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Progression and Forecasting of Steel Demand in Kenya

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Abstract : *Increase in usage of steel in Kenya has been witnessed due to the immense growth in the industrial sector and infrastructure. It is quite evident that as the country transforms herself into a middle income economy, it shall continue to invest heavily in infrastructure and thus steel usage shall with no doubt continue to rise. This paper seeks to forecast steel demand and supply in Kenya till 2030. Time-series model is used to carry out the forecast particularly moving averages and trend projection methods being employed. The results project an increase in steel demand from 1.6 million tons in 2014 to 2.7 million tons by 2020 and 4.4 million tons by 2030. Also, of the 1.2 million tons' net imports in 2014, 704,000 tons were hot-rolled coils (HRC) a value which was projected to rise to 2.5 million tons HRC by 2020 and 3.6 million tons by 2030 signifying a massive investment opportunity in this area. This paper established that with the country investing in this opportunity, it would have a market of about 1 million tons to serve by 2018.*
Keywords- *Steel, Demand, Forecasting, Time-series, Hot-rolled Coil.*

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I. Introduction

Three major policy regimes namely; import substitution, market liberalization and export promotion have greatly influenced Kenya industrialization process since independence in 1963 [1]. In overall, import substitution strategy was successful in establishing some primary industries among others; Textile mills, dry cells factories, light-bulb manufacturing, Automobile assembly and stainless steel tanks, but led to reduced domestic competition and low capacity utilization. Inability of local industries to compete with imports led to the failure of the market liberalization strategy in the 80's. The 1990's export promotion strategy also failed due to mismanagement and poor implementation of fiscal activities. Reforms since 2003 have tried to stabilize the industrial production though energy, market access and infrastructure remain a big challenge. However, Kenya's future growth in industrialization lies in high-value production, with steel production topping the chart as it is the overly used material in manufacturing, building and construction.

In Kenya currently, steel making process is only centered in melting steel scrap in induction furnaces and manufacture of wire and wire products, pipes, cold-rolled steel products and downstream finishing process such as galvanization [2]. For the country to grow and industrialize, it then has to grow its steel industry through investing in massive steel production. Construction of an integrated steel mill in the country is one major step towards realization of this industrialization dream as envisioned in her vision 2030. This bold step shall with no doubt be the leader in driving the country's economy forward. Concerning this importance of iron and steel industry in Kenya's economic and industrial development, it makes it paramount to study and predict the demand of steel in the country as this information should help in the qualitative and quantitative planning towards investment in this sector.

Presently, there is no single comprehensive source that clearly outlines the current up- and down-stream steel-making capacity in the country. Moreover, the little available data and information is scanty and scattered all over making it difficult to find a credible source, rich with information. However, as at 2014, the country had 20 steel makers which involved scrap-based induction furnace instead of an Electric Arc Furnace(EAF) steel making. These steel makers have a capacity of producing 440,000 metric tons of liquid steel. Finished steel production capacity within the country is majorly dominated by light long and flat products standing at 555,000 and 245,000 tons respectively [6]. There is seemingly no production capacity for heavy sections, steel plate and hot-rolled coil within the country. However, it is worth noting that Devki Steel Mills plan an expansion of its steelmaking capacity, with investment in a new 125,000 tons per year melt shop and billet mill in Kitui. The Table 1.0 below shows the steel producing plants in Kenya as well as their production capacity as at the end of 2014.

Table 1.0 Steel Producing Plants in Kenya as of 2014 (Source: Numerical Machining Complex Units= '000 tons)

Company	Location	Steel	CC	Plate	HRC	CRC	AlZn	Corrugated	OCS	H/S	L/S	Wire	L/ Tube	H/Tube
Apex Steel	Athi River	30									25			
Athi River Steel	Athi River	20									60	20		30
Brollo Kenya	Mombasa													50
Corrugated Sheets	Mombasa							20						5
Devki Steel Mills	Athi River	100									70		10	25
Devki Steel Mills	Ruiru										85			
Doshi Enterprises	Mombasa	30									15			15
Emco Billets Insteel Jitan Steel Mills	Nairobi Nairobi Mombasa	25	20								75 30			 45
Kenya United Steel Co.	Miritini	25	25			185	120				30	10		
Mabati Rolling mills Morris & Co.	Mombasa Nairobi Nairobi	10							 40					
Standard Rolling Mills SteelMakers Limited	Mombasa Athi River	 60				60					 60			
Tarmal Steel	Mombasa										60	10		30
Tononoka Steel	Nairobi (Embakasi)	40									35			
Totals		**440**	**45**	**0**	**0**	**245**	**120**	**20**	**40**	**0**	**555**	**40**	**10**	**200**
Devki Steel Mills [under construction]	*Kitui*	*125*	*125*											

***HRC**-Hot Rolled Coil, **CRC**- Cold Rolled Coil, **AlZn**- A zinc or aluminum-zinc coating line, **OCS** - Organic Coated Sheet (a painted and metal-coated sheet steel product). The **light long** category shown above includes medium and light sections, bar, rebar, and wire rod, **H/S** – Heavy section, **L/S** – Light section, **L/Tube** – Light tube, **H/Tube** – Heavy tube.*

Kenyan trade in steel has also increased significantly since 2010 from net imports of 695,000 tons in 2010 to approximately 1.2 million tons in 2014. By way of comparison, Ethiopia, Tanzania and Sudan recorded steel net imports of 780, 710 and 380 thousand tons by 2014 respectively [6]. Out of the 1.2 million net steel imports in Kenya in 2014, approximately 740 thousand tons comprised hot rolled coil, which was majorly imported from South Africa, India, Japan and South Korea.

