Kaunas University of Technology
School of Economics and Business

Revealing Opportunities to Improve the Competitiveness of Turkey‘s Iron and Steel Industry

Master’s Final Degree Project

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Declaration of Academic Integrity

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Summary

The iron and steel industry constitutes a significant proportion of international trade by providing inputs as intermediary commodities to wide variety of sectors such as construction, automotive, aviation, shipbuilding, mechanical equipment, and others. Therefore, condition of the steel production and consumption of a country is considerably related with its industrialization and development. Turkey as a competitive country in the steel industry has started to lose its rank among other competitive steel producer countries over the last five years.

The purpose of this thesis is to recommend a guideline to improve competitiveness of Turkish steel industry by addressing present major problems. In the scope of this thesis, reasons of decline are researched, and the main problems of the industry in Turkey are identified through evidence from common industrial practices around the world related with the steel manufacturing. The problem analysis highlights the prevalent product focus of Turkey on lower value-added long steel products, external dependency on raw material and protectionist policies applied by foreign markets.

Subsequent to the problem analysis, theoretical solutions are investigated within the context of the iron and steel industry and the concept of value chains to improve competitiveness. Eventually, eight improvement options addressing firm specific features and value chains of steel industry are revealed as a result of theoretical findings.

Empirical research which is composed of mixed methods is carried out in three stages to examine applicability of these options on Turkish steel industry. First, steel industry dynamics are investigated through a quantitative correlational analysis of steel industry trends-economic activity relationships for top 10 steel producer countries in 2018 to determine exemplary export/import product focus of countries similar to Turkey in terms of correlations. Proposition of the research implies that learning from equivalent countries with similar correlations which are China, South Korea, and India, on their export product focus as high value-added flat steel, is the very first option to consider in a broad sense.

Following analysis is done by an online survey via questionnaires for 28 Turkish steel companies in order to evaluate the compatibility of their features with improvement options. Firm size, partnership propensities, innovativeness, competitive priorities, and financial performance are chosen as constructs of steel industry competitiveness. Bivariate correlations are analysed according to the conceptual framework of firm specific features, then results are interpreted to explain current condition of Turkish steel companies before taking ultimate decision about revealed improvement options. For a more detailed understanding of readiness of Turkey’s steel industry for suggestions,

third part of the empirical research, a qualitative value chain analysis is conducted within the frame of eight improvement options.

A generic value chain of Turkish steel industry is drawn by analysis of trade data, annual reports of steel companies, and publications of Turkish Steel Producers Association. Consequently, influence of the revealed improvement options on the steel value chains of Turkey is discussed, and decisions are made.

Results show that approved alternatives to improve competitiveness of Turkish steel companies are: manufacturing of high-quality alloy steels, shifting from low-value added long products to high value-added flat products, pursuit of R&D partnerships with innovation leaders, implementation of green logistic practices and more active collaborations with suppliers to achieve the modular governance. Achieving any of these options is expected to improve competitiveness of steel companies in Turkey, when the decline of country's industry in global competition is considered.

Güngör, Nejat Ozan. Turkijos plieno pramonės konkurencingumo didinimo galimybių atskleidimas. Magistro baigiamasis projektas. Vadovas doc. dr. Egidijus Rybakovas; Kauno technologijos universitetas, Ekonomikos ir verslo fakultetas.

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Santrauka

Geležies ir plieno pramonė sudaro reikšmingą pasaulinės ekonomikos ir tarptautinės prekybos dalį. Joje sukuriama daug tarpinio vartojimo produktų, kurie tiekiami daugeliui kitų pramonės sričių: tokių kaip statyba, automobilių gamyba, aviacijos įrangos gamyba, laivų statyba, inžinerijos pramonė. Plieno pramonės produktų gamyba ir vartojimas artimai susiję su šalies ekonominio ir pramonės išvystymo lygiu. Pastebėta, kad Turkijos plieno pramonė per paskutiniuosius penkerius metu prarado turėtą konkurencinę poziciją kitų šalių – plieno gamintojų – pramonės kontekste.

Šio magistro baigiamojo darbo tikslas parengti rekomendacines gaires Turkijos plieno pramonės konkurencingumui didinti, atsižvelgiant į svarbiausias problemines sritis. Siekiant tikslo, visų pirma, yra identifikuojamos svarbiausios Turkijos plieno pramonės konkurencingumo praradimo priežastys. Probleminės sritys yra identifikuojamos vadovaujantis bendrąją šios pramonės vystymo praktika kitose pasaulio šalyse. Situacijos ir pramonės šakos probleminių sričių analizė atskleidė, kad Turkijos plieno gamintojai daugiausia orientuojasi į žemos pridėtinės vertės produktus; kad pramonės šaka stipriai priklauso nuo žaliavų tiekėjų ir yra veikiama protekcionistinės užsienio šalių prekybos politikos.

Ieškant teorinių sprendimų identifikuotoms problemoms spręsti, darbe yra analizuojamos tarptautinio konkurencingumo, tarptautinių vertės kūrimo grandinių vystymo teorinės koncepcijos. Teorinė analizė atskleidė aštuonias potencialiai galimas taikyti konkurencingumo didinimo alternatyvas, kurios yra pagrįstos geležies ir plieno pramonės raidos tendencijų apžvalga. Teorinių konkurencingumo didinimo alternatyvų pasirinkimas bus grindžiamas veiksnių įmonės ir tarptautinių vertės grandinių lygmenyse tyrimu.

Empirinis tyrimas yra atliktas trimis etapais. Empiriniame tyrime derinami kokybiniai ir kiekybiniai tyrimo metodai. Empirinio tyrimo tikslas įvertinti šalies lygmens, įmonių vidinius ir plieno pramonės vertės grandinių išorinius veiksnius, kurie pagrindžia teorinių konkurencingumo didinimo alternatyvų pasirinkimą ir praktinį pritaikymą. Šalies lygmens veiksniai yra analizuojami tiriant 10-ties didžiausių šalių (2018 m. duomenimis) plieno pramonės gamintojų raidos tendencijas, pramonės šakos ir šalies raidos rodiklių sąsajas. Taikomas koreliacinės analizės metodas. Analizuojami Turkijos ir į ją panašiausių šalių (pagal pramonės struktūrą) importo / eksporto struktūros profilis, siekiant identifikuoti korekcijų poreikį. Nustatyta, kad Kinija, Pietų Korėja ir Indija, pagal eksporto tendencijas yra panašiausios į Turkiją. Tačiau šios šalys daug labiau fokusuojasi į aukštos pridėtinės vertės produktus. Todėl tokia tolimesnės pramonės raidos kryptis yra pateikiama kaip pirmoji bendrojo pobūdžio alternatyva, kuri toliau tikslinama i detalizuojamas pagal kituose tyrimo etapuose surinktus duomenis.

Įmonių lygmens konkurencingumo veiksniams ištirti buvo atlikta anketinė Turkijos plieno pramonės gamintojų apklausa. Apklaustos 28 įmonės. Yra analizuojami šie vidaus veiksniai: įmonių dydis, partnerysčių aspektai, inovatyvumas, konkurencinių pranašumų prioritetai ir finansinės veiklos rezultatai. Vadovaujantis teorinėmis įmonės lygmens veiksnių sąsajomis su pasiūlytomis konkurencingumo didinimo strategijų alternatyvomis, yra atliekama koreliacinė kiekybinė analizė.

Tarptautinių vertės grandinių kontekstas yra analizuojamas tiriant tarptautinės prekybos duomenis, plieno pramonės įmonių metines ataskaitas, Turkijos plieno pramonės asociacijos pranešimus. Įmonių vertės grandinių lygmens veiksnių tyrimai suteikė reikalingos informacijos konkurencingumo didinimo strategių pasirinkimui ir pasirinkimo argumentavimui.

Apibendrinti tyrimo rezultatai parodė, kad, siekdamos didinti konkurencingumą, Turkijos plieno pramonės įmonės turėtų persiorientuoti į aukštesnės pridėtinės vertės produktų gamybą, vystyti partnerystes su inovacijų lyderiais tyrimų ir vystymo srityse, taikyti žaliosios logistikos principus ir praktiką, aktyviai bendradarbiauti su tiekėjais, plėtojant modulinį vertės grandinės valdymo modelį. Šių rekomenduojamų alternatyvų įgyvendinimas padėtų didinti Turkijos plieno pramonės įmonių konkurencingumą kitų šalių gamintojų atžvilgiu; padėtų stabdyti jau prasidėjusį pramonės šakos nuosmūkį.

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Introduction

The iron-steel industry is directly related with global economic development and economic potential of countries. The fundamental of economic growth and industrialization lies behind possessing a competitive iron and steel industry. The main reason is that steel commodities are main inputs of consumer and investment goods which are widely used in various sectors such as automotive, construction, agriculture, defence industries and many more. Total industrial output is significantly correlated with economic activities within national economies. In another words, the amount of steel consumed is an indicator of degree of industrial development of nations (Huh, 2011). Improving demand on steel escalates the competition fiercely amongst steelmakers all around the world. Since the steel industry acts as an intermediary goods provider for many diversified industries and is strongly dependent upon upstream and downstream processes in the value chains, understanding market dynamics begins with definition of key success factors within the chain for companies. Turkey, as a competitive steel exporter country in the sector, has started to fall behind in the competition due to outdated strategies being still implemented despite its competitive position once.

This study seeks to reveal opportunities and challenges to make Turkey's iron-steel industry more competitive, by researching the most recent global trends in steel GVC's which are implemented by leading competitive nations across the world. To start with, as a result of theoretical research, options that are prominent in the steel industry to improve current competitiveness are revealed with opportunities and challenges. Subsequently, interactions between industrial dynamics of steel and economic activities are determined for 10 leader steel producer countries to acquire insights from major competitors. Following that, implications of revealed options related with firm specific features and steel global value chains are examined. As an outcome, an ultimate guideline is developed, explaining what adjustments to make on value chain activities in order to achieve a better overall performance in international trade of iron-steel commodities for global steelmakers in Turkey. Threefold empirical research is conducted, and results are first interpreted individually, then are integrated as a whole to the guideline to be developed. Aim of the research is to establish a competitiveness improvement guideline for the steel companies in Turkey.

Objectives within the scope of thesis are provided as follows:

1. To reason why the iron and steel industry in Turkey needs an improvement with its advantages and disadvantages
2. To reveal improvement options theoretically for a higher competitiveness in the context of the iron and steel industry
3. To identify global steel trends of top 10 steel producer countries, firm specific features of Turkish companies and global value chains of Turkish steel industry within the frame of the improvement options
4. To critically evaluate the applicability of the revealed options in the theory on country, industry, and firm levels
5. To recommend a guideline to improve competitiveness of Turkish steel industry with alternatives including their opportunities and challenges

The research method is comprised of quantitative and qualitative applications, and their combination in order to establish a solid base for outcome prescription. Empirical research is threefold: revealing the steel industry dynamics, the correlation of firm specific features with performance outcomes and the value chain analysis. On each step, generated results intend to touch upon options that Turkish steel industry need to focus on to be more competitive in global markets.

The first stage of empirical research is determination of the steel industry dynamics, after the problems related with Turkish steel industry are identified. These embedded dynamics are important to identify main trends, how they shape the sector and economies. For this purpose, a trend analysis is performed on trade data from the period 2000-2018 of top 10 steel producer country in 2018, and competitive behaviours of these countries are examined through the correlation of global steel trends with GDP measures. Export structures of countries having similar dynamics with Turkey are researched to determine their product focus in international markets. Export product focus of equivalent competitive countries to Turkey in terms of the correlations with their steel trends and economic activities are used as possible exemplary options to be considered in detail during empirical research.

After having revealed the industrial dynamics of steel, a quantitative firm level analysis is performed by survey method to Turkish steel manufacturers in order to identify how firm-related parameters influence the competitiveness in global competition. The survey is composed of five main parts, each of them targeting to provide an outlook on the features of Turkish steel companies. Constructs of the survey are; firm size, partnership propensities, competitive priorities, innovativeness, and financial performance. Primarily, the impact of firm size and partnership propensities on the degree of innovativeness, and correlation between competitive priorities and financial performance are investigated. Then, the bivariate correlation between innovation and financial performance is examined to find out how business approaches of Turkish steel companies influence their profitability. Results explain the general state of companies for the applicability of the improvement options.

In the third part, to ascertain the main opportunities, challenges, hurdles the steel industry of the country is facing more in detail, a value chain analysis is conducted on the steel industry of Turkey with respect to a framework developed by Gereffi and Fernandez (2011). The qualitative analysis of secondary data, mainly composed of trade statistics, annual reports and sustainability reports of leading companies, targets at a generalized mapping of the steel industry global value chains of the country. The analysis is carried out in six dimensions: input-output structure of global value chains, geographic scope, governance structure, upgrading, local institutional context and industry stakeholders, where each dimension is linked together with a firm specific feature. The analysis is centred around the revealed competitiveness improvement options, and each component is interpreted individually. Key points to improve global performance are discussed respectively along with their compatibility with Turkish steelmakers.

As a result of all the three analyses, theoretically revealed options to improve the global competitiveness of Turkish steel industry are probed factor by factor considering their associated characteristics with firm specific features and GVC's. In the end, applicability decisions are made about the options, then an ultimate general guideline is developed and suggested. The most important outcome of this research is that revealed up-to-date opportunities and challenges on the competitiveness improvement by starting from country level analyses, moving towards industry level and firm level analyses to recommend solutions to the decline of Turkish steel industry.

1. The Iron and Steel Industry in the World Briefly

The world steel production until 2000's has been carried out heavily by public corporations. But, during the following years iron and steel facilities started to be privatized and privately held companies gained an important share in the sector. By means of developing information technologies, economic liberalization and decrease of trade restrictions, global economic developments affect all the nations in a shorter span of time. The iron and steel sector is affected by sectoral developments rapidly within such a global environment where raw materials are procured by imports from certain regions with iron ore reserves, very similar production processes are employed by competitive countries and common global problems are faced due to excess capacity compared to demand existing time to time (TSKB, 2018). In parallel with global developments, variety of changes occurred in the steel industry. Shifts in industrial directions are observed, from production-oriented to customer-oriented strategies, standardization to customization for customer needs, and from mass capacities to the higher added-value. Under these circumstances, value being added to commodities became the most important aspect right next to the increased market values of companies.

The increase of the world steel production is correlated with economic growth in a broad sense. As the world economy grows faster, demand of steel increases proportionally. As given in the Figure 1, crude steel production between 2015-2018 is observed as 3.7%. Likewise GDP per capita growth between same years increased 1.8%, from $15,814 to $17,948 (World Bank, 2020). After 2000s steel production exhibits the biggest increase of 50 years, and keeps this pace with a high acceleration. In order to be competitive in the global economy, countries need to perform well in the steel industry at some extent with an evidence of continuously increasing demand. Figure 2 exhibits the world crude steel production distribution in 2018. So far, the biggest steel manufacturer has been China which is followed by EU 28 and NAFTA countries.

The unstable global economic environment affects the steel industry drastically. Emerging tensions on trade between nations and effects of fluctiations in exchange rates increase uncertainties as well as the price volatility of the sector. Nevertheless, global steel is demand expected to keep growing by World Steel Association at a moderate place in line with the slowing global economy. As stated before, uncertainities over the trade environment and financial market vulnerabilities are also highlighted by association (OECD, 2019). Along with the expected growing demand, diversifications in the product portfolios take place continually due to technological advancements. This increases the added value in the manufactured steel during the processes.

Improvement of the value-added to the steel in the simplest form entails an advance understanding of its properties as well as enrichment techniques. By definition, the steel is an iron-carbon alloy containing less than 2% of carbon and less than 1% of manganese along with very low amounts of silicon, phosphor, sulphur and oxygen. Specifications of steel can be customized through adjustments in the amount of carbon (Callister, 2011) . In terms of durability, elasticity, recycling and abundance and price of raw materials in nature, steel is the most important input material for construction and engineering applications,for this reason the industry is highly associated with economic activities. In order to meet various needs of downstream industries supplying inputs from the iron and steel industry, different production methods exist in the sector.

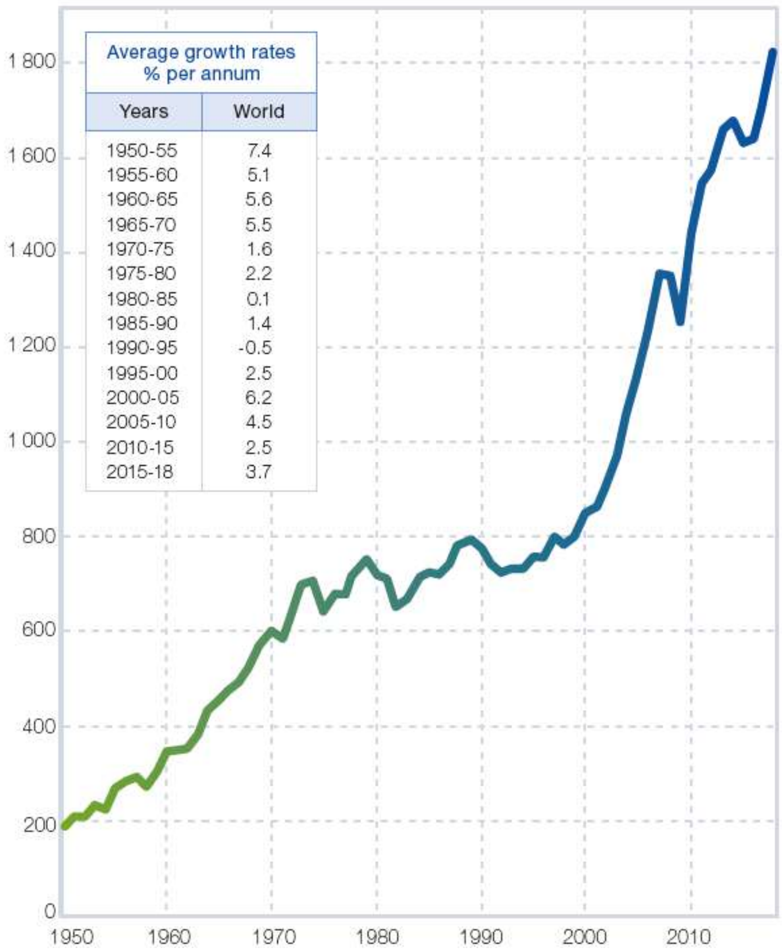

Fig. 1. Crude steel production, million tons, 1950-2018 (World Steel Association, 2019)

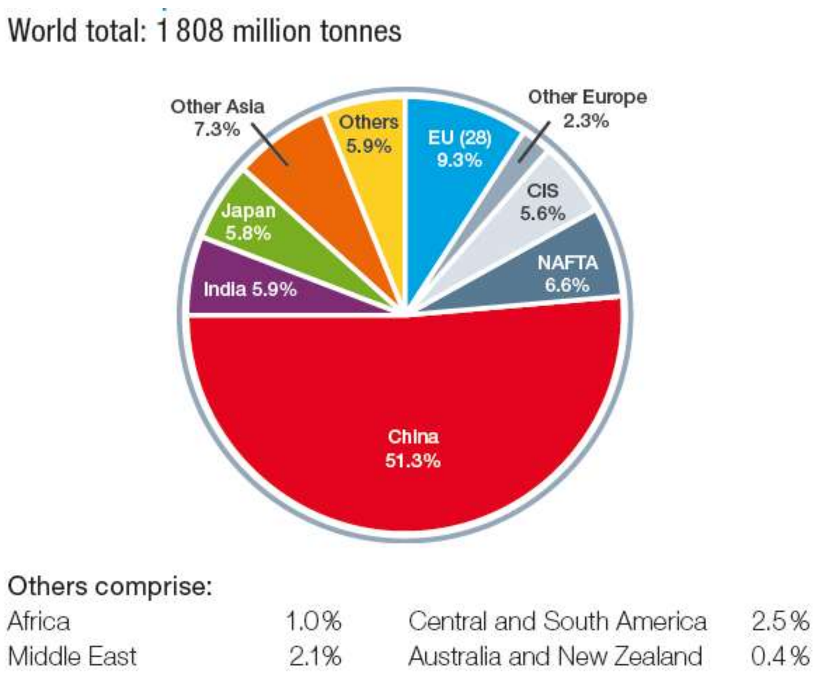

Fig. 2. World crude steel production by regions – 2018 (World Steel Association, 2019)

1.1. Steel Production Methods

The iron and steel industry involves the processing of iron ore and production of steel through various methods by cold/hot milling to form rod, wire, slab, plate, pipe or other profiles. Also, complementary phases are applied such as forging, moulding and casting as well as coating with protective material (e.g. alloy steels). This technology and capital intensive sector entails high quality workforce through the processes. Perpetual developments in production technologies within the industry, escalates the global competition severely, so the steelmakers need to keep investing on R&D to remain competitive.

The most common production methods of steel are; integrated methods and electric arc furnace steelmaking. In integrated mills, blast furnace (BF) - basic oxygen furnace (BOF) is fed by iron ore, limestone and coke obtained from coal as inputs as a preparation phase to steelmaking. The most primary raw materials during the process are liquid hot metal. In addition to this, steel scrap is added to system to be balanced in BOF vessel. Raw material costs resulted from iron ore accounts for more than 50% of BOF steel costs. End products are typically flat/plate products with thicknesses ranging from 10 mm to 200 mm. Flat products are used from automotive sector to white appliances, and in many other industries. When the ironmaking process is done, conversion into steel is done in another furnace to follow up refining process (World Bank Group, 2007) (Figure 3).

With EAF method, steel can be produced from scrap steel in an electric arc furnace in which the scrap is melted. The scrap is usually pre-heated in a specific furnace and loaded together with lime or dolomite, which are used as a flux for the slag formation. This method uses a large amount of electric power (World Bank Group, 2007). Electric arc furnaces use high-current electric arcs to melt scrap and produce liquid steel. Iron ore and coal are fed through direct reduction to the EAF. Also, a smaller proportion of iron ore is fed after being processed with pellets. Then processed material is forwarded to ladling phase to metallurgical processing of steel (Figure 4). The main raw material need of EAF systems is scrap which accounts around 75% of manufacturing costs. Electric arc furnaces produce long products which are used often in construction sector as reinforcing bars, rods.

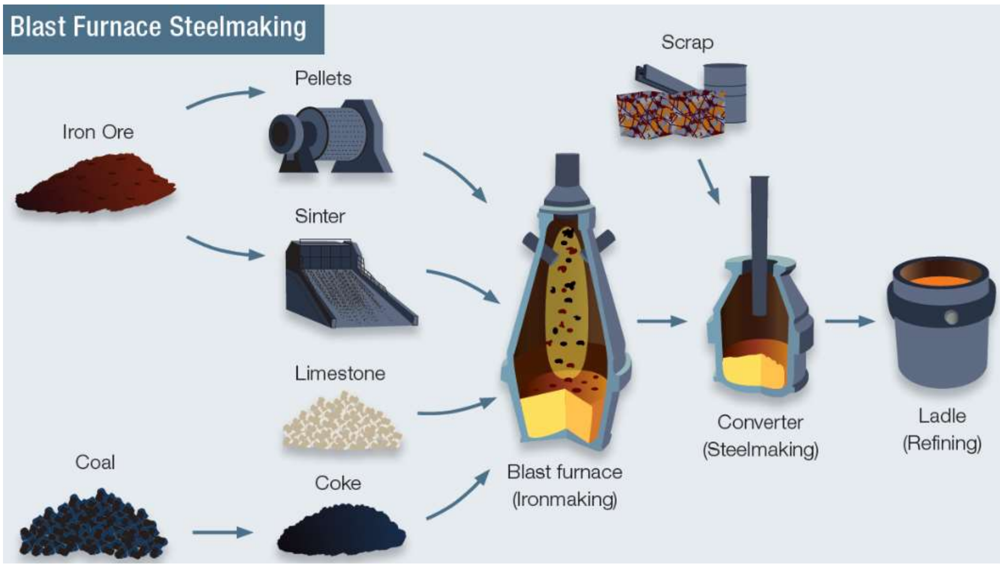

Fig. 3. Steelmaking in integrated mills (World Steel Association, 2013)

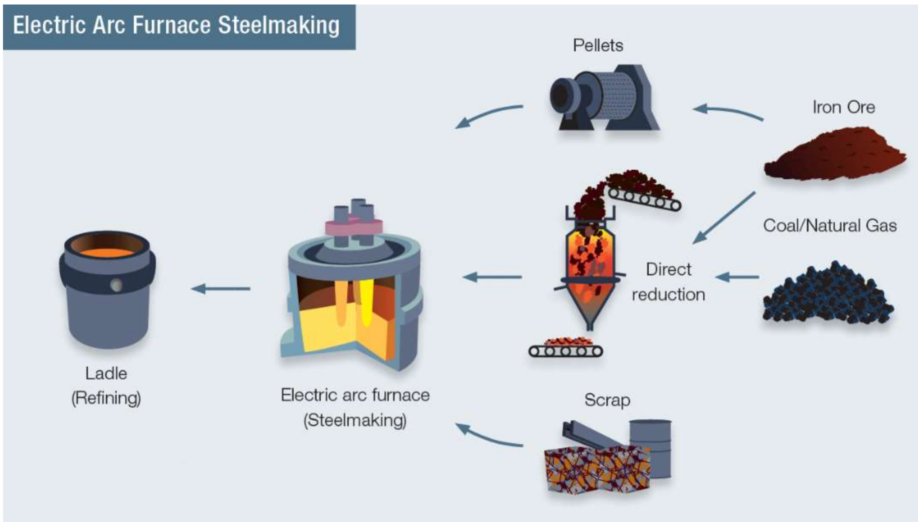

Fig. 4. Steel making in electric arc furnaces (World Steel Association, 2013)

Differentiation of end products takes place after secondary processes into either flat or long products. (Figure 5). There is also another method called open-hearth furnace which is still used by some countries. But, the open-hearth furnace technology, also known as the Siemens-Martins process, is outdated, and no longer considered as a good industry practice, because it has a detrimental effect on steel quality and significant environmental impacts. (World Bank Group, 2007).

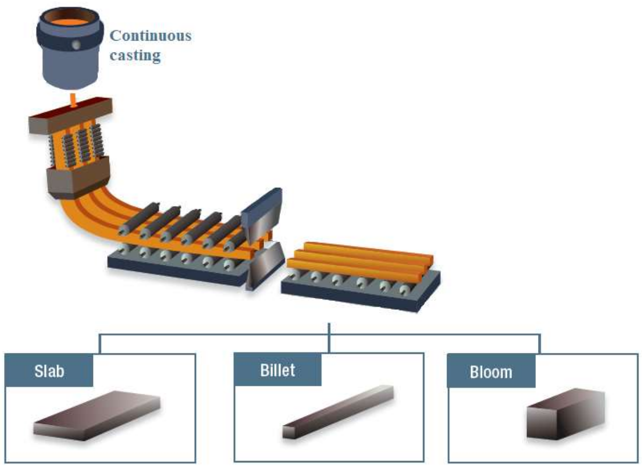

Fig. 5. Secondary steelmaking processes (World Steel Association, 2013)

Two methods distinguish mainly with their capital investment costs. A typical integrated steel mill operates with $1100 per tonne of installed capacity, whereas a medium-size EAF mill operates under $300 per tonne in terms of the initial capital outlay ("Basic Oxygen Steel Making Process", n.d.). Additionally, integrated mills are the most suitable method of producing flat steel products due to high-quality composition of their output material. The electric arc furnace steel making has some limitations due to the presence of tramp elements in scrap as the main charging material and higher nitrogen content compared to blast furnace operation. To produce flat products, these tramp elements and gases have to be reduced to prevent deterioration in surface quality and the mechanical properties of steel (Huellen, *et al.* 2006). So, output products of electric arc furnaces are lower value-added long products.

1.2. Products of the Iron and Steel Industry

End products of the steel industry typically divide into two categories: long and flat products. Long products are often used in construction industry (Figure 6). They are classified as:

- Billets and blooms
- Rebars and wire rods
- Sections
- Rails
- Sheet piles and drawn wires

Fig. 6. Long steel products (“Profiles/long products“, n.d.)

Flat products are higher value-added outputs of the industry which are mainly used in automotive, appliances, aircraft, shipbuilding, and suchlike industries and include (Figure 7):

- Slabs
- Hot or cold-rolled coils
- Coated steel products
- Tinplate and heavy plates

Fig. 7. Flat steel products (“Flat products“, n.d.)

Steel can be further divided into four different categories according to its chemical composition that are: carbon steel, alloy steel, stainless-steel, and tool steel. Each category contains different physical, chemical, and environmental properties according to the end use purposes. These various properties are formed by adjusting grades of steel differently. What determines the grades is the amount of carbon and additional alloys being mixed into steel (“The four types of steel“, 2015).

The carbon steel is classified into three according to the amount of carbon content. Low-carbon steels contain between 0.04% - 0.3% carbon within. They are generally used as structural steel and can be found almost everywhere. From car panels to agriculture, construction to heavy machinery low carbon content steel is versatile in wide variety of areas (“What are uses of low carbon steel“, n.d.). Medium-carbon steels contain carbon between 0.31% and 0.6%. They are harder than low-carbon content in terms of strength, as well as harder to shape, weld and cut. Medium-carbon steels are majorly utilized in railway tracks, machinery parts and mechanical equipment. High-carbon steels contain from 0.61% to 1.5% of carbon, that are usually known as carbon tool steels and mostly used in springs and cutting tools with their high tensile strength (“Carbon Steel“, n.d.).

Alloy steels are produced by mixing different elements with steel to generate different characteristics such as hardness, corrosion resistance and enhancement of strength or hardness (“The four types of steel“, 2015). They are used mostly in pipes which require an exceptional performance or in bearings to be used in machinery, aircraft, or containers.

Stainless steel is produced by including to its composition 10% to 20% of chromium which is extremely resistant to corrosion. The most common application areas of stainless steel are kitchen tools, dental or surgical equipment and other cutting tools. Tool steel is produced by subjecting the steel to different processes according to the desired end use. The main purposes of tool steel are cutting, excavating, mold making or other impact applications (“The four types of steel“, 2015).

Following the short introduction about current global condition of steel industry, steel manufacturing methods and types of steel products, the competitive position of Turkey’s iron and steel industry needs to be identified associated with manufacturing methods, market strategies and policies.

1.3. Competitive Position of Turkey in the Global Iron and Steel Industry

Distribution of the steel production by process in 2018 for top steel exporter countries is given in the Table 1. According to the data, majority of top manufacturers prefer integrated production methods, in blast and basic oxygen furnaces, whereas 36% employ electric arc furnaces. Due to its side effects on steel and environment, open hearth method has the lowest use with only 2%. Worldwide data about the process method distribution is given in Figure 8. 71% of the world use integrated methods for the steel production.

Table 1. Crude steel production by process, 2018 (World Steel Association, 2019)

	Million tons	**Oxygen (Integrated) %**	**Electric %**	**Open hearth %**
China	928.3	88.4	11.6	0
Japan	104.3	75	25	0
Russia	71.7	66.9	30.8	2.4
South Korea	72.5	66.6	33.4	0
EU (28)	167.7	58.5	41.5	0
Germany	42.4	70.1	29.9	0
Turkey	**37.3**	**30.9**	**69.1**	**0**
Italy	24.5	18.4	81.6	0
Belgium	8	67.7	32.3	0
Ukraine	21.1	69.7	7.5	22.8
France	15.4	68.4	31.6	0

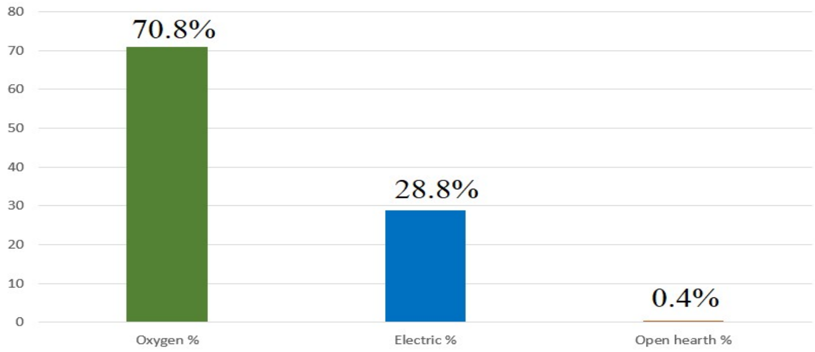

Fig. 8. Overall distribution of steel production methods in World, 2018

Crude steel producers in Turkey majorly prefers the electric arc furnace technology (Table 1). And the main focus is on low value-added long products as finished steel production due to method. This is not advantageous for country, because higher value-added flat products have a higher global demand along with technological developments. According to Figure 9, total amount of flat products being exported all over the world accounted for 230 million tons, whereas long products were 147 million tons in year 2018. Distribution of demand is divided into 5 years and the data shows that flat products has been exported more than long products for also previous years.

million tonnes

		2013	2014	2015	2016	2017	2018
	Ingots and semi-finished material	54.1	54.3	51.8	54.3	60.2	62.0
Long Products	Railway track material	3.0	2.2	2.1	3.1	2.7	2.6
	Angles. shapes and sections	22.1	24.6	21.7	24.0	22.1	22.7
	Concrete re-inforcing bars	18.9	22.2	18.9	21.4	18.3	18.8
	Bars and rods. hot-rolled	18.1	29.7	40.7	40.3	21.2	18.7
	Wire rod	24.2	29.4	29.0	30.3	27.0	27.6
	Drawn wire	7.7	8.9	8.4	8.7	8.9	9.0
	Other bars and rods	4.9	6.0	5.3	5.8	5.9	6.4
Flat Products	Hot-rolled strip	3.0	3.3	2.9	3.3	3.9	3.8
	Cold-rolled strip	3.5	4.1	3.9	4.2	4.5	4.5
	Hot-rolled sheets and coils	67.3	75.8	77.7	86.1	85.0	79.0
	Plates	29.0	34.5	30.1	34.1	33.2	33.3
	Cold-rolled sheets and coils	33.0	37.2	32.8	35.6	37.4	35.7
	Electrical sheet and strip	4.0	4.2	4.1	4.2	4.5	4.6
	Tinmill products	6.4	6.7	6.3	7.2	7.0	6.8
	Galvanised sheet	37.1	40.7	37.6	45.0	46.2	44.7
	Other coated sheet	15.4	17.9	16.3	18.8	18.0	17.9
Long Products	Steel tubes and fittings	39.7	43.6	35.3	37.2	41.9	41.3
	Wheels (forged and rolled) and axles	0.9	0.8	0.8	1.0	0.8	0.9
	Castings	0.7	0.9	0.8	1.1	1.2	1.3
	Forgings	0.7	0.8	0.8	0.9	1.0	1.1
	Other	0.0	0.0	0.0	0.0	0.0	0.0
	Total	393.8	447.7	427.0	466.7	450.7	442.7

Fig. 9. Analysis of world steel exports by product from 2013 to 2018 (World Steel Association, 2019)

Another issue is that owing to electrical arc furnaces technology, Turkey is the biggest importer country of ferrous scrap all around the world with 21 million tons (Table 2). So, high volumes of scrap dependency make the industry more vulnerable to restrictions in international trade.

