş., 2015).

2.6. Computers in Turkey

The first computer in Turkey which was IBM-650 came to the General Directorate of Highways in 1960. This computer was used for calculations on highway construction for 12 years and came to Turkey after 15 years than ENIAC the first computer of the world (KGM, 2015). Second one, IBM 1620, brought to Istanbul Technical University, the Taskisla Campus, for academic purposes in 1963 (IBM Türk, 2015). After ITU the Middle East Technical University (METU) gained the same model of IBM computer in 1965 (ODTÜ Bilgi İşlem Daire Başkanlığı, 2010).

According to a report from the Turkish Information Industry Association (TUBISAD), 2.555 companies labor at information sector in 2013. Employment of the information and communication sector went beyond 100.000 people. The IT sector size reached to 61.6 billion Turkish Liras (TUBISAD, 2014).

2.7. Internet in Turkey

Turkish Internet Connection was established between METU, Ankara and NSF (National Science Foundation Network) Washington DC. A line of 64 kbps was established between METU and NSF in 1993. This connection used TCP/IP Protocol to communicate. Many other universities (like ITU, Bilkent, Gazi and Hacettepe) connected to METU over X-25 leased line standard in between 1993 and 1996.

1996 is the year of the internet connection that is used by commercial organizations and individuals. TURNET project that allows internet connection to the internet service providers (ISP) and commercial organizations carried out in August, 1996 (TMMOB Elektrik Mühendisleri Odası, 2007: 67). Superonline, a private ISP Company had 80 registered users and established 10.000 business organizations' connection through 30.000 computers in 1997. End of 1999 and early 2000, some famous websites began to appear like eksisozluk, sahibinden.com, itiraf.com and siberalem.com. Kablo TV launched its internet service in 2000. 42.500 schools were provided internet connection through ADSL technology in 2003. Wi-Fi came into operation in Turkey in 2005. According to a report written by The Information and Communication Technologies Authority (BTK), the number of internet subscribers reached to 41.227.022 people in the last quarter of 2014 (BTK, 2015).

2.8. Graph Theory

In many fields like science, databases, electronic circuits and password hashing, graph theory which was found in 1736 by solving a traditional math problem named "Königsberg's Seven Bridge" is still being used today (Bondy and Murty, 2008). The city of Königsberg was set on both sides of the Pregel River, and included two large islands which were connected to each other and the mainland by seven bridges. The problem was to find a walk through the city that would cross each bridge once and only once, with these conditions: the islands could only be reached by the bridges and every bridge once accessed must be crossed to its other end.

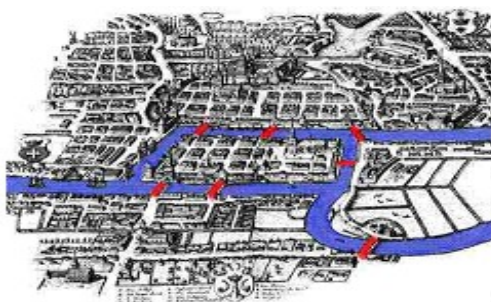


Figure 2. Königsberg's City Map

Euler, represented each of the four lands with a point (vertex) and the bridges join lands with a line (edge) and simplified the map with a graph as below. And he pointed out that there is no answer to the Königsberg's Seven Bridge Problem.

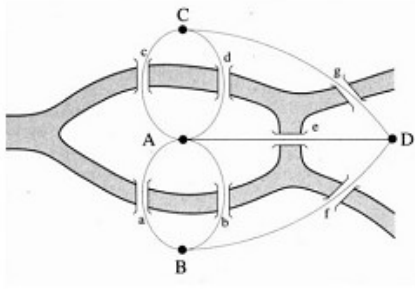


Figure 3. Königsberg's Seven Bridge

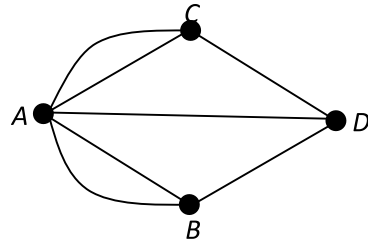


Figure 4. Euler's simplified approach

In the last 20 years graph theory and its implementation played a big role to solve complex problems that humankind faced with (Trudeau, 1993). Especially on electronic engineering's coding theory, communication networks, computer science's data organization, algorithms, financial systems' loss-profit calculations, social networks on sociology and molecule stability on chemistry are the fields that graphs and its related matrices are being applied (Golombic, 1980).