Different studies in the forecasting of steel have been conducted by different scholars to predict future steel usage in different countries. The widely adopted technique of forecast in these studies is the intensity of use technique (IOUT) This technique is usually modelled for different end use industries in a country. Roberts [3] used this approach to estimate steel consumption in US over the period 1984-2010 by disaggregating the total steel use in the country in to the amounts consumed in each of the machinery, transport and infrastructure industries. Crompton [4] used IOUT to determine steel consumption in Japan over the period 1997-2005. He identified six steel consuming industries; machinery, electrical machinery and equipment other manufacturing, construction and fabricated metal products. The model is based on any of the following equations (1), (2), and (3):

$$s_t = \sum_{i=1}^{n} \left(\frac{S_{it}}{P_{it}} X \frac{P_{it}}{GDP_{it}} X\, GDP_t\right) \ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$s_t = \sum_{i=1}^{n} (MCP_{it}\, X\, PCI_{it}\, X\, GDP_t) \ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$s_t = (IU_t\, X\, GDP_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

It is important to note that this technique is best suited to be used in an environment where comprehensive data is available for each of the industries mentioned. Due to lack of comprehensive and authoritative data in these industries in the country (available data is very rare and scanty), it therefore becomes almost impossible to use IOUT and therefore time-series model is best suited.

II. Materials and Methods

2.1 Data

The data used in this research was majorly secondary. It was collected from government bodies and private agencies containing relevant data to this study. It was then structured to fit this study.

2.2 Time-series model

This study adopted time-series model for forecasting demand of steel in Kenya. The assumption made was that the future is a function of the past. Heizer [5] notes that, this model looks at what happened in the past over a period of time and uses that series of data to make a forecast. Two time-series model methods were used in forecasting;

2.2.1 Moving averages

This technique was used primarily to smooth out short term irregularities within the forecast data. It is modelled as shown below;

Moving average:

$$\boldsymbol{M_a} = \frac{\sum \boldsymbol{D}}{\boldsymbol{n}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

where $\sum \boldsymbol{D}$= sum of demand in previous n periods

$\boldsymbol{n}$= number of periods

$\boldsymbol{M_a}$ = Moving average

2.2.2 Trend projection:

The trend projection employed was linear and was developed by use of least squares method.

$$\hat{\boldsymbol{y}} = \boldsymbol{a} + \boldsymbol{bx} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

$$\boldsymbol{b} = \frac{\sum \boldsymbol{xy} - \boldsymbol{n}\bar{\boldsymbol{x}}\bar{\boldsymbol{y}}}{\sum \boldsymbol{x^2} - \boldsymbol{n}\bar{\boldsymbol{x}}^{\boldsymbol{2}}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

where

$\sum$ =summation sign, $\boldsymbol{y}$ = known values for the dependent variable,

$\boldsymbol{x}$ = known values for the independent variable. $\bar{\boldsymbol{x}}$ = averages of the x-values,

$\bar{\boldsymbol{y}}$ = averages of the y-values, $\boldsymbol{n}$ = number of data points,

$\boldsymbol{a}$ = y- axis intercept, $\boldsymbol{b}$ = slope of the regression line

$\hat{\boldsymbol{y}}$ = computed value of the variable to be predicted

III. Results and Discussion

3.1 Steel production and demand in Kenya

Statistical data for steel production in Kenya is scarce. However, the simple approach below was carried out to get an estimate of the values:

- The amount of steel scrap used in the industry provided an estimate of liquid steel production.
- Liquid steel production levels together with billet import volumes was used to give a fair estimate of probable light long production volumes.
- Assumptions about flat product plant capacity utilization (which for steel mills is normally in the 50-90% range) provided further estimates of cold rolled and coated product production volumes with the upper limit on Kenyan flat product production set by the volume of hot rolled coil imports.

The Table 2.0 below shows Kenyan steel demand from 2010 to 2014. The demand in steel can be seen to rise from 804,000 tons to approximately 1.6 million tons. The calculated steel demand compared well with world steel estimates.