Main disadvantage of Turkey in the iron and steel sector is relying heavily on outside in terms of raw material. Iron ore reserves and scrap inputs are not enough to procure the need domestically. Despite that fact, it is possible to take an advantage as in example of Japan by consolidating their businesses through alliances with foreign steel companies. Currently, 80% of the iron ore reserves are abundant in Ukraine, Russia, China, Brazil, Australia, India, Canada, USA, and Sweden. Evidence highlights that Turkey is highly dependent upon iron ore procurement which is used in integrated facilities with 11 million tons import in 2017 (World Steel Association, 2019).

After 2002, as a result of privatized companies, investments in integrated facilities has commenced to improve product portfolio of country. Erdemir Group has become the pioneer on R&D investments, and they opened up İsdemir in İskenderun to shift operations gradually to flat products with a new integrated steel production facility. However, the country cannot still produce flat procuts as much as the need for its own industry.

Table 2. World ferrous scrap trade statistics (World Steel Association, 2019)

Ferrous Scrap Trade (Million tons)				
	Exports		**Imports**	
	2017	**2018**	**2017**	**2018**
EU (28)	47.8	50	31.9	32.7
CIS	5.8	6.1	2.5	2.6
NAFTA	20.1	23.2	8.5	10.4
Asia	15	12.4	31.6	33
Central and South America	1.9	2	0.9	1
Africa	1.4	1.4	2.5	0.6
Middle East	2	2.5	1.1	0.9
Turkey	**0.2**	**0.2**	**21**	**20.7**

The data of 2018 shows that Turkey has been 7th exporter country of total exports with almost 20 million tons (Figure 10) in the world. In terms of export performance results seem to be promising for competitiveness along with net exports with 5.8 million tons (Figure 11). Nevertheless, it is not accurate to solely interpret export volumes in order measure the efficiency of global performance in the trade of commodities. The more detailed look into range of products, export intensities, and value-added to commodities need to be considered as a whole.

Rank	Total exports	Mt	Rank	Total imports	Mt
1	China	68.8	1	European Union (28)	44.9
2	Japan	35.8	2	United States	31.7
3	Russia	33.3	3	Germany	26.6
4	South Korea	30.1	4	Italy	20.6
5	European Union (28)	28.4	5	Thailand	15.5
6	Germany	26.0	6	South Korea	14.9
7	Turkey	19.9	7	France	14.9
8	Italy	18.2	8	Belgium	14.8
9	Belgium	18.0	9	China	14.4
10	Ukraine	15.1	10	Viet Nam	14.1
11	France	14.4	11	Turkey	14.0
12	Brazil	13.9	12	Mexico	13.1
13	Taiwan, China	12.3	13	Poland	12.1
14	India	11.1	14	Indonesia	11.7
15	Netherlands	11.0	15	Spain	10.8

Fig. 10. Major importers and exporters of steel, 2018 (World Steel Association, 2019)

Rank	Net exports (exports - imports)	Mt	Rank	Net imports (imports - exports)	Mt
1	China	54.4	1	United States	23.1
2	Japan	29.8	2	European Union (28)	16.5
3	Russia	27.0	3	Thailand	13.6
4	South Korea	15.1	4	Philippines	9.1
5	Ukraine	13.5	5	Viet Nam	8.7
6	Brazil	11.6	6	Indonesia	7.9
7	Iran	7.5	7	Mexico	7.5
8	Turkey	5.8	8	Malaysia	6.3
9	Taiwan, China	4.6	9	Poland	6.0
10	Belgium	3.1	10	United Kingdom	3.3
11	Austria	2.6	11	United Arab Emirates	3.2
12	India	2.1	12	Algeria	3.1
13	Slovakia	2.1	13	Bangladesh	3.0
14	South Africa	1.8	14	Israel	3.0
15	Luxembourg	1.8	15	Pakistan	2.9

Fig. 11. Net exports/net imports of steel, 2018 (World Steel Association, 2019)

A further look into product portfolio of Turkey's exports shows that long products comprise the biggest proportion of exports with more than 10 million of tons. Flat products follow with 6 million tons. Stainless steel production is significantly low in Turkey's steel industry, respectively exports are low (Figure 12). As average export price for flat products were $600/tons, long products were sold at $564/tons in Turkey which are calculated from Figure 9 statistics. However, the world average prices for flat products on December by the end of 2018, were $767/metric ton for mid to high-quality flat products and $678/tons for long products (Table 3). The data shows the urgency for increasing the quality of steel being produced particularly on flat segment. Not only to increase margins, but also to close deficit stemming from excess import of high-quality steel portfolio, some steps are needed to be taken in value chains of the iron and steel industry.

Table 3. Flat & long steel product prices - $/tons (Steel Prices, 2019)

Month	Flat products World	Flat products EU	Flat products North America	Flat products Asia	Long Products World	Long Products Eu	Long Products North America	Long Products Asia
Oct-2018	813	749	1028	663	694	638	827	616
Nov-2018	792	720	1003	653	684	622	815	615
Dec-2018	767	704	953	644	678	612	813	594
Jan-2019	756	687	911	637	673	612	813	594
Feb-2019	733	680	883	635	672	608	812	597
Mar-2019	733	683	887	630	680	615	821	603
Apr-2019	735	670	892	643	675	601	817	607
May-2019	705	653	824	637	659	593	787	589
Jun-2019	680	646	766	628	650	579	782	589
Jul-2019	677	648	755	629	635	574	743	588

One another dimension to consider is main importers of Turkey in the industry. In 2019 year, top 5 exports markets of Turkey by product in are given in Figure 13 (U.S. Department of Commerce, 2019). The largest share occurred with flat products to Italy with 1.5 million tons. Spain and Belgium followed with 900 thousand tons and 516 thousand tons respectively. Israel has the largest share of Turkey's exports of long products at 11 percent (1.2 million tons). Turkey has still access to EU market, but it started to lose his share in United States due to recent political tensions. Anti-dumping implementations also cause a drop of Turkey 's shares in those markets.

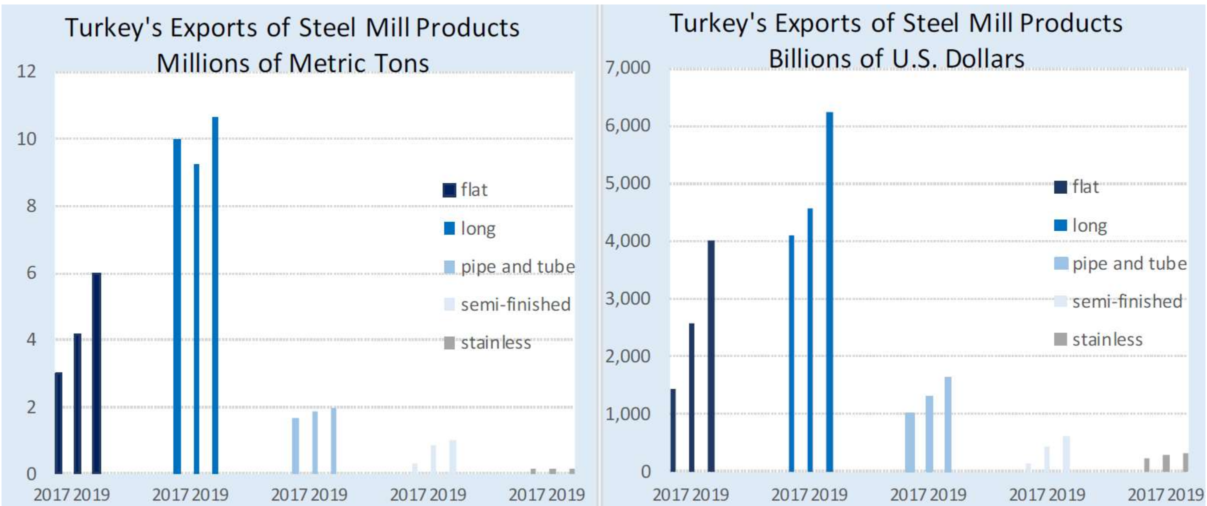

Fig. 12. Turkey's exports of steel mill products volume-turnover 2016-2018 (U.S. Department of Commerce, 2019)

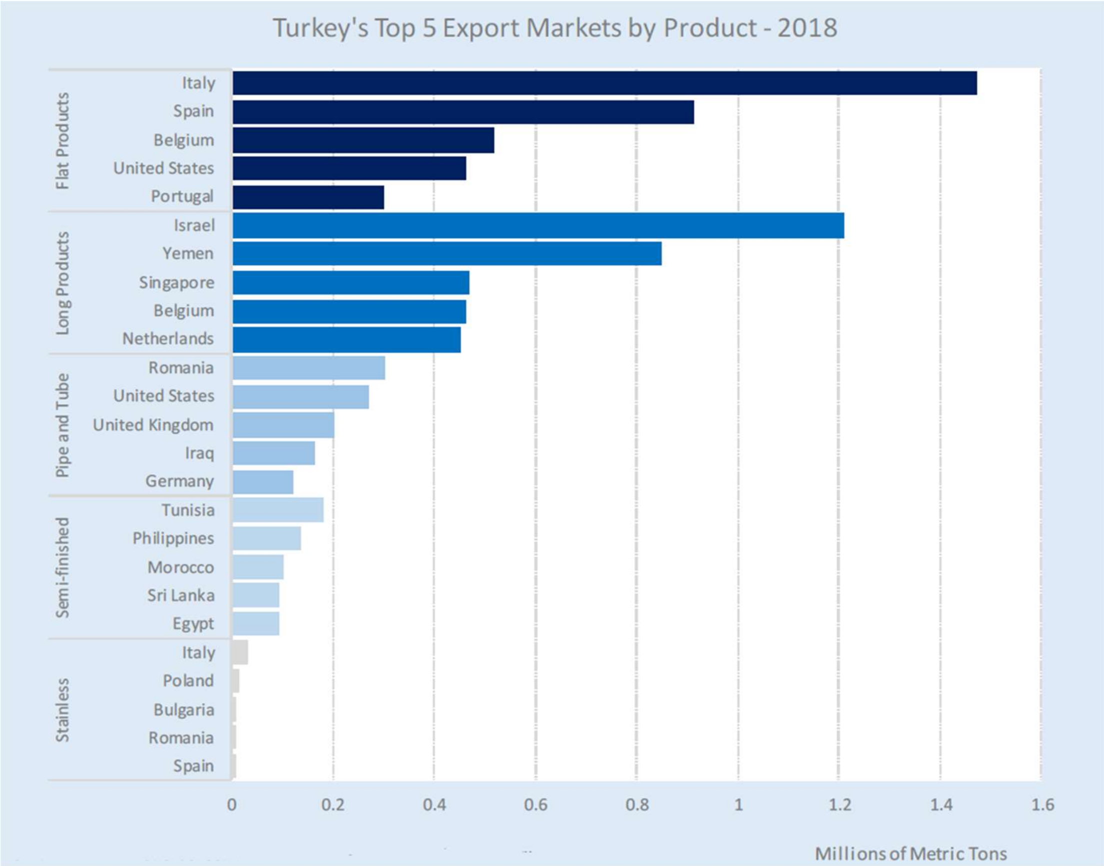

Fig. 13. Turkey's top 5 export markets by product- 2018 (U.S. Department of Commerce, 2019)

From import portfolio point of view, flat products and semi-finished products comprises the biggest proportion of import structure of Turkey in steel. In 2018, Turkey imported 7 million tons of flat steel products (Figure 14). Considering the main need for many industries also in Turkey, high-quality flat products are inevitable to import with the existing electric arc furnace technologies in major that produces only long products.

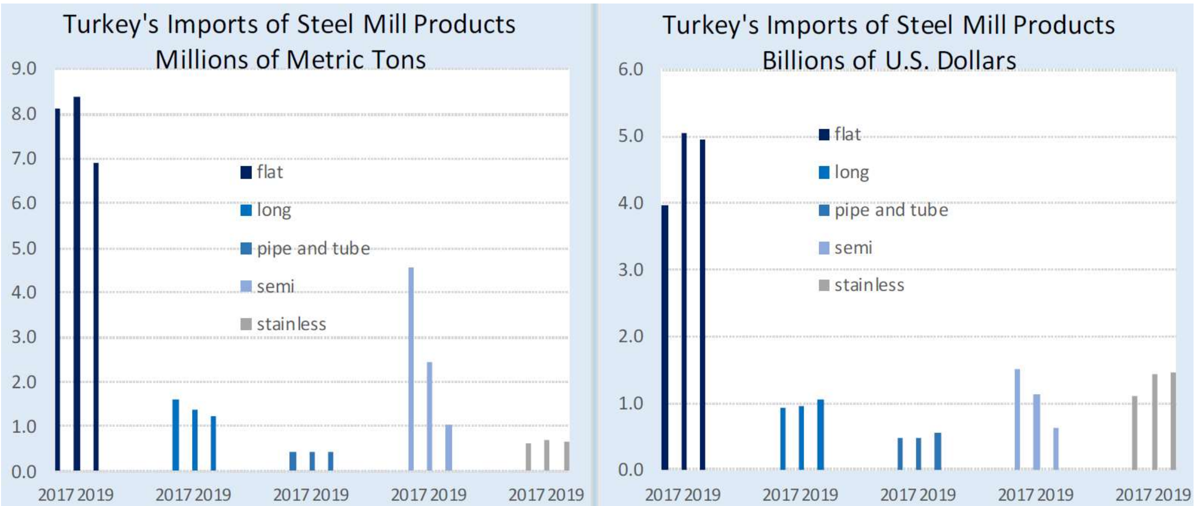

Fig. 14. Turkey's import of steel mill products volume (U.S. Department of Commerce, 2019)

When Table 4 pertaining to consumption of end product of steel in Turkey analysed, the consumption of long products containing construction commodities has 52% shares which is provided by domestic market. In addition to this, the consumption rate of flat products as input to industry appeared as 48% of all the consumption. Insufficient flat product manufacturing directs end users in Turkey towards imports. An aftermath of the situation is mainly observed on domestic flat product sales of existing few companies manufacturing these products with a low demand for their commodities as a result of competition with imported flat products in terms of quality and price. Another point is that since the year 2000 the steel consumption in Turkey increased periodically until 2015, slowed down after 2016 and started to decrease in 2018. The results are concerning when the current situation of such a developing country within top 10 exporters of steel is considered, because the steel consumption is significantly correlated with industrial development.

Table 4. Iron-Steel end product consumption in Turkey (SATSO, 2019)

thousand tonnes	2000	2005	2010	2014	2015	2016	2017	2018	Change %	Share %
Long Products	6784	9077	11660	16168	17926	17639	18130	15804	-12.8	51.7
Flat Products	6286	9363	11944	14605	16455	16455	17796	14779	-17	48.3
Total	13070	18440	23604	30773	34381	34094	35926	30583	-29.8	100

Drastically increased steel capacity in the world caused Global Forum on Steel Excess Capacity GFSEC to be established under the chairmanship of G-20. Especially with the Republic of China's vast pressure in the global markets on steel supply, countries started to make policies in order to protect their own steel sectors to reduce competitiveness. Particularly tariffs on steel within the context of Section 232 investigation which is applied by U.S. to Turkey severely limited the amount of exports to US, which is followed by other countries with different protective policies. Steelmakers in Turkey are in the search for new markets because of strict policies applied by nations such as increased tariffs, export limitations via quotas, and import bans. (TSKB, 2019).

The Turkish Steel Producers Association (TÇÜD) reported that Turkey could become an open market for dumped steel imports, unless some actions are taken by the government. Within the context of Section 232, 25% tariff is applied by United States on steel imports from Turkey. Hence, exports were diverted back to Turkey as a result of access loss to the US market. Main steelmakers in Turkey had to lower their price to compete against dumped imports or they had to lower capacities and deal with idle capacity problems, because they could not compete on prices. The situation will result with a raise in steel prices in domestic market. (AMM, 2018) Effects caused by global policies of nations still resonate in 2019, and will likely to damage the industry more uncompromisingly.

Considering all the issues which Turkey's steel sector encounters, there are variety of dimensions to be touched upon to reinvigorate the competitiveness of the iron and steel industry. Firstly, the production method focus on EAF facilities keeps product range of country limited with mostly low value-added long products. Turkey procures 35% of scrap as raw material for EAF facilities domestically, whereas 65% is provided through imports. Similarly, iron ore as raw material procured 40% domestically as the rest 60% is imported. Furthermore, flat product manufacturing is insufficient, thus approximately annually 5-6 million tons of high value-added steel product gap is tried to be covered through imports. Another fact is that only one company which is Erdemir Group, has entered to top 50 steelmakers list of World Steel Association, with 45th rank (Figure 15). Given the total steel exports of country in 2019 which is 19.9 million tons, the rest of the steelmakers operate as separate clusters in a small scaled manner. In this respect, integration of companies to achieve a better export performance is also another missing aspect of Turkey's steel industry.

Rank	Company	Tonnage	Rank	Company	Tonnage
1	ArcelorMittal	96.42	26	U. S. Steel Corporation	15.37
2	China Baowu Group	67.43	27	Baotou Steel	15.25
3	Nippon Steel Corporation [(1)]	49.22	28	Rizhao Steel	14.95
4	HBIS Group [(2)]	46.80	29	Liuzhou Steel	13.53
5	POSCO	42.86	30	EVRAZ	13.02
6	Shagang Group	40.66	31	MMK	12.66
7	Ansteel Group	37.36	32	thyssenkrupp	12.58
8	JFE Steel Corporation	29.15	33	CITIC Pacific	12.55
9	Jianlong Group	27.88	34	Severstal	12.04
10	Shougang Group	27.34	35	Sanming Steel	11.68
11	Tata Steel Group [(3)]	27.27	36	Shaanxi Steel	11.38
12	Nucor Corporation	25.49	37	Jingye Steel	11.25
13	Shandong Steel Group	23.21	38	Anyang Steel	10.97
14	Valin Group	23.01	39	Taiyuan Steel	10.70
15	Hyundai Steel	21.88	40	Jinxi Steel	10.33
16	Maanshan Steel	19.64	41	Nanjing Steel	10.05
17	NLMK	17.39	42	Metinvest Holding	9.37
18	JSW Steel	16.83	43	Xinyu Steel	9.36
19	IMIDRO [(4)]	16.79	44	Tsingshan Stainless Steel	9.29
20	SAIL	15.93	45	Erdemir Group	9.14
21	Benxi Steel	15.90	46	Steel Dynamics, Inc.	8.92
22	China Steel Corporation	15.88	47	Zenith Steel	8.70
23	Gerdau	15.80	48	SSAB	8.03
24	Fangda Steel	15.51	49	Tianjin Steel	7.77
25	Techint Group [(5)]	15.38	50	Donghai Special Steel	7.61

Fig. 15. Crude steel production of top steelmakers in million tons-2018 (World Steel Association, 2019)

All in all, Turkey's iron and steel sector needs to be scrutinized as a whole, and possible opportunities need to be revealed distinctively to have a concrete trajectory for global steel trade in long term. The main problems related with Turkish steel industry are summarized as below:

1. Due to lack of integration between companies, operations are in clusters with lower capacities,
2. Main method used in Turkey – electric arc furnace production method – requires an expensive raw material which is scrap, and country is dependent on imports in procurement of it,
3. High external dependence in terms of raw material,
4. Insufficient production of high value-added commodities such as flat products or high-quality commodities like alloy steels,
5. Low steel export prices in global markets mainly to be able to compete in global markets as a result of lower product quality,
6. Anti-dumping taxes, import restrictions and international trade sanctions applied on Turkey causes a loss of exports.

2. Global Value Chain Concepts and Approaches in the Context of the Steel Industry

The approach of value chains is created and first mentioned by Porter in 1980 in his book "Competitive advantage of nations: creating and sustaining superior performance". The notion describes strategies to create a value by accumulating independent activities together (Figure 16). The framework is customized and integrated for variety of services/industries by many researchers, but the conventional framework itself is still applicable regardless of its age. Firms gain competitive advantage from conceiving of new ways to conduct activities, employing new procedures, new technologies, or different inputs. What matters in such a system is linkages between activities. But expectedly linkages often create trade-offs while performing variety of activities. Diligence in management of linkages and optimization helps companies achieve a competitive advantage (Porter, 2011).

The main focus of GVC concept is on utilization of supply chains globally, creation and capturing of value to be delivered (Gereffi *et al.* 2012). Particularly in developing countries, the pressure is more severe to keep improving their competitive performance along with the new entrants producing at lower costs which provide more developed services and products. The competition is more intense than ever by means of globalization. According to the literature, the most feasible way to parry these pressures and adapt better in global markets, is upgrading on products, services, processes, or every single step helps create a value (Kaplinsky 2000). The strongest pressure on the iron and steel industry is applied by China 's aggressive strategy of mass production with lower costs and prices in global markets. National competitiveness of the country pushes all other competitors to take precautions against such an overwhelming strategy. Consequently, to deal with that pressure more conservative policies that are implemented greatly affect the companies that do not adapt their global strategies into new environments.

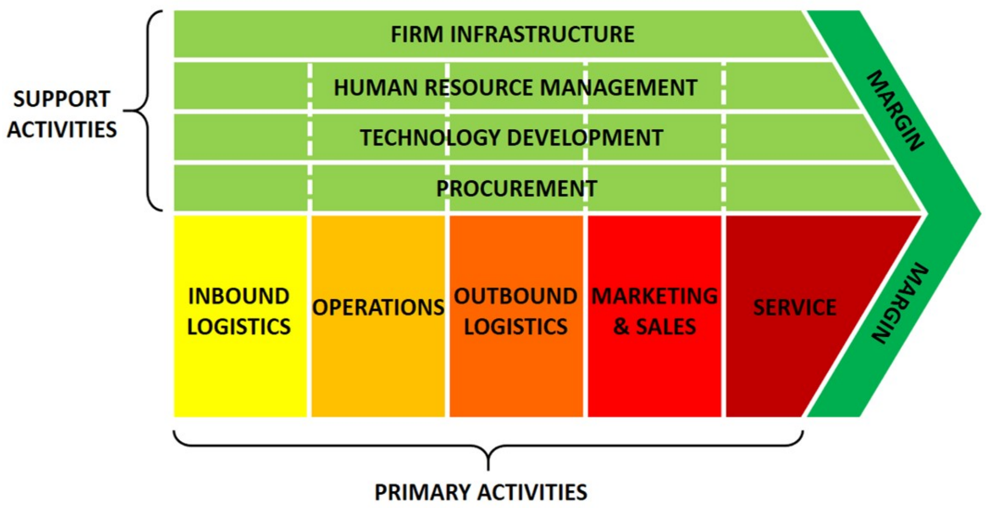

Fig. 16. Porter's Generic Value Chain (Porter, 2011)

Emergence of global value creation and advanced delivery systems defines characteristics of international production pertained with globalization. Gereffi and Korzeniewicz (1994) define these mechanisms as qualitative for integration of global value creating activities presenting current prominent features of globalization. Here, the importance of global networks arises as a major innovation for the organisations doing international business which defines the way nations and firms operate with stronger links to these networks and contribute to global economy (Ramirez and Rainbird, 2010).

For a better understanding of approaches like global networks or integrative activities, an overarching outcome of GVC theories implies that network analyses for value chains should be extended to include cooperative relations between international firms and their networks of upstream and downstream activities, supporting institutions and other global stakeholders taking part in entire value delivery processes. Since variety of approaches exist in literature to research the essence of GVCs, despite each of them focuses on different theoretical fundamentals, there are plenty of researches overlapping. Results obtained from empirical researches reflect that several GVC approaches converge to that the diffusion of international knowledge provided by lead firms acts as driving force to help upgrade the capabilities of supplier firms (Ernst and Kim, 2002; Gereffi, 1999; Humphrey and Schmitz, 2002). In other words, successful upgrading by suppliers acts as a driving force and fosters leading firms to direct focus on highe value-added activities in the chains (Ernst and Kim, 2002). In this case, the iron and steel industry as an intermediary commodity supplier is strongly affected by quality of raw material supply as well as impacting downstream industries.

Network dynamics of GVCs provide a valuable knowledge on international production sharing and offshoring activities and they form a detailed framework about how global trade works in practice and evolves (Tsekeris, 2017). GVCs are not widely explanatory only by a holistic view, but requires an examination of interlinkages between these networks. In fact, specifications of GVCs are determined by features of interactions between actors within chains, technologies being developed and how they are applied to design, production, and governance stages. These determinants are also highly variable, for example, patterns of governance might broadly vary even in the same industry in the same location. Yet, the measure of how firms in developing countries benefit from changing value chain dynamics is unclear (Barrientos, 2016). These benefits or improvements are achieved with implementation of accurate strategies matching with capabilities of companies and value chain dynamics of linked industries.

Upgrading option has been long researched within chains by scholars. Barrientos *et al.* (2011) examined upgrading possibilities from two perspectives: economic upgrading involving a move towards higher value-added activities, and social upgrading aiming at provision of better work standards, and rights for workers. Some authors argue that strategic downgrading is another option to be able to remain in the markets for some suppliers by focusing on lower price domestic markets (Pickles *et al.* 2006). For the iron and steel industry, downgrading option need to be considered twice before implementing. Since there is a vast pressure applied by China in global markets, this may not be a viable option for most of the countries. Barrientos *et al.* (2016) research the possible outcomes of economic and social upgrading along with downgrading option in order to reveal further about GVC dynamics, and conclude that competitive pressures are the main driver of economic downgrading. Besides, some producers with lower quality labour force are even eliminated from global and regional value chains in time. Analytical implications argue that global value chains and global production networks together provide supportive outcomes towards dynamics of global markets. To comprehend those dynamics researches focusing on the iron and steel industry value chains provide a significant information. Following sub-chapter addresses value chain approaches in the steel industry in order to shed a light to previous and current industrial applications.

2.1. Value Chain Approaches in the Iron and Steel Industry

An integration of the steel value chains to Porter's framework is given in Figure 17 which is created by Acharyulu *et al.* (2015) to explain how activities are interrelated in the industry. Primary activities are divided into two sections as product related and market related. Product related section is more pertained with procurement of raw material, processing of major raw materials and manufacturing steel commodities. Inbound logistics include collecting input raw materials used for steelmaking process and distribution of them internally along various activities. Operations/production management is composed of handling and processing of raw material like coke, iron ore or scrap. Dispatch planning, distribution management, warehousing and order trace are done during outbound logistics. Marketing and sales activities might vary according to the market focus either domestic or foreign. The rest of the activities follow the framework of generic value chain developed by Porter (2011) (Acharyulu *et al.* 2015). However, this depiction is too generic to represent the irond and steel industry value chains and fails to reveal essential activities in a steel value chain. Furthermore, these steel value chains strongly vary with between regions, even within the same region between firms depending on their customer segments. These value chains are generally defined by the mode of governance, input-output structures, corporate structures, and firms' business models. It is not accurate enough to describe the general framework of the iron and steel global value chains in such a simple form, for this reason a detailed value chain analysis is necessary to understand industry of a subject country.

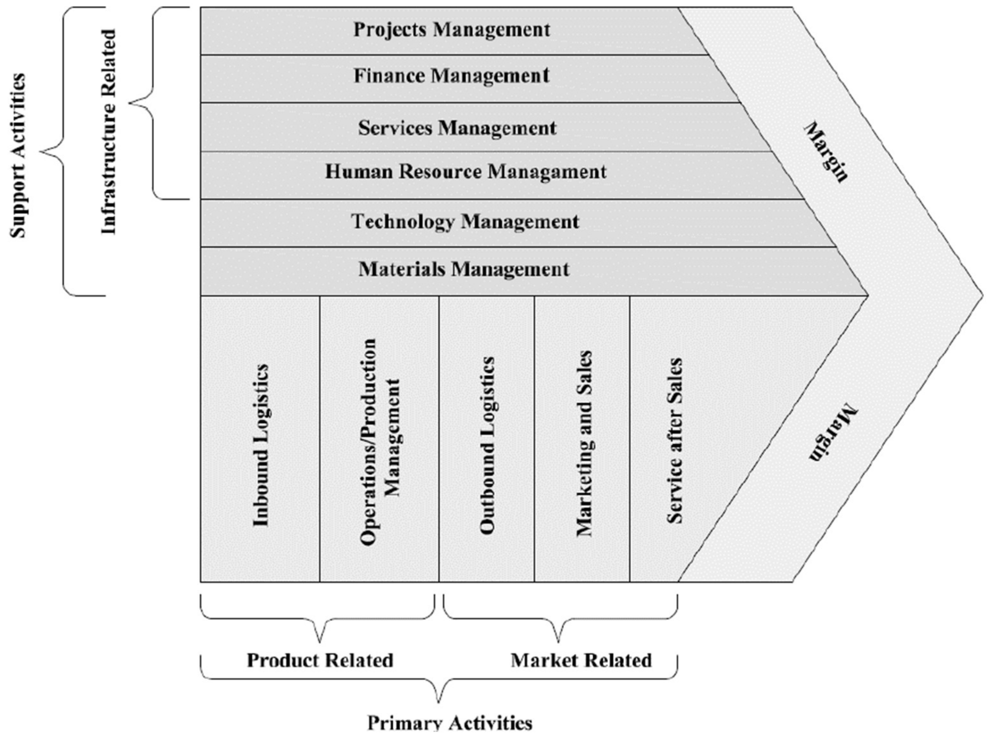

Fig. 17. Steel Industry GVC (Acharyulu et al. 2015)

A more detailed framework for steel industry accumulation of value through production steps is summarized by Mattera (2017) in Figure 18. Amongst all the activities, obviously there are high and low value-adding activities. Key to achieve a better overall performance is utilization of synergies through linkages, by focusing on a certain competitive strategy such as delivering a high value-added product or service, cost leadership, high delivery performance, or operational flexibility. Determination of a strategy starts with the identification of downstream and upstream activities. Upstream industries are dependent upon the production method throughout steelmaking process. Input materials vary in accordance with the production method either in integrated facilities or electric arc furnaces. Downstream industries can vary widely with respect to customer segment that steelmakers are focusing on. In the general concept of steel industry value-adding starts first with the primary upstream supply activity that is mining. Subsequently, other activities come after by increasing the value with respect to direction of market (Figure 19). The framework suggested by Mattera (2017) is a more accurate mapping of value chain activities related with the irond and steel industry, however it differs slightly from conventional framework of Porter (2011). An adaptation of this framework would be relevant when a steel industry value chain analysis for a particular country or cluster is to be performed.

