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The Internationalisation of the World Steel Industry

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Global Political Economy (GPE) Research Group

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The aims of the project are to:

1. Promote Lifelong Learning within the European Steel Industry
2. Support workers' adjustment to new ways of working.
3. Promote equal opportunities.
4. Support workers' adjustment to new technologies.
5. Provide workers with transferable skills.

In meeting these aims the project undertook the following:

1. Mapped existing qualifications using new and existing research to ascertain the level of need in new and transferable skills.
2. Developed transnational qualification modules comprising new and transferable skills.
3. Developed an on-line training programme.

The duration of the project was three years, from December 2000 to November 2003.

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The Reports are:

1. New Steel Industry Challenges
2. The Internationalisation of the World Steel Industry.
3. The European Steel Industry: From a National to a Regional Industry.
4. The Changing European Steel Workforce.
5. Skills, Qualifications and Training in the German Steel Industry: A Case Study
6. Skills, Qualifications and Training in the Italian Steel Industry: A Case Study
7. Skills, Qualifications and Training in the Netherlands Steel Industry: A Case Study
8. Skills, Qualifications and Training in the Polish Steel Industry: A Case Study
9. Skills, Qualifications and Training in the British Steel Industry: A Case Study
10. Future Skill Needs in the European Steel Industry
11. Training and Qualifications in the European Steel Industry.
12. The Question of pan-European Vocational Qualifications
13. Equality and Diversity in the European Steel Industry

The Internationalisation of the World Steel Industry

Introduction

The world steel industry has undergone significant change over the last two decades. Two related developments have taken place. First, the steel industry in the developed capitalist economies has been transformed from a state-owned and supported industry to one where private ownership and market relations prevail. Historically, the steel industry originated in geographically specific areas, servicing national industry and often seen as a key strategic industry. With the advent of neo-liberal economic doctrines these industries were privatised or de-regulated. Second, the private steel corporations that emerged over the last two decades have operated in a trading context where there has been a diversification of materials away from steel as well as increasing competition between steel producers. In this context, the corporations have looked to varied markets for the sale of products, with more emphasis on so-called down-stream production, as well as looking to international markets for the sale of their products. The result is an embryonic internationalised industry, increasingly characterised by multinational steel producers.

These developments open up questions about the nature and character of change that is taking place. A first question is about the industry itself and to what extent is it an industry that is moving beyond national boundaries in relation to production, trade and consumption. It may be the case that this is an industry where there are growing 'interconnections and interdependencies', one feature of a globalised world (Cohen and Edwards, 2000: 24). Further, it may be an industry where the companies that comprise it are increasingly transnational in the organisation and activity, another feature of a globalised world (Dicken, 1992: 47). The second question focuses on the changing focus of companies that make up the industry. It may be the case that with the privatisation and deregulation of the industry, that these companies will reorganise in more integrated ways, taking into account production procedures and the implications of such reorganisation for consumption, in the case of steel beginning to differentiate markets and focus on down-stream activity, rather than leave this to other sectors, such as automobiles or construction or engineering (Gereffi, 1999). Third, is this a process whereby the industry is simply becoming international in the sense that activities are occurring across national boundaries, rather than being confined to the nation state? If this is so, then such developments are relatively long-standing and not necessarily distinctive.

Arguments have been advanced about the nature of the shift that may be taking place in the industrial sector in general. Some argue that the process of change that is in place is one that is laying the foundation for globalised industries, with the implication that formerly nationally based industries, such as steel, are likely to be in a process of change, towards a globalised industry. The implications are that there has been a shift from an international economy to a global one, and that major industrial sectors will not be immune to these processes (Dicken, 1992). Alternatively, it could be argued that while it may be possible to characterise key aspects of social and economic life as global, with implications for the way society organises and operates, including the implications for social identity and awareness (Robertson, 1992), it is not the case that economic life has become globalised; rather it may be the case that the international economy is becoming more complex, but is not changing in the fundamental way that is implied by some (Hirst and Thompson, 1996). The argument is that the steel industry is becoming regionalised, with most trade taking place within regional blocs. In Europe this regionalisation has a further dimension to it, with companies looking to each other for mergers and acquisitions. The result may be that a number of European companies are well placed to become genuine transnationals but, with one exception, this is not the case to date.