Table 2.0 Kenyan Steel Demand, 2010-2014 {Source: Kenya Association of Manufacturers,2014 & Worldsteel,2016}

000s tons	**2010**	**2011**	**2012**	**2013**	**2014**
Production from semi-finished	91	105	121	140	150
Production from liquid steel	18	18	18	225	242
Imports	695	1088	807	1145	1167
Total (Demand)	**804**	**1211**	**946**	**1510**	**1559**
World Steel Association Estimate	***808***	***1218***	***960***	***1316***	***1342***

3.2 Future steel demand

Using the data in Table 2.0 above, future demand for steel in the country was determined for the period 2010-2030. The forecasting was done using a time-series model equation (7) as shown below. This equation was automatically generated through excel 2016, as shown in Fig 1.0 below, based on the data provided in Table 2.0 above. The assumption made during the forecast was that the economy of the country would continue to grow positively into the foreseeable future. Export values for steel were not captured since they were insignificantly small in number. The Table 3.0 and Fig 2.0 below shows a demand projection of about 4.4 million tons by 2030.

$$\hat{\boldsymbol{y}} = \boldsymbol{853.17 + 169.33x} \ldots\ldots\ldots (7)$$

$\hat{y}$ = computed value of the variable to be predicted
x = known values for the independent variable

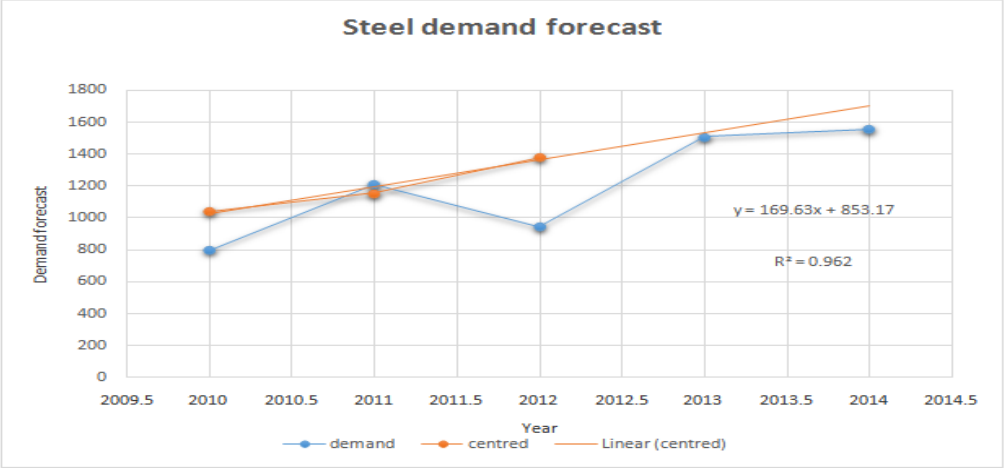

Figure 1.0 Steel demand in Kenya 2010-2014

Using the trend projection model equation (7) above, steel projection was calculated analytically between the year 2010 and 2030. The resultant values are as shown in table 3.0 below.

Table 3.0 Projection of Kenyan Steel Demand to the year 2030

Year	Demand	Year	Demand
2010	804	2022	3058
2011	1211	2023	3228
2012	947	2024	3398
2013	1510	2025	3567
2014	1559	2026	3737
2015	1871	2027	3907
2016	2041	2028	4076
2017	2210	2029	4246
2018	2380	2030	4415
2019	2549		
2020	2719		
2021	2889		

The figure 2.0 below shows a line graph of the demand forecast as obtained in table 3.0

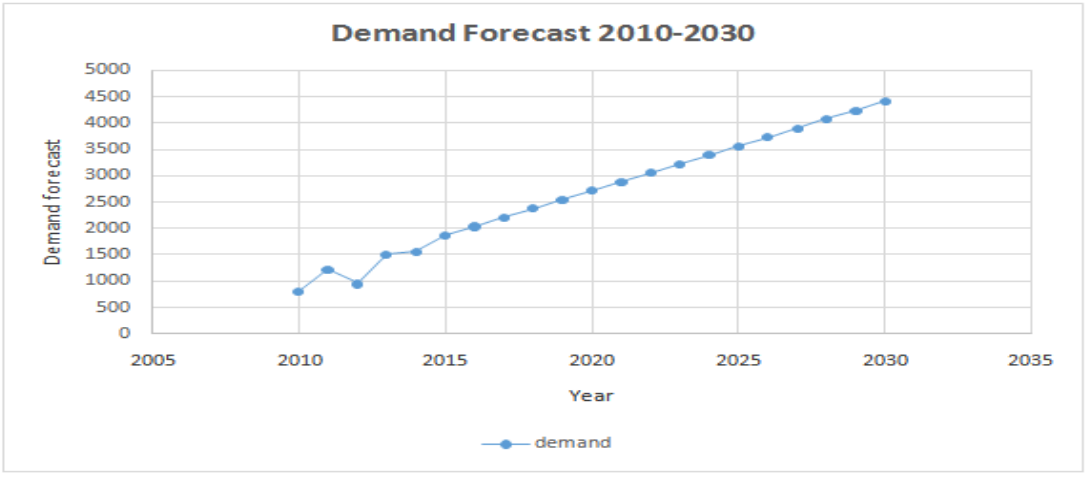

Figure 2.0 Graph showing Kenya steel demand, 2010-2030

When expressed in per capita basis and compared to the world context, the apparent steel use (ASU) per capita of finished steel in Kenya is seen to be unduly low as shown in the table 4.0 below. This illustrates a

need to invest in this sector. Table 5.0 shows the computed comparison between 2016 and 2030 based on the projected steel demand and population.