2.9. Tree Graph & Its Implementation in Education

There are many different and highly sophisticated types of graphs today. In this study a tree graph, one of the simplest, will be used to demonstrate the Turkish Technology History.

3. METHOD

Historical survey is used in this study for the method. Literature was searched and findings are shown with a tree graph. It is an interdisciplinary study that combines mathematics, history and information technology.

4. FINDINGS

4.1. Tree Graph

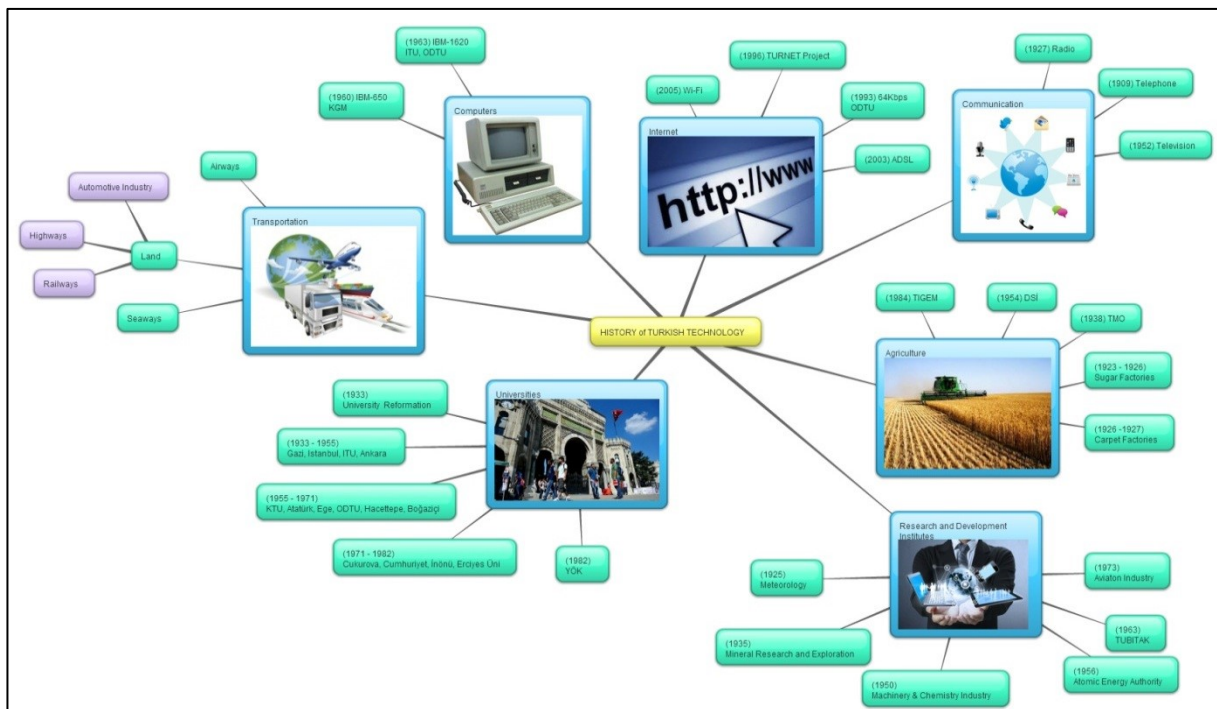


Figure 5. A Tree Graph Sample for the History of Turkish Technology

5. CONCLUSION

In this study History of Turkey's Technology had shown and reformed with a tree graph to display it in a tangible way. On the conjunction of IT, mathematics and history sciences this study was created. This study aims to reinforce instructional materials which can be prepared with an interdisciplinary concept. Complex information can be thought by using such materials which are more memorable for students. Teacher may use such graphs to enrich their class environment.

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