The Report is organised into five sections. In the first section, we identify the regional patterns of production and consumption over time. The second section presents the major producing and consuming countries worldwide. Third, there is an increasing concentration by major companies in production, and these developments are discussed in this section. Fourth, as part of the emergence of major steel producing companies operating on a multinational scale there is a pattern of technological change taking place, away from continuous cast production and towards more technologically innovative and focused forms of production. These developments are examined with reference to company, country and region, as a pointer to where the centres of steel production are likely to locate. Fifth, the trends and patterns identified in this report are reviewed and an assessment provided.

Section One: World Steel Regions

Steel production has a long history to it, as a strategic product of military significance and a core aspect of an industrialising economy. The result is that the pattern of steel production reflects the trends of location and production that distinguish the developed and developing economies.

Geographical Patterns of Production

Steel production is located in loose regional blocs, reflecting the historical patterns of industrial development and change during the twentieth century.

Table 1: World steel production by region 2001 (Crude steel)

Country	Production (million mt)	Percentage of World Total Production
Asia	353.20	41.5
European Union (15)	158.7	18.6
NAFTA	118.7	14.0
Former USSR	100.1	11.8
Other Europe	45.9	5.4
Central and South America	38.4	4.5
Africa	15.1	1.8
Middle East	11.7	1.4
Oceania (Australia and New Zealand)	7.9	0.9
World Total	**849.6**	

Notes: NAFTA – North American Free Trade Agreement
USSR – Union of Soviet Socialist Republics

Source: International Iron and Steel Institute, 2002

By 2001 the largest concentration of steel production was in the Asian region (principally the East Asian area), followed by North America, Europe Union, Other Europe and the former USSR (see Table 1). What is striking about this pattern is that there is a concentration in terms of steel production in the Asian region, involving China in particular, but also South Korea and Japan.

The current pre-eminence of the Asian region was consolidated during the 1990s, with a major increase in output in this region, reflecting the industrialisation that has been taking place there. During the same period, the former Soviet bloc produced less as the process of transition from a Soviet command society to variations of a marketised economy occurred. At the same time there has been a slight decline in the proportion of world crude steel output accounted for by the fifteen members of the European Union (IISI, *Steel Statistical Yearbook 2002*, Committee on Economic Studies, Brussels, December 2002, Table 4). These patterns are pointed to in Table 2.

Table 2: Steel production by region: 1991 and 2001 (Crude steel)

Country	Percentage of World Total Production 1991*	Percentage of World Total Production 2001**
Asia	33.7	41.5
European Union	20.3	18.6
NAFTA	13.7	14.0
Former USSR	18.1	11.8
Other Europe	6.3	5.4
Central and South America	4.2	4.5
Africa	2.0	1.8
Middle East	0.7	1.4
Oceania	0.9	0.9

Notes: *World total: 733.5 million metric tons crude steel.
**World total: 849.6 million metric tons crude steel.

Source: International Iron and Steel Institute, 2002

The steel industry is thus an industry where production is clustered on a regional basis, with the main areas being Asia, EU, NAFTA, and the former USSR. .

Geographical Patterns of Consumption

Similar patterns can be identified with regard to world consumption of crude steel. Table 3 (below) highlights patterns of apparent consumption by region in 2001. It is clear that the Asian region is by far the largest consumer of steel, when measured in terms of apparent consumption. The European Union and NAFTA are the second and third largest consumers respectively. It should be noted however, as will be discussed in more detail later in this section, that the EU is the only one of these three regions that produces more than it consumes. The Asian and NAFTA regions consume markedly more than they produce. The Former USSR following its collapse now produces many times more steel than it consumes.