Table 4.0 Comparison of Kenya's finished Steel demand per capita *{Source: Worldsteel,2016}*

Apparent Steel Use per Capita
(kg finished steel products)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria (1)	496.4	499.1	479.9	386.3	433.9	462.3	428.1	416.7	421.3	408.9
Belgium-Luxembourg (1)	495.6	500.9	479.4	361.2	402.2	436.4	384.1	376.1	384.5	383.6
Bulgaria	225.3	264.5	245.3	98.6	105.7	144.1	129.6	142.6	199.2	179.9
Croatia	186.4	236.3	256.3	179.8	170.2	153.4	145.5	150.4	149.2	159.5
Cyprus	368.0	466.5	455.5	279.5	309.1	207.0	142.5	113.7	93.1	123.0
Czech Republic (1)	581.2	635.8	628.6	430.8	525.4	575.6	554.8	556.2	587.6	627.4
Denmark	375.9	371.5	324.6	167.0	189.5	255.7	254.5	251.9	251.4	257.7
Estonia	423.1	370.7	297.7	130.7	218.9	263.4	239.2	247.2	259.0	242.4
Finland (1)	451.5	480.4	435.3	292.1	261.6	206.8	353.4	315.4	311.9	310.0
France	272.4	288.3	266.1	183.4	229.3	240.5	207.7	213.3	210.9	210.7
Germany (1)	483.9	528.4	525.2	350.3	450.5	506.2	465.9	471.8	491.6	485.4
Greece	369.5	374.8	324.9	228.0	172.8	130.2	92.8	104.6	118.5	94.1
Hungary (1)	222.4	263.2	271.6	152.8	177.4	189.0	171.3	187.7	210.9	237.7
Ireland	242.2	256.6	199.3	78.0	91.3	85.2	87.1	86.4	102.4	124.5
Italy (1)	618.5	607.6	561.2	337.6	430.5	444.9	360.2	367.5	367.9	412.3
Latvia	219.2	244.1	197.0	128.8	176.6	283.3	98.6	107.2	161.5	138.8
Lithuania	194.8	223.5	170.3	82.8	113.7	143.2	152.4	175.8	201.8	196.0
Malta	157.9	170.2	131.5	109.3	134.7	81.1	78.6	74.3	93.9	103.5
Netherlands (1)	222.1	317.6	287.4	182.4	211.5	244.5	240.4	222.9	205.5	194.8
Poland	297.9	335.6	302.2	204.3	250.2	282.4	266.6	272.8	314.4	331.0
Portugal	324.3	322.9	311.5	217.5	235.6	209.9	191.3	225.3	202.2	225.0
Romania	215.1	265.6	249.1	129.0	161.9	187.1	166.6	166.5	194.9	204.8
Slovak Republic (1)	360.4	425.5	395.8	256.5	332.8	340.6	339.6	372.2	393.9	402.5
Slovenia	599.9	691.9	614.5	428.4	482.9	497.7	435.6	428.9	442.5	467.2
Spain (1)	530.8	541.9	392.8	256.5	280.4	280.8	223.7	229.5	250.7	275.9
Sweden (1)	491.8	530.5	470.3	276.1	388.0	411.3	366.9	373.0	349.2	344.4
United Kingdom (1)	233.2	234.1	211.3	126.6	157.8	161.9	151.7	149.5	165.6	161.4
European Union (28)	**389.1**	**412.3**	**376.5**	**242.6**	**294.7**	**314.4**	**280.6**	**284.6**	**297.6**	**306.0**
Albania	169.8	177.0	146.6	199.7	167.3	184.3	211.4	205.6	196.2	236.2