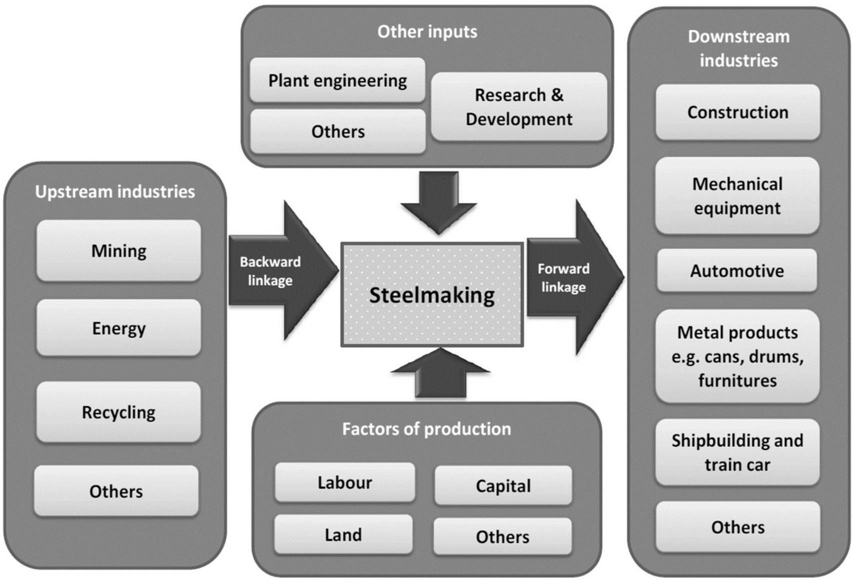

Fig. 18. Steelmaking backward and forward linkages (Mattera, 2017)

The value accumulation is provided by Mattera in Figure 19, showing the degree of value-added during the activities where steel involved as the intermediary commodity. The most importantly the value-added of steelmaking is highly dependent upon the product focus of firms, whether they produce flat products for advance technology or sectors that require superior standards of steel, or whether they produce long products for sectors where relatively lower standards are acceptable. But there is an obvious fact that advancements in almost all the industries using steel, make the market more demanding in terms of input qualities. Therefore, in order to capture high-end-markets an absolute requisite is growing the value being delivered to those segments. The opportunity for steelmakers to improve their value to be delivered starts with the procurement of raw materials, and consolidated with resource capabilities and their efficient utilization of those capabilities. As an example, product differentiation to manufacture more exclusive steel commodities such as stainless steel, or other specific alloy steels is one way to achieve a higher value-added. But, before implementation of such alternative production options, cost structures need to be well analysed taking all possible impacts on steel value chains into account.

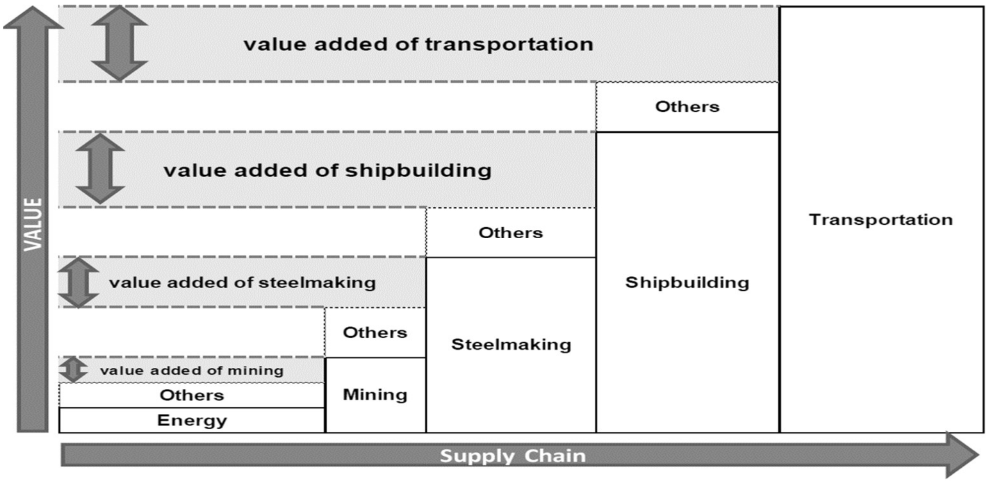

Fig. 19. Value accumulation through production steps (Mattera, 2017)

A further look into the iron and steel industry value chains is done by Mattera (2018) stressing out the fragmentation in steel value chains. Key stages in the industry start with iron making where oxygen is removed from iron ore using coal in a blast furnace to be used as input in crude steel making. After the primary steelmaking is done, semi-finished products are processed into different outputs during rolling/finishing stages where products also can be customized to meet particular requirements with respect to customer needs (Mattera, 2018). This simple framework applies almost to all the companies of steel industry with a slight difference in raw material as scrap instead of iron ore if the method is electric arc furnace manufacturing. (Figure 20).

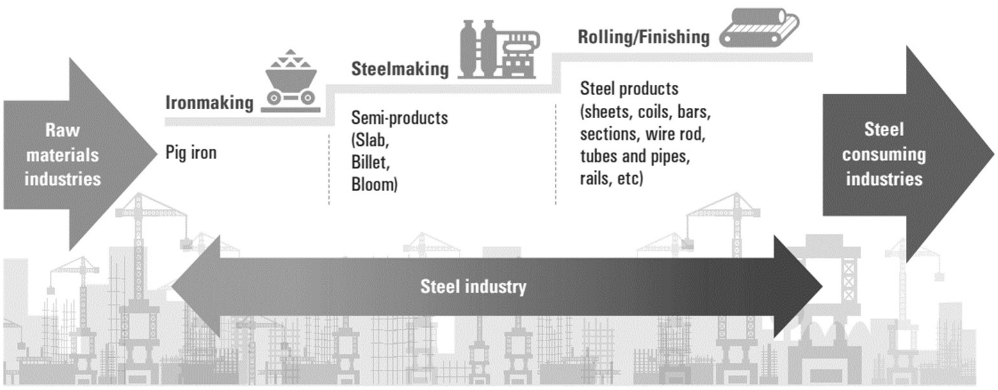

Fig. 20. Steel Value Chains (Mattera, 2018)

A more firm specific research is conducted by Terland and Mankowitz (2008) on the supply chain management of Swedish steel industry to exhibit strategies of the Swedish steel companies along with their prevalent approaches on business. They present how value chains differ between Swedish companies as a result of their qualitative analyses on the data obtained from the largest steel companies. The research generally covers activities related with marketing and distribution of value to the end use, yet it is explanatory enough to identify the mode of governance and provides significant insights to be used for further value chain analyses on steel industry.

Main customers of company Oxelösund in Figure 21 are construction and mining machinery and crane manufacturers. Since Oxelösund can not compete in price due to its small capacity, the firm aims for niche market and prefers creating a pull for customers with after-market contact. They produce the exact needs of their clients for OEMs and end-users according to the demand. Furthermore, the firm owns its own service centers to be close to potential customers. 50% of their portfolio is produced as make-to-order, and the remaining 50% is make-to-stock (Terland and Mankowitz, 2008). However, it should not be ignored that this type of strategy brings captive governance together which means that firms will be highly dependent upon the end-user they serve for as well as the buyers will be dependent upon the suppliers. Exiting or switching options for such a strategy could be costly and risky.

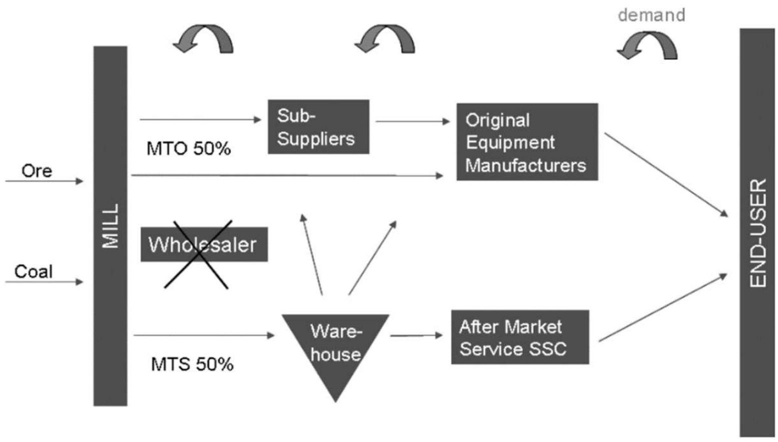

Fig. 21. Value Chain SSAB Oxelösund (Terland and Mankowitz, 2008)

A similar approach can be followed by steelmakers that cannot compete in price in global markets. Blitz (2017) points out fundamentals of a strategy to compete with competitive low price/cost achiever in the steel industry by explaining the quintessence of Korean steel company POSCO's success. When it is not an option to compete on price, the best way to overtake competitors is innovation to achieve the value-added differentiation. The key element of company's success is innovation which is composed of four steps. The first step is accelerating internal collaboration by upgrading company's business process management systems by introducing integrated ERP systems. It is followed by an active collaboration with customers by sending engineers instead of salespeople to address customer needs. This way ensures an accurate information flow associated with customer standards through feedbacks. The third step is implementing innovation along their supply chain by including their suppliers into process. Essential factor here is to perceive supply chain actors as partners, and involve them into value chain improvement. POSCO supports their suppliers financially with low interest loans. The fourth and the most effective element is establishment of strategic alliances with leader innovators. POSCO has lots of strategic alliances with leader innovators even out of the steel context such as information technologies firms. As a result of the partnership with Google, they developed a "Smart Workplace" that integrates mobile devices, cloud systems and other technologies to improve operational activities like logistics, energy use or safety (Blitz, 2017). When it is not ideally possible to compete on price the pursuit of competitive advantage has variety of trajectories that pushes firms to innovate given that the major matter is defining a consistent strategy to capture this advantage.

Another value chain framework being identified is of Outokumpu which is a global stainless-steel manufacturer. Their customers are from oil and gas, chemical, nuclear power or pulp and paper industries. The pricing of stainless-steel products mainly is dependent upon both steel and alloys introduced to the process. So that price volatility and demand variations are relatively higher than other steel products. They sell 50% of their products through internal distributors directly to sub-suppliers, whereas other 50% is sold to external distributors (Terland and Mankowitz, 2008) (Figure 22).

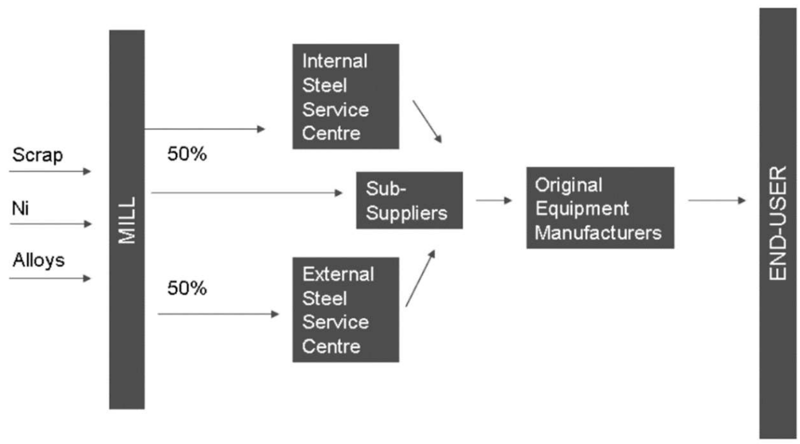

Fig. 22. Value Chain Outokumpu (Terland and Mankowitz, 2008)

The steel industry itself is already extremely volatile in terms of prices due to its dynamics. Furthermore, stainless-steel is more volatile due to dependency on other exclusive materials such as alloys during the processing. This approach also could be an option to increase value-added on steel commodities of steelmakers, but the management of resources plays the most important role, particularly for countries that are already highly dependent on foreign markets in raw material procurement. Not only allocation of resources, but also organisational capabilities, mainly related with manufacturing facilities are crucial. So, an attentive planning of assets needs to be carried out and feasibility studies must ensure if the attributes are sufficient enough to undertake manufacturing of alloy steels along with the steel industry factors such as domestic and foreign market conditions or environmental concerns.

An important factor to take into account related with the steel industry is environmental concerns, as ecological footprint of the industry is considerably high. R&D practices need to be actively performed aiming at reduction of CO2 emissions and energy consumption (Peaslee, 2008). Development of new production processes with more recycle of inputs, and reduction of carbon emissions of the processes are crucial, since it is pertained with all the steel industry stakeholders. Conejo *et al.* (2020) stress the environmental challenges of the steel industry value chain by probing CO2 emissions by different processes and conclude that the circular economy concept need to be carried further in the iron and steel industry context. Fostering the use of scrap, or use of recycled input materials need to be utilized more by integrating more breakthrough production technologies. POSCO – the leader steelmaker company according to World-Class Steelmaker Rankings in 2019 – aims at cost reduction by lowering energy consumptions. With their collaboration with Siemens, they introduced an iron making process called Finex that lowers emissions as well as operation costs (Blitz, 2017). They also pursue green logistics applications apart from production-based innovations to reduce footprint of the other operations in the steel value chains (Hong *et al*., 2012).

To sum up the competitiveness improvement across the global value chains of steel industry has more than one dimension to consider. Essentially, industrial dynamics apply for all the global players with different impacts on each of them. What defines their competitive advantage is the compatibility of prevalent strategies with their resources and capabilities. Certain approaches are arguably accurate on analysing these value chains in the iron and steel industry such as Gereffi and Fernandez's framework (2011) or Mattera's (2018) steel value chains, and can yield significant results when combined adaptively on an improvement study. Investigation of prominent strategies starts with the understanding of current dynamics of steel industry given that these dynamics change rapidly in time.

2.2. Evolutionary Trends of Steel Industry Dynamics

Global competition in the steel industry is actively restructured by developments in the other businesses that are linked to it, so are the product portfolios. A high level of dependency of the steel industry on other sectors leads to volatile prices of steel or raw materials, and unstable supply-demand patterns. To be able to interpret the interactions between value chain actors, the steel industry dynamics need to be identified as a whole. Global trends of steel consumption, production, import, and exports are useful in revealing properties and conditions of industrial activities across economic systems (Coccia, 2014). According to Huh (20011), the consumption of steel is main evidence of the industrial dynamism as an indicator of development to a higher stage. For this reason, explanation of these industrial dynamics is vital to improve national competitiveness through the steel industry.

Analyses related with steel industries of nations are performed annually by World Steel Association, The Organisation for Economic Cooperation and Development, and many other institutions to exhibit positioning of players in markets statistically. Scholars and economists employ different approaches on evaluation of industrial dynamics of steel to assess national performances. For example, the intensity use technique that is applied by Robert (1988) on OECD countries concludes that 25% of decline is observed in crude steel consumption resulting from slowdown in GDP, 65% of which is attributed to a decrease in the intensity of use. In another research, Robert (1990) puts forward a model to do a trend analysis in metal consumption of US data between years 1963-1983 to forecast metal input-output structures, and presents a slight growth in use of the steel. In order to forecast steel consumption in Japan between 1997-2005, Crompton (2000) uses the intensity of use model focusing on changes in the steel intensity of production in six selected steel using industries. He observes a drop in crude steel consumption in Japan from 82 million tons in 1997 to 73 million tons in 2005. A more up-to-date research analysing industrial dynamics of the steel focuses on steel consumption and economic growth correlations from the point of long-run equilibrium. For instance, Evans (2011), as a result of his trend analyses on UK steel sector, determines a long-run equilibrium hypothesis between steel consumption of crude steel and economic activity, also argues that the equilibrium might change due to economic activity over time. Ghosh (2006) researches the Granger causality between the steel use and the economic growth in developing countries, with a main focus on India, and he does not find a significant long-run equilibrium correlation. However, he concludes that growth in income fosters steel consumption. Coccia (2014), probes competitive behaviours of leader geo-economic players by analysing steel market and global trends of these nations. The study reveals a generic outlook on roles of nations in global steel markets by associating a causality between GDP and total steel consumption as well as including flow analysis based on trends of the steel. Results conclude that there is a positive correlation between GDP per capita and steel consumption for 6 countries out of 7, with a negative causality exception in UK's steel industry. Exceptional case of UK is attributed to structural change of the economy between the years of subject in the region. Such an analysis paves the way for interpreting general outlook of the steel industries of countries, also their competitive behaviours.

Due to fluctuating dynamics of the industry, in spite of overlaps between researcher's opinions about concepts, there appears plenty of diverse applications assessing vital factors on iron-steel industry. Literature shows that analyses of steel trends in association with other economic growth variables such as GDP, are popular frameworks in assessment of steel market dynamics along with national competitiveness. Also, analysis of import-export trends of nations by product provides a vital information about global strategies of leading players in the global steel industry. A similar trend analysis to Coccia's (2014) up-to-date approach on the world steel data would be relevant in terms of understanding industrial dynamics and competitive behaviours of leader steel producing countries. Once these dynamics are revealed during the evaluation stage, it is important to employ a certain approach related with competitiveness of the steel industry to centre the research around a relevant methodology.

2.3. Approaches to Evaluate Global Competitiveness in International Trade of Steel

Globalization has caused variety of changes in the framework of many industries. Along with these changes for the trade of intermediary products manufacturers targeted at different sources to generate a competitive advantage. Explanation of different focuses by companies is best inferred from literature review in the context of the iron and steel industry. Scholars researched various economic theories to evaluate possible advantage generation options. Researches that have been done on the steel industry need to be interpreted along with their both compatible and short-coming aspects before an up-to-date evaluation methodology is developed. In this part, different approaches evaluating the competitiveness notion in the steel industry are examined.

An early measure to rate competitiveness of a manufacturing industry that is suggested by Abdel and Abla, (1993) asserts that product quality, innovativeness, design, distribution network, after sales, transaction costs, institutional factors related with the bureaucracy of export procedures and other non-price factors are parameters to be considered to measure the competitiveness. Another approach is that labour costs, unit costs, exchange rates, interest rates, prices of inputs and other quantitative factors are tools to measure competitiveness of manufacturing industries (Edwards and Volker, 2002; Fukunishi, 2004). Both approaches are relevant while seeking for sources of advantages by companies of the steel industry. Wu and Zhong (2010) investigate the competitiveness of top three steelmaker firms in China by examining e-business resources focusing on the profitability dimension. The empirical study finds out that capability of e-business technology has a distinctive power to increase efficiency of processes, but an improvement is not observed in overall enterprise competitiveness.

Technology is one of the key drivers of competitiveness, particularly in the steel industry where R&D has a significant impact to enable the reduction of production costs and increase quality (Reppelin-Hill, 1999). Explanation of industrial development and innovation for developing countries has been the ultimate goal of GVCs in the context of increased globalization (Morrison, 2008). Here the approach called technological capability emerges to form a solid theoretical foundation for integration of GVCs and for constructing a framework that explains dynamics of the industrial development in developing countries (Pietrobelli, 1997). According to Nelson and Winter (1982), technological changes arise from aimful investment initiatives by firms to reveal possibilities for knowledge and technology distribution within boundaries of industries. The most convenient practice to enable diffusion of knowledge and technology is the pursuit of strategic partnerships in the steel industry given that high investments costs often incur.

In the context of GVC, the concept of upgrading remains quite ambiguous, if it results from innovation or stands exactly for innovation despite being frequently mentioned. Morrison (2008) harmonizes the concept of technological capabilities with global value chains to clarify notion upgrading in this regard. Capability development paves the way for upgrading at firm level, to originate a base for improvements along the chain. Exploration of how technological capabilities and GVCs are integrated sums up that technological capabilities such as technical, managerial, or organisational are firm specific features, and the knowledge is comprised of individual skills and experience gained over time throughout the global value chains of firms. Around the intersection of firm specific features and GVC dynamics, learning-by-doing enables companies to achieve an incremental upgrading according to the approach. As an example, cost leadership is not possible to achieve in a short span of time, in fact it requires experience and time.

Mukherjee and Roy (2010) stress the suitability of cost leadership in the markets in order to remain competitive by statistically analysing market shares of top 10 steel producer countries between 2002 and 2008. They point out on a decrease between those years in global competition through an empirical formula they developed to measure the degree of the competition where the market share and the rank of a country are the independent variables. The research implies that cost advantage by achieving lower production costs, as well as selling products at relatively lower prices than competitors, is the absolute way for an effective market penetration. This is the strategy being followed by Chinese steel industry in global markets. Nevertheless, such an approach is challenging for countries lacking raw material resources to cover necessary input for mass production. This situation has led many other countries to implement protectionist policies on import of certain products to protect their own steel industry.

Impact of policies on management of value chains are researched from different point of views. A paper focused on the impact of export subsidies on industrial cost competitiveness in the steel industry by Ohashi (2005) in Japanese steel industry of 1950s-1960s suggests that subsidy policy is insignificant with competitiveness in the steel industry. However, this research is out of date to discuss impact of subsidies, because there are various developments and new policies in the context of the steel industry such as anti-dumping duties, or international agreements signed by countries prohibiting subsidies on the steel industry to protect the global steel market as a whole.

Another important dimension of competitiveness to consider is environment, because the iron and steel industry has the largest consumptions of energy in the world in addition to harmful impacts on nature. Nevertheless, the industry has more flexible limitations compared to the other sectors in the context of European Trading Scheme. The competitiveness in the iron and steel industry is examined by Demailly and Quirion (2008) through production and profitability dimensions in compare with European Emission Trading Scheme by using a partial equilibrium model. Significance between emission trading scheme and competitiveness is found to be very low. However, it is important to employ a positive attitude towards corporate social responsibility not only to be responsible towards environment, but also to be more favourable business partners in the value chains for other actors. ArcelorMittal in their Climate Action Report (May 1, 2019) states that, "Our ambition is to significantly reduce our carbon footprint". Company focus on innovations to reduce harmful impacts, by reduced CO2 emissions and energy consumptions. In order to achieve an optimal sustainable and environment friendly steel manufacturing, technology development plays a crucial role (Conejo *et al.*, 2020). The most significant impact related with environmental issues are observed as a result of rising carbon prices and climate regulations. Consequently, the steel sector started to suffer from increased carbon prices, particularly the companies operate in EU zones that do not remain below the emission thresholds are significantly affected.

A more relevant research for the case of Turkish steel industry is the identification of critical success factors by using a Fuzzy DEMATEL method in order to reveal aspects to be focused for improvements which is done by Kabak et al (2016). The determination of these factors is first done by a web-based survey in which participants are asked to scale 111 WEF global competitiveness indicators on a scale of 1 to 10. Their findings to remain afloat in global markets for Turkey steel industry are more macro environment related critical success factors such as burden of customs procedures, total tax rate and the soundness of banks in Turkey. Nevertheless, it is not enough to develop an improvement guideline by interpreting results obtained only from external environment-based factors. Corporate strategies, organisational capabilities, interactions between partners through value chains play crucial role in competitiveness of steelmakers.

A more organisational features-oriented research is done by Mullin *et al.* (1995) on the effects of mergers by using the hypotheses noted by Eckbo (1983) and Stillman (1983) which imply that market-power and efficiency affect differently a merger's performance on profitability. Through the Eckbo-Stillman methodology they determine that the steel industry of the United States is composed of monopoly power and mergers might result in serious anticompetitive outcomes. Stuart and Wallis (2007) investigate the partnership approaches for learning in the industries by drawing attention to European steel and metal sectors. They emphasize that learning practices within these partnerships has become more common all over the Europe with positive outcomes such as increased innovation intensities, more skilled workforce with fewer amount of employee, as well as reduced production costs through takeovers aiming for manufacturing. European firms diversified their market strategies, operational processes and concentrated more via partnerships such as mergers and takeovers (Stroud and Fairbrother, 2006).

All in all, there are various dimensions of competitiveness, particularly when the industrial developments in the steel sector are taken into account. Alignment of resources, supply-demand patterns, value-added, and other market related parameters matter while determining a competitive trajectory for a steel company. All the dimensions require to be examined in detail to reveal possibilities for a more competitive steel industry. An understanding of the iron and steel industry's value chains with all the activities paves to way for revealing possible advantages to be taken in future. The major outcome of literature is that focus needs to be put more on non-price parameters in analyses such as quality, distribution networks, institutional factors given that the high market pressure applied by China where it is not logical to compete on price. The most frequently mentioned concepts in the majority of researches in the assessment of competitiveness are: innovation, cost structures, partnerships, and profitability in evaluation of GVC performances. Next, these factors are researched in theory to constitute a base for the empirical research evaluating competitiveness of the steel sector.

2.4. Options to Improve the Competitiveness in the Iron and Steel Industry

According to Porter (2011) competitive performance of countries is dependent upon the capacity to innovate within their industry. The major driver of acquiring the advantage as a lead actor in the competition is attributed to the challenges in both foreign and domestic markets. Demanding customers, competitive market conditions, threats of new entrants, advancements in technologies and many dynamic parameters in the macro environment force companies to develop their own competitive advantages to survive. Scholars put forward various approaches for different industries, however, there are certainly overlapping common approaches and strategies exist describing ways to acquire an advantage. Revealing prominent up-to-date factors in steel industry to achieve a more competitive stance is a vital practice to start with.

Global competition is driven by both price and non-price competitiveness parameters in the iron and steel industry like all the other sectors. Price based parameters are more dynamic and volatile, since the steel industry is one of the most price sensitive industries with lower profit margins compared to many others. Aggressive strategy implemented by China over the last two decades in the steel industry help them achieve cost advantage in steel production and a domination in international markets by means of mass production capacities. Owing to low operational costs achieved by easy access to raw materials and to cheap labour force such countries are capable of achieving low price advantage over their competitors. A takeaway stressing the importance of non-price strategic focus from the success story of POSCO implies that when it is not possible to compete on price, an alternative is focusing on product quality or value-added differentiation (Blitz, 2017). Non-price determinants of the competitiveness are related with the delivery of value to the consumers in various forms such as quality of products, delivery, capacity, design, after sales services, brand name and marketing. In some cases, non-price determinants of competitiveness compensate price differences for customers as there are other significant requirements rather than the price of products (Kang, 1994). In advanced technology sectors where steel is used as an input material, unless the defined standards are not met, price is no more an important determinant. For example, in sectors like aviation, automotive or shipbuilding, consumers seek for the most convenient high quality of steel commodities to use in their manufacturing processes. Steelmakers require choosing the most advantageous aspect focus in accordance with their capabilities.

Competitiveness has some prevalent dimensions especially in the iron and steel industry which are often studied by researchers, to explain critical success factors for companies to be prominent. Innovation and knowledge are crucially important for economic growth and competitiveness almost in all technology related industries. Therefore, managers, policymakers and scholars keep their focus on the diffusion of knowledge and grasping the first mover advantage on emerging advancements (Farinha *et al.*, 2016). Innovativeness as a concept itself requires to be considered for the steel industry. Because not only acquiring the first mover advantage, but also retaining a sustainable innovative strategy is key to succeed in such an intermediary industry where the value to be delivered could broadly differ from very simple to complex technology using markets. As the final use of steel shifts towards more advanced technology-based industries due to versatile technical properties of commodity, higher value-added steel gains more importance recently. Lieberman and Kang (2008) research the sources of POSCO's superior performance from the perspective of productivity and value-added by benchmarking five leader steel companies, and conclude that high capital intensity of a company on advance processes leads it to achieve higher value-added per worker-hour compared to other firms. It is not possible to achieve optimum operational costs with initial implementations of such new technologies to produce, however shifting the value-added of products from the lower to the higher through both product and process innovations could be a safeguard to remain in competition in a longer term. Another point that is related with sectoral innovations worth mentioning is environmental impacts of the industry, due to its significant ecological footprint. Yellishetty *et al.* (2010) examines material flows of the iron and steel industry to evaluate sustainability of the sector and conclude that major impact apart from production methods is observed in the flow of iron ore and steel via sea transport with an additional contribution to the CO2 emissions by 10-15%. Apart from conventional steel production-based views, they stress the possibility to reduce ecological damage by paying attention on other means of streamlining the material flows to reduce environmental impact across the value chains such as environmentally responsible inbound or outbound logistics practices. A similar research pertained with the context of environmental outcomes of the iron and steel industry is done by Dahlström and Ekins (2005) on UK steel producers through a value chain analysis. They imply that primary stages in the value chain of steel are responsible for the most remarkable environmental impacts such as waste or CO2 emissions. There is more than one dimension to tackle environmental issues of steel industry, but the most explicit options are introduction of reverse logistics solutions or employment of breakthrough production processes reducing energy consumptions and CO2 emissions to be more responsible for environment. Innovations require substantial organisational capabilities and access to resources or knowledge in order to be implemented. Some scholars associate firm size and innovativeness of companies which are explained in following sub-chapters.

Firm size is a broadly researched determinant of the competitive advantage, including its components such as, capital structure, number of employees and production capabilities. A research, that is conducted by Becker *et al.* (2010) on 109 manufacturing firms with respect to SIC four-digit code industries in USA, investigates the relationship between the size of a firm and profitability. They noted that, correlation differs for various industry clusters. According to the data between years 1987-2002, research put forward a negative correlation between profitability and number of employees in general. Additionally, they find out that the profitability increases up to an extent with the size of firms and eventually starts to decline. Another study examining the impact of age of a firm on performance is carried out by Coad *et al.* (2010). They suggest that, increasing age comes with increasing profits, higher level of productivity, lower debt ratios and larger size. However, their findings also support that, overall firm performance declines over years with age. As long as firm size and performance correlation is highly variable for different industries, the iron and steel industry needs an empirical research to produce some reliable evidence assessing the impact of firm size. When limitations are considered due to firm size emerge particularly on undertaking high investment costs, partnerships come as an option to tackle these issues in various forms.

Industries like the iron and steel have complex value chains in which vertical or horizontal integrations are often observed, as well as strategic alliances to expand existing capacities and resources. So, in terms of increasing capabilities, establishing partnerships as an option also should be considered. There are two types of competitive advantages that are created through partnerships: the first one is integration of complementary resources as a result of successful collaboration to deliver a value, and the second is learning how to manage alliances to create a higher value through learning by doing (Makadok, 2001). Hence, having better management skills than competitors particularly on partnership portfolios creates a significant advantage. Expansion of organisational capabilities can be done for various purposes such as to access new technologies, know-how, new markets or to upgrade in value chains. Pursuit of R&D partnerships with innovation leaders helps accelerate implementing breakthrough technologies in the steel industry, not only in production terms but also in business processes as in the case of POSCO partnership with Google on Smart Workplace (Blitz, 2017). Such partnerships generate opportunities for companies to share risks, expand R&D resources, and closely follow the latest advancements in the industry. Hagedoorn (2002) suggests that one of the strongest motives for entering into R&D partnerships is to lower the cost of some activities by sharing expenses. These reduction attempts play an important role in R&D intensive industries. Another mode of partnerships arises in the form of buyer-supplier partnerships to improve supply chain performance. In the context of steel industry, pursuit of long-term partnerships with foreign buyers is mostly possible by undertaking a captive governance value chain interaction where supplier manufactures only in accordance with specified standards by the buyer. Proactiveness in building short or long-term collaborations with customers to deliver accurate solutions is important to capture foreign markets. For example, in order to address needs of an automotive manufacturer company, instead of casual salespeople, engineers or employees with technical background could create a significant advantage over competitor suppliers (Blitz, 2017). Flip side of the coin in buyer-supplier relationships is collaboration with suppliers. Theory suggests that partnerships with suppliers pave the way for lower capital expenditures, a greater responsiveness, and a higher commitment on performance improvements. Carr and Pearson (1999) probe the correlation between intensity of supplier partnerships and customer's financial performance, and suggest that suppliers are more responsive to the needs of companies when there is a cooperative relationship exists, and companies pursuing partnerships with their key suppliers benefit in long term with a significant improvement outcome in their financial performances.

Apart from partnership attempts to build a competitive advantage, there is another dimension worth considering; policies applied by states to protect their local producers. Along with tax exemptions and other incentives, local producers can be supported by their governments. Governments' can support companies in the boundaries of their nations through various forms such as subsidies, tax incentives or loans to foster innovation activities (Beugelsdijk and Cornet, 2002; Feldman and Kelley, 2006). Kang and Park (2012) test the hypotheses about correlation between government funding of R&D projects and firm's innovation in biotechnology industry in South Korea, and conclude that government support on R&D have a strong positive impact on R&D intensity of firms.

International strategies and tendencies of companies define their position in the global competition. Competitive priorities of companies are useful to explain why they lag behind in global markets. The focus of the strategy is important to be able to define at which aspect to create an advantage. There is a commonly agreed taxonomy of competitive priorities applying on manufacturing companies. According to theory components defining competitive priorities are: low cost, quality, delivery time, and flexibility (Fine and Hax, 1985). The concept of flexibility is explained by Wörtler *et al.* (2010) as an important determinant of the prosper or the decline of a steel company. They point out in the report importance of capacity management through inventory management to respond the high demand volatility in steel industry, since there are lots of industries consuming steel products. An option to improve flexibility through a non-production facility-based way is utilization of a better integrated demand projection system. Because responsiveness of firms in steel industry to the volatile demand is extremely important given the fact that the industry has high fixed costs, where inconsistent production increases operating costs drastically. Thus, they point out the importance of operational flexibility in the steel industry (Wörtler *et al.*, 2010). In addition to four major priorities mentioned before, Leong *et al.* (1990) contributes a fifth component to these priorities, which is innovativeness. However, within the context of this research, innovativeness is considered as an individual component with its specific constructs apart from competitive priorities to assess firm specific features. Because innovativeness can act as a tool to lead firms to achieve any of those four competitive priority components depending on its focus. In addition to the determination of the state of innovativeness, firm size, mode of partnerships and competitive priorities, there needs to be a factor touching upon financial outcomes of certain approaches in the context of the competitiveness.

In order to assess the competitiveness of a company, financial performance is a commonly preferred component. There are two main approaches used in assessment which are traditional approach measuring absolute, ratio and difference indicators, and modern methods that include balanced scorecard approach to evaluate performance of a company (Kožená and Chládek, 2007). However, development of a simple balanced scorecard would be too narrow while assessing performance of steel companies, whereas dynamics balanced scorecard would be too complicated to evaluate performance. Therefore, financial performance as traditional approach is more advantageous during the research as one of the components during performance assessment.

Table 5 shows the summary of possible competitiveness improvement options at the first stage for the steel industry derived from the literature. Revealed options need to be associated with value chains further to be able to evaluate and discuss their applicability.