Table 3: World apparent steel consumption by region 2001 (Crude steel)

Country	Apparent Consumption (million mt,)	Percentage of World Total Apparent Consumption
Asia	336.6	42.1
European Union (15)	154.5	19.3
NAFTA	149.9	18.6
Other Europe	36.5	4.6
Former USSR	36.2	4.5
Central and South America	36.1	4.5
Middle East	21.5	2.7
Africa	20.0	2.5
Oceania	8.1	1.0
World Total	**799.4**	

Note: 'Apparent' steel consumption of crude steel is derived from the formula: crude steel production + imports – exports. This is as opposed to 'Real' consumption, which is derived from the formula: Apparent consumption – Net increase in stocks. For details see International Iron and Steel Institute (2002) *Steel Statistical Yearbook 2002*, Brussels: Committee on Statistics, p 107.

Source: International Iron and Steel Institute, 2002

Another dimension of consumption patterns is indicated by the apparent consumption of finished steel products. These patterns are presented below (see Table 4).

Table 4: World apparent steel consumption by region 2001 (Finished steel products)

Country	Apparent Consumption (million mt.)	Percentage of World Total Apparent Consumption
Asia	362.5	47.0
European Union (15)	138.3	17.9
NAFTA	134.3	17.4
Other Europe	33.1	4.3
Former USSR	29.3	4.2
Central and South America	28.9	3.8
Middle East	20.0	2.6
Africa	18.0	2.3
Oceania	7.2	0.9
World Total	**771.3**	

Source: International Iron and Steel Institute, 2002

The importance of the apparent consumption patterns of finished steel products is that they provide a more complete picture of trade relations. As indicated, three regions account for the vast majority of apparent steel consumption of finished steel products, Asia, EU and NAFTA (82.3

%). More significantly the Asian region has a higher relative consumption of finished steel products when compared with other regions. Presumably, this consumption level reflects the scale of construction and related industrial expansion taking place in this region, and particularly in China (which accounted for 46.9% of this consumption in 2001; up from 30.1 % in 1991).

The picture in 2001 is the outcome of important changes in the patterns of consumption during the 1990s. While there are fluctuations in consumption trends during this period, particularly in relation to the economic collapse in the Asian region in 1997, a comparison between 1991 and 2001 steel consumption presents the overall trend, as presented in Table 5.

Table 5: Apparent steel consumption of crude/finished steel by region 1991 and 2001

Country	**Consumption 1991 (crude steel)** (%)	**Consumption 2001 (crude steel)** (%)	**Consumption 1991 (finished steel products)** (%)	**Consumption 2001 (finished steel products)** (%)
Asia	36.5	42.1	37.4	47.0
European Union (15)	18.0	19.3	18.8	17.9
NAFTA	15.2	18.6	15.4	17.4
Other Europe	4.6	4.6	4.6	4.3
Former USSR	18.1	4.5	16.2	4.2
Central and South America	3.0	4.5	2.8	3.8
Middle East	1.7	2.7	1.7	2.6
Africa	2.3	2.5	2.2	2.3
Oceania	0.8	1.0	0.8	0.9

Source: International Iron and Steel Institute Reports

The striking feature is that consumption in the former USSR has fallen away dramatically, as the pressure for export earnings mounted with the collapse of the former political regimes. The result is that the three main areas of steel consumption in 2001 are Asia, particularly the northern part of the Asian region, NAFTA, and Europe.

However, when production and apparent consumption is compared then the current over-capacity of the steel industry becomes evident, as indicated in Table 6.