Bosnia-Herzegovina	191.1	161.0	169.7	115.7	127.2	131.1	125.5	132.9	131.3	176.0
Iceland	176.6	373.5	278.1	97.0	105.7	107.3	112.9	318.0	108.0	151.7
Macedonia	176.1	119.6	106.4	131.7	138.1	67.6	37.1	27.8	89.4	105.4
Montenegro		132.2	105.5	137.1	187.3	182.1	178.3	126.8	236.3	288.1
Norway	275.9	256.9	249.8	192.7	173.1	214.3	200.4	188.8	278.4	197.1
Serbia		113.2	119.0	85.6	49.5	66.9	51.9	44.9	55.0	74.8
Serbia and Montenegro	163.7									
Switzerland	318.4	336.5	320.0	250.8	313.9	332.6	336.4	342.6	337.6	311.5
Turkey (1)	308.9	341.9	305.0	253.0	325.9	366.3	380.3	410.6	396.9	436.8
Other Europe	**281.2**	**299.3**	**271.8**	**224.9**	**276.7**	**309.6**	**318.5**	**340.3**	**337.0**	**365.1**
Azerbaijan	98.6	90.3	104.6	86.4	96.5	100.6	119.2	143.8	143.3	102.2
Byelorussia	215.1	241.1	259.8	191.9	271.6	262.9	275.2	273.5	226.7	179.1
Georgia	41.2	58.7	70.7	44.8	47.2	48.9	65.1	33.8	58.0	81.2
Kazakhstan (1)	152.7	190.1	150.6	163.8	129.1	134.6	165.3	209.9	161.3	150.3
Moldova	192.2	67.4	67.9	60.5	30.8	51.8	42.9	51.1	46.9	72.3
Russia (1)	243.6	282.0	247.8	173.5	256.7	289.7	298.7	302.1	299.8	274.8
Ukraine (1)	142.9	174.1	145.9	84.6	119.9	139.2	137.0	123.6	94.8	74.7
Uzbekistan	38.7	48.8	49.1	55.9	46.0	46.2	52.7	63.8	64.6	57.9
C.I.S.	**189.0**	**217.9**	**192.7**	**138.5**	**190.1**	**211.9**	**220.1**	**224.0**	**213.1**	**191.8**
Canada (1)	555.6	470.3	439.8	282.4	412.9	410.8	446.7	420.1	443.3	371.3
Costa Rica (2)	104.7	114.9	154.9	104.9	111.8	128.9	147.0	168.1	167.7	181.4
Cuba (2)	9.4	10.4	11.0	8.7	11.1	11.4	11.9	12.5	13.1	12.6
Dominican Republic (2)	35.9	27.4	30.3	25.7	32.7	27.1	33.8	36.1	49.6	40.4
El Salvador (2)	68.0	65.3	47.3	14.1	36.1	43.1	45.1	44.8	50.3	52.9
Guatemala (2)	42.6	52.1	39.2	16.9	21.4	21.4	42.0	46.8	62.9	64.7
Honduras (2)	23.4	25.7	39.8	13.8	11.1	24.9	27.8	21.1	22.4	43.9
Mexico (1)	153.8	151.2	154.3	129.9	149.7	164.5	171.3	162.7	182.5	190.6
Nicaragua (2)	27.5	28.3	25.4	12.9	8.2	12.4	17.9	18.5	19.2	18.4
Panama (2)	88.8	87.2	95.8	98.6	117.1	56.8	65.7	153.5	145.8	126.8
Trinidad and Tobago (2)	372.2	377.3	206.8	180.1	231.2	203.8	223.6	233.6	244.2	234.8
United States (1)	400.2	359.0	323.2	192.7	257.8	285.5	305.6	301.8	334.8	298.8
North America	**312.9**	**282.3**	**259.3**	**164.5**	**216.4**	**235.6**	**252.1**	**246.9**	**272.8**	**249.0**