Table 5. Factors to improve competitiveness in steel industry

Factors	Source
Increase existing product quality	Kang (1994); Fine and Hax (1995); Blitz (2017)
Focus on higher value-added products	Lieberman and Kang (2008)
R&D partnerships with innovation leaders	Hagedoorn (2002); Makadok (2011); Blitz (2017)
Improve operational flexibility	Fine and Hax (1995); Wörtler et al. (2010)
Reduction of harmful environmental impacts	Dahlström and Ekins (2005); Yellishetty et al. (2010)
Governmental incentives and supports for R&D	Beugelsdijk and Cornet (2002); Feldman and Kelley (2006); Kang and Park (2012)
Cultivate partnerships with foreign buyers	Makadok (2011); Blitz (2017)
Collaborate with suppliers	Carr and Pearson (1999)

Following sub-chapters further detail each dimension, in order to develop a scale measuring competitiveness of Turkish steel companies. Moreover, in chapter three emphasis is put on development of the scale by drawing upon building stones of a comprehensive approach which is applied by World Steel Dynamics to select top world class steel companies each year and integration of this approach into the new methodology to be put forward for research.

2.4.1. Relationship Between Innovativeness and Competitiveness

The term innovativeness is defined by scholars through various approaches. The simplest and the fundamental one claims that, firms frequently adopting innovations are prone to be more innovative, despite they do not develop these innovations in-house (Attewell, 1992). This idea is further expanded by contribution of Rogers (2003) with inclusion of frequency determinant of these adoptions. He implies that, an earlier adoption of new ideas and innovations than competitors result in with a more innovative performance in systems. Garcia and Calantone (2002) contribute with a distinctive explanation for the innovativeness of a firm. According to their research, the organisational innovativeness is tendency of a firm to innovate as a whole and provide new products as a result. The most convenient approach to innovativeness in the steel industry would be one that includes both macro and micro perspectives. Factors to be included while developing a scale to measure innovativeness must include in macro level current state of innovations in worldwide steel sector; and in micro level must include newness of product innovations to the company or to their customers. Gebert *et al.* (2003) sum up innovativeness as an improvement of both processes and products of an organisation in order to expand existing capacities that leads to a rigorous management and utilization of resources. Here the importance of an effective utilization of all the resources emerge.

Integration and cooperation between technological, financial and scientific resources is key to develop innovative strategies (Zhou, 2013). Management of the flow of knowledge is substantial in terms of improving global performance by changing even conventional or so-called irreplaceable traditional behaviors and approaches when necessary with a new emerging knowledge (Dayasindhu, 2002). A striving decision to determine trajectory to succeed is major matter of the innovation for companies, whereas they try to deal with arising challenges and try to capture the competitive advantage by introducing new products and services (Schwab, 2011; Budd and Hirmisf, 2004).

Abdel and Abla (1993) defines elements to measure competitiveness of a manufacturing firm as product quality, innovativeness, design, distribution network, after sales service, transaction costs and, institutional factor. They highlighted non-price parameters, whereas Edwards and Volker (2002) take a stand on more price-based parameters. They imply that operational costs such as labor, unit costs, exchange and interest rates, prices of raw materials are factors to measure competitiveness. Nevertheless, price-based parameters are not efficient to achieve a competitive advantage for many steelmakers in a wide perspective, due to volatility of steel prices, as well as vast market pressure applied by China. Surely the minimization of price determinants is important for success, however putting entire focus on price-based factors by ignoring the impact of non-price factors, brings unfavorable results for steel enterprises in global markets. Therefore, innovation is an important determinant of the competitiveness given the current conditions of global steel market are considered.

Innovation in the steel industry context has been studied by Grabowska and Furman (2015). They point out the effects of innovations from three different perspectives that are implementation of products innovations, process innovations and organisational and marketing innovations (Figure 23). It is safe to say that, innovation has to be taken into account while determining a strategy in accordance with possible improvement options. A proper management of innovation helps firms possess a sustainable and consistent competitive advantage (Grabowska and Furman, 2015).

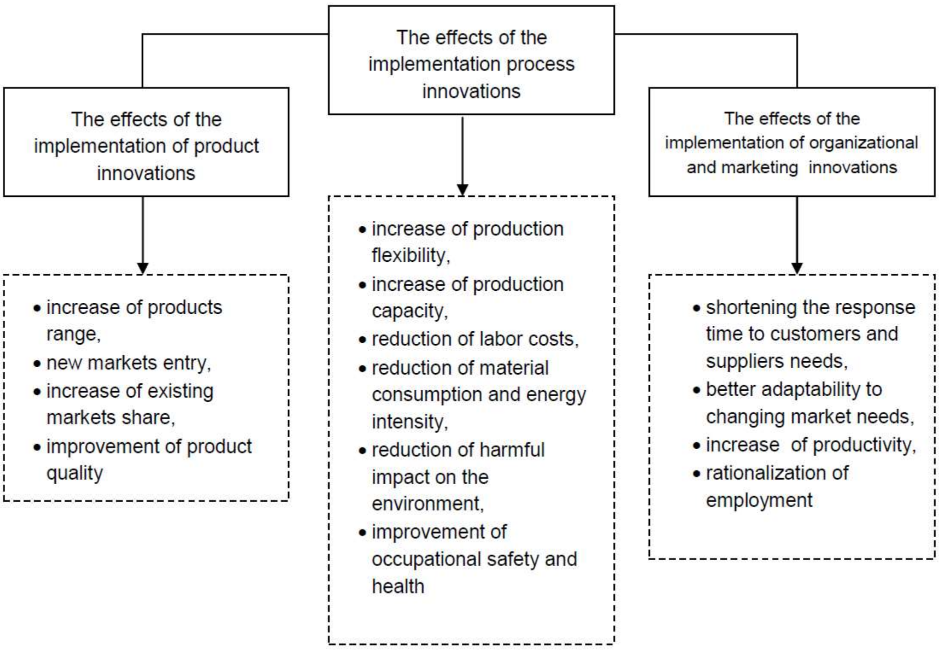

Fig. 23. Innovation activity effects in industrial enterprises (Grabowska and Furman, 2015)

The management of innovations lead theoretical analysis and competitiveness concerns up to another level, which is internal and external integration of activities and key partners in steel value chains. The majority of the studies circle around manufacturing process and product innovations. But business process management and supply chain management interactions are also crucial to implement efficient strategies in global markets. Business process management, in its simplest form, can be described as a paradigm in operations management. Zairi (1997) describes BPM as "A structured approach to analyse and continually improve fundamental activities such as manufacturing, marketing, communications, and other major elements of a company's operations". Way to achieve organisational innovations pass through business process management approaches. Dynamics of interactions between business process management and supply chain collaboration are studied by Pradabwong *et al.* (2017) to investigate whether BPM and SCC have positive significant effects on performance improvement. Supply chain collaboration is found to be effective indirectly on also corporate performance. In the study, they highlighted that firms collaborating with their supply chain partners are found to have better competitive performance. Also, a positive impact of BPM on collaborations across supply chains is observed as a result of their study. For industries with complex value chain activities, these approaches play a crucial role defining the value adding activities. However, there is a lack of studies on the steel industry pertaining with BPM notion. In order to develop integrative strategies to achieve competitive advantage, interrelations between activities need to be well monitored and managed through business process approaches. Eventually, these observations require a consistent measurement scale to understand innovativeness of companies in a more structured way. The extent to which a company utilizes and develops BPM practices is useful to determine innovativeness in the steel industry, since management is crucial throughout all the value chain.

Knowles *et al.* (2008) developed a measurement tool that consists of six dimensions where each of them includes five items to measure innovativeness construct through a quantitative research. They focused on propensities of how firms see innovations at different processes of manufacturing. Along with theoretical findings, a more simplified version of such a scale is developed to be used in questionnaire for the steel industry. With respect to various innovativeness definitions, three dimensions are relevant in terms of revealing how decisions impact competitiveness of steelmakers (Table 6). Two sub-items per each category in Table 6 are adapted from the research of Knowles *et al.* (2008) to be used in assessment in the questionnaires. A detailed information is provided in Chapter 3 about the construct and items.

Table 6. Innovativeness items for steel industry

Innovativeness items for steel industry	**Source**
Tendency to develop new products	Gebert *et al.* (2003); Knowles et al. (2008); Grabowska and Furman (2015)
Tendency to implement new manufacturing processes	Vazquez *et al.* (2001); Knowles et al. (2008); Grabowska and Furman (2015)
Tendency to utilize new BPM practices	Gebert *et al.* (2003); Knowles et al. (2008); Pradabwong et al. (2017)

2.4.2. Impacts of Firm Size on Competitiveness

Firm size has been useful for many years on the classification of businesses. There are various measurement frameworks for the size and the selection of one depends on the purpose of a research. Decision of a measurement tool is defined by Shalit and Sankar (1977) in three alternatives. These alternatives are, dependency on practical considerations of data availability, estimation problems and priori economic considerations. In assessment of the performance, alternative components of firm size are used by scholars to see if there is a relationship between the firm size and the performance. Yet, there is not a consensus on measurement of the firm size. The most common financial approach is natural logarithm of total assets. Dalbor *et al.* (2004) used different proxies of the firm size together to establish an ultimate measurement scale in hospitality industry that contains total assets, total sales, number of owners, age of the firm and number of employees, and concluded with a significant measurement tool except the age of the firm factor. The relationship between firm age and financial performance is found negatively correlated as a result of the assessment by Loderer and Waelchli (2009). In their research they associated getting older with lower profitability on 10,930 firms. Another research is done by Onaolapo and Kajola (2010) to put forward the structure of relationship between capital structure and firm performance on 30 non-financial firms listed on the Nigerian Stock Exchange. The relationship between the size, the capital structure and the financial performance is found significant. However, the research does not relate any significance between the age and the performance. Effect of the firm size on profitability is studied by Akbas and Karaduman (2012) in manufacturing sector for companies listed in Istanbul Stock Exchange (ISE) between 2005 and 2011. Findings of the research conclude that the bigger firm size results in a higher profitability. A similar research is conducted by Doğan (2013) on the impact of the firm size, experience in years and leverage on profitability for companies listed in ISE which presents a positive significance between size and liquidity on profitability. A negative correlation is observed again with the age on profitability. So, the inclusion of firm age would not be an accurate approach to measure the firm size neither in the steel industry researches. The firm age could be used as a separate construct to research impacts of experience according to the scope of a research.

In literature, the tendency of companies towards R&D investments is probed often by correlations with the firm size to find out whether larger firms are more innovative than small and medium-sized firms. It varies highly between different industries, but, generally, large firms are prone to invest more in R&D than smaller firms (Shefer and Frenkel, 2005). Varona and Pianta (2008) investigates how innovative performance of small, medium-sized, and large firms in 22 manufacturing sectors for eight European countries. Results suggest that large firms perform better than medium-sized and small firms in terms of both product and process innovations. The impact of the firm size on innovativeness is proven positively significant by Bosma and De Wit (2004) as a result of their research on 66 industries in Netherlands. In manufacturing sectors, particularly like the iron and steel, a similar correlation can be expected, due to high investment costs on R&D practices, production facilities or processes where resources and financial capabilities play a crucial role.

Table 7. Firm size measurement items for steel industry

Firm size items for steel industry	Source
Number of employees	Dalbor *et al.* (2004); Shefer and Frenkel (2005); Doğan (2013)
Annual turnover	Varona and Pianta (2008); Onaolapo and Kajola (2010); Akbas and Karaduman (2012)
Annual steel production	–

In order to assess important factors that are affected by capabilities of firms in the iron and steel industry, a firm size construct is developed including three items within: number of employees, annual turnover, and annual steel production (Table 7). In addition to the common items used to measure the firm size, annual steel production is included as an important determinant of the size in the iron and steel industry. It would be useful to investigate how the firm size is correlated with the innovativeness for steel companies to detect if insufficient innovativeness stems from being relatively smaller than others. Following that, impacts of strategic partnerships need to be researched to deal with limitations arising from with respect to size or other factors.

2.4.3. Effect of Strategic Partnerships on Firm Competitiveness

Strategic partnerships are interactions in which companies share their resources and capabilities to achieve a better competitive advantage consequently. They can be defined as primary forms of cooperative strategies where relationships act as a bridge that are made out of combination of resources which one of the partners lacks whereas other possesses it (Uddin and Akhter, 2011). Such alliances can be established between wide variety of partners acting in the value chains such as with suppliers, sub-contractors, or freight-forwarders. The time period of alliances might vary from short to long-term according to the intents of partners. The most of the time acquiring a competitive advantage is not possible by an individual firm without collaborating particularly in industries where the value chain complexity is extremely high. Resources subject to be shared can vary widely from knowledge to technologies, supply chain patterns to financial resources. Companies of more capital and technology intensive sectors are more prone to approach partners with strategic alliances. Kelly et al (2002), put forward that executives of technology companies they surveyed agree on the fact that strategic alliances are key to their entrepreneurial success. From another point of view, investors are usually in favour of alliances as resource sharing enable to achieve better performance, also sharing the risks, and generating a better value (Das *et al.*,1998; Chan *et al.*, 1997).

According to Barney (1991), companies aligning their efforts and resources on information-based assets like technology, customer trust, brand image, distribution control, corporate culture and management skills are potentially more consistent in sustaining their competitiveness. Horizontal alliances are the most investigated mode of partnerships to achieve these advantages, because they are significantly effective in increasing competitiveness of partner companies respectively by enhancing capabilities, hence diluting market concentration. Such collaborations particularly between local firms of the same regions help building an enhanced competitiveness in foreign markets together. These alliances enable partners to increase internal capabilities with the diffusion of knowledge by means of learning-by-doing (Hamel, 1991). Odoje (2004) observes the impact of horizontal strategic alliances on the U.S. steel industry between 1977 and 1997 from the capability hypothesis point of view. Findings of the research put forward a positive impact of horizontal alliances on industry competitiveness in terms of profitability, productivity, dilution in the industry concentration and the decrease of market prices. They achieved the dilution of the concentration in the industry by managing high costs in all segments through increasing capacity utilization among major producers. Despite the positive impact in competitiveness, study also indicates the excess capacity that resulted in idle capacity with low capacity usage ratios that steel producers encountered as a result of horizontal alliances where they over extended their resources compared to the existing demand. Nonetheless, integration between manufacturers via horizontal strategic alliances still enabled companies to cope with the pressures from foreign exporters and minimill producers. An exemplary collaboration is performed between the Canadian steelmaker Algome Steel and U.S. producers on an integrated new production combining thin-slab rolling with the conventional blast furnace technology (BF). Low operational costs that are achieved by BF method and clean liquid steel with low conversion costs along with high tolerances of thin-slab-casting reduced costs by \$18 to \$20 per ton (Ojode, 2004).

The majority of scholars lay stress on analyses of alliance formation feasibility through transaction cost theory and resource-based views. Before initiation of partnerships, companies seek for resources of partners that might help them reduce time to develop products and distribute in markets. The main purpose of the approach is initial cost reduction during the formation of alliances to benefit at highest proportion for the following stages. Yasuda (2005), differently from these approaches put forward the advantage of resource-based view over the transaction cost. According to the theory, the impact of partnerships based on research and knowledge have more persistent advantages in long term. The most known country with these kind of alliance practices is Japan. Due to its lack of raw material resources country has limited chances for mergers and acquisitions in its steel industry. For this reason, Japanese steel industry is composed of intense local collaborations, thus it has a more consolidated structure to expand capabilities of companies.

In an intense technology and resource-based industry like iron-steel, both resource-based view and transaction costs are important to sustain an advantage in markets. Commitments to establish strategic alliances where resources are shared to improve performance is crucial for steel companies to be able to compete in foreign markets with leader companies. The capability of a firm to manage its alliances is addressed by Schilke and Goerzen (2010) and they conceptualize alliance management capability into five constructs as follows: inter-organisational coordination, alliance portfolio coordination, inter-organisational learning, alliance proactiveness and alliance transformation. The framework they suggest with the constructs alliance proactiveness, inter-organisational learning, and alliance structures can be utilized to evaluate partnership construct in the iron and steel industry, because they contain the essence of both resource and transaction costs views. Alliance proactiveness is defined by Sarkar *et al.* (2001) as the degree of a company's attitude and routine activities towards opportunities to build valuable partnerships. Inter-organisational learning stands for the extent of activities enabling knowledge diffusion through R&D alliances (Dyer and Nobeoka, 2000). Knowledge transfer is an important component of competitive advantage in the iron and steel industry particularly with developments of new technologies utilizing steel commodities, thus customers become more demanding. Lastly, alliance structures refer to the extent to which a company dedicates its resources to management of these partnership such as particular departments or employees that are in charge of alliance management (Ireland *et al.*, 2002).

Above mentioned constructs are related with R&D based alliances, due to the importance of innovation in steel sector. In addition to these, partnerships within supply chains as well as supplier replaceability is subject to a research through quantitative analyses apart from R&D focus on the steel industry, because suppliers constitute keystones of the steel global value chains. Khan et al. (2015) research the effect of buyer-supplier partnerships on supply chain performance through Chinese manufacturing industry and put forward that this mode of partnership is significantly effective on supply chain performance as well as on distribution of information. They highlight that the flow of information between partners enhance the supply chain management process. Thus, the importance of perceiving suppliers as partners rather than independent actors of their value chains is stressed. Walter *et al.* (2003) argue that when availability of alternative suppliers is higher, quality of relationship between buyer and suppliers is higher. Scholars define replaceability as a measure of dependence (Geyskens *et al.* 1996) and measured in seven-point scale by Walter *et al.* (2003). Given the fact that the steel industry of countries without natural iron ore reserves abundant in their regions is highly dependent upon suppliers, availability of alternatives vital in terms of improving competitiveness next to having reliable long-term supply chain partners. Table 8 shows two different dimensions of important partnerships to be considered in the context of the steel industry. The purpose of such partnerships should be defined in accordance with competitive priorities of firms in order to avoid priority conflicts provoking the efficiency of relationships.

Table 8. Strategic partnerships items for steel industry

Strategic partnerships items for steel industry	Source
Attitudes towards supplier partnerships	Geyskens et al. (1996); Walter el al. (2003); Khan et al. (2015)
Attitudes towards R&D partnerships	Ireland et al. (2002); Sarkar et al. (2001); Ojode (2004); Yasuda (2005); Schilke and Goerzen (2010);

2.4.4. Performance Outcomes of Competitive Priorities

Identification of competitive priorities particularly in manufacturing sector, has been subject to research for many years. According to the suggestions of early literature, manufacturers need to focus on at least one or more capabilities to appeal in global competition (Skinner, 1969). Four broadly accepted components of competitive priorities which are low cost, quality, delivery time and flexibility are applicable to almost all kind of manufacturing industries. Treacy and Wiersema (1993), point out the importance of value disciplines for companies to sustain a value leadership in their industries. They suggested three major disciplines that are operational excellence, customer intimacy and product leadership, to cluster competitive firms with respect to their prevailing strategies. Due to their manufacture-oriented nature, operational excellence and product leadership are highly related to the steel industry in which both value disciplines have competitive power when adequately focused. Customer intimacy is also possible to achieve at some extent in the steel industry, but this value applies on more service-related sectors. Almost all manufacturing companies try to optimize costs in their operations, so at some extent low costs are priorities of all the steel manufacturers. However, some prefer competing particularly on cost minimization, and acquire a competitive advantage in production costs, productivity, capacity utilization and inventory reductions (Ward *et al.*, 1998), such as Chinese steelmakers.

The second component, quality is explained through lenses of different dimensions such as engineering, marketing and manufacturing. Eight dimensions of quality parameter is described by Gerwin (1987) including performance, features, reliability, conformance, durability, serviceability, aesthetics and perceived quality. Dimensions to be taken into account within this research comprise all factors except aesthetics. Because in intermediary sectors like steel industry aesthetics is not a concern of steel manufacturers initially as well as it is hard to measure. However, products need to conform with requirements of downstream businesses of steel producers. So, the companies competing on quality need to heavily invest on R&D to meet requirements of demanding customers.

As steel commodities constitute input materials for many sectors, time management of deliveries come to the forefront. In this dimension, a company might not have the cheapest nor the most qualified products, but can excel at reliability of delivery on promised deadlines. Some customers put delivery speed ahead, even before product quality, depending on industry (Ward *et al.*, 1998). Item to survey overall delivery performance are used as a mix measure of both reliability and speed factors related with steel commodity deliveries.

The final determinant of competitive propensities is flexibility, which is explained conceptually by Gerwin (1993) with seven dimensions as follows: product mix, volume, changeover, modification, rerouting, material and sequencing. Measurement of how capabilities of companies on manufacturing flexibility for steel industry can be done by adaptability to rapid production changes. To develop an overall comprehensive scale to measure flexibility component, flexibility on capability to create different product features, different designs, capacity expansions or reductions are the items to be used. Wörtler *et al.* (2010) suggest that operational flexibility needs to operate through all the supply chain in order to respond volatile demand. For this purpose, as it is presented with a positive impact of business process management on supply chain performance by Pradabwong *et al.* (2017), an integration of business process management and supply chain management systems would be relevant to research improve in operational flexibility in order to respond the volatile demands of the steel market rapidly.

Table 9. Four major focus of competitive priorities

Competitive priorities	**Source**
Low cost	Gerwin (1987); Gerwin (1993); Treacy and Wiersema (1993); Ward *et al.* (1998); Wörtler *et al.* (2010)
High quality	
Delivery speed and quality	
Operational flexibility	

In brief, four dimensions of competitive priorities; cost, quality, delivery and flexibility, are used in quantitative analysis to depict tendencies intrinsic to steel manufacturers, to be used in reasoning of advantages or disadvantages in global markets (Table 9). Identification of general priorities of steel companies in the competition provides a basis to further reason the current state of their competitive position. To understand what kind of outcomes these priorities bring to companies, correlation with financial performance is a suggested.

2.4.5. Financial Performance as an Indicator of Competitiveness

Organisational performance of firms in competition can be measured through various dimensions, such as, financial performance, product market performance and shareholder return (Richard *et al.* 2009). Financial performance is most commonly applied measurement practice by scholars and field experts by means of its formulated nature in literature which is well acknowledged all around the world. The most effective result deriving from financial measurements is that they enable researchers to perform a benchmarking of firms operating across the same industry or a comparison of different sectors depending on the selected ratio. Particularly in the steel industry, in which numerous performance indicators such as size, capacity, costs, market shares, R&D investments, and overall balance scorecards are used, correlation of all inputs with all performance outcomes would be too complicated to establish a convenient strategy accordingly (Steel Guru, 2007). Therefore, the selection of financial performance via profitability dimension to assess competitiveness would be an accurate approach to reveal impacts of other parameters, for instance firm size, strategic alliances, innovativeness, and competitive priorities.

Profitability is a vital component used in assessment of organisational performance, presenting how appealing is a business to shareholders or investors financially. According to another description, it is the capability of a company to generate income and retain its growth for short and long term (Arab *et al.* 2015). A relative assessment of a company's profit in accordance with the size of its business is determined by using profitability ratios. In other words, it is known as measurement of efficiency (Investopedia, 2019). Impacts of strategic actions or attributes of firms on financial performance, often on profitability, have been a topic of interest for many years, and they are still deeply researched to explain dynamics of those relationships. Chandy and Tellis (2000) research the influence of firm size on competitive power and conclude that financial performance is affected positively by the firm size. Chen and Stranger (2006) explore the capital structures of companies in China that are in Shanghai and Shenzhen Stock Exchange, and conclude that profitability is negatively correlated with the size and the age of those companies. Tulsian (2014) performs a comparative profitability analysis on two steel companies using gross profit, operating profit and return on capital employed ratios to assess which company achieved better performance between 2007 and 2011, and reveals certain deficiencies in management of companies. A similar profitability analysis is done by Popat (2012) on the steel industry for five companies via examination of the correlation between net operating profit, gross sales ratio, shareholders fund ratio and total assets ratio. In consideration of previous researches, an analogue analysis is performed in this research with the purpose of revealing how other features firms are correlated with their financial conditions. The choice of which ratio to use in analyses is dependent upon the research purpose. Carr and Pearson (1999) analyse buyer-supplier relationships and performance outcomes through profitability ratios: return on investment, profit as a percent of sales, net income before taxes, and the present value of the firm for 739 firms from various industries. They use relative changes on financial status over time to evaluate influence of strategical purchasing on financial performance. When an outcome analysis is up to be performed for steel industry, four items of profitability analysis: return on investment, gross profit margin, net income before taxes, and the present value of the firm, are relevant as building blocks of the measurement. In order to compare companies in the same industry, performing a profitability analysis by using return on assets instead of return on investment is more accurate to measure how effective companies generate net income over the money they invested into assets. Gross profit margin is the second item not to ignore impact of cost of the goods sold given the high raw material costs in the iron and steel industry. Lastly, net income before taxes and present value of firm would give depiction of how much a company benefits from the value it delivered briefly (Table 10).

Table 10. Financial performance items for steel industry

Financial performance (profitability items for steel industry)	**Source**
Return on assets	Carr and Pearson (1999)
Gross profit margin	Carr and Pearson (1999); Tulsian (2014); Popat (2012)
Net income before taxes	
Net present value of firm	

Detailed information about items related with the questionnaire is given in the methodology chapter along with sub-items developed to measure firm specific features of the steel companies. Following stage of the theory focuses on value chain analysis to understand how revealed improvement options may affect steel global value chains.

2.5. A Value Chain Analysis Framework

Recent developments related with value chain frameworks started to provide important insights to identify and improve their structures. Particularly after 1990s, the notion value chain analysis came forward broadly resulting from the writings of Michael Porter about the concept (Porter, 2011). Kaplinsky (2000) examines the value chains from three point of views which are: barriers to entry and rent to explain conditions to build up barriers; governance to transform value chains from a heuristic approach to an analytical concept considering all the diversified activities in the chain; and the last but not least, focus on the systemic efficiency instead of individual points. These elements are closely linked and are considered as a whole when analysing the value chains. Escalating competition forces leader players to induce their suppliers and customers to adapt their own operating procedures to new developments, whereas they try to lower barriers to entry into new links across the chain. So, all the actors are involved to possible upgrading practices. Within the scope of a value chain analysis the concept of upgrading is subdivided into three possible shifts which firms can go through to deal with competition pressure. Process upgrading is the mode in which production or provision processes are performed more efficiently by restructuring the system or improving the technologies. Secondly, product upgrading requires shifting towards more sophisticated product lines or outputs of higher values. And third, functional upgrading is the type in which firms employ new functions in their value chains such as design, marketing, customer relationships (Humphrey and Schmitz, 2000). There are also strong synergies between these aspects of upgrading, for example, in order to achieve product upgrading steelmakers move their manufacturing methods up to next level with integrated facilities instead of electric arc furnaces, which stands for a process upgrading. Integrated approaches on upgrading opportunities need to be evaluated through a value chain analysis when the competitiveness of a steel firm is intended to be improved.

The most detailed framework for a global value chain analysis is provided by Gereffi and Fernandez (2011) through two perspectives: global (top-down) and local elements (bottom-up). The concept implies that there are six dimensions of analysis at global and local levels which are given in Figure 24. These dimensions can be used to perform a value chain analysis to reveal properties of steel industry of the subject country.

Fig. 24. Six dimensions of the GVC analysis (Gereffi and Fernandez, 2011)

Input-output structure starts with the identification of main activities and segments in global value chain. Despite there are variations in different industries across the value chains, typically R&D activities, inputs-outputs, production, distribution, marketing, and sales are in common for many sectors. It is crucial to exhibit these activities in a simple, but in an explanatory scheme. Subsequently, identification of the structure of actors under each segment of the value chains take place. Each activity within the chain has its own characteristics and dynamics along with different actors (Gereffi and Fernandez, 2011). Identification of input-output structure is done in two stages. It starts with main activities, for instance processing of raw materials to manufacture desired end steel commodities and subsequent stages the commodity is through. Then the identification of dynamics and structures of actors in these value chains is required. It is concerned with the key characteristics of companies involved, such as the features – location, firm size, provided input – of suppliers while producing a commodity.

The second dimension, geographic scope helps map the distribution of area of activities in conjunction with providing global supply and demand patterns. Geographical analysis done by using international statistical data which are in general related with trade flows from variety of secondary sources like World Bank, World Steel Association, OECD database, and annual company reports. The mapping of export/import structure according to the geographies, provides a base for criticism of strategies whether they need shift their target to other more advantageous locations, or remain the same but with reconstructed trade policies.

The notion governance has been the most frequently mentioned term that is highlighted by scholars at different approaches within the global value chains. Gereffi (1994) claimed that the governance is "authority and power relationships that determine how financial, material and human resources are allocated and flow within a chain." The governance is explained broadly as buyer-driven or producer-driven chains by author. Whereas buyer-driven chains are composed of retails, brands merchandisers and their suppliers which are dictated to meet certain standards to sustain in commodity chains, producer-driven chains centralize manufacturers and vertical integration throughout all the segments of the supply chains (Gereffi and Fernandez, 2011). A general steel manufacturer delivering their products to various industries can be classified as a buyer driven business, however a further look is required to determine the exact mode. The identification of governance structure of firms can be achieved by analysing market reports and requires a firm-specific data. Focusing on lead firms and actors that are associated with their value chains, and investigating how they interact with each other enable the identification of the mode of governance. There are various types of governance along the different segments of GVCs. In terms of structures, a typology for governance forms is suggested by Gereffi *et al.* (2005) that mode of governance vary with the lead firms' extent of power through the coordination of suppliers. Concept involves five main type of governance (Figure 25). Market governance is the simplest form in which suppliers produce with a little coordination with buyers. There is almost no intervene power of segments, and the price is the central mechanism. Modular type of governance targets for particular customers with respect to specifications defined by the buyer. Information flow between buyers and suppliers relieves the challenges of complexity in those specifications for both sides. When the complex information is not easily transferred through segments, and frequent interactions are performed where mutual trust and social relationships between parties play a critical role, relational governance prevails. It relies on reciprocal trust, cooperation, flow of knowledge and dependence between companies involving. Captive governance exists where generally a group of smaller scaled suppliers exist which are dependent upon one or few buyers. Power of buyers is relatively strong in this mode of governance, and dictations regulate standards to be met by these suppliers. The last type with the highest degree of power asymmetry is hierarchical governance, which points out vertical integration by being in charge of management of lead firms assisted by inbound operations. These patterns might change in time back and forth to different levels as the industry dynamics evolve. Researches show that different types of governance might occur at the same time which significantly affect opportunities and challenges in economic and social upgrading (Dolan and Humphrey 2004).

Within the global value chains of steel industry, it is important to define mode of governance that exists between actors while developing an overarching competitive strategy. Thus, each actor is treated with respect to the interaction, accordingly either search for other suppliers or vertical integrations are performed. For example, coal mines are captive to steel industry since they provide the mass raw material output. Some companies have even their captive mines in order to uphold mass production, such as Tata Steel which has captive coal mines in India (Tata Steel, 2019). To conclude, the determination of type of governance enables an effective integration between business units and help establishing sustainable strategic partnerships.

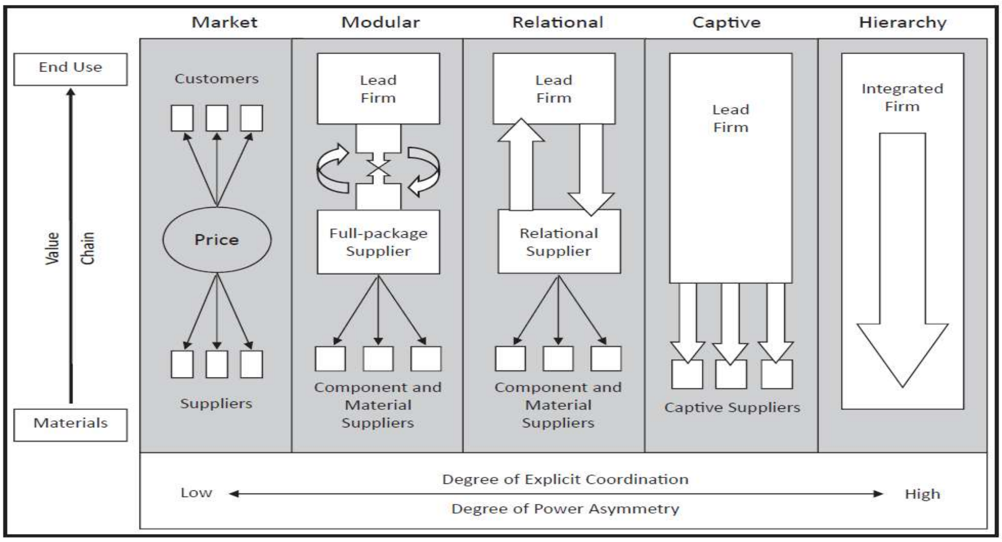

Fig. 25. Five types of global value chain governance (Gereffi et al. 2005)

The fourth dimension of analysis is upgrading which can take place at different stages and segments of GVCs. Humphrey and Schmitz (2002) denote four major types of upgrading: process upgrading by introducing a superior technology for input transformation; product upgrading, where product group focus is more sophisticated; functional upgrading to improve overall skill content of activities by means of evolving former functions or abandoning them; chain or inter-sectoral upgrading, in which companies move to relatively similar industries that are possible to integrate. Upgrading strategies must be considered as a whole for steel industry to derive a consistent direction for companies. Because, naturally, some improvements entail a concrete foundation to be able to upgrade others. For example, without an integration between raw material suppliers and manufacturers, lean manufacturing is hard to achieve. Or without an advanced process of manufacturing, it is not possible to produce high-quality products. Determination of a resilient upgrading strategy is achieved by examination of mapped value chain activities in detail. For each step that contains upgrading opportunities, linked activities to those also need to be well researched, moreover impacts of these upgrading scenarios on various actors need to be considered thoroughly.