Table 6: World steel production and apparent consumption by region 2001

Country	**Production 2001** (million mt. crude steel)	**Apparent Consumption 2001** (million mt. crude steel)	**Apparent Consumption** (crude steel) *As % of crude steel production*	**Apparent Consumption 2001** (million mt. finished steel products)	**Apparent Consumption** (finished steel products) *As % of crude steel production*
Asia	353.20	336.6	95.3	362.5	102.6
European Union (15)	158.7	154.5	97.4	138.3	116.5
NAFTA	118.7	149.9	126.3	134.3	113.1
Other Europe	100.1	36.5	36.5	33.1	33.1
Former USSR	45.9	36.2	62.2	29.3	63.8
Central and South America	38.4	36.1	94.0	28.9	75.3
Middle East	15.1	21.5	142.4	20.0	132.5
Africa	11.7	20.0	170.9	18.0	153.8
Oceania	7.9	8.1	102.5	7.2	91.1
World	**849.6**	**799.4**		**771.3**	

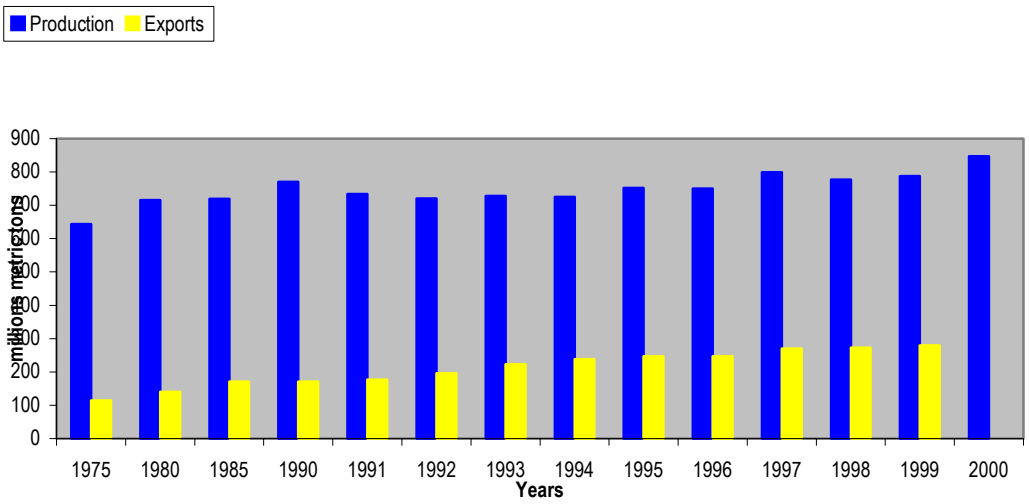
Source: International Iron and Steel Institute, 2002

This table also gives some clue to the current over-capacity in the world steel industry. It would appear that more steel is produced than consumed, but that a number of regions consume more steel than is produced in that region, underwriting the patterns of trade that now characterise the steel industry. The European region as a whole, (the EU, Other European and the former USSR), all consume less than they produce, although it is only the former Soviet bloc that is driven by the necessity of exports in terms of relatively precarious economies. This clustering, however, hides substantial and perhaps growing inter-regional trade in steel goods.

Geographical Trading Patterns

Important in the assessment of the steel industry and the way in which it is developing is the trade relations between countries, in terms of net imports and exports of crude steel products. These patterns are shown in Figure 1.

Figure 1: Steel Production and Exports World-wide 1975 – 2000 (million m/t)