Apparent Steel Use per Capita
(kg finished steel products)

(continued)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Argentina (1)	113.6	115.5	118.5	78.5	112.1	128.1	116.4	119.0	116.5	121.0
Bolivia (2)	15.3	19.0	12.1	9.0	11.5	11.6	11.7	50.2	58.8	54.2
Brazil (1)	97.2	114.4	123.5	94.4	134.3	130.1	131.3	137.2	124.3	102.4
Chile (2)	141.4	140.3	154.2	101.3	140.0	159.2	173.0	153.7	148.5	155.8
Colombia (2)	64.4	62.2	57.0	49.2	61.0	69.3	74.8	73.7	82.7	83.6
Ecuador (2)	81.1	58.3	91.1	71.1	83.3	115.3	97.6	123.5	104.4	105.3
Paraguay (2)	23.6	18.3	8.1	21.1	34.3	39.4	34.5	35.7	37.0	35.3
Peru (2)	49.6	54.5	75.0	54.7	82.4	81.4	88.7	90.5	93.6	111.3
Uruguay (2)	54.3	30.2	45.1	33.6	44.7	61.4	72.1	66.9	64.9	68.2
Venezuela (1)	116.8	131.8	120.9	94.0	78.1	88.6	100.1	94.9	66.4	59.3
South America	**90.9**	**99.7**	**106.3**	**80.2**	**108.4**	**111.9**	**113.2**	**117.1**	**108.8**	**99.5**
Algeria (1)	91.9	84.9	106.2	120.8	85.0	103.1	124.0	147.7	158.5	151.0
Angola	25.7	1.3	49.6	46.0	29.8	35.8	45.8	43.4	42.7	31.1
Benin	7.8	13.0	11.0	15.8	11.8	13.9	16.6	11.5	12.9	11.9
Cameroon	8.0	7.8	7.8	8.4	7.7	7.3	10.7	10.4	11.8	11.5
Congo	24.2	32.5	29.1	27.0	18.7	27.1	33.3	54.2	61.2	32.4
Dem. Rep. of the Congo	1.0	0.9	1.3	1.2	1.1	1.4	1.4	1.6	2.0	1.6
Djibouti	120.2	112.9	163.9	164.7	164.3	173.6	234.1	138.1	181.1	658.7
Egypt (1)	61.1	70.4	94.5	137.4	113.7	92.9	110.5	105.1	113.7	118.7
Equatorial Guinea	94.0	91.9	98.1	110.5	151.6	139.5	166.4	160.0	130.5	91.6
Ethiopia	2.6	5.1	3.5	5.9	3.5	5.1	7.5	8.5	8.6	10.4
Gabon	46.6	62.9	62.2	48.2	64.2	78.3	83.7	84.6	89.6	54.2
Ghana	12.0	11.7	20.5	18.4	20.6	32.1	28.9	27.6	29.5	33.2
Guinea	7.1	4.2	5.7	5.7	6.0	8.8	6.9	9.6	9.0	11.3
Ivory Coast	6.9	6.7	9.1	8.6	10.3	9.3	9.7	12.3	13.6	15.2
Kenya	16.1	15.7	16.1	21.2	20.0	29.4	22.6	30.1	29.9	37.2
Libya (1)	145.1	191.3	176.5	302.8	224.7	10.3	142.9	244.3	259.9	220.6
Madagascar	2.2	3.2	0.3	4.0	3.4	3.0	3.7	4.2	4.6	4.6
Mauritania		14.7	12.7	15.3	17.2	27.1	28.3	31.6	37.6	26.1
Mauritius	66.5	86.5	90.5	78.7	97.5	76.6	67.7	72.7	68.2	88.8
Morocco (1)	48.8	45.8	59.8	54.5	50.9	86.0	78.8	82.9	74.7	78.5
Mozambique	6.3	7.8	6.4	7.2	7.7	7.7	10.5	13.5	14.6	13.1
Nigeria	8.8	8.6	11.4	12.0	9.0	11.3	10.9	13.2	11.4	9.7
Senegal	17.8	17.3	15.9	21.2	26.1	30.1	26.7	22.0	26.3	27.7
South Africa (1)	119.7	116.9	121.7	87.4	96.9	102.1	99.7	106.5	94.7	97.1
Sudan (1)	12.5	11.5	9.5	11.1	9.3	8.0	8.9	6.9	7.6	8.0
Tanzania	5.2	5.0	5.9	7.2	7.2	9.4	8.4	14.4	11.6	12.4
Tunisia (1)	69.7	72.0	94.4	68.0	83.7	71.8	70.3	68.5	70.1	71.1
Togo	14.1	14.8	8.9	12.4	21.7	17.3	25.8	22.2	26.0	26.0
Uganda		3.2	3.6	3.6	5.7	4.4	2.1	3.4	4.0	3.7
Zambia	7.3	9.8	9.4	8.1	8.3	11.7	10.0	12.8	10.1	10.4
Zimbabwe		5.4	2.9	3.0	5.3	7.5	7.7	7.9	8.3	9.5
Other Africa	2.4	2.5	2.7	3.5	3.0	3.4	3.2	4.3	4.2	4.9
Africa	**23.2**	**23.7**	**28.6**	**31.5**	**27.4**	**27.6**	**30.1**	**32.5**	**32.5**	**32.8**
Bahrain (1)	315.7	292.2	281.1	203.0	252.9	141.7	159.7	183.8	195.3	197.1
Iran (1)	194.3	255.3	207.4	239.1	265.2	280.9	249.1	243.5	242.1	236.6
Iraq (1)	29.4	33.6	41.4	71.0	69.6	82.9	103.3	109.4	91.9	83.7
Israel	208.3	198.3	205.2	215.9	237.3	268.4	281.8	310.7	328.6	362.5
Jordan (1)	142.4	162.6	190.3	198.2	163.1	145.4	153.1	140.0	144.5	146.4
Kuwait (1)	364.8	384.0	481.6	304.0	353.7	297.9	322.2	349.8	379.4	372.0
Lebanon (1)	98.0	106.5	134.3	193.2	175.5	186.2	169.6	147.7	151.8	150.1
Oman (1)	221.7	242.5	322.7	202.0	313.5	299.4	302.1	314.3	320.8	324.4
Qatar (1)	802.3	759.1	1 128.2	961.6	658.2	521.1	536.8	588.2	655.6	669.4
Saudi Arabia (1)	310.6	322.7	359.5	365.1	381.6	416.8	425.1	440.4	456.5	428.0
Syria (1)	98.7	115.5	90.8	121.4	90.8	65.4	34.9	21.9	13.9	14.3
United Arab Emirates (1)	1 256.4	1 283.2	1 752.4	809.9	795.7	782.3	786.8	754.4	786.8	787.0
Yemen (1)	18.0	20.4	23.2	33.8	22.0	14.2	21.2	17.6	33.4	20.8
Middle East	**189.0**	**220.9**	**234.1**	**221.1**	**228.3**	**235.2**	**228.2**	**228.1**	**232.0**	**225.0**