Local institutional context frameworks pertain to local, national, and international level of policies applied by countries in value chain stages. The status of countries whether developed or developing, foreign trade policies, access to financial resources, access to competent labour force, government incentives to support businesses, tax and labour regulations and many other factors describe the extent to which industry growth takes place. Since the steel industry is mainly governed by private firms after 2000s, impact of states is only observed on trade policies of international trade of steel commodities. However, incentives by states such as tax exemptions, land allocations would enable companies, which are particularly in countries like Turkey that struggle entering to high-end markets, are crucial to support the industry whereas improving the global performance of firms. This stage of analysis puts emphasis on local, national, and international policies on steel industry such as international treaties in the context of iron and steel industry, trade remedies on steel, or government support on R&D activities.

The final dimension is stakeholder analysis to provide detailed information about all the actors of a value chain. Main actors as stakeholders in value chains are: firms, industry associations (e.g. World Steel Association), workers, suppliers, institutions, ministries of foreign trade, and economy. Before the determination of upgrading possibilities, significant amount of effort should be exerted to reveal how relations between stakeholders of particular segments are, what are the implications from their interactions and which stakeholders contribute in the development of the sector associated with the degree of power. This analysis provides a critical information to identify key actors in the value chain, together with what kind of strategy to follow while managing those relationships. Definition of key stakeholders in accordance with the purpose of a strategy to be researched should be the main focus of this dimension of a value chain analysis.

A global value chain analysis provides a holistic perspective by focusing on each value-adding activity, from the conception and the production to the end use, both by investigating governance patterns related with networks and by scrutinizing how business decisions influence economic and social upgrading possibilities for further development (Gereffi and Fernandez, 2011). The framework developed by Gereffi and Fernandez (2011) can be utilized to evaluate and analyse the value chains of steel companies in order to evaluate applicability of competitiveness improvement options. The methodology is explained in following chapters with conceptual framework. Before conducting the empirical research, an investigation of former researches on value chain patterns particularly on the iron and steel industry provides significant insights during the development of a comprehensive guideline to be globally competitive.

2.6. An Overview on Competitiveness Improvement Options in the Iron and Steel Industry

As a result of the theoretical research, different dimensions of possible upgrading options are touched upon, and an overview of challenges and opportunities is put forward theoretically. In the literature there are wide variety of dimensions probing competitiveness and global value chain approaches for the iron and steel industry. This research summarizes all GVC related competitiveness approaches in a framework given in Figure 26. The model suggests that examination of the sector initially starts with the identification of the global steel industry dynamics by examining relationship between steel production and use of nations with economical activities to reveal impact of industry on national economic development. Afterwards, countries with similar industry dynamics with respect to relationships between their steel trends and economic activity trends can be compared in terms of export/import focus by product type to determine the most explicit differences between industries of countries in the beginning. This provides a significant data in order to comment on competitive positions of similar countries with different product focuses in the iron and steel industry.

Following the implementation of a strategy by a leader competitive country in the industry first requires a detailed understanding of existing capabilities of the industry and companies of the subject country. For example, the pursuit of strategies of competitive steel producer countries by Turkey first entails an identification of Turkey's capabilities in terms of raw materials, existing technologies, local and global policies, and other parameters. In this stage, options to improve competitiveness need to match with firm specific features and value chain dynamics of the country.

The identification of firm specific features follows the steel industry dynamics in order to describe competitive capabilities of steel companies. Attributes of companies are used to cluster them according to their capabilities, to suggest a proper improvement option to be implemented later on. Four components of firm specific features – firm size, competitive priorities, innovativeness, and partnership propensities – are defined as main determinants of competitiveness in the steel industry. Primarily firm level factors need to match with the options to be able to improve competitiveness. For example, expecting a steel company without R&D investments to be an innovation leader for a better competitiveness does not sound sensible. Also, relationships between these constructs such as firm size and innovativeness or competitive priorities and financial performance need to be researched for a better understanding of company dynamics in the country. Firm specific features are intersecting with GVCs, and define all the interactions between actors. Competitiveness improvement options appear around these intersections. Therefore, identification of global value chains of the steel industry is necessary, because modifications on GVC dynamics will be necessary for the orientation of the options in addition to firm specific features.

The third level of the model classifies the steel GVCs according to the value chain analysis framework suggested by Gereffi and Fernandez (2011). The model in Figure 26 implies that firm specific features are associated with different dimensions of analysis framework with different options applicable on each GVC element. Intersections of firm features and GVC dimensions are indicated in the model by arrows as eight alternatives to put forward theoretically revealed improvement options.

Table 11 details all possible performance improvement options along with opportunities to be captured and challenges to be dealt with. Eventually, all the alternatives presented are subject to the validation after an empirical research is conducted, because determinants of performance improvement can be explained best only after essentials of three main – steel industry dynamics, firm specific features, steel global value chains – stage is analysed. As in the case with the firm specific features, GVCs need to be suitable in order to successfully implement the options to improve competitiveness.

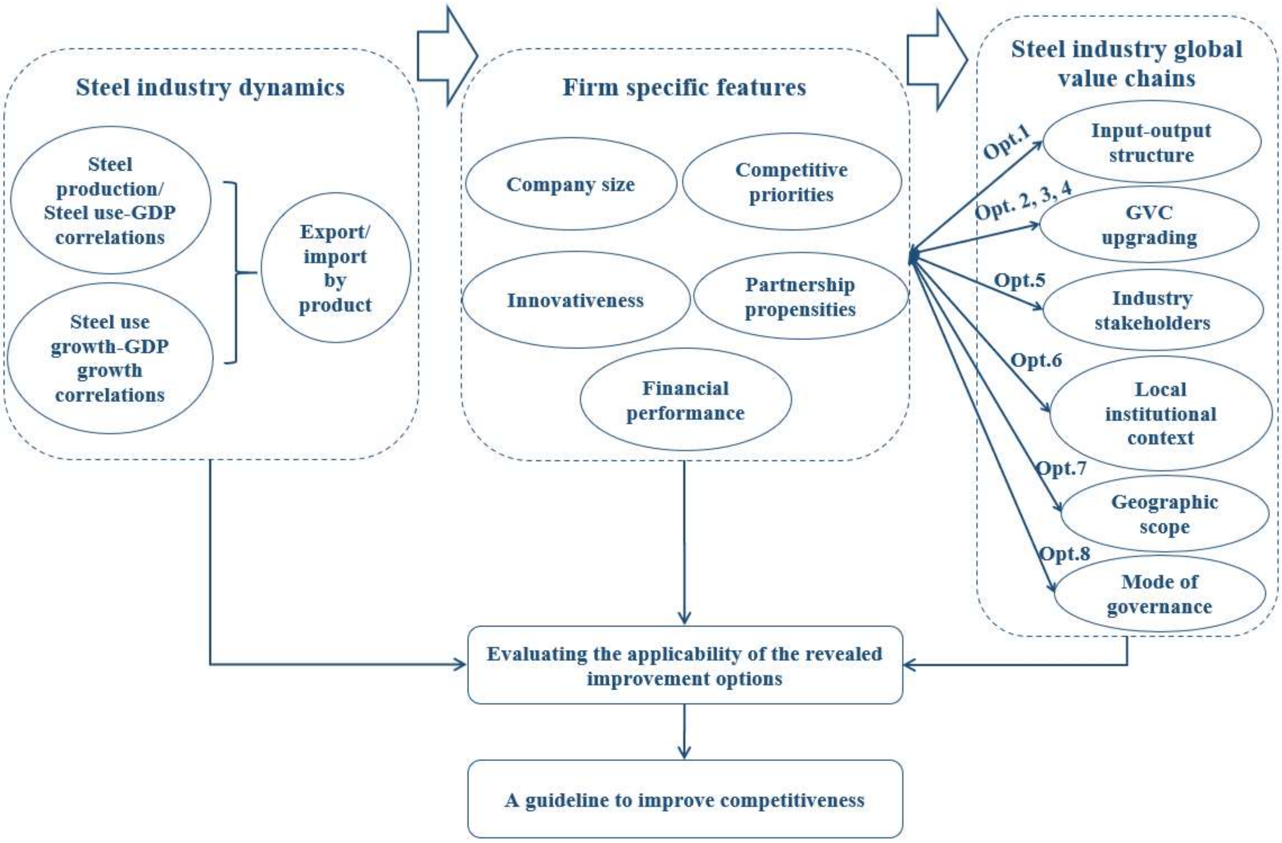

Fig. 26. Theoretical Model

Table 11. Competitiveness improvement options in the iron and steel industry

Competitiveness improvement options in the iron and steel industry				**Firm specific features**	**GVC dimension**
Option	**Description**				
Opt.1	Increase existing product quality	*Opportunity*	Improving general properties of steel commodities provided to customers in order to prevent being substituted	Competitive priorities	Input-output structure (more sophisticated production process, new raw materials)
		Challenge	Hard to generate profit in short period of time, learning know-how, cost optimization, increased prices		
Opt.2	Focus on higher value-added products	*Opportunity*	Shifting from low-value added products to high-value added flat product portfolio	Innovativeness	GVC upgrading (Process/Product upgrading)

		Challenge	Requirement for integrated facilities, expensive investment costs, market penetration		
Opt.3	R&D partnerships with innovation leaders	*Opportunity*	Augmentation of R&D resources, sharing risks and costs, following and implementing the latest emerging technologies	Partnership propensities	GVC upgrading (Process upgrading)
		Challenge	Management issues of partnerships, priority conflicts between partners, cultural differences		
Opt.4	Improve operational flexibility	*Opportunity*	Integration of business process management and supply chain management systems for a better supply/demand scheduling	Competitive priorities	GVC upgrading (Process upgrading)
		Challenge	Organisational culture may not be familiar with new management systems, time consuming and costly trainings		
Opt.5	Reduction of harmful environmental impacts	*Opportunity*	Introduction of environmental solutions such as green logistics, technologies or processes to make firms more desirable partners	Innovativeness	Industry stakeholders (perception of companies by stakeholders)
		Challenge	Adaptation of previous process procedures into green manufacturing may not be economically feasible		
Opt.6	Governmental incentives and supports for R&D	*Opportunity*	Support on R&D investments by government to foster innovative steel industry	Outer-firm specific features	Local institutional context (impact of policies on innovations)
		Challenge	Mostly a nation-wide decision independent from firms' authority		
Opt.7	Cultivate partnerships with foreign buyers	*Opportunity*	Establishing long-term relationships with large foreign buyers of steel industry	Outer-firm specific features	Geographic scope (access to new markets)
		Challenge	Building trust initially, captive governance could be irreversible, limiting protectionist policies of countries		
Opt.8	Collaborate with suppliers	*Opportunity*	Treating suppliers as partners, involving them to chain upgrading (knowledge diffusion and integrated supply chain)	Partnership propensities	Mode of governance (general tendency in industry)
		Challenge	Excessive diffusion of knowledge may result in new entrants/competitors in market, issues of trust, discordant priorities		

Each option has exclusive impacts on different levels of steel global value chains in accordance with previously researched approaches in the iron and steel industry. For instance, the first option– increase existing product quality – is related with competitive priorities of firms.Actions to be performed to increase properties of steel product offerings are using more advanced casting equipment like argon casting pertained with input-output structure of steel value chain or adding new raw materials to the processes in order to enhance steel properties, such as manufacturing steel alloys. It might increase the value-added correspondingly. But it requires companies to prioritize quality and challenged by cost optimization mainly.

The second option, that is focusing on higher value-added products, is frequently mentioned in the theory, and mainly achieved through manufacturing flat steel commodities. This mode of improvement appears as both process and product upgrading in GVC context, and challenged by establishment of new facilities with expensive investment costs that are suitable for flat steel product manufacturing such as integrated steel facilities instead of electronic arc furnaces. Market penetration is another challenge when a new product segment is introduced, in terms of competing with major flat commodity producers. Furthermore, the main determinant of product upgrading is substantially dependent upon innovativeness of firms.

Acceleration of first two alternatives is best achieved through the third option, R&D partnerships with innovation leaders. It is associated with partnership propensities of firms, that is often challenged by initiation and management of these partnerships, organisational or cultural differences between partners. Strategic R&D partnerships should not be merely considered in industrial boundaries, as in the example of Korean steel company POSCO and Google partnership to develop a Smart Workplace.

The fourth option is associated with GVC upgrading dimensions by improvement of operational flexibility. An alternative practice is integration of business process management and supply chain management systems to efficiently control demand fluctuations of customers. Agile adaptation to changes in supply and demand is important to have optimum capacity utilization rates in steel industry, because idle capacity triggers significant profit losses in the industry. Nevertheless, implementation of such systems, especially when organisations are not used to integrated practices, comes with application challenges such as training requirements. This kind of applications require intense training for the staff, as well as an adaptation period for organisation to benefit from those new practices.

The iron and steel industry has significant impacts on environment due to the nature of production methods, for this reason there are stringent regulations applied by governments to reduce those impacts. However, it is still possible to minimize these impacts by introducing new production methods as well as employing green practices within activities of value chains. Major challenges of the fifth option are adaptation issues, because it takes time to transform processes, especially manufacturing related ones, into less harmful practices. Here innovativeness of companies plays an active role. Primary outcome of green innovations is that, firms could enhance their brand reputation in minds of industry stakeholders to be a highly preferable partner for possible collaborations. Incentives on innovation by governments is critically important in order to expand organisational capabilities.

The sixth option is concerned with local institutional context, since governments are authority to be supportive for their industry. Supporting R&D investments foster diffusion of innovation through the industry. However, it is widely affected by national and local policies that are out of companies' control.

The seventh option is cultivation of strategic partnerships with leader foreign buyers in order to initiate and sustain long-term presence in markets of new geographies. All options come with their challenges as well, such as falling into a captive governance mode in foreign collaborations is not favourable for the buyer. So, there will be usually the danger of substitution possibility for the supplier. Furthermore, protectionist tariffs applied by governments such as anti-dumping duties might cause foreign firms to be more reluctant on such collaborations.

The eight option is perceiving suppliers as partners, to improve entire performance of chain as delivering the value. Modular governance helps achieving accurate supply for customer needs by integrating sub-suppliers into processes. There are many leader companies benefit from this type of governance with their suppliers such as POSCO from Korea as explained in theory. The alternative is highly affected by partnership propensities of companies seeking for such collaborations.

It should be noted that, there is not only one dimension of value chains affected by firm specific features. In reality, multiple dimensions involve in improvement processes and all interactions need to be taken into account as a whole. Generalized up-to-date theory-based options are evaluated as a result of an empirical research. Eventually more accurate improvement options are generated, because the dynamics of the iron and steel industry is highly variable in different geographies with respect to location to access raw material resources or suppliers, physical and political distance to high-end markets, government support on industry or organisational propensities of companies operating in the same national boundaries. Subsequent to the evaluation of revealed options on improvement of competitiveness, a guideline for competitiveness improvement can be established.

3. Methodology to Reveal Opportunities and Challenges on the Competitiveness Improvement

Establishing a competitiveness improvement guideline for Turkish steel companies is achieved through a three-staged empirical research. There are eight possible improvement options associated with firm specific features and GVC's of steel industry as it is suggested in theoretical model. This research strives to answer the following main research question; "What are the viable alternative options for improving the competitiveness of Turkish steel industry?" via mixed research methods. Eventually, an ultimate guideline about the alternative options for Turkish steelmakers is suggested as a result of evaluating the applicability of theoretically generated improvement options in reality. Sub-questions are developed to be scrutinized during the empirical research where each of them reflecting an essence of expected outcomes from steel industry dynamics, firm specific features and GVC analyses. Table 12 illustrates the sub-questions along with their outcomes. Sub-questions serve to answer main research question by progressing from a broader explanation to the narrower.

Table 12. Sub-questions of the research and their purposes

Question	Purpose
1. What is the relationship between steel trends (steel production/steel production growth/use per capita) and economic activities (GDP/GDP growth per capita) of 10 leader country?	To detect countries with similar correlations to Turkey
2. What is the export product focus of countries with similar relationships to Turkey's steel industry-economic activity correlations?	To choose an exemplary product focus to learn from
3. How innovativeness of Turkish steel companies is affected by firm size and partnership propensities?	To identify innovative capabilities of companies and their determinants for evaluation of the improvement options
4. How innovativeness and competitive priorities of Turkish steel companies are correlated with their financial performance?	To reveal financial outcomes of innovativeness and particular competitive priorities for evaluation of the improvement options
5. What are essentials of global value chain structure of Turkish steel industry for each dimension of analysis?	To depict a general outlook of steel GVCs of Turkey for evaluation of the improvement options
6. What are the implications of theoretically revealed options on each dimension of value chain analysis?	To explain benefits and limitations of the options for selection
7. What are the viable alternatives for a better competitiveness for Turkish steel industry?	To recommend a competitiveness improvement guideline

The framework in Figure 27 constitutes the spine of empirical research with a three staged analysis that is utilized to generate an overview of steel industry dynamics and companies in Turkey. At the end of the empirical study, expected outcomes are replaced with obtained results and an ultimate guideline is recommended to improve competitiveness.

Proposition of the research is that learning from export/import focus by product of leader countries equivalent to Turkey in terms of steel industry-economic activity correlations is an alternative direction to improve the competitiveness. This implies that these countries are similarly dependent upon their steel industry in economic development. Figure 27 illustrates the workflow of empirical research step by step including relevant sub-questions for each stage, data sources and expected outcomes.

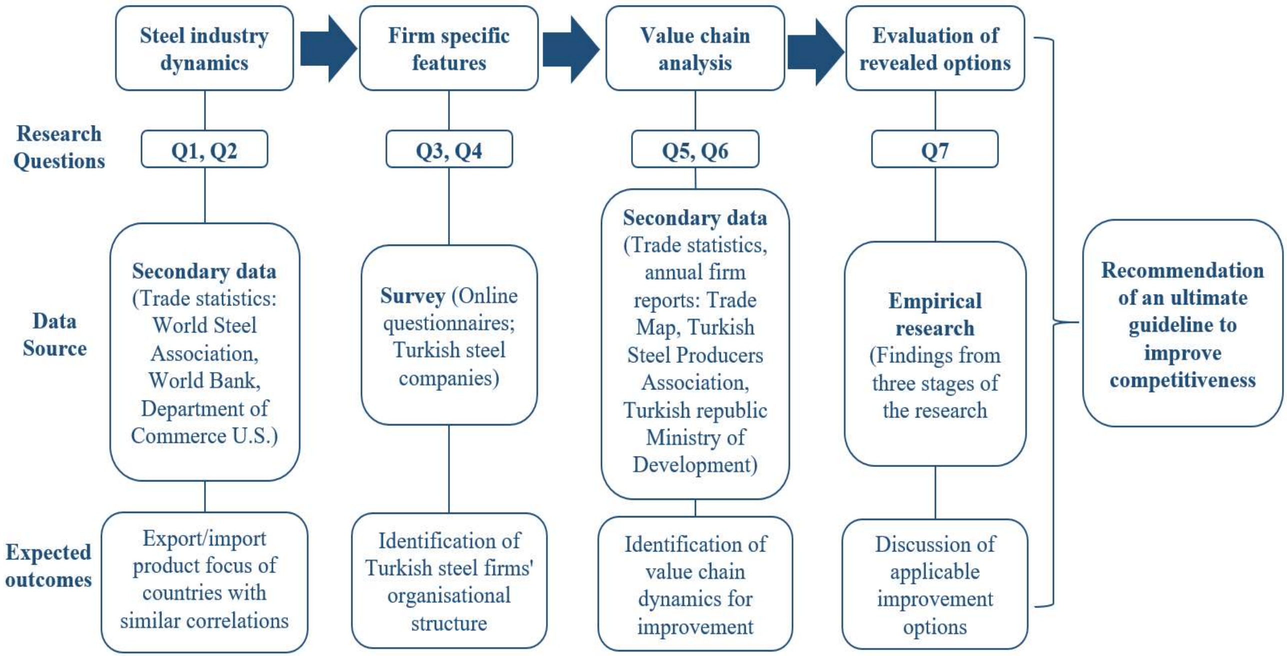

Fig. 27. Empirical research workflow diagram

3.1. Quantitative Analysis of Steel Industry Dynamics

The first stage of the empirical analysis, the research of steel industry dynamics helps describe current structure of sector by defining how Turkey is located globally. In this research 10 top steel producer countries of 2018 are selected including Turkey, with respect to the report of World Steel Association in 2019 (Figure 29). Initially, correlations between steel and economic condition of countries are performed to identify steel industry structures of each country. Assigned measurement items to evaluate industrial dynamics are: total production of crude steel per capita, total production of crude steel per capita growth, apparent steel use per capita, GDP per capita and GDP per capita growth. Data sets are obtained from the time period between 2000-2018. Bivariate correlations are observed between total steel related trends and economic trends to understand how much can those countries actually benefit from their steel sector strategies apart from being globally competitive (Figure 28). In addition to the quantitative correlation analyses of trends, export/import data is investigated for similar countries to Turkey to put forward their product focuses in international markets. Determined correlations are explained from the perspectives of export/import for those countries. As a result, export focuses of countries having similar industrial dynamics with Turkey are considered as alternative improvement possibilities at the first stage to be evaluated later in detail according to firm specific features and value chain analyses.

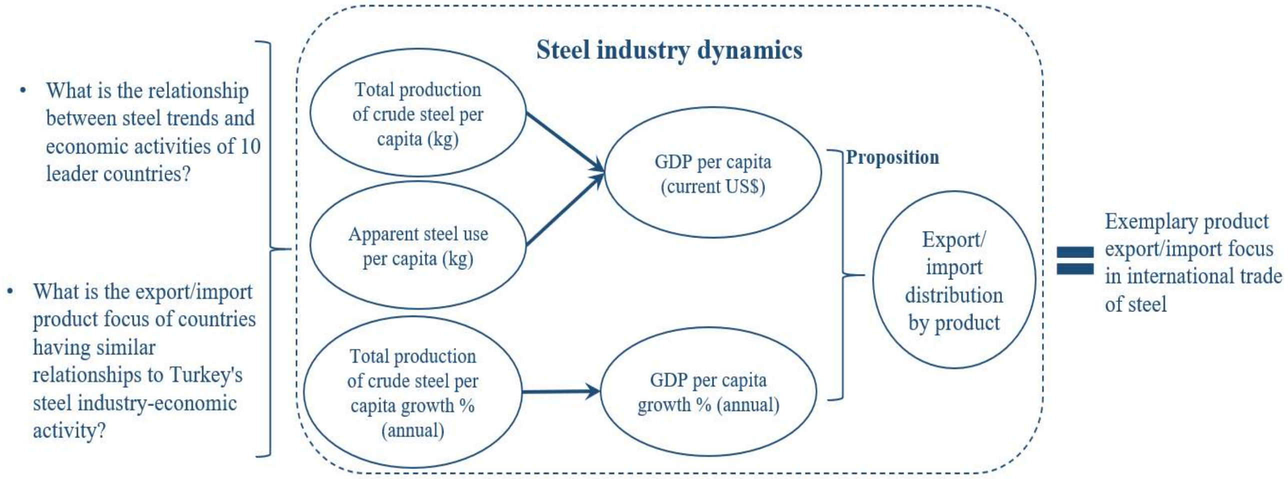

Fig. 28. Steel industry dynamics framework

Country	2018	
	Rank	**Tonnage**
China	1	928.3
India	2	106.5
Japan	3	104.3
United States	4	86.6
South Korea	5	72.5
Russia	6	71.7
Germany	7	42.4
Turkey	8	37.3
Brazil	9	34.9
Italy	10	24.5

Fig. 29. Top 10 Major steel-producing countries 2018, million tons, crude steel production (World Steel Association, 2019)

The apparent improvement possibility to be presented aims at a broad description for major differences in international markets between Turkey and other countries given the fact that the iron and steel industry and economic activities are similarly affecting each other. Later on, the reasoning of why such a focus would be viable or unfavourable is done.

3.2. Quantitative Firm Level Analysis

The second stage is quantitative analysis of firm specific features of Turkish steel companies. Data to be processed is collected via questionnaires from companies by using non-probability quota sampling method. There are in total 61 companies steel companies in Turkey, but not all of them involve in international trade. For the purpose of the research, 23 companies that are registered to Turkish Steel Association, and 14 firms that are not members of association, yet manufacturing steel and doing international trade in Turkey are selected to be surveyed. Therefore, the population size of the relative research is defined as 37 Turkish steel companies. Data is collected from 28 respondents via online questionnaires. The questionnaire is composed of majorly close ended 5-point Likert scale type questions in which respondents are asked to fill the survey with respect to attributes, strategies, and propensities of their companies. The questionnaire is consisted of five main constructs and sub-items constituting each construct which are developed in consequence of theoretical review. Differently from previous studies, this research intends to reveal these features of the competitiveness particularly from the perspective of companies in Turkey steel industry. Measurement methodology is adapted from global steel competitiveness scale of World Steel Dynamics. The concept was introduced on June 1st 2007 by WSD to understand attributes of firms and their positioning in the global competition better. There are 23 parameters in the scale each of them with different weight distributions (Figure 30). Inspired by the WSD competitiveness scale, five parameters are chosen in questionnaire to be analysed associated with the literature review and research aim. These constructs are: firm size, partnership propensities, innovativeness, competitive priorities, and financial performance. The development of the constructs with their items and sources of adoptions are shown in Table 13. Outcomes of the quantitative firm level analysis provides a critical overview on the general steel company profile in Turkey from the perspective of the constructs. According to the methodology, developed constructs touch upon almost to 25% of overall the weight distribution of WSD ranking system which means that the research is expected to yield significant results on the global competitiveness of Turkish steel industry along with the other stages.

SI	Area	Weight
1	Size	6%
2	Expanding capacity	6%
3	Location in high-growth markets	6%
4	Dominance in mature markets	4%
5	Downstream businesses	4%
6	Alliances, M&A and JVs	6%
7	Harnessing tech revolution	6%
8	Environment and safety	4%
9	Country risk factor	6%
10	Pricing power with large buyers	6%
11	Threat from nearby competitors	4%
12	Conversion costs; yields	5%
13	Cost-cutting efforts	4%
14	Raw material costs (14% of total)	3%
15	Iron ore mines	3%
16	Coking coal mines	3%
17	Location to procure raw materials	3%
18	Labor costs (7% total)	4%
19	Skilled and productive workers	3%
20	Liabilities for retired workers	3%
21	Energy costs	4%
22	Profitability	4%
23	Balance sheet	3%

Fig. 30. WSD ranking of world class global steelmakers (Steel Guru, 2007)

Table 13. Creation of constructs and related items to measure firm specific features

Construct	Source of adoption
Firm size	
Number of employees	Dalbor *et al.* (2004); Shefer and Frenkel (2005); Doğan (2013)
Annual turnover	Varona and Pianta (2008); Onaolapo and Kajola (2010); Akbas and Karaduman (2012)
Annual steel production	-
Partnership propensities	
Attitude towards supplier partnerships	
We are adept at finding new alternative supply chain partners, and suppliers when necessary.	Geyskens *et al.* (1996); Walter *et al.* (2003) Khan *et al.* (2015)
We perceive our suppliers as partners and actively collaborate with them to deliver solutions to customers.	
Attitude towards R&D partnerships	
We are more responsive and proactive than our competitors in prospecting R&D partnerships.	Sarkar *et al.* (2001); Schilke and Goerzen (2010)
We take the initiative in approaching firms with R&D alliance proposals.	Dyer and Nobeoka (2000); Ojode (2004); Schilke and Goerzen (2010);
We are adept at acquiring knowledge and experience through R&D partnerships.	
We actively utilize experience on improvement and benefit from knowledge through R&D partnerships.	Ojode (2004); Schilke and Goerzen (2010)
In our firm there are employees or departments dedicated to management of R&D partnerships.	Ireland *et al.* (2002); Schilke and Goerzen (2010)
Innovativeness	
Tendency to develop new products	
Our firm actively develops and adds new products to portfolio	Knowles *et al.* (2008)
Our firm perceives developing new products as critical for success.	Gebert et al. (2003); Grabowska and Furman (2015)
Tendency to implement new manufacturing processes	
Our firm actively develops in-house solutions in order to improve manufacturing processes.	Vazquez *et al.* (2001); Knowles *et al.* (2008)
Our firm perceives adoption/utilization of new and up-to-date manufacturing processes as critical for success.	Gebert *et al.* (2003); Knowles *et al.* (2008)
Tendency to utilize new business process management practices	
Our firm actively develops in-house solutions in order to improve business process management systems.	Gebert *et al.* (2003); Knowles *et al.* (2008); Pradabwong *et al.* (2017)
Our firm perceives adoption/utilization of new business process management systems as critical for success.	
Financial performance (over the last 5 years)	
Return on assets	Carr and Pearson (1999)

Gross profit margin	Gerwin (1987); Popat (2012); Tulsian (2014)
Net income before taxes	Ward et al. (1998)
Net present value of firm	Gerwin (1993)
Competitive priorities	
Achieving low costs in operations is priority of our strategy.	Ward *et al.* (1998)
High product quality is priority of our strategy.	Gerwin (1987)
Quality and speed of delivery to customers is priority of our strategy.	Ward *et al.* (1998)
Flexibility in production is priority of our strategy.	Gerwin (1993)

Table 14 illustrates the response scale and the way they are codified during operationalization to briefly describe general properties of questionnaire. All the constructs except firm size are measured through 5-point Likert scale. The firm size consists of number of employees, annual turnover, and annual steel production in year 2019 which are filled with integer numbers. According to the measurement methodology, as the number increases positivity of the construct increases for opinion-based questions where degree of the agreement is assessed. For the financial performance (over the last 5 years) increase of number stands for a corresponding change – increase, decrease or remain constant – in the profitability items. The questionnaire is provided in appendices.

Table 14. Description of the scales used in questionnaire

Constructs	**Survey Response Scale**	**Codification**
Firm size	Numeric	Integer
Attitudes towards R&D partnerships; Attitudes towards supplier partnerships; Innovativeness; Competitive priorities	5-Point Likert scale	1: strongly disagree 2: disagree 3: neutral 4: agree 5: strongly agree
Financial performance (over the last 5 years)	5-Point Likert scale	1: decreased significantly 2: decreased 3: remained constant 4: increased 5: increased significantly

Hypotheses that are constructed to be tested are given as follows in consequence of the literature review:

H1: There is a positive significant correlation between firm size and innovativeness of steel companies.

H2.1: Companies that have more positive attitude towards R&D partnerships are more innovative.

H2.2: Companies that have more positive attitude towards supplier partnerships are more innovative.

H3: Innovativeness of steel companies is significantly correlated with financial performance.

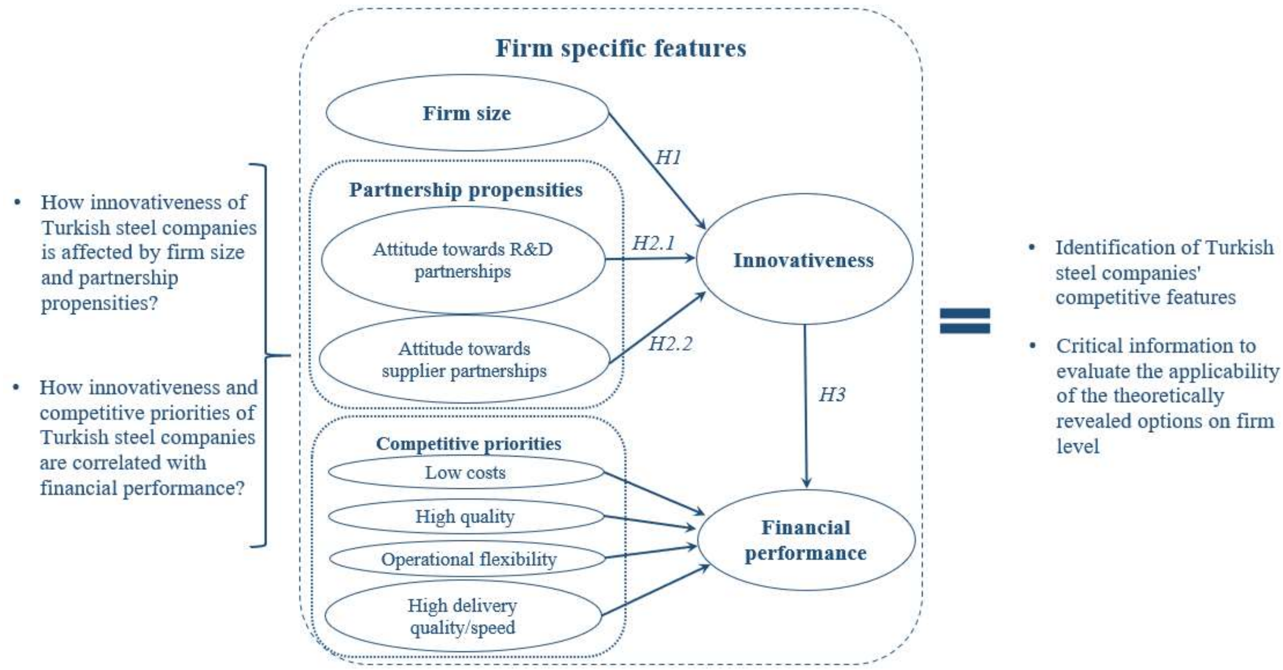

Fig. 31. Conceptual framework of bivariate analyses for firm specific features

Bivariate analyses are performed between constructs as shown in Figure 31 to research empirically how firm specific features influence global positioning of Turkish steel companies. H1 intends to explain whether the innovativeness is positively correlated with the firm size of Turkish steel companies. In the case of the hypothesis rejection, revealed improvement options related with R&D partnerships are revised, because in this case capabilities related with firm size do not seem to matter for innovativeness. H2 helps identify the general attitude of Turkish steel companies towards two different partnerships and their effect on innovativeness along with examining the consistency of all the revealed options pertained with partnerships. According to the status of H2.1 and H2.2, if they are rejected, relative options are reconsidered to suit better for Turkish steel companies, and some are excluded when necessary. H3 is tested to understand how beneficial is the innovativeness for the financial performance of companies. It is obvious that innovation in the context of steel industry is a vital determinant of competitiveness. However, if the hypothesis is rejected, it means that financial performance of companies over the last five years is not long enough to benefit from innovation, and a further research is required measuring financial outcomes for a longer time frame. In addition to the testing the hypotheses, the general structure of Turkish steel companies' competitive priorities is exhibited, and correlation of particular focuses are tested with financial performance outcomes to present which aspects of four major priorities prevail and companies benefit from mostly. Outcomes provide a critical information to be used in the evaluation of viability of the theoretically revealed options.