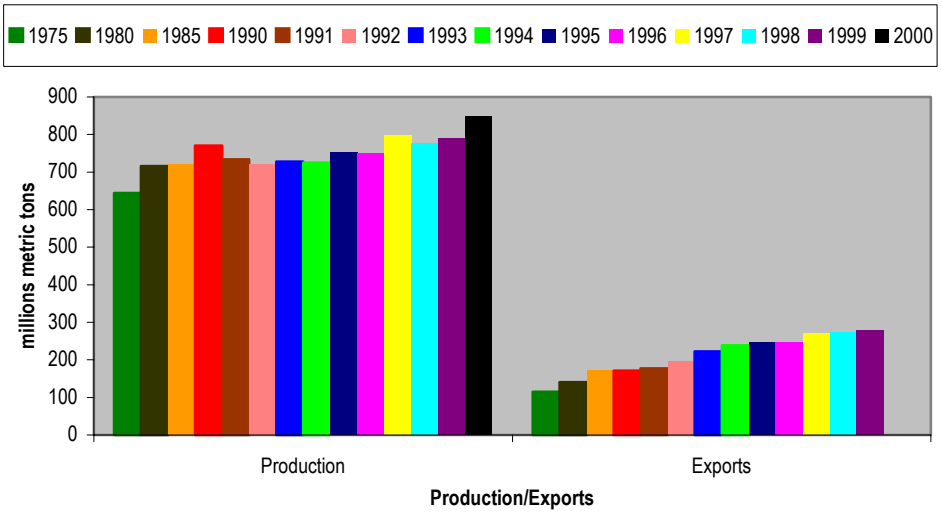


Note: These figures are probably an underestimate since they do not take account of improvements in yield. See International Iron and Steel Institute, 2001, p. 83

Source: International Iron and Steel Institute Reports

There has been a slow but consistent growth in exports of trade over the twenty five years until 2000 (the final export figures for 2000 are not available). This same pattern is presented in another form in Figure 2.

Figure 2: World Steel Production and Exports 1975 – 2000 (million m/t)

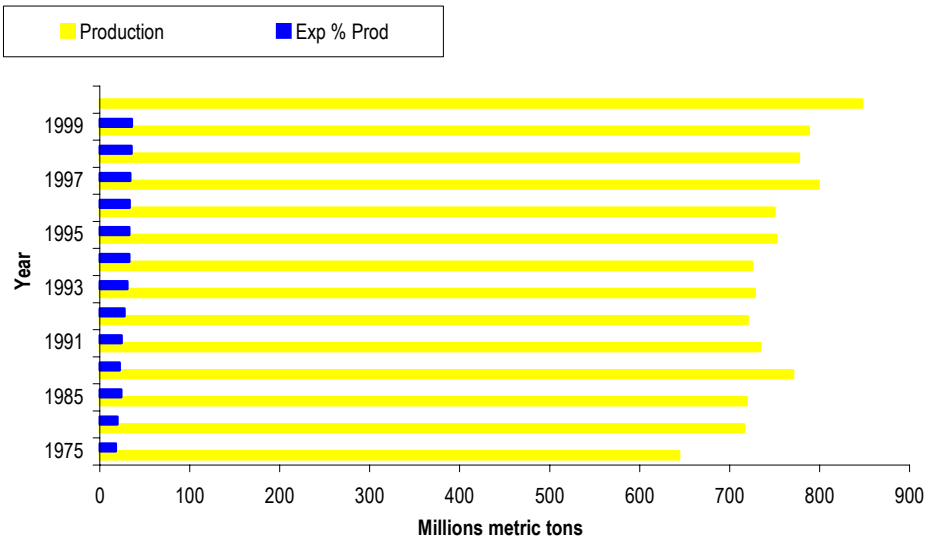


Source: International Iron and Steel Institute Reports

It can be expected that this trend will continue as individual companies position themselves in an increasingly internationalised steel economy.

However, when this data is presented for exports as a proportion of production then the disparity between production and exports becomes clear, as indicated in Figure 3.

Figure 3: Worldwide Exports as a percentage of Production 1975 – 2000 (million m/t)



Source: International Iron and Steel Institute Reports

In terms of the geo-political organisation of steel production and consumption of the broad range of steel products, the main steel trade region is the European Union (EU) plus Eastern Europe/CIS. This region accounts for 28.3 per cent of the global demand for steel, as indicated in Table 7.