Apparent Steel Use per Capita (kg finished steel products)

(continued)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Bangladesh	5.9	5.7	5.4	11.2	12.3	13.1	14.9	15.5	16.9	25.0
China (1)	287.7	317.1	336.8	413.4	438.2	475.6	487.0	539.5	519.0	488.6
Hong Kong, China	354.8	365.2	266.9	228.3	257.0	249.5	261.5	317.3	352.3	483.8
India (1)	39.2	43.6	43.0	47.7	52.8	55.9	57.3	57.6	58.7	61.1
Indonesia (3)	27.2	31.2	37.5	31.1	37.0	44.7	50.4	50.5	50.7	44.2
Japan (1)	621.3	638.0	612.2	414.6	499.3	503.7	503.0	513.8	533.9	497.3
North Korea	49.2	45.9	41.7	43.6	41.8	44.6	43.6	43.4	45.0	47.9
South Korea (1)	1 040.3	1 145.2	1 207.4	930.5	1 067.2	1 142.5	1 089.9	1 038.4	1 108.8	1 109.5
Malaysia (3)	258.1	287.8	312.2	240.2	295.7	288.3	307.4	341.0	337.1	329.7
Mongolia	44.1	49.1	44.3	46.9	45.9	108.1	126.1	152.4	154.9	116.2
Myanmar	10.6	10.6	9.8	16.0	18.0	23.3	27.7	27.6	40.8	45.4
Pakistan	16.4	16.3	11.8	12.6	10.2	14.7	17.1	18.6	22.6	30.0
Philippines (3)	36.1	38.2	39.4	37.5	43.0	54.1	62.6	68.7	73.9	87.0
Singapore (1)	433.4	612.7	700.3	564.7	527.7	750.8	713.3	802.6	690.1	728.4
Sri Lanka	24.3	24.1	19.6	19.8	24.1	26.8	30.6	29.2	33.3	46.6
Taiwan, China (1)	868.2	788.1	733.9	487.7	766.8	778.0	762.8	795.8	837.2	750.6
Thailand (3)	190.3	191.7	202.6	161.5	211.2	217.0	251.8	266.4	256.0	246.2
Viet Nam (3)	72.3	108.6	94.5	124.9	119.7	108.6	121.3	128.8	156.2	195.3
Asia	**172.5**	**187.1**	**193.0**	**208.5**	**226.4**	**242.5**	**247.2**	**266.1**	**261.0**	**250.1**
Australia (1)	334.9	349.8	347.5	245.3	314.3	267.2	281.8	247.4	273.0	262.5
New Zealand (1)	212.5	219.4	210.0	129.4	168.2	158.9	166.1	172.2	187.5	178.4
Other Oceania	11.2	7.9	12.8	12.1	14.2	13.1	13.2	12.1	12.3	16.2
Oceania	**232.6**	**241.5**	**240.3**	**168.2**	**215.4**	**185.2**	**194.9**	**174.2**	**191.5**	**185.0**
World	**176.8**	**186.7**	**185.1**	**171.2**	**192.8**	**205.7**	**207.3**	**218.0**	**216.9**	**208.1**

Assuming the country's economy will continue to grow towards a rate of double digits and the population will continue to rise, table 5.0 below shows the computed future steel use per capita {kg/capita} by 2020, 2025 and 2030. It can be seen that the demand use per capita rises to 67.1 up from 42.7 as at 2016.

Table 5.0 Future Kenya Steel demand intensity per capita {Kg/capita}

Year	2016	2020	2025	2030
Population size,	47.8	52.9	59.3	65.7
Steel Demand '000 tons	2041	2719	3567	4415
Steel demand, Kg/capita	**42.7**	**51.3**	**60.3**	**67.1**

3.3 Steel supply gap in Kenya

The amount of steel imported into Kenya today {as at 2016} - together with some of the steel which is currently imported by Kenya's neighboring countries - presents an immediate steel production opportunity.

3.3.1 Near-term supply gap (Based on imports)

An appraisal of the capacity structure of the Kenyan steel sector indicated that there is presently no Kenyan production of hot rolled coil. Moreover, import statistics showed that in 2014, imports of hot rolled coil averaged 740,000 tons (table 6.0), a figure that has ranged between 400,000 tons and 740,000 tons since 2010. The appraisal also indicated a combined average of 390,000 tons' worth of HRC imports in the neighboring countries.

Significant volumes of semi-finished steel {mostly billet} are also imported into Kenya, with 2014 imports at 168,000 tons/year. It is noted however that Devki's capacity expansion plans - which involve construction of a 125,000 tons/year billet plant at Kitui -should largely displace these billet imports.

The biggest immediate volume opportunity for Kenya therefore lies in production of hot rolled coil which is quantified on the basis of:

- 100% import displacement of current HRC imports into Kenya.
- 50% share of current HRC imports into neighboring countries.