3.3. Value Chain Analysis

The third stage of the empirical research is the value chain analysis of Turkish steel industry. An exploratory analysis aims to uncover essential determinants of the competitiveness improvement on the subject industry by using the framework suggested by Gereffi and Fernandez (2011) (Figure 32). Steps and sources of data for the six-dimensional value chain analysis are shown in Table 15, where each step aims at addressing distinctive elements of the industry. Usually this kind of an approach is performed on the firm specific level to reveal all the interactions between links of chain, because even in the same industry variations are observed with different value chain structures. However, the purpose of the research is to provide a general outlook on Turkish steel global value chains to develop an overarching guideline. With regard to the access possibilities to secondary data, annual and sustainability reports of six steel companies in Turkey are investigated in accordance with disclosed information to illustrate a general outlook of Turkish steel GVCs. The companies whose reports are analysed are respectively: Erdemir Group, İçdaş, Borusan Holding, İzmir Demir Çelik, Tosyalı Holding and Kardemir. The general outlook explains common activities in GVCs in order to interpret implications of the revealed options across the chains. All the dimensions of the value chain analysis are examined from the standpoint of the revealed improvement options intersecting with firm specific features. Qualitative analyses of the secondary data from sectoral reports of Turkish Steel Producers Association (TÇÜD), Republic of Turkey Ministry of Industry and Technology and trade data from International Trade Center (INTRACEN) are performed in addition to annual reports of companies. Results obtained from the value chain analysis intend to clarify viability concerns about the options, to be discussed later in the development of a guideline process.

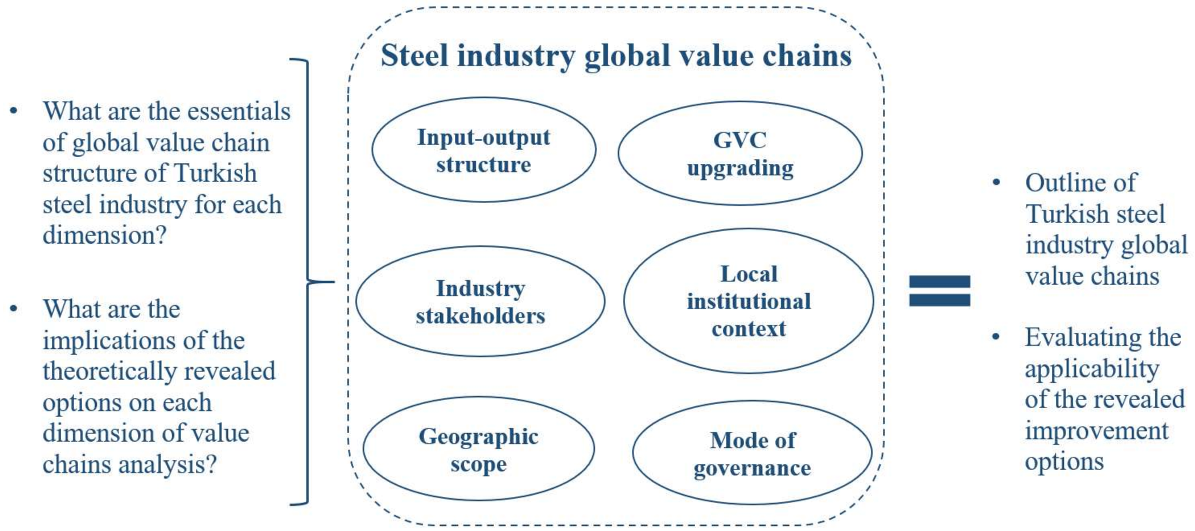

Fig. 32. Value chain analysis framework

The six-dimensional analysis (Table 15) starts with the examination of input-output structure of industry. Value adding activities and existing input-output structures are revealed through identification of upstream-downstream industries. Annual reports that are officially published by leader Turkish steel companies and trade data are the data sources to probe input-output structure, and activities are represented in separate segments. Consequently, possibilities to increase product quality is discussed according to current properties of GVCs and required modifications on activities.

Upgrading possibilities are researched in two categories: process and product chain upgrading according to the improvement options. Each option of the upgrading is evaluated by using data obtained from annual firm reports related with current capabilities and activities of companies. Also, sectoral publications by associations and ministries are utilized to learn more about industrial developments in the context of the iron and steel. In the case of lack of information about innovative state of companies results obtained through innovativeness construct serve for a supporting data to further reveal effective factors on the options. Opportunities and challenges on upgrading options are thus revealed, and possibilities related with higher value-added products, R&D partnerships with innovation leaders and improvement of operational flexibility are evaluated.

Industry stakeholders dimension commences with the identification of the most common stakeholders. This dimension is centralized at environmental impacts of the industry to be a favourable partner from the viewpoint of stakeholders in accordance with its related option. Approaches of companies to reduce ecological footprint are investigated to identify tendencies of companies on environment friendly initiatives within their value chains. Innovations on sustainability of industry in terms of ecological impacts is analysed through annual firm reports. Not only to be responsive to tackle harmful impacts of industry, but also to achieve a favourable reputation as a business partner by other industry stakeholders, this dimension is a crucial determinant. Eventually, in addition to existing sustainability practices in the industry, new suggestions are made to achieve a better environmental performance.

Local institutional context is researched in order to determine the extent of governmental support on R&D for steel industry. Sectoral reports introduced by Ministry of Industry and Technology shed light on policies affecting production of steel commodities as well as explaining current nationwide steel export policies. This dimension of value chain analysis highlights the role of government as an external driver of innovativeness.

Geographic scope is used to determine the distribution export markets through an analysis of trade flows via trade data analysis. Additionally, the current sanctions that are in force on Turkey in terms of steel trade are listed for regions in line with disclosed sectoral reports of Republic of Turkey Ministry of Industry and Technology. Changes in the export value of Turkey in main trade partner countries after these sanctions are evaluated and reasoned. Thus, the viability of the suggested option – partnerships with foreign buyers –is discussed along with opportunities and challenges.

Lastly, the determination of governance structure is performed to understand interaction dynamics between steel companies and suppliers. Practically, the main area of the research is composed of the identification of how companies in Turkish steel industry interact with their suppliers, the degree of power on them, and the extent of existing collaboration with suppliers. These complex structures are not found codified easily in industries. The suitability of Turkish steel value chains to modular governance is discussed as a result of analysis of annual reports offered by leader steelmakers in Turkey to exhibit the vital summary of the general mode of governance. Focus of each analysis and related data sources are illustrated in Table 15.

Table 15. Steps of value chain analysis on Turkish steel industry

Dimension	Relevant improvement option	Focus of the analysis	Source
Input-output structure	Option 1: Increase the product quality	Required changes on existing input-output structure and value adding activities	Republic of Turkey Ministry of Industry and Technology; Trade Map
Upgrading	Option 2: Focus on higher value-added products; Option 3: R&D partnerships with innovation leaders; Option 4: Improve operational flexibility	Current state of existing technologies and organisational capabilities for process and product upgrading	Republic of Turkey Ministry of Industry and Technology; Turkish Steel Producers Association; Annual reports of companies; Questionnaires (innovativeness construct)
Industry stakeholders	Option 5: Reduction of harmful environmental impacts	Commonly accepted stakeholders, current state of companies' environmental responsibility	Annual reports of companies
Local institutional context	Option 6: Governmental incentives and support for R&D	Policies of government on R&D for the iron and steel industry	Republic of Turkey Ministry of Industry and Technology, Republic of Turkey Ministry of Development
Geographic scope	Option 7: Cultivate partnerships with foreign buyers	Locations of export markets, list of sanctions applied on Turkey steel industry	Republic of Turkey Ministry of Industry and Technology, Trade Map
Governance Structure	Option 8: Collaborate with suppliers	Identification of the general mode of governance with suppliers	Annual reports of companies

At the end of the empirical research, viabilities of the eight theoretical improvement options are discussed as a result of findings from three stages. Possible implications of options on firm specific features and steel GVCs of Turkish steel industry are discussed along with their opportunities and challenges. By taking intersections of these competitiveness improvement options between firm specific features and value chain analysis into account, the final decisions are made about each option. Consequently, an ultimate guideline to improve competitiveness of Turkish iron and steel industry is suggested.

The main limitation being encountered during the research has been contacting companies as a result COVID-19 pandemic in order to collect interview data for a more comprehensive and detailed value chain analysis. Practically, performing a value chain analysis through interviews provides an additional chance to access undisclosed data by companies in their annual and sustainability reports, as well as leading researches directly to the required data accurately. Another limitation is that when a detailed value chain analysis through interviews is to be carried out for each steel company in Turkey, the established guidelines to improve competitiveness would be firm specific, which will cause the thesis to exceed boundaries of research capabilities. On the other hand, given that the research aims at touching upon industry wide competitiveness of Turkish iron and steel through apparent problems, focusing on considerably detailed data for each company may cause a divergence from the research purpose. This research serves as a base study for upcoming researches about the competitiveness of Turkey’s iron and steel industry.

4. Development of a Competitiveness Improvement Guideline for Turkish Steel Industry

In consideration of the theoretical model, the empirical research is conducted in three levels starting from macro with identification of general industry structure, and moving towards firm level and GVC oriented analyses to develop a competitiveness improving guideline for Turkish steel companies. Analyses start with quantitative methods performing correlational investigation of constructs in steel industry dynamics and firm specific features stages via IBM SPSS Statistics Version 25. Quantitative analyses are followed by a qualitative value chain analysis of Turkish steel industry. Compatibility of theoretical improvement options based on six-dimensional value chain analysis is discussed. Opportunities and challenges related with revealed improvement alternatives are detailed further with respect to essentials and dynamics of Turkey's steel industry. As a result of three stages of the empirical research an ultimate guideline is established for Turkish steel companies to improve their competitiveness taking all the implications of the selected options on firm specific features and value chains into account.

4.1. Steel Industry Dynamics

Given that fact that Turkey has been falling behind the competition in global steel industry over the last five years, primarily due to not following industrial advancements as a whole, the majority of companies still keep manufacturing only low-value added products in old conventional methods. The proposition of the research is that learning from export/import focuses by product of leader countries is an alternative to improve Turkey's competitiveness in global markets. For this purpose, top 10 crude steel producer country of 2018 are selected. Before examination of export/import focus of the most competitive countries in terms of steel production, the relationship between steel industry trends and economic growth is analysed to put forward, if economic activities are parallel to steel trends. Countries having similar relationships to Turkey's correlations are considered as equivalent whose products focuses are evaluated as examples to learn from. For this purpose, analyses start with bivariate Pearson correlations between total production of steel per capita/apparent steel user per capita and GDP per capita for 10 countries. Data related with GDP is retrieved from World Bank and the steel data is obtained from annual sectoral reports of World Steel Association between years 2000-2018. Correlations shown in Figure 33 are performed for each country and results are evaluated.

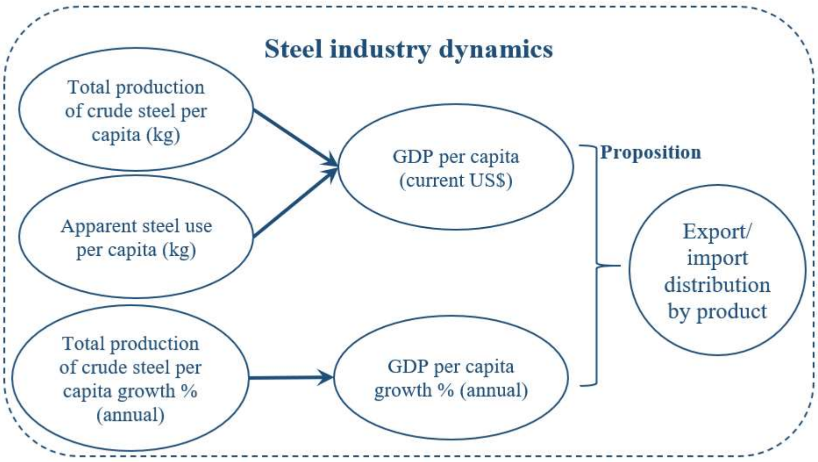

Fig. 33. Bivariate Pearson correlations between steel trends and economic activities

Table 16 displays results obtained from Pearson correlations and it shows that China, India, South Korea, Russia, and Turkey have positive significant relationships between critical variables of steel industry and economic activity at the 0.01 level. The rest of the countries have insignificant relationships, whereas in some of them negative significant correlations are observed, such as in United States or in Japan for GDP-Apparent steel use. For Germany, Japan, and Brazil total production per capita -GDP per capita correlations seem insignificant, as GDP per capita-apparent steel use per capita is highly significant. Italy shows insignificant correlations for all the variables.

Table 16. Pearson Correlations GDP per capita/ Total production of crude steel per capita and apparent steel use per capita

Country	GDP per capita (current US$)	Total production of crude steel per capita (kg)	Apparent steel use per capita (kg)
China	Pearson Correlation	**,962****	**,947****
	Sig.(2-tailed)	**0.000**	**0.000**
	N (years)	**19**	**19**
India	Pearson Correlation	**,991****	**,992****
	Sig.(2-tailed)	**0.000**	**0.000**
	N (years)	**19**	**19**
Japan	Pearson Correlation	-0.175	-,493*
	Sig.(2-tailed)	0.474	0.032
	N (years)	19	19
United States	Pearson Correlation	-,662**	-,511*
	Sig.(2-tailed)	0.002	0.025
	N (years)	19	19
South Korea	Pearson Correlation	**,916****	**,759****
	Sig.(2-tailed)	**0.000**	**0.000**
	N (years)	**19**	**19**
Russia	Pearson Correlation	**,740****	**,904****
	Sig.(2-tailed)	**0.000**	**0.000**
	N (years)	**19**	**19**
Germany	Pearson Correlation	-0.257	,531*
	Sig.(2-tailed)	0.289	0.019
	N (years)	19	19
Turkey	Pearson Correlation	**,937****	**,898****
	Sig.(2-tailed)	**0.000**	**0.000**
	N (years)	**19**	**19**
Brazil	Pearson Correlation	0.168	,784**
	Sig.(2-tailed)	0.491	0.000
	N (years)	19	19
Italy	Pearson Correlation	-0.070	-0.259
	Sig.(2-tailed)	0.777	0.285
	N (years)	19	19

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Next bivariate correlations are performed to determine whether the extent of growth is significant for GDP per capita and total production of crude steel per capita (Table 17). This intends to reveal an information about the dynamics of growth parameters whether they show similarities. All countries except India have significant correlations with their GDP growth and total crude steel production. Following India, Turkey has the least significance at the level of 0.05, as other 8 countries have their correlation positively significant at the level of 0.01. Since there is not a distinctive similarity observed with Turkish steel dynamics and other countries, results of Table 16 are used to determine equivalent countries whose export/import focuses to learn from. The growth related correlations are utilized to interpret how much GDP growth is influenced by production growth for China, South Korea, Russia, and Turkey. Results explain that Russia has the highest amount of growth on GDP per capita related with total production of crude steel per capita and followed by China. Turkey and South Korea come after with correlation coefficients of 0,457 and 0,419 respectively. Other countries like Japan, United States, Germany, and Italy have relatively higher correlations. This is attributed to the fact that the growth of GDP increased proportionally with the steel production for developed countries. Because after 2000s steel production has kept growing continually regardless of the fluctuations in economic activities. However, in countries like China, Turkey and Russia, GDP per capita growth did not follow the positive growth of production per capita that much due to slower more unstable growth of GDP in those countries after 2000s.

Table 17. Pearson Correlations GDP per capita growth % / Total production of crude steel per capita growth %

Country	GDP per capita growth % (annual)	Total production of crude steel per capita growth % (annual)
China	Pearson Correlation	**,595****
	Sig.(2-tailed)	**0.007**
	N (years)	**19**
India	Pearson Correlation	**0.296**
	Sig.(2-tailed)	**0.218**
	N (years)	**19**
Japan	Pearson Correlation	,858**
	Sig.(2-tailed)	0.000
	N (years)	19
United States	Pearson Correlation	,641**
	Sig.(2-tailed)	0.003
	N (years)	19
South Korea	Pearson Correlation	**0.419**
	Sig.(2-tailed)	**0.074**
	N (years)	**19**
Russia	Pearson Correlation	**,617****
	Sig.(2-tailed)	**0.005**
	N (years)	**19**
Germany	Pearson Correlation	,753**
	Sig.(2-tailed)	0.000
	N (years)	19
Turkey	Pearson Correlation	**,457***
	Sig.(2-tailed)	**0.049**
	N (years)	**19**
Brazil	Pearson Correlation	,594**
	Sig.(2-tailed)	0.007
	N (years)	19
Italy	Pearson Correlation	,758**
	Sig.(2-tailed)	0.000
	N (years)	19

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Subsequent to bivariate correlations, countries that are found equivalent to Turkey are China, India, South Korea, and Russia with respect to their economic benefits from the iron and steel industry. Export and import distributions of those countries are illustrated respectively in abide by the data that is retrieved from 2019 steel export/import reports of United States of America Department of

Commerce. Figure 34, 35, 36, 37 and 38 display export and import distributions by product between years 2017-2019 for China, India, South Korea, Russia, and Turkey. For reports related with Russia, import by product statistics are not presented due to limited access, so only the export product distribution is illustrated. According to the statistics, China, India, and South Korea majorly focus on exports of flat product which are of the highest value-added commodities amongst others. Especially South Korea's almost 70% of exports are flat products (Figure 36). Russia primarily focuses on exports of semi-finished products apart from being a considerably large flat product exporter (Figure 37). Turkey is the largest exporter of long products according to percentage distributions with 55% of all the export portfolio (Figure 38). When import statistics are observed, it is safe to say that all the countries vastly import flat products to use in their advanced technology requiring industries. Export/import statistics of the steel give signals about upcoming trends and future supply/demand patterns that flat products are in a great demand globally.

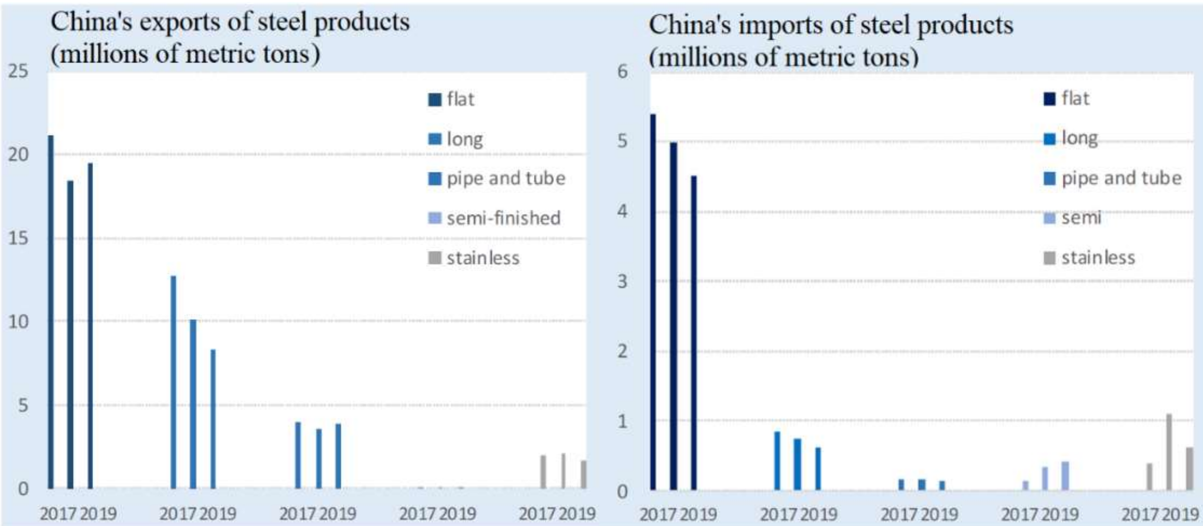

Fig. 34. China's export-import distribution by product 2017-2019 (U.S. Department of Commerce, 2019)

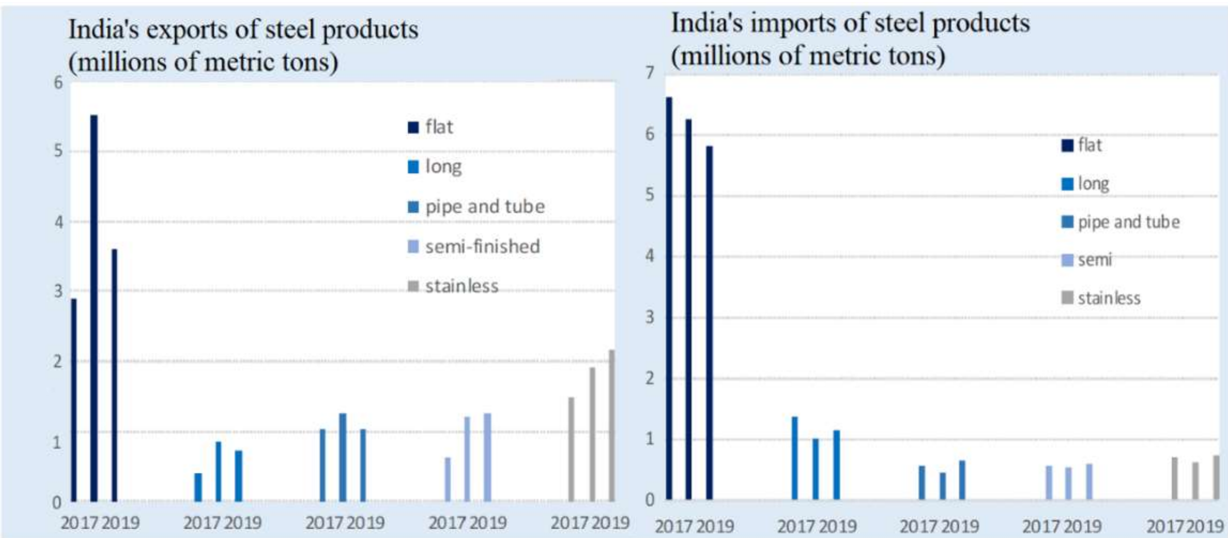

Fig. 35. India's export-import distribution by product 2017-2019 (U.S. Department of Commerce, 2019)

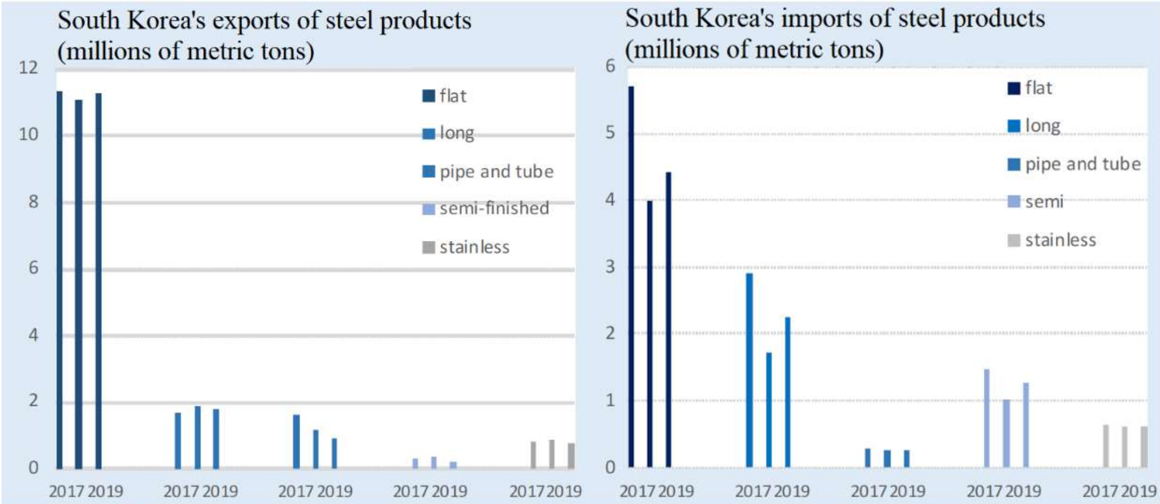

Fig. 36. South Korea's export-import distribution by product 2017-2019 (U.S. Department of Commerce, 2019)

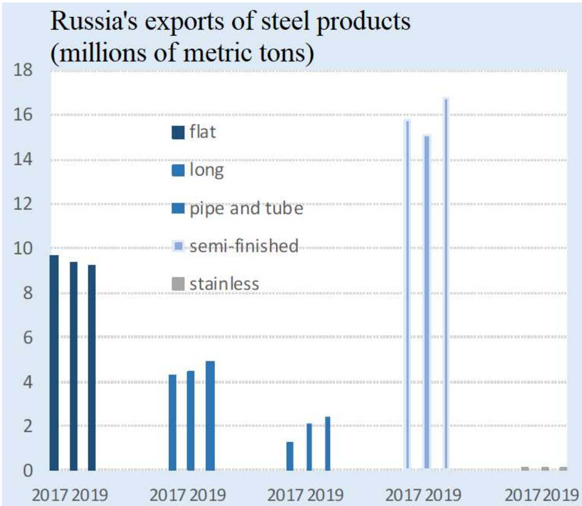

Fig. 37. Russia's export distribution by product 2017-2019 (U.S. Department of Commerce, 2019)

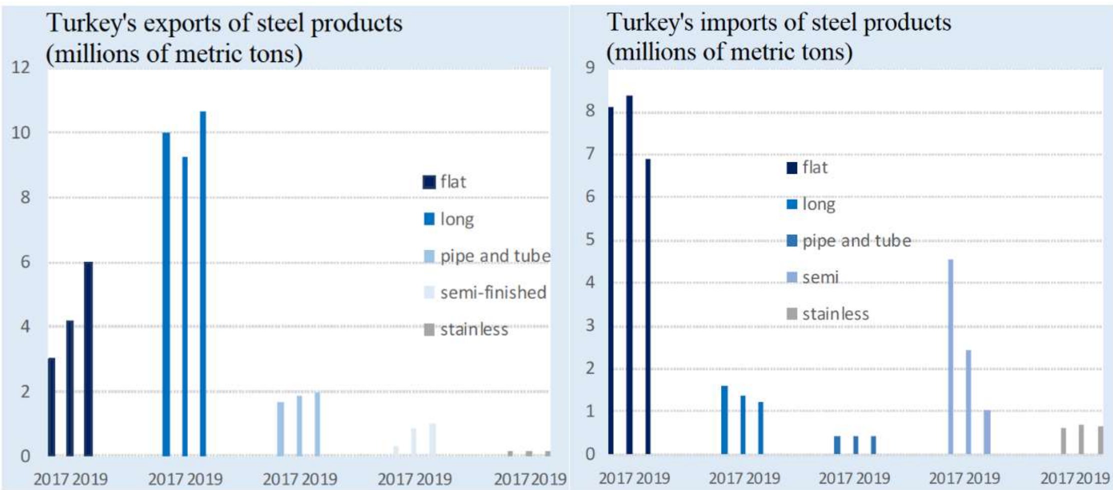

Fig. 38. Turkey's export-import distribution by product 2017-2019 (U.S. Department of Commerce, 2019)

Table 18 shows the distribution of export product types for 5 countries. The applicability of similar product focus is evaluated for Turkey with opportunities and challenges in discussion chapter. Findings show that Turkish steel industry has a strong significance with economic activities particularly on total crude steel production per capita and GDP per capita according to Pearson correlation coefficient of 0,937 (Table 16). Therefore, following the most up-to-date trends closely is important for economic development of country in long term. In this case pursuit of a flat product strategy is more beneficial for Turkey, because semi-finished product focus of Russia, would not create a significant advantage in terms of value-added compared with existing long steel products.

Table 18. Distribution of product types in exports for countries with similar correlations by percentage

Country	Proportion of exports (% average between 2017-2019)				
	Flat products	Long products	Pipe and tube	Semi-finished	Stainless
China	54	29	10	0	6
India	45	7	11	14	22
South Korea	69	12	11	3	6
Russia	28	14	6	51	0
Turkey	25	57	11	6	1

Outcome of the first stage is that focusing on high value-added flat steel commodities in production and then in exports would improve competitiveness of Turkish steel industry along with a strong positively effect in economic development. Next, firm specific features are analysed for a better understanding of organisational tendencies and capabilities of companies in Turkish steel industry in order to further examine possibilities to change product focus from long to flat commodities before recommending an absolute product focus trajectory.

4.2. Firm Specific Features in Turkish Iron and Steel Industry

Prior to selection of viable options for the improvement of Turkish steel industry's competitiveness, the general structure of companies has to be identified. For this purpose, questionnaire results are analysed quantitatively for the competitiveness related constructs of the iron and steel industry. Before conducting bivariate correlations, reliability analyses are performed for items of each construct to test how consistent are the defined items. (Table 19). All construct items have Cronbach's Alpha values higher than 0.7 which means that items to measure are highly reliable and relevant to each construct.

Table 19. Case processing summary and reliability analyses results

Case Processing Summary		
		N
Cases	Valid	28
	Excluded [a]	0
	Total	28

a. Listwise deletion based on all variables in the procedure.

Reliability Analyses		
Constructs	Cronbach's Alpha	N of Items
Firm size	0.972	3
Attitudes towards R&D partnerships	0.819	5
Attitudes towards supplier partnerships	0.723	2
Innovativeness	0.762	6
Financial Performance	0.906	4

The development of a suitable guideline is possible through a better understanding of firm specific features of Turkish steelmakers. Descriptive statistics in Table 20 exhibit an overarching outline of current condition of companies. Mean values for each construct describe attitudes, priorities, and financial performances of companies to be evaluated during the guideline development. Measurement scale is between 1-5 where, the higher the number is, the more positivity the nature of scale states. Standard variations are generally low except the constructs of competitive priorities (low cost, high product quality, high delivery quality/speed, operational flexibility). Therefore, data set is distributed closely to the mean. According to the statistics, Turkish steel companies have more positive attitude towards supplier partnerships than R&D. Despite that, their innovativeness is above average with 3,64 out of 5,00. Financial performance of Turkish steel companies over the past 5 years seem to have remained constant with 3,08. Competitive priorities support the tendency of Turkish steel companies towards low costs and high delivery quality/speed with the mean values of 4,50 and 4,11 respectively. Moderate level of innovativeness amongst companies explains the reason why high product quality is not widely preferred, as well as operational flexibility. Reasoning of some constructs are further explained through bivariate correlations.

Table 20. Descriptive statistics of firm specific features

Statistics									
		Attitudes towards supplier partnerships	**Attitudes towards R&D partnerships**	**Innovativeness**	**Financial Performance**	**Low costs**	**High product quality**	**High delivery quality/Speed**	**Production Flexibility**
N	Valid	28	28	28	28	28	28	28	28
	Missing	0	0	0	0	0	0	0	0
Mean		**3.55**	**3.31**	**3.64**	**3.08**	**4.50**	**3.46**	**4.11**	**3.68**
Mode		3.5	2.6	3.17	3	5	3	5	3
Std. Deviation		0.83155	0.66774	0.57027	0.77595	0.745	1.232	0.875	0.945
Variance		0.691	0.446	0.325	0.602	0.556	1.517	0.766	0.893

The Spearman's bivariate correlation is performed in accordance with the conceptual framework (Table 21) according to the explanation in the methodology chapter to test hypotheses of the research as well as to reveal how these relationships exist between constructs for Turkish steel companies. Outcomes are used to evaluate the compatibility of the theoretically revealed improvement options dependent upon firm specific features.

Hypothesis 1: There is a positive significant correlation between firm size and innovativeness of steel companies.

Innovativeness of Turkish steel companies is found significantly correlated with their firm size at the p-value level of 0.01, with the correlation coefficient of ,659** (Table 21). The positive correlation implies that as firm size increases, innovativeness of those companies increases correspondingly. Eventually, *Hypothesis 1* is accepted for Turkish steel companies.

Table 21. Firm size – Innovativeness bivariate correlation results

Correlations			
			Innovativeness
Spearman's rho	**Firm size**	Correlation Coefficient	,659**
		Sig. (2-tailed)	,000
		N	28

**. Correlation is significant at the 0.01 level (2-tailed).

Hypothesis 2.1: Companies that have more positive attitudes towards R&D partnerships are more innovative.