Table 7: Steel trade by region, 2001 (million m/t)

Destination \ Exporting Region	European Union (15)	Other Europe	former USSR	North America	Latin America	Africa & Middle East	China	Japan	Other Asia	Oceania	Total Imports	of which: extra-regional imports*
European Union (15)	75.5	13.7	7.7	0.2	1.7	1.6	0.4	1.8	1.5	0.1	102.7	27.7
Other Europe	13.0	4.0	7.1	0.0	0.1	0.0	0.1	0.3	0.4	0.0	24.9	20.9
former USSR	2.4	2.3	4.3	0.0	0.0	0.0	0.0	0.1	0.0	0.0	9.0	4.7
North America	6.3	1.9	2.4	7.9	7.1	0.7	1.0	2.4	4.2	0.1	33.9	26.0
Latin America	1.6	0.8	3.1	1.8	2.3	0.3	0.1	1.3	0.7	0.1	11.9	9.6
Africa	2.6	1.4	4.6	0.1	0.1	1.7	0.1	0.4	0.2	0.1	11.1	9.4
Middle East	1.9	3.0	8.5	0.1	4.6	0.2	0.2	1.5	1.1	0.0	21.0	20.3
China	0.7	0.5	9.0	0.0	0.3	0.5	-	4.4	10.1	0.0	25.6	25.8
Japan	0.1	0.0	0.1	0.0	0.0	0.0	0.3	-	3.6	0.0	4.0	4.0
Other Asia	2.6	1.1	10.0	0.3	2.4	3.3	5.0	17.8	10.0	0.3	52.9	42.9
Oceania	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.5	0.3	1.7	1.4
Total Exports	106.3	28.6	56.7	10.5	18.6	8.5	7.2	29.5	32.1	1.0	298.8	193.1
of which: extra-regional exports*	31.3	24.6	52.4	2.6	16.3	6.5	7.2	29.5	22.0	0.7	193.1	
Net Exports (exports-imports)	3.6	3.7	47.6	-23.4	6.7	-23.7	-18.4	25.5	-20.8	-0.7		

* - excluding intra-regional trade marked

Note: Trade figures are based on a broad definition of steel industry products including ingots and semi-finished products; tubes and tube fittings; single strand wire; and railway wheels; tyres and axles. International Iron and Steel Institute, p. 107

Source: International Iron and Steel Institute, 2003

Overall, there is a relatively extensive and expanding intra-regional trade pattern and a more limited one between the regional steel producing and consuming clusters, although this latter dimension is increasing. Nonetheless, four points can be made about this pattern. First, the trade relations of a number of major regions have negative net exports (that is exports do not off-set imports of steel goods). These regions include the EU, North America, Africa and the Middle East, China and the 'Other Asia' region. In contrast, Japan and the former USSR are major exporters, with exports far outweighing imports. Second, most trade is intra-regional, either within

trade blocs, such as the EU, and less so North American and the 'Other Asia' region. If China and Japan are included with the 'Other Asia' countries, then this Asian region constitutes a major intra-regional trade bloc, with extensive trade between Japan and 'Other Asia'. Third, the North American region and particularly the USA, is a major consumer of steel goods produced in other regions, including the EU, former USSR, Latin America and 'Other Asia'. Fourth, the importance of production and consumption within particular countries, such as the USA is underlined by these patterns.

These patterns of production and consumption are reflected in employment patterns in the world steel industry, as is indicated in Table 8.

Table 8: Employment in the steel industry by region or major producer in region 1975 and 2001 (excludes China and CIS)

	Employment ('000s)**						
Country **Year**	**1975**	**1980**	**1985**	**1990**	**1995**	**2000**	**2001**
European Union*	958	792	561	434	321	277	270
Japan	447	380	349	305	252	197	195
South Africa	71	70	65	54	39	24	20
United States	457	399	238	204	171	151	141
NAFTA (excluding Mexico)	511	460	307	257	225	207	196
Brazil	124	132	133	115	78	65	65
Australia	38	-	30	30	22	21	20

Notes: *Includes former German Democratic Republic 1996-2000
**All figures rounded, Japan and Australia are estimates.

Source: International Iron and Steel Institute, 2002

While employment levels have declined over the last thirty years, it is also the case that production output has increased dramatically. Such a pattern suggests a marked increase in worker productivity. The major production regions, East Asia, North America and the EU are the areas where the focus has been on technological innovation, increased competitiveness, and considerable restructuring of steel producing companies – with major implications for the structure of employment in the steel industry and the way work is organised.