Based on this analysis of HRC imports, it was found out that a near-term supply gap (year 2014) stood at about 936,000 tons as shown in table 7.0. Since it would be some time before any new mill was constructed, the near-term supply gap was better expressed in terms of the expected demand in years 2018 and beyond. This future demand for HRC was best calculated based on a compounding formula to capture the demand growth

rate. The near- term supply gap for HRC is found to be at least 1 million tons/year assuming a 5% growth in demand between 2014 and 2018 (table 7.0). The table 6.0 below shows the amounts of imports of HRC in Kenya and her neighbors as of 2014.

Table 6.0 HRC imports in Kenya and her neighbors,2014 *(Source: Numerical Machining Complex,2014)*

Country	**Current imports '000 tons**
Kenya	**740**
Ethiopia	43
Madagascar	1
Mozambique	15
Somalia	0
Sudan	63
Tanzania	229
Uganda	40
Total	**390**
Total 2014	**1120**

Table 7.0 The near-term HRC supply opportunity.

Country	**Current imports '000 tons**	**Kenya steel industry share**	**Kenya steel industry share, 000 tons**
Kenya	740	100%	740
Ethiopia	*43*	50%	196
Madagascar	*1*		
Mozambique	*15*		
Somalia	*0*		
Sudan	*63*		
Tanzania	*229*		
Uganda	*40*		
Total	390		
Total 2014	**1120**	**83%**	**936**
Assume ~5% demand growth between 2014-2018			
Total 2018			**>1000**

Using the HRC import amounts in table 7.0 above and taking a 50% share in all the imports in the neighboring countries and 100% share in Kenyan imports, the future potential orders of HRC from the year 2018 {assuming 100% output capacity and 5% growth in the HRC demand} is envisaged as below;

Table 8.0 Future Potential Demand {HRC} 2018 and Beyond

Country	**Sales '000 tons**
Kenya	856
Tanzania	133
Sudan	37
Ethiopia	24
Uganda	23
Others	9
Total Sales (Potential Demand)	**1082**

It is envisioned that this demand shall continue to grow as the economy of the country and that of her neighbors grows.

3.3.2 Longer-term supply gap (based on demand growth)

The growth in market expected beyond 2018 will lead to an increased need for supply of large amounts of HRC hence a longer-term supply gap. This shall spark a need for longer-term solution. Though Kenyan iron-ore is contemplated to be available from 2018, the LAPPSET rail net-work will possibly not be functional by that time, and still probably not earlier than 10 years {until after the Lamu Port is fully built}, therefore it would be more appropriate to assess the longer-term supply gap between years 2020-2030. This supply gap is however quantified on the basis of the following assumptions;

- Assuming a 1 million ton HRC supply gap as at 2016 through 2018/2030.
- Recognizing expected growth of Kenyan flat-rolled steel demand between 2016 and 2020 / 2030.
- Recognizing also the growth in Kenyan steel tube demand, on the basis that hot or cold rolled steel coil is the main feedstock for the production of welded tube.
- Assuming also some degree of steel demand growth in the adjacent steel markets of Tanzania, Sudan, Ethiopia and Uganda.

The TABLE 9.0 below shows the expected HRC steel demand between 2020-2030. The values were calculated based on a compounding formula.

Table 9.0 Longer-term HRC Supply Opportunity

			HRC Demand estimate ('000 Tons)		
	Year	**2015 Imports**	2020	2025	2030
Near-term supply gap,2016			1000	1000	1000
Kenya flat-rolled demand growth (~5%)		850	1084	1318	1682
Kenyan growth in tube demand (~5%)		76	97	117	150
Demand growth in adjacent steel markets (~10%)		196	315	462	744
TOTAL TONNAGE			**2496**	**2897**	**3576**

From the analysis above (table 8.0), it is evident that the demand will grow from 1 million tons in 2018 to 2.496 million in 2020, 2.897 million in 2025 and 3.576 million tons in 2030 given that favorable economic conditions prevail.

IV. Conclusion

The purpose of this paper was to forecast steel demand in Kenya to the year 2030 to ascertain the present and future demand in the country hence market. The paper also looked at the HRC steel demand in the neighboring countries to assess the possible future market in those countries and hence the possible regional demand for steel.

The most important findings of this paper was that a combined near-term HRC steel supply gap of at least 1 million tons existed in the country and her neighbors by the year 2018 and later, a longer-term HRC supply gap of about 3.6 million tons by 2030. This supply gap presented a very good investment opportunity in the steel industry in Kenya. The total steel demand in the country was also realized to be on the rise predicted to hit 2.7 million tons and 4.4 million tons in 2020 and 2030 respectively.

V. Policy recommendations

The paper provides the following policy recommendations:

i) The Kenyan government should immediately invest immensely in the iron ore and steel production industry if the country has to achieve her vision 2030 industrial growth as there is a massive investment opportunity in this area especially in HRC.

ii) The Kenyan government should establish a working framework in the iron and steel industry sector which would enable availability and easy access of any essential iron and steel data,upstream and downstream, as this would go a big mile in understanding better the steel dynamics in the country as well as steel demand and supply hence better forecasts and policy formulations.

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