Hypothesis 2.2: Companies that have more positive attitudes towards supplier partnerships are more innovative.

Next correlations are conducted between partnership propensities related constructs and innovativeness to test two hypotheses that were put forward. Table 22 illustrates that attitudes towards R&D partnership is positively significant with a strong magnitude at the 0.01 significance level, whereas attitudes towards supplier partnership shows no significant correlation with innovativeness of companies with a low p-value of ,054. In this case *Hypothesis 2.1* is accepted and *Hypothesis 2.2* is rejected. Results imply that attitudes towards supplier partnership does not have any contribution to the innovativeness of companies. Subsequently, a new correlation to be tested is derived during the empirical research so as to evaluate the versatility of the collected data about supplier partnerships.

Table 22. Partnership attitudes – Innovativeness bivariate correlation results

Correlations

			Innovativeness
Spearman's rho	**Attitudes towards supplier partnerships**	Correlation Coefficient	,368
		Sig. (2-tailed)	,054
		N	28
	Attitudes towards R and D partnerships	Correlation Coefficient	**,841****
		Sig. (2-tailed)	**,000**
		N	28

**. Correlation is significant at the 0.01 level (2-tailed).

As a result of the rejection of *Hypothesis 2.2*, attitudes towards supplier partnerships is correlated with the financial performance, in order to utilize gathered data, furthermore to test whether the improvement options related with partnerships with suppliers in the industry have any positive or negative impact on the competitiveness of Turkish steel companies after recommendations. Table 23 shows that there is a positive significant relationship between attitudes towards supplier partnerships and financial performance of Turkish steel companies, which means that companies collaborating with their suppliers have better financial performances.

Table 23. Partnership attitude towards suppliers – Financial performance correlation results

Correlations

			Financial Performance
Spearman's rho	**Attitudes towards supplier partnerships**	Correlation Coefficient	,563**
		Sig. (2-tailed)	0.002
		N	28

**. Correlation is significant at the 0.01 level (2-tailed).

Importance of innovations in the iron and steel industry have been stated many times theoretically. Bivariate correlations to research relationship between innovativeness and financial performances of Turkish steel companies, show that there is a strong positive significance between two constructs at the level of 0.01, with a smaller p-value (Table 24). This implies that innovative steel companies are prone to have better financial performances over the last five years.

Table 24. Financial performance – Innovativeness bivariate correlation results

Correlations			
			Innovativeness
Spearman's rho	**Financial Performance**	Correlation Coefficient	,678**
		Sig. (2-tailed)	0.000
		N	28

**. Correlation is significant at the 0.01 level (2-tailed).

Competitive priorities of companies are important in terms of understanding their market strategies. Four major components of these priorities are researched for Turkish steel companies, and their correlations with financial performance are analysed. Table 25 shows that all those priorities are significantly correlated with financial performance at the 0.01 level. However, low costs and high delivery quality/speed priorities are negatively correlated with financial performance, whereas high product quality and operational flexibility have positive relationships with the financial performance. Implications of existing strategies are discussed at the end of the empirical research.

Table 25. Financial performance – Competitive priorities bivariate correlations results

Correlations						
			Low costs	**High product quality**	**High delivery quality/speed**	**Production flexibility**
Spearman's rho	**Financial Performance**	Correlation Coefficient	-,460*	**,588****	-,440*	**,533****
		Sig. (2-tailed)	0.014	0.001	0.019	0.003
		N	28	28	28	28

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Results obtained from quantitative analysis of firm specific features are shown in the conceptual framework in Figure 39. In addition to suggested conceptual framework, in the course of analyses a new bivariate correlation is researched between attitude towards supplier partnerships and financial performance as a result of rejection of the *Hypothesis 2.2*.

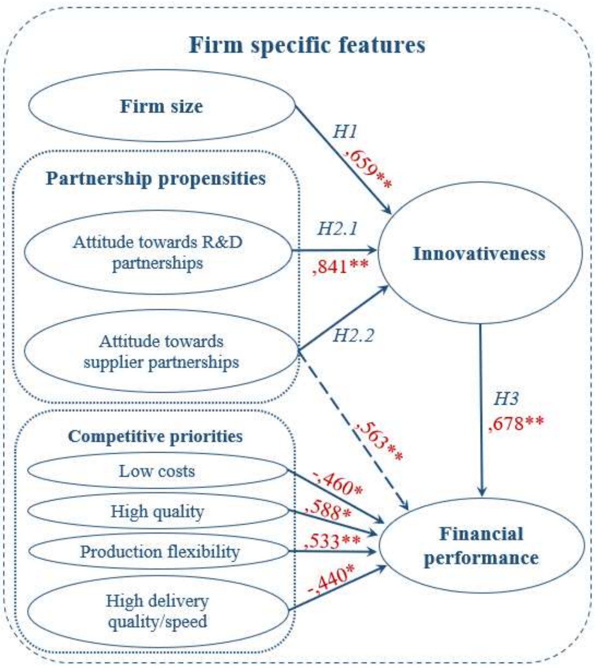

Fig. 39. Results of bivariate analyses for firm specific features on conceptual framework

The quantitative correlation analysis of firm specific features related with Turkish steel companies highlights the importance of innovation through a strong relationship with financial performance. Firm size and attitudes towards R&D partnerships of companies are strong determinants of innovativeness. Another correlation is analysed between attitudes towards supplier partnerships to see whether integration of suppliers is effective on financial performance, and it is found positively significant. The final correlations are performed between competitive priorities and financial performance. High quality and delivery focus are positively correlated with financial performance, whereas low cost and operational flexibility strategies have negative association. All outcomes are tabulated in Table 26 to be evaluated. According to the Table 26, all revealed improvement options are related with firm specific features that have positive correlations with financial performance or innovativeness for their exclusive constructs. For the firm size, mean values are not indicated because the results are ratio as integer numbers such as 10.000.000 EUR or 250.000 tons, and items of the constructs are standardized between amongst each other to put forward a reliable measurement during correlations. Because there is a big difference in numbers between annual turnover with millions between number employees with maximum of thousands. Mean values except low cost and high delivery quality/speed constructs show low values close to the neutral point which imply that there is still lack of infrastructure, or organisational capabilities to achieve higher scores on features related with the competitiveness improvement options. However, all the means above 3.0 illustrates that there is still a positive average attitude towards applicability of the options. Exemplary product focus determined as a result of steel industry dynamics analysis, which is flat product, matches with the *Option 2*, and results of the correlation between innovativeness and financial performance support the need for the implementation of new production methods. Besides the mean value of innovativeness is 3.64, which indicates the positive attitudes of companies for the applicability on firm level.

Table 26. Results of firm specific features analysis

Firm specific feature	Mean	Improvement Option	Correlated construct	Correlation coefficient
High product quality	3.46	*Opt. 1* (Increase existing product quality)	Financial performance	,588**
Innovativeness	3.64	***Opt. 2* (Focus on higher value-added products)**	Financial performance	,678**
		Opt. 5 (Reduction of harmful environmental impacts)		
Firm size	–	*Opt. 3* (R&D partnerships with innovation leaders)	Innovativeness	,659**
Attitudes towards R&D partnerships	3.31			,841**
Operational Flexibility	3.68	*Opt. 4* (Improve operational flexibility)	Financial performance	,533**
Attitudes towards supplier partnerships	3.55	*Opt. 8* (Collaborate with suppliers)	Financial performance	,563**
Financial Performance	3.08	-	Innovativeness	,678**
Low costs	**4.5**		Financial performance	-,460*
High delivery quality/Speed	**4.11**		Financial performance	-,440*

So as to check validity of the revealed options on Turkish steel industry, the final step, value chain analysis is performed before collating outcomes of empirical research and then suggestions are made by evaluating intersections of the eight improvement options between firm specific features and value chains.

4.3. The Value Chain Analysis of Turkish Iron and Steel Industry

The third part of the empirical study is the qualitative research to perform a value chain analysis on Turkish steel industry. The scope of analysis is theoretically revealed improvement options and their intersections between value chains and firm specific features. Assessments are carried out by using publications of Turkish Steel Producers Association (TÇÜD), Republic of Turkey Ministry of Industry and Technology, annual firm reports of Turkish steel companies which are open access content and trade statistics via Trade Map of International Trade Center. With respect to analysis of disclosed information about activities reports of six Turkish steel companies, a generalized value chain activity framework is developed to address improvement options on each dimension (Figure 40). The diagram is created according to the value chain framework suggested by Porter. Annual reports of six prominent steel companies in Turkey – Erdemir Group, İçdaş, Borusan Holding (Borçelik), İzmir Demir Çelik, Tosyalı Holding and Kardemir – are used to identify common main and supporting activities to represent the fundamental structure of value chains of steel industry. Only the common activities of each companies are selected in development of the value chain framework. It should be noted that the framework represents conventional outlook of steel value chains for the companies of subject country and from a more detailed perspective, these activities differ for each company according to their business models, vertical or horizontal integrations in their systems.

In general, the delivery of the value in Turkey's steel industry is achieved through production of low-value added long commodities. Major raw material is steel scrap that is mostly imported from United States, Netherlands, United Kingdom and Russia to feed electric arc furnaces, then the steel is further processed into semi-finished products via facilities located in Turkey (Table 27). Iron ore, coke coal and iron pellets are inputs of integrated steel production facilities, which are indicated in green boxes on value chain framework. These activities comprise only 30% of total amount of the steel production in Turkey, because majority of companies own electric arc furnace facilities. After the ultimate forming of semi-finished products into wire rods, tubes or bars, products are distributed to the customers via road or train transportation in domestic market, and mostly via marine transport to the foreign markets (Erdemir, 2019; İçdaş, 2018; Borusan, 2018; İzdemir, 2019; Tosyalı, 2017; Kardemir, 2019). To be used in outbound logistics large companies like Erdemir, İzmir Demir Çelik, Tosyalı Holding which are close to ports, have their own port management units and ships for transportation activities (Erdemir, 2019; İzdemir, 2019; Tosyalı, 2017). Sales are done either directly to end users or to merchants in domestic or foreign markets. End-user sales are more common approach by larger companies, whereas smaller organisations prefer merchants with wider networkings (TÇÜD, 2016). Supporting activities are not in the scope of this research in detail, but they are used to evaluate pertained options on improvement during dimensional analysis. Possible improvement factors options are indicated on their associated parts of steel value chains to be evaluated in six dimensions of analysis.

Analysis is conducted in accordance with the methodology suggested by Gereffi and Fernandez (2011) from the standpoint of revealed improvement factors (Table 27). Relevance, opportunities, and challenges of options within each dimension of analysis are shown in the Table 27.

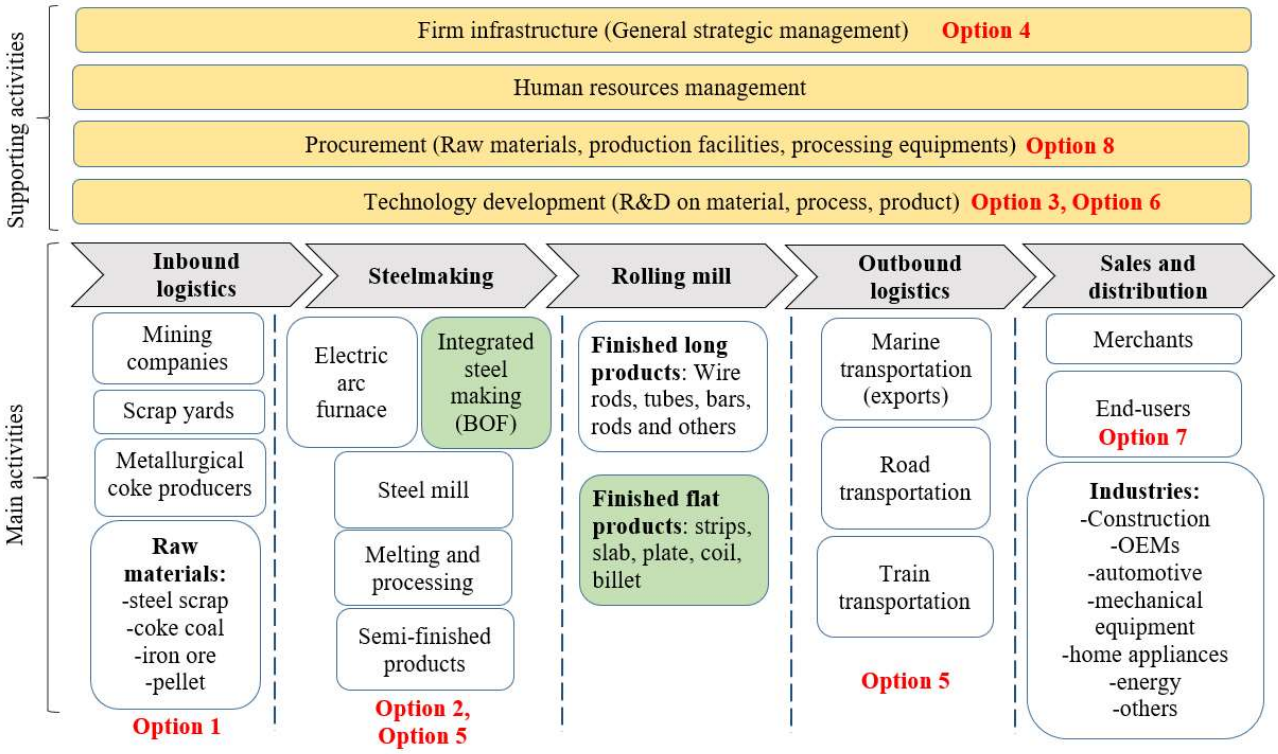

Fig. 40. The value chain diagram of Turkey's Iron and Steel Industry

Table 27. Properties of the improvement options and GVC dimensions

Competitiveness Improvement Options				
Option	**GVC Dimension**	**Relevance**	**Opportunity**	**Challenge**
Option 1: Increase existing product quality	Input-output structure	Change in raw materials and intermediary production processes	Improving general properties of commodities in order to capture new markets, utilization of chromite reserves	Cost optimization, increase of market prices, know-how
Option 2: Focus on higher value-added products	GVC upgrading	Change in the main production method (process and product upgrading)	Shifting from long to flat steel production to increase value-added to capture new markets	High investment costs, training of the staff, know-how
Option 3: R&D partnerships with innovation leaders	GVC upgrading	Technology development to improve processes in GVC	Augmentation of R&D resources, sharing risks and costs	Priority conflicts between partners, cultural differences
Option 4: Improve operational flexibility	GVC upgrading	Utilization of BPM in firm infrastructure level for a better supply/demand management	Integration of BPM and SCM systems for a better supply/demand scheduling	Unfamiliarity of organisational culture with such systems
Option 5: Reduction of harmful environmental impacts	Industry stakeholders	Current state of environmental responsibilities to be favorable partners for stakeholders	Implementation of environment friendly solutions to become more desirable industry partners	Adaptation of processes may not be economically feasible
Option 6: Governmental incentives and	Local institutional context	Current state of policies and planned actions by	Support on R&D investments by government	A nation-wide decision independent from

supports for R&D		government on R&D	to improve innovativeness of the industry	companies' authority
Option 7: Cultivate partnerships with foreign buyers	Geographic scope	Distribution of export markets and list of sanctions on Turkey in global trade of steel	Establishing long-term relationships with large foreign buyers against substitutability	Initially building trust, protectionist policies of countries
Option 8: Collaborate with suppliers	Mode of governance	Existing mode of governance for supplier relationships	Treating suppliers as partners by involving them into chain upgrading to improve efficiency	Excessive diffusion knowledge, issues of trust, discordant priorities

The six-dimensional analysis starts with the identification of input-output structure of industry in Turkey. *Option 1* – increasing the existing product quality – is associated with input-output structure of steel value chains, because it requires a revision of raw materials, certain steps of manufacturing processes, or employment of intermediary new production systems. In the iron and steel industry manufacturing of higher quality of steel commodities is done by involvement of alloys during continuous casting in integrated facilities. Here the major change in the value chain would be observed in the input structure by including alloys as raw materials. In addition to price volatility of the steel, involvement of another input component with volatile market prices which are alloys like chromite, tungsten, or nickel, brings challenges on procurement given the fact that Turkey is already externally dependent upon scrap and iron ore inside the inbound logistics of value chains. Trade statistics in Table 28 shows the amounts of scrap and iron ore imports of Turkey in 2019. The biggest proportion of iron ore is imported from Brazil with a much lower unit value than other countries as 86 USD/unit. The most expensive imports of the industry as raw material scrap are imported from USA, Netherlands, UK, and Russia. According to the sectoral report published by Republic of Turkey Ministry of Industry and Technology (SATSO, 2019), there is a lack of infrastructure to manufacture alloy steels, particularly for stainless steel, despite having approximately 100 million tons of chromite reserves in Turkey. Furthermore, high energy consumption prices in Turkey cause companies to remain reluctant in production of high-quality alloy steels, and the chromite extracted is exported to foreign countries mainly to China, Sweden, Russia, and Belgium without any additional value is added (Table 29). Under these circumstances, the biggest opportunity for Turkey steel industry to increase existing production quality is taking location advantage in terms of possessing sufficient amount of chromite reserves. Evidence from Trade Map (INTRACEN) import statistics of flat stainless products in Table 30 shows that Turkey consumes significant amount of stainless steel in domestic markets with a vast import quantity from South Korea. Production of stainless-steel entails investment in integrated alloy facilities by companies as well as support of government to expand capabilities. Increasing product quality not only provides access to new markets for steel companies, but also helps increase the value-added of chromite reserves of country as well as closing the gap originating from imports of stainless products. The major challenge of the option is cost optimization and learning know-how initially as the method is not applied in Turkey.

Table 28. Turkey imports of Iron ore and scrap in 2019 (INTRACEN)

Iron Ore Imports	Value imported in 2019 (USD thousand)	Trade balance 2019 (USD thousand)	Share in Turkey's imports (%)	Quantity imported in 2019	Quantity unit	Unit value (USD/unit)
Brazil	479,982	-479,982	44	5,596,052	Tons	86
Sweden	189,284	-189,284	17.4	1,346,454	Tons	141
Canada	145,769	-145,769	13.4	999,849	Tons	146
Russia	81,900	-81,889	7.5	573,652	Tons	143
Ukraine	69,705	-69,704	6.4	512,914	Tons	136
South Africa	58,512	-58,512	5.4	505,056	Tons	116
India	54,853	-54,853	5	426,011	Tons	129
Scrap Imports	**Value imported in 2019 (USD thousand)**	**Trade balance 2019 (USD thousand)**	**Share in Turkey's imports (%)**	**Quantity imported in 2019**	**Quantity unit**	**Unit value (USD/unit)**
USA	1,132,655	-1,132,635	20.2	3,837,607	Tons	295
Netherlands	765,530	-732,855	13.6	2,598,123	Tons	295
United Kingdom	663,711	-662,450	11.8	2,190,027	Tons	303
Russia	569,847	-569,847	10.1	1,88,1218	Tons	303
Belgium	385,594	-383,490	6.9	1,304,098	Tons	296
Germany	294,849	-292,830	5.3	929,701	Tons	317
Romania	248,109	-248,063	4.4	851,130	Tons	292

Table 29. Turkey chromite exports in 2019 (INTRACEN)

	Value exported in 2019 (USD thousand)	Trade balance 2019 (USD thousand)	Share in Turkey's exports (%)	Quantity exported in 2019	Quantity unit	Unit value (USD/unit)
China	142,282	142,219	63	845,420	Tons	168
Sweden	53,893	53,893	23.9	346,106	Tons	156
Russia	12,236	12,236	5.4	58,077	Tons	211
Belgium	9316	9316	4.1	42,321	Tons	220

Table 30. Turkey imports of 7219 Flat-rolled products of stainless steel, of a width of >= 600 mm, hot-rolled or cold-rolled in 2019 (INTRACEN)

	Value imported in 2019 (USD thousand)	Trade balance 2019 (USD thousand)	Share in Turkey's imports (%)	Quantity imported in 2019	Quantity unit	Unit value (USD/unit)
South Korea	357,572	-357,465	38.6	207,765	Tons	1721
China	143,689	-143,687	15.5	84,990	Tons	1691
Spain	64,389	-57,118	7	28,160	Tons	2287
Italy	48,024	22,928	5.2	26,164	Tons	1835
Taipei, Chinese	46,533	-46,533	5	27,565	Tons	1688
Finland	43,271	-43,271	4.7	17,424	Tons	2483
Belgium	38,686	-23,138	4.2	16,832	Tons	2298

Option 2,3 and *4* are researched under the topic of GVC upgrading as process and product upgrading opportunities. *Option 2* is related with focusing on a different product portfolio – flat products – which is known as high value-added advanced commodities of the steel industry that is produced with a completely different manufacturing process. This option is highlighted as an exemplary product focus at the end of the steel industry dynamics stage of the empirical research, to learn from China, India, and South Korea. Instead of using conventional electric arc furnaces, integrated facilities are used where basic oxygen furnaces (blast furnace) are utilized to manufacture flat products by feeding facility with iron ore, pellets, and coke coal as raw materials. Amongst all the steel companies in Turkey, there are only Erdemir Group which is the biggest steel producers of Turkey manufacturing flat products with 7 million tons in 2019 (Erdemir, 2019), Borçelik with ArcelorMittal partnership to produce flat commodities (Borusan, 2018), Tosyalı Holding partnership with Tokyo Kohan on manufacturing flat steel (Tosyalı, 2017), and Kardemir with their portfolio expansion plans to coil flat products to increase their Turkey share in 4140 high-quality steel products that is vastly used in automotive and defence industry to reduce imports of those commodities significantly (TÇÜD, 2019). There are only 3 integrated steel plants to manufacture flat products and 31 electric arc furnaces to manufacture long products in country (SATSO, 2019). Except some large leader companies in country, current capabilities and facilities of majority are suitable only for semi-finished or finished long steel commodities. Significant investments are necessary in establishment of new blast furnaces to generate an opportunity to benefit from in long term, since Turkey's infrastructure of steel industry is still under development. These operations both reduce the dependency on scraps which are the most expensive raw materials of industry, and external dependency on high value-added products through imports, as well as providing an access to advanced technology markets. Table 28 shows the significant difference in prices of two different input materials scrap and iron ore respectively for electric arc furnaces and blast furnaces. Companies should allocate their resources to build integrated facilities and shift their operations towards flat manufacturing. Major changes are observed in raw materials and in the main production methodology. Opportunities of the option is to increase value-added in order to capture new markets and increase the economic benefits from the steel industry in long term. Whereas primal challenge is high investment costs, know-how of the new flat commodity production method and training requirements for the labors.

Option 3, the pursuit of R&D partnerships with innovation leaders in the industry either with local producers or with foreign companies is important in terms of sharing resources, risks, costs and implementing new technologies in a timely manner. The scope of these partnerships can be also beyond steel industry as in the example of POSCO with Google cooperation on Smart Workplace. In the five-year progress report of Republic of Turkey Ministry of Development (T.C. Kalkınma Bakanlığı, 2018), scarcity of R&D practices and insufficiency of infrastructures to foster innovations are highlighted in nationwide steel sector. To tackle resource and infrastructure scarcity in terms of R&D practices, building up partnerships with innovation leaders is an opportunity to acquire the latest advance technologies and implications are observed through all the linkages of value chain. An example partnership is signed between the biggest steel company in the world ArcelorMittal and Turkish company Borusan Holding. Borçelik was established as a result of this partnership to produce high quality galvanized flat steel commodities in Turkey with its own R&D centre focusing on material, process, and technology development (Borusan, 2018). A similar partnership is observed between Tosyalı Holding and Japanese Toyo Kohan to manufacture flat steel products to increase value-added in their steelmaking operations. With the exception of large major producers, this kind of partnerships are rarely seen in Turkey's steel industry particularly between local companies due to severe domestic competition. The sector seems to be governed by the oligopoly of leader firms, however there is too little collaboration between these companies to benefit as a whole (T.C. Kalkınma Bakanlığı, 2018). Outcomes of this option are observed through all the GVC of Turkish steel industry as supporting activities. The opportunity is that it enables companies to expand their R&D resources, sharing the risks and high costs. Initiation of these partnerships is challenged mostly by priority conflicts between partners and cultural differences.

Option 4 is related with process upgrading in order to improve operational flexibility. There are already leader companies with their R&D centres striving to upgrade processes, such as Erdemir Group with their practices on achieving lean manufacturing, or other companies investing in computer-integrated manufacturing processes to better adapt fluctuations. In the context of improving operational flexibility, a non-facility-based factor which is day-to-day management of supply/demand and people is an option to consider. For this purpose, integration of business process managements into supply chain systems is evaluated, because these systems enhance management of supply chains by improving communication within organisations, between partners, and projections of supply and demand across supply chain partners and customers. The option applies to the general management of value chains in firm infrastructure level. To be able to interpret the extent to which Turkish steelmakers utilize such systems, annual reports of companies were not an efficient source of data due to lack of detailed information about management systems. Therefore, items of innovativeness construct related with BPM utilization in the questionnaire applied on 28 Turkish steel companies from quantitative stage of this research is selected. Items of sub-construct BPM intends to measure the degree of utilization of BPM systems, and their perception as critical success by companies. Two items of the sub-construct measured by 5-point Likert scale show more positivity as values approach to 5 (Strongly agree) starting from 1 (Strongly disagree). Mean of two items is almost 3,5 which means that companies benefit from business process management systems a little above the neutral stand point (Table 31). This implies that integration of BPM systems needs to be implemented more often to achieve an efficient management through the chains. Also, the extent to which integration of these BPM units is subject to a further firm level interview-based research to collect more accurate data, because it is not possible to comment on BMP-SCM integration with the current data. Such an option would provide an opportunity to integrate activities in the scope of BPM, thus provides a better management of supply/demand scheduling. A challenge to overcome is unfamiliarity of many companies producing with old conventional methods to this kind of approaches. But limitations to access interview data prevents a further commenting about the option.

Table 31. Descriptive statistics of BPM utilization construct

Statistics			
1- Our firm actively develops in-house solutions in order to improve business process management systems. **2-** Our firm perceives adoption/utilization of new business process management systems as critical for success.	BPM		
	N	Valid	28
		Missing	0
	Mean		**3.4821**
	Std. Deviation		0.75132
	Range		3.00

Mapping of all the stakeholders in value chain along with their main roles in important in terms of understanding the local and global dynamics of value chains. Key stakeholders vary with respect to the strategies of companies, or according to each project they plan to carry on. Apart from the conceptual approach of the suggested value chain analysis, industry stakeholders' dimension of the analysis focuses on the evaluation of *Option 5* – reduction of harmful industrial effects on environment – to enhance environmental responsibility of companies. Environment is one of the most important aspects to take into account in steel industry due to significant harmful effects on nature, and even though it is not mentioned as a stakeholder by none of the companies in their reports, leader companies take serious initiatives for a more environment friendly steel production. Almost all of the companies explain their main sustainability topics as, energy, water, emission and waste management and protection of biological diversity. Tosyalı Group, Borçelik and Erdemir Group have their own responsible environmental approaches with significant amount of investments and ongoing project disclosed in their sustainability reports. In 2017, Tosyalı Group invested in solar energy with 9MW power capacity to prevent emission of 10.000 tons of CO2 in their long product facilities (Tosyalı, 2017). Erdemir Group states that they carry on R&D practices to inhibit CO2 during the emissions of process gases during the manufacturing of steel and undertook a project with TUBITAK MAM (The Scientific and Technological Research Council of Turkey) to combat CO2 emissions. In 2019 through energy efficiency projects they managed to reduce 260,348 tons of CO2 emissions (Erdemir, 2019). Borçelik carried out a project aiming to reduce water consumption by 14% as a result of 16% increase in their demineralized water consumption (Borusan, 2018). They achieved 17% water consumption reduction in their steel manufacturing progress. Turkish steel industry seems to perform responsible when leader companies are investigated for the environmental factors particularly related with manufacturing, however the research suggest that a further investigation in future for SMEs and smaller firms is necessary to understand how they allocate their resources in terms of environment friendly production. Non-production related environmental responsibility practices are not mentioned in the reports of the investigated companies. Other dimensions of value chains should be also considered to achieve a better environmental performance, such as application of green logistics. Because, responsible attitude in production towards nature also provides a good reputation for companies making them more desirable partners for stakeholders. In a joint project carried out by Western Black Sea Development Agency (BAKKA, 2019) and Republic of Turkey Ministry of Environment and Urbanization in 2019, key stakeholders are defined as shown in Figure 41 for a project about environmental awareness and sustainability of the steel for the Western Black Sea region cluster of Turkish steel industry. A similar framework is applicable to other regions of the country. A challenge to deal with is that such solutions may not be economically feasible in the beginning and organisational culture may not be familiar with green approaches, particularly SME's. However, a collaborative approach with the key stakeholders paves the way achieving a more environmentally responsible steel GVC as a result of joint projects, feasibility studies, workshops with stakeholders and new innovative solutions.

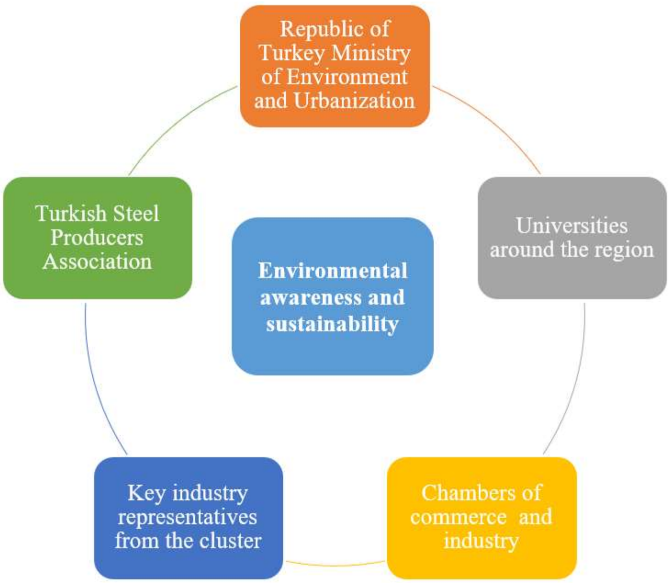

Fig. 41. Key stakeholders in Turkey's steel industry for environmental awareness and sustainability

Steel industry in Turkey is still in the development stage even though there are prominent companies with advanced manufacturing technologies, compared to the other competitor countries in a larger scale the industry needs significant investments to enhance overall competitiveness. *Option 6,* governmental incentives on R&D is a sensible option to accelerate the development of steel companies. The option touches upon the local institutional context of value chain analysis to identify available infrastructures, and governments possible support. Within the context of agreement signed with European Coal and Steel Community in 1996, Turkish Government cannot provide a state aid directly to the steel sector. According to the Article 107(1) TFEU state aid is defined as subsidies, grants, tax waivers, deferrals, omission to collect or enforce debt, guarantees and sheltering from bankruptcy proceedings. However, types of aid in the form of R&D and innovation, environmental and training aids are exempted from the treaty (Lienemeyer, 2005; Lücking, n.d.). There are currently nine R&D centres in Turkey which are established over the last five years serving to the innovations in Turkish steel industry (SATSO, 2019). The action plan that is established in the five-year progress report of Republic of Turkey Ministry of Development (2018) does not include any decision to foster R&D and innovations for advancement in steelmaking technologies whereas overall decisions aim to tackle domestic unfair competition conditions in domestic markets, raw material supply, problems related with human resources, environmental, health and safety regulations. Despite the importance of R&D is mentioned in the report, a governmental support is not considered. Since this factor is independent from initiatives of companies, workshops prepared by companies, or proposals of R&D projects could be an option to increase awareness on the significance of sectoral innovation. Main challenge of the option is that it is an outer company alternative which completely depends on initiatives of the government.

Geographic scope requires the identification activity locations in the value chain on the basis of supply and demand. Evaluation of *Option 7* – Cultivate partnerships with foreign buyers – starts with the analyses of major export markets of Turkish steel. According to Table 32, the biggest importers of Turkish steel are Italy, Israel, Spain in 2019. But the exports to Italy and Spain decreased remarkably by 23% and 16% respectively between 2018 and 2019. This drop in certain markets is attributed to protectionist policies applied by countries on Turkey's steel exports. EU steel quotas and US Section 232 tariffs together caused a significant decline in Turkish steel exports in these markets.

Table 32. Turkey steel exports in 2019 (INTRACEN)

Importers	Value exported in 2019 (USD thousand)	Trade balance 2019 (USD thousand)	Share in Turkey's exports (%)	Growth in exported value between 2018-2019 (%, p.a.)	Ranking of partner countries in world imports
Italy	860,090	502,552	8.7	**-23**	4
Israel	763,811	696,527	7.7	2	42
Spain	648,607	311,896	6.5	**-16**	14
Yemen	481,877	481,877	4.8	5	71
Egypt	420,549	411,730	4.2	52	34
Romania	375,535	-103,048	3.8	-19	28
Morocco	330,395	330,394	3.3	37	43
Singapore	324,995	324,861	3.3	38	32
Iraq	241,576	241,548	2.4	20	80
Belgium	224,893	-424,454	2.3	**-63**	7
Netherlands	217,423	-725,874	2.2	-42	10

Table 33 illustrates the worldwide major protectionist policies applied on Turkish steel industry. The majority of policies apply on long products in the forms of construction steel which is the only advantage of Turkish steel industry in global markets. Under these circumstances a strive for establishing long term partnerships with foreign buyers does not seem favourable from the perspective of foreign companies. Besides, when such policies are applied on steel industry of Turkey, foreign big customers would not risk falling into a captive partnership due to high switching costs. If succeeded, a captive governance with a leader buyer foreign company brings an opportunity to eliminate substitutability chance due to dependency on Turkish steel companies in intermediate steel commodities. In this case Turkey is easily replaceable with either local suppliers or with suppliers from geologically or politically closer countries, mainly because of the fact that Turkish steel is not irreplaceable with its quality and product types. An explicit challenge of the option is protectionist policies to limit Turkish steel in foreign markets.

Table 33. List of protectionist policies applied on Turkish steel industry (SATSO, 2019)

Country	Products	Policy on Turkey
USA	Construction steel, wire rods, hot flat, pipes	Section 232 (Tariff quotas)
Canada	Construction steel, pipes	Tariff quotas and
Costa Rica	Construction steel	Safeguard investigations
Columbia	Construction steel	Tariff quotas
Europe Union	28 steel product categories	Tariff quotas
Iran	All	Import bans
Egypt	Construction steel, wire rods	Tariff quotas
Thailand	Hot-rolled flat	Tariff quotas
Australia	Construction steel	Tariff quotas

The identification of governance structure in terms of supplier relationships helps explain to what extent suppliers are integrated into the business to achieve a maximum supply chain performance. *Option 8* – collaboration with suppliers – is evaluated according to the general mode of governance approach of Turkish steelmakers with their suppliers. For this purpose, annual reports of Turkish steel companies which disclosed information about their supplier relationships are investigated. İçdaş states that their priority is procurement from local suppliers for non-raw material requirements when quality/price conformity exists rather than imports to support locals (İçdaş, 2018). Raw material supply comprises of the majority of imports of company which are carried out by simple transactions in the form of market governance. The price is the main determinant of their selection criterion, because company produces long products by using scrap as raw materials of which 60% is procured via imports. İçdaş does not actively build partnerships to keep their transactions simple even with other suppliers in domestic market such as subcontractors, wholesalers, consultants, and scrap producers (İçdaş, 2018). Differently from other companies in Turkey, Erdemir Group has its own captive coal mines in order to reduce external dependency and to prevent any stalls to avoid bottleneck in value chains as a result of insufficient raw material procurement. Additionally, the company uses an online platform for their suppliers and strive for long term agreements to collaborate with them. There are various modes of governance with different suppliers in the value chains, with respect to the evaluation score assigned by Erdemir Group in consequence of supplier risk assessments. The organisational structure of the company is closer to modular governance in which high specifications are defined for suppliers to take full responsibility on delivering desired standards (Erdemir, 2019). İzmir Demir Çelik A.Ş., as a long steel product manufacturer has also its own e-supplier portal in which they state their standards and requirements for partners, but it is not as complex as the system of Erdemir Group. Company maintains arms-length transactions with raw material suppliers in the mode of market governance, whereas there is a relational governance between mechanical equipment suppliers and more collaboration exists (İzdemir, 2019). Companies have different modes of governance in accordance with their organisational characteristics. Yet, it is safe to say that long product manufacturers are prone to have more market governance particularly with raw material suppliers, because quality of input materials is not the priority, neither the quality of products.

The value chain analysis results provide a general outlook of Turkish steel industry from the standpoint of the revealed improvement options. Obtained results are shown for each option and dimension of the value chain analysis are illustrated in Table 34. Viabilities of these actions are evaluated through six dimensions of the value chain analysis to form an ultimate decision chart in which intersections of options are highlighted by taking results from quantitative firm specific features research into account.

Table 34. Results of the value chain analysis

Competitiveness Improvement Options		
Option	**GVC Dimension**	**Outcome**
Option 1: Increase existing product quality	Input-output structure	Alloy steel production does not exist currently. Stainless steel production is an alternative.
Option 2: Focus on higher value-added products	GVC upgrading	There are only three integrated steel plants in Turkey for flat products. Investments are required for higher value-added production.
Option 3: R&D partnerships with innovation leaders	GVC upgrading	R&D partnerships are not widespread practice. The approach requires more attention in the industry.
Option 4: Improve operational flexibility	GVC upgrading	Companies are moderately positive towards BPM utilization. More detailed information is needed to evaluate the current condition accurately
Option 5: Reduction of harmful environmental impacts	Industry stakeholders	Companies are attentive on production related practices to reduce footprint of the industry. There is no evidence of other non-production related practices about green solutions.
Option 6: Governmental incentives and supports for R&D	Local institutional context	Government does not have any support on R&D according to the five-years action plan.
Option 7: Cultivate partnerships with foreign buyers	Geographic scope	No evidence of existing partnerships is observed with buyers. Protectionist sanctions cause export shares of Turkey in major markets to decline.
Option 8: Collaborate with suppliers	Mode of governance	Market governance is performed by long product manufacturers in general. Modular governance is done by one flat manufacturer.

4.4. Evaluation of the Options to Establish a Competitiveness Improvement Guideline

The threefold empirical study has been performed in the context of the research to evaluate applicabilities of theoretically revealed improvement options on Turkish iron and steel industry, At the end of analysis decisions are made about each option to establish a competitiveness improvement guideline for Turkey's iron and steel industry.

The first stage of analysis targeted at understanding relationship between steel trends and economic activity to interpret competitive behaviours of 10 leader steel producer country. Correlations between GDP per capita and total production of crude steel/apparent steel use per capita for China, India, South Korea, Russia, and Turkey are positively significant which mean that economic activities of these countries change corresponding to their steel industry trends. It can be argued that with strong correlation coefficients, these countries are highly affected by their steel industry in economic developments. United States have a negative significant correlation that can be attributed to the growth of IT, service, and others sectors at a faster pace than steel industry within their economy and requires a further research to understand main reason. For Germany, Italy, Brazil, and Japan these correlations are found insignificant. Afterwards, to check if the amount of this GDP growth is significantly correlated with total production of steel, and to detect out the highest amount of similarity amongst subject countries whose steel industry dynamics are found similar to Turkey's, growth correlations are performed. Results differ with insignificance of growth relationship in India, and a weaker significant positive correlation in Turkey, whereas all other countries have positive significant correlations at the level of 0.01. Since the amount of growth for both parameters could be attributed to lots of parameters related with economic activities, and there is not a consistency found between first correlations, so the evaluation criterion is selected as GDP per capita- total production of crude steel/apparent steel use per capita correlations. When export/import distributions of China, India, South Korea, and Russia are investigated by product, the majority of countries seem to focus on high value-added flat products in both exports and imports, except Russia with semi-finished product exports. There has not been an import product data for Russia found. Turkey is focusing differently from those countries vastly on low value-added long product manufacturing. Research argues that, given the fact that Turkey's correlational dependency of economic activities on steel industry trends resembles China, India, South Korea, and Russia, shifting manufacturing focus towards higher value-added commodities which are used in more advanced technology based sectors, is an option to remain in the competition as their demand is always on increase with technological developments. Semi-finished goods strategy like Russia does seem to be a viable option, since these commodities do not differ much in terms of added value from long steel products. To infer that flat-products are an absolute way to better competitive performance, a further reasoning of country decisions is required, such as raw material resources, distance to the high-end markets, organisational infrastructures, tendencies, and capabilities of companies. For this purpose, firm specific features of Turkey steelmakers are quantitatively researched.

The second stage of the analysis that is done to research correlations between constructs developed to represent competitiveness of 28 Turkish steel companies show that bigger companies are more innovative through larger capabilities, more resources, and wider networks. The most effective correlation amongst all is between attitudes towards R&D partnerships and innovativeness. This type of partnerships enables companies to access R&D resources faster, share the risks and exhibit a more innovative overall performance. Attitudes towards supplier partnerships seems to have no significant impact on innovation dimension, but a positive impact on financial performance. It is safe to say that collaboration with suppliers help Turkish steel companies perform financially better. Following that, relationships between each of the four major competitive priorities and financial performance are correlated. Results imply that, low cost and high delivery performance constructs have negative significant correlation with financial performance, whereas high product quality and operational flexibility are positively correlated financial performance. According to questionnaire results steel companies seem to focus on low costs and high delivery performance with means of 4.50 and 4.11 respectively. The last observations between innovativeness and financial performance show a high positive significance at the level of 0.01. Inference from the correlation is that more innovative companies achieved financially better over the last five years. For all the options means of related firm specific feature values are between 3 (neutral) and 4 (Agree). There are not high mean values of pertained features as much as in low cost (4.50) and high delivery performance (4.11). It can be argued that Turkish steel companies still need to allocate their resources more on the constructs with mean values below 4.0 to achieve described improvement opportunities.

The third stage of the empirical research – the value chain analysis – identified the essentials of Turkish steel global value chains in the scope of the revealed competitiveness improvement options. Applicabilities of these options are scrutinized during the value chain analysis, then a decision matrix is generated in which the intersections of improvement options between the firm specific features and the value chain analysis are discussed to justify acceptances or rejections. Also, opportunities and challenges related with options are illustrated on the Table 35.

Option 1 is increasing the product quality and related with the high product quality construct of competitive priorities at firm level. Amongst other priorities, high product quality is the least preferred one by Turkish steel companies, but still has a positive state with the mean value of 3.46 (Table 35). At the level of value chain, the option is related with the revision of raw materials and some intermediate production processes, to produce higher quality alloy steels. As a result of value chain analysis there is not alloy steel production observed. Challenges with the option are cost optimization in the beginning; acquiring know-how because it is not a common approach; volatile prices of alloy steels. Given the fact that country has chromite resources to enrich steel during production as steel alloy manufacturing, and with respect to evidence from quantitative analyse that prioritizing high product quality brings better financial performance, the option is evaluated as accepted.

Option 2, importance of focusing on higher value-added products is first stated during the steel industry dynamics stage of the empirical research with the conclusion of flat product focus, as similar leader steel producer countries produce majorly flat commodities. The firm specific factor innovativeness that is pertained with the second option, has a positive state with 3.64 mean value. But it needs to be further improved by other companies apart from the leader producers. The results of value chain analysis imply that there are only three integrated facilities manufacturing flat steel commodities. As innovativeness leads to a better financial performance according to the bivariate correlation results, this impact would be remarkable when the production is adapted to a higher value delivery with commodities in longer term. Furthermore, there is a lack of infrastructure to manufacture these products. Hence, the option is accepted as a product upgrading option in GVC of Turkish steel. The challenges are high investment costs to install integrated facilities, training requirements for the staff and the know-how as it is not a widespread method in the country.

Option 3, requires more attention due to the lowest mean value with 3.31 at the firm level. In general, the third option is key to achieve all the options related with innovativeness to improve competitiveness, as it enables companies to consolidate their resources, share the costs and risks of R&D investments. Furthermore, this type of partnerships is found strongly correlated with innovativeness as a result of firm specific features analyses. Apart from some companies such as Borusan Holding and Tosyalı holding, R&D partnerships with innovation leaders are not widely observed in Turkish steel. The higher mean value of innovativeness than of R&D partnership construct exhibits that there is a separate innovation perception widely distributed among companies. R&D partnerships with innovation leaders is accepted as an improvement option for process upgrading across the value chains in accordance with sectoral conditions. The primal challenge of the option is priority conflicts between partners and cultural differences between organisations.

Option 4, is analysed from the standpoint of a non-manufacture related option which is the integration of business process management and supply chain management systems for a better supply/demand scheduling. Operational flexibility is not found as a competitive priority of Turkish steel companies despite it has a positive significant correlation with financial performance at the firm level. But existing positive state with the mean value of 3.68 (Table 35) illustrates favourable conditions to shift competitiveness focus exist. During the value chain analysis, annual firm reports were not informative enough to comprehend the extent to which integration of these systems. In order to gather some evidence, the sub-construct BPM is used within innovativeness in the GVC upgrading dimension of the value chain analysis. Utilization of BPM has a mean value of 3.48. The evidence implies that BPM utilization exists in companies. Nevertheless, collected information is not enough to evaluate applicability of the option due to lack of data about value chain implications. So, it is identified as undetermined and suggested for a further research probing SCM and BPM structures of companies.

Option 5 – reduction of harmful environmental impacts – is analysed in the context of green innovations during the value chain analysis. The positive state of innovativeness at the firm level indicates viability of the option along with a necessity to improve construct. There are many practices observed in terms of reducing footprint of industry such as investments in solar energy, innovations to reduce $CO2$ emissions during productions, and water consumptions by analysed Turkish steel companies. Companies in Turkey already exhibit a responsible environmental performance majorly on the processes related with manufacturing. In addition to existing practices, a suggestion is made to employ eco-friendly approaches also within the other activities of value chains, such as green logistics applications given that marine transport covers a large amount of inbound and outbound logistic activities with serious negative impacts on environment such as air pollutions, and greenhouse gas emissions. Eventually, it is accepted as an applicable alternative. The option is challenged by the fact that such practices may not be economically feasible; or in the case of outsourced logistics services intervention with such innovations becomes dependent upon logistics partners.

Option 6, is about the governmental support for R&D purposes in Turkish steel with a significant boosting impact on innovativeness of companies in time as an externally effective option. It is an outer-firm specific feature alternative. However, according to five-years action plan published by Republic of Turkey Ministry of Development, there is not a planned R&D support to foster innovations in steel industry. Therefore, the factor is rejected, but as a result of joint workshops together with Ministry of Turkish Steel Producers Association, leader companies, and existing R&D centres, proposals could be prepared for future incentives from government.

Option 7 – cultivation of partnerships with foreign buyers – to capture high-end markets in long term is researched, and applicability of the option is not found feasible, given the protectionist policies applied on Turkey by foreign markets. Policies applied by major regions to which Turkey exports significantly, are illustrated along with the aftermaths on growth in exported values. Due to tariff quotas establishment of partnerships with foreign buyers does not seem so realistic. Turkish steel industry is currently replaceable with existing export product portfolio, so *Option 7* is rejected.

Option 8 – collaboration with suppliers – is analysed quantitatively and qualitatively. Results of bivariate correlations with financial performance show high significance which implies that companies collaborating with their suppliers achieve better financial performances. Mean value of the constructs as 3.55 (Table 35) shows positive attitude, but it has to be further improved by all the companies. In the value chain analysis major mode of governance is observed as market governance particularly between raw material suppliers where transactions are kept simple and based on price. Except that, larger companies, particularly flat steel manufacturers have more proactive attitudes towards integrating their suppliers to their operations even in raw material procurement in which input material quality matters, providing that their specifications and standards are met by suppliers. *Option 8*, is accepted but a further research is suggested to propose more accurate recommendations for companies with different modes of governance.

Table 35. Overall summary of the empirical research and decisions about the competitiveness improvement options

Option	Firm specific features	Value chain analysis	Opportunity	Challenge	Decision
Opt.1	High product quality **(MEAN: 3.46)**	Alloy steel production does not exist currently.	Stainless steel production to benefit from chromite ore reserves in Turkey	Cost optimization, know-how, raw material with volatile prices	**Accepted**
Opt.2	Innovativeness **(MEAN: 3.64)**	There are only three integrated steel plants in Turkey for flat products.	Production of high value-added flat steel products	High investment costs, training requirements, know-how	**Accepted**
Opt.3	Attitudes towards R&D partnerships **(MEAN: 3.31)**	R&D partnerships are not widespread practice. The approach requires more attention in the industry.	R&D partnerships with innovation leaders for process upgradings	Priority conflicts between partners, cultural differences	**Accepted**
Opt.4	Operational flexibility **(MEAN: 3.68)**	Companies are moderately positive towards BPM utilization. More detailed information is needed to evaluate the current condition accurately	Integration of BPM systems into the entire value chain	–	**A further research required**
Opt.5	Innovativeness **(MEAN: 3.64)**	Companies are attentive on production related practices to reduce footprint of the industry. There is no evidence of other non-production related practices about green solutions.	Innovative environment friendly non-production-oriented solutions across the value chain. Green logistics applications.	Adaptation of existing outbound logistics activities may not be economically feasible; outsourced logistics is out of control	**Accepted**
Opt.6	Outer-firm specific feature	Government does not have any support on R&D according to the five-years action plan.	–	–	**Rejected**
Opt.7	Outer-firm specific feature	No evidence of existing partnerships is observed with buyers. Protectionist sanctions cause export	–	–	**Rejected**

		shares of Turkey in major markets to decline.			
Opt.8	Attitudes towards supplier partnerships **(MEAN: 3.55)**	Market governance is performed by long product manufacturers in general. Modular governance is done by one flat manufacturer.	Pursuit of modular governance with all the key suppliers to improve efficiency of processes	Excessive diffusion of knowledge; issues of trust; discordant priorities between partners	**Accepted (a further research suggested)**

4.5. Discussion

The reasoning of the decline in Turkey's steel industry in global competition was performed and the major sources of problem were stated within the scope of the research in order to establish a competitiveness improvement guideline for steel companies in country be more competitive. The generation of the guideline was initiated with the investigation of theoretical solutions to find out prominent strategies, trends and approaches applied in steel value chains globally. Subsequently, improvement options were revealed theoretically to analyse applicability the of each option during the empirical research. Through the threefold empirical research a basis was formed to evaluate the applicability of revealed options. As a result of the empirical findings, the research workflow diagram is shown in Figure 42 along with the featured obtained outcomes of each stage.

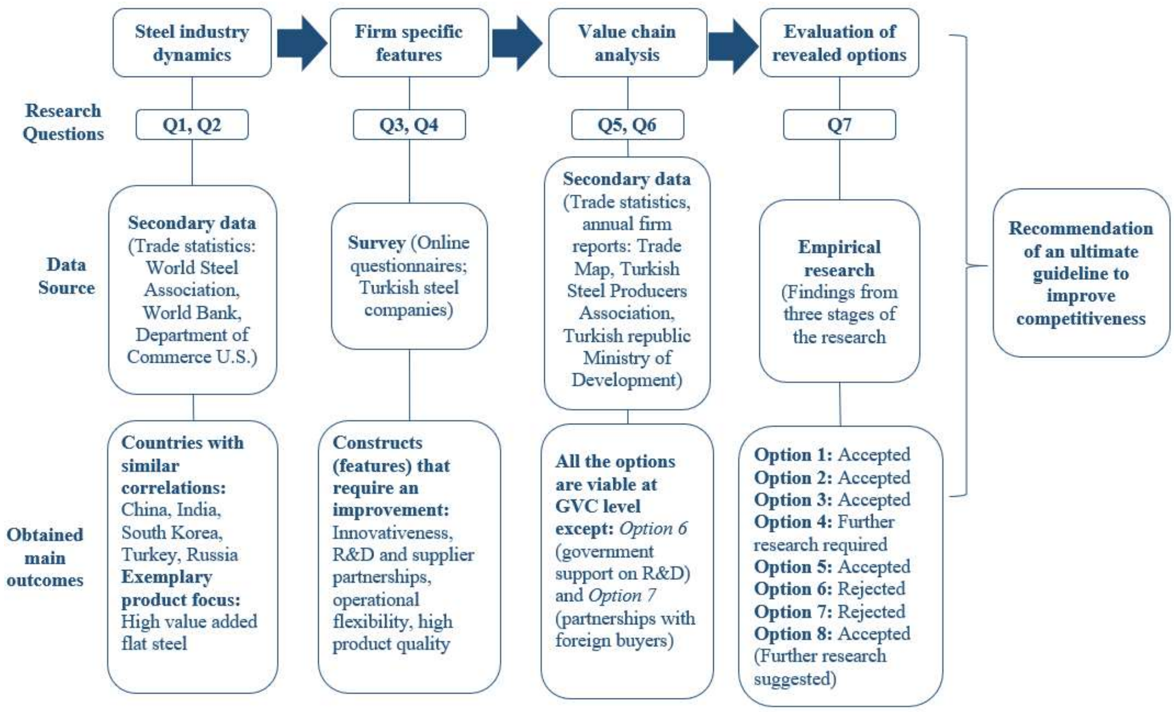

Fig. 42. Empirical research workflow diagram with obtained outcomes

The empirical research started with revealing exemplary product focus as high value-added steel commodities that Turkey may follow to contribute more in his economy as well as introducing more demanded products. Subsequently, correlations related firm specific features are analysed, and features that require improvements are determined as: innovativeness, attitudes towards R&D and supplier partnerships, competitive priorities on operational flexibility and high product quality

(Figure 42). The last stage focused on the steel GVCs in Turkey and applicability of revealed options were scrutinized. As a result, Option 6 is rejected, because there is not a planned R&D support by government on Turkish steel industry in the action plan for 2019-2023. Option 7 is rejected due to repressive protectionist policies applied on Turkish iron and steel industry which block initiation of partnerships with buyers in consequence of tariff quotas. Accepted options touch open to the fields that Turkish iron and steel industry need urgent modification not to be eliminated from the competition due to high pressure in global steel market in the following years.

In the scope of the research, the competitiveness improvement options for Turkish steel companies are given below with their opportunities and challenges:

1. Employment of suitable intermediary processes to manufacture high-quality steel alloys, beginning with stainless steel,

   – *Opportunity*: Stainless steel production creates a chance to take advantage of existing chromite reserves of Turkey.
   – *Challenge*: Cost optimization is time consuming; volatile prices of intermediary raw materials like chromite and other alloys; acquisition of know-how.

2. Investing in integrated steel production facilities to shift product focus towards higher value-added flat steel commodities,

   – *Opportunity:* Production of high value-added flat steel products to capture new markets and the growing demand.
   – *Challenge:* High investment costs; training requirements for the staff; acquisition of know-how.

3. Establishment of partnerships on the basis of R&D with innovation leaders from steel sector as well as from other sectors to diffuse process innovations through all the value chain,

   – *Opportunity:* Expanding resources; sharing costs and risks of R&D to improve innovativeness of companies for process upgradings.
   – *Challenge:* Priority conflicts between partners; organisational differences.

4. Implementation of more environment friendly approaches on logistics of steel industry through green innovations,

   – *Opportunity*: Non-production-oriented solutions to reduce environmental impact of the steel value chains such as green innovations on logistics operations.
   – *Challenge*: Adaptation of existing logistics operations into new innovations may not me economically feasible; intervention to external partners is not usually possible in the case of outsourced logistic.

5. More sustainable collaborations with suppliers to achieve modular governance on maximizing performance across the value chains while improving efficiency of the procurement.

   – *Opportunity*: Pursuit of the modular governance with all the key suppliers to improve efficiency of activities across the value chain.
   – *Challenge*: Excessive diffusion of knowledge may not be desired by companies; issues of trust; priority conflicts between partners.

Conclusions

1. Turkey has started to lose its current competitive position globally as a large steel producer country due to variety of reasons. The problem analysis highlighted the major issues of this decline that require to be addressed. The most apparent difference between the iron and steel industry in Turkey and other competitive countries is the main steel manufacturing method. 70% of the world steel producers use basic oxygen furnaces (integrated facilities) for flat steel products, whereas 30% prefer electric arc furnace method. In Turkey 70% of the steel production is carried out through electric arc furnaces manufacturing low value-added long products. Therefore, Turkey is the biggest importer of the expensive raw material scrap to be used in electric arc furnaces. Furthermore, with a vast pressure applied by China in the manufacture of steel, market prices of Turkish steel are relatively low in global markets to remain competitive. In addition to the industry of the country related problems, international trade sanctions applied on Turkey cause a decline in the export shares in major markets. Currently the only advantage country has in the iron and steel industry is low value-added long steel commodity manufacturing.

2. Global value chain practices in the context of industry were researched to learn from prominent up-to-date approaches in order to improve competitiveness of the iron and steel industry. Firm specific features that define competitiveness in the scope of the steel were determined as: firm size, innovativeness, partnership propensities, competitive priorities, and financial performance. Alternative options were identified as a result of the theoretical research and eight competitiveness improvement options in the iron and steel industry were put forward. Afterwards, opportunities and challenges related with the options were explained around the intersections of these alternatives between firm specific features and the iron and steel GVCs to study their applicability on Turkish iron and steel industry later. These options to improve competitiveness for the iron and steel industry are: increase existing product quality, focusing on higher value added-products, R&D partnerships with innovation leaders, improve operational flexibility, reduction of harmful environmental impacts, governmental incentives and supports on R&D, cultivating partnerships with foreign buyers and collaboration with suppliers.

3. The empirical research yielded results in three stages to identify Turkish iron and steel industry for the implementation of the competitiveness improvement options. Results obtained from the identification were used to evaluate the applicability, opportunities, and challenges of the options in the development of the competitiveness improvement guideline.

3.1. Analysis of the steel industry dynamics for top 10 steel producer countries concluded that China, India, South Korea, Russia, and Turkey have similar correlations between their total production of crude steel per capita/apparent steel use per capita and GDP per capita variables. Focusing majorly on manufacturing and exports of higher value-added flat products like China, South Korea and India do, was found as a relevant alternative given that Turkish iron and steel industry is highly correlated with economic activity. Increasing the value-added of commodities is expected to contribute GDP per capita respectively in long term. The viability of the alternative has been discussed in detail after analyses of the firm specific features and the iron and stel GVC.

3.2. Firm specific features that are composed of firm size, innovativeness, partnership propensities, competitive priorities, and financial performance (over the last five years) were analysed via collected questionnaire data from Turkish companies. Innovativeness has positive significant correlations with firm size, attitudes towards R&D partnerships and financial performance. Moderate mean values that are close to the neutral state implies that Turkish steel companies need to pay more attention on innovativeness and features helping them improve it. Another dimension of the next bivariate correlation analysis concluded that attitudes forwards supplier partnerships is positively correlated with financial performance which requires also a more attention among companies in general. Turkey prioritize low costs and high delivery quality/speed in competitive priorities which are negatively correlated with financial performance, though operational flexibility and high product quality are positively correlated with financial performance. Companies should revise their competitive priorities to improve their competitiveness and financial performances in longer terms by shifting towards higher product quality and more operational flexibility-oriented approaches.

3.3. The value chain analysis of Turkey's iron and steel industry depicted the general outlook of the activities. The analysis that is centred around the revealed competitiveness improvement options concluded with specific outcomes for each option providing a basis for the upcoming evaluation of applicabilities. Findings are listed as follows:

- *Option 1*: Alloy steel production does not exist currently in Turkey. Stainless steel production is an alternative as there are chromite resources in country to procure raw material.
- *Option 2*: There are only three integrated steel plants in Turkey to manufacture flat products. Investments in manufacturing facilities are required for a higher value-added production.
- *Option 3*: R&D partnerships are not widespread practices. The approach requires more attention amongst companies.
- *Option 4*: Companies are moderately positive towards BPM utilization. A more detailed information is needed via interviews to evaluate the current condition of companies accurately.
- *Option 5*: Companies are attentive on production related practices to reduce footprint of the industry. There is no evidence of other non-production related practices about green solutions.
- *Option 6*: Government does not have any support on R&D according to the five-years action plan.
- *Option 7*: No evidence of existing partnerships is observed with foreign buyers. Protectionist sanctions cause export shares of Turkey in major markets to decline.
- *Option 8*: Market governance is employed by long product manufacturers in general. Modular governance is observed only in one company that manufacture flat products.

4. As a result of the evaluation of the revealed competitiveness improvement options according to their applicability and suitability with firm specific features, decisions were made about each option as follows:

- *Option 1*: Accepted. High product quality as a competitive priority of companies needs to be prioritized more. Alloy steel production does not exist currently. This could be a viable option to improve competitiveness considering the chromite ore reserves of the country.
- *Option 2*: Accepted. Though innovativeness of companies exhibits a positive attitude, it still needs to be improved. Shifting the product portfolio is applicable at the level of firm specific features with positive attitude towards innovations, and the dimensions of the value chains with the evidence of existing product shifts by some companies.
- *Option 3*: Accepted. The lowest mean value is obtained from attitudes towards R&D partnerships. Nevertheless, it is still above 3.0 on the positive side. The approach is not observed except for two companies. It is applicable to improve competitiveness.

- *Option 4*: A further research is required. Operational flexibility is not a major competitive priority of companies. The value chain analysis did not produce accurate results because of insufficient information in annual reports.
- *Option 5*: Accepted. Improvement of the innovativeness construct is required. The positive attitudes of companies towards the innovativeness construct and towards environmental responsibility make it a viable option.
- *Option 6*: Rejected. It is not an applicable alternative, since there are not planned incentives in the following five years by government.
- Option 7: Rejected. Given the condition of protectionist policies applied on Turkey, it is not applicable currently.
- Option 8: Accepted (a further research is suggested). Attitudes towards supplier partnerships have a positive mean value (3.55 out of 5.00), but needs to be improved as it is correlated positively with financial performance. It is an applicable and necessary option, but a further qualitative research is suggested to understand exact modes of governance for companies in detail.

5. Steps in the guideline of the competitiveness improvement options for Turkish iron and steel industry are given respectively:

5.1. Employment of suitable intermediary processes to manufacture high-quality steel alloys, beginning with stainless steel,

5.2. Investing in integrated steel production facilities to shift product focus towards higher value-added flat steel commodities,

5.3. Establishment of partnerships on the basis of R&D with innovation leaders from steel sector as well as from other sectors to diffuse process innovations through all the value chain,

5.4. Implementation of more environment friendly approaches on logistics of steel industry through green innovations,

5.5. More sustainable collaborations with suppliers to achieve modular governance on maximizing performance across the value chains while improving efficiency of the procurement.

Before the implementation of any options, an elaborative feasibility research is required to further evaluate their absolute applicability and key success factors to achieve the improvement. Recommended steps might vary and modified in accordance with organisational capabilities as a result of feasibility studies. This research illustrates the steps that Turkish steel companies need to centralize in competitiveness improvement practices in a broad sense. To sum up, competitiveness of Turkey’s iron and steel industry is expected to be strengthened with a successful implementation of these options by touching upon the major problems of the country’s industry.

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Appendices

APPENDIX A

Turkish Iron-Steel Industry Evaluation Survey for Firm Specific Features

Page 1

Dear Company Representative,

As a student of Kaunas University of Technology International Business Master Degree Program, I am researching alternatives to improve competitiveness of Turkish steel industry. In the scope of the research positioning of Turkish steel companies is investigated and alternatives for improvement are evaluated. This questionnaire takes approximately 10 mins to fill in, and your answers are significantly important in terms of understanding firm specific features of steelmakers in Turkey. Anonimity of participants is going to be preserved. If you are interested in the outcomes of the research, do not hesitate to contact me via contact details given below, so I can share results with you in June 2020. Thank you in advance for your precious time.

Kind Regards,

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1. **When was your company established?** *

2. **How many employees does your company have?** *

3. **What is the annual turnover of your firm at the end of year 2019?** *

   Please indicate in Euro currency

4. **What is the total production tonnage of your firm at the end of year 2019?** *

   Please indicate in metric tons

APPENDIX B

5. Please rate the following statements related with your firm's strategic partnerships on a scale of 1-5 *

	1 (Strongly disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
We are adept at finding new alternative supply chain partners, and suppliers when necessary.	◯	◯	◯	◯	◯
We perceive our suppliers as partners and actively collaborate with them to deliver solutions to customers.	◯	◯	◯	◯	◯
We are more responsive and proactive than our competitors in prospecting R&D partnerships.	◯	◯	◯	◯	◯
We take the initiative in approaching firms with R&D alliance proposals.	◯	◯	◯	◯	◯
We are adept at acquiring knowledge and experience through R&D partnerships.	◯	◯	◯	◯	◯
We actively utilize experience on improvement and benefit from knowledge through R&D partnerships.	◯	◯	◯	◯	◯
In our firm there are employees or departments dedicated to management of R&D partnerships.	◯	◯	◯	◯	◯

6. Please rate the following statements related with your firm's financial performance over the last 5 years on a scale of 1-5 *

(Please evaluate for 2015, 2016, 2017, 2018, 2019)

	1 (Decreased significantly)	2 (Decreased)	3 (Remained constant)	4 (Increased)	5 (Increased significantly)
Return on assets (ROA)	◯	◯	◯	◯	◯
Gross profit margin	◯	◯	◯	◯	◯
Net income before taxes	◯	◯	◯	◯	◯
Net present value of firm	◯	◯	◯	◯	◯

7. Please rate the following statements related with your firm's innovativeness on a scale of 1-5 *

	1 (Strongly disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly agree)
Our firm actively develops and adds new products to portfolio.	◯	◯	◯	◯	◯
Our firm perceives developing new products as critical for success.	◯	◯	◯	◯	◯
Our firm actively develops in-house solutions in order to improve manufacturing processes.	◯	◯	◯	◯	◯
Our firm perceives adoption/utilization of new and up-to-date manufacturing processes as critical for success.	◯	◯	◯	◯	◯
Our firm actively develops in-house solutions in order to improve business process management systems.	◯	◯	◯	◯	◯
Our firm perceives adoption/utilization of new business process management systems as critical for success.	◯	◯	◯	◯	◯

8. Please rate the following statements related with your firm's competitive priorities on a scale of 1-5 *

	1 (Strongly disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly agree)
Achieving low costs in operations is priority of our strategy.	◯	◯	◯	◯	◯
High product quality is priority of our strategy.	◯	◯	◯	◯	◯
Quality and speed of delivery to customers is priority of our strategy.	◯	◯	◯	◯	◯
Operational flexibility is priority of our strategy.	◯	◯	◯	◯	◯