Summary

The world steel industry is grouped in broad regions, where production is located and where historically employment was centred. While the evidence is patchy it would appear to be the case that trade is becoming more international in its focus. However, it is also the case that steel production has been located in particular countries within the major steel producing regions, and it is to this feature that the examination now turns.

Section Two: Steel Producing and Consuming Countries

The regions comprise a range of steel producing and consuming countries. The pattern of country production is revealed by the disaggregation of the regional patterns, as presented in Table 9.

Table 9: World's steel consuming areas, 2000

Region/Country	Consumption (million mt, finished steel products)	Region Percentage of World Total
European Union	**143.8**	**18.6**
Austria	3.9	
Belgium/Luxembourg	4.2	
France	17.6	
Germany	36.9	
Italy	30.9	
Netherlands	4.9	
Spain	17.5	
Sweden	3.7	
UK	13.1	
Other	11.1	
Eastern Europe/CIS	**74.8**	**9.7**
Czech Republic	3.9	
Poland	7.5	
Romania	2.3	
Turkey	12.4	
Russia	23.0	
Ukraine	9.7	
Other	16.0	
NAFTA	**146.9**	**19.1**
Canada	17.5	
Mexico	14.4	
USA	115.0	
Central and South America	**27.0**	**3.5**
Brazil	15.8	
Other	11.2	
Africa	**15.4**	**2.0**
Middle East	**10.8**	**1.4**
Asia	**339.1**	**44.0**
PR China	141.2	
India	26.9	
Japan	76.1	
Republic of Korea	38.5	
Taiwan	21.7	
Other Asia	34.7	
Australia and New Zealand	**6.2**	**0.8**
World	**768.8**	

Source: International Iron and Steel Institute, 2002

World steel production is principally located in ten countries, which account for around 70 per cent of all steel production. Based on the distribution of the ten largest steel producing countries in 2000 the pattern is as follows (Table 10):

Table 10: The Ten Largest Steel Producing Countries, 1992-2000
(millions metric tons crude steel production)

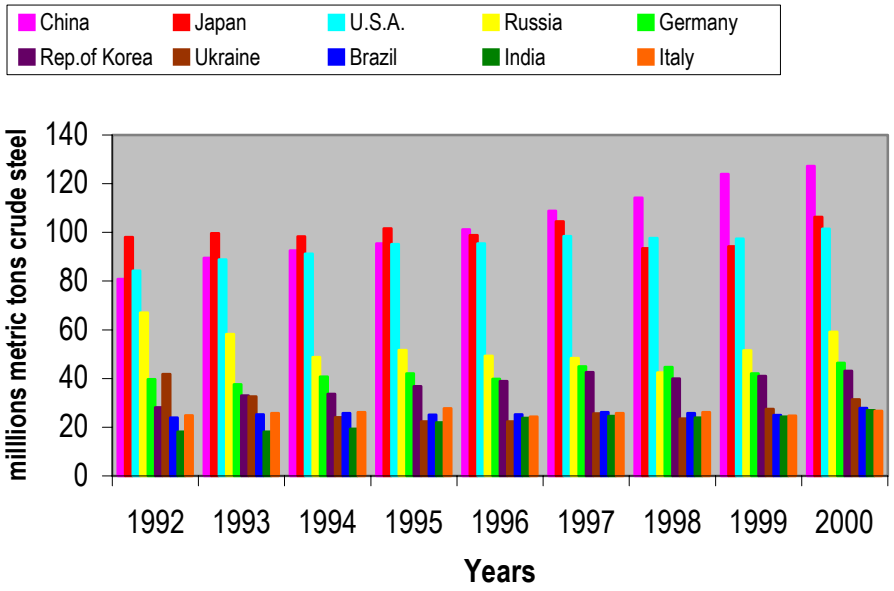
		Crude Steel Production (million m/t)								
Country	**Year**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
China		81	90	93	95	101	109	114	124	127
Japan		98	100	98	102	99	105	94	94	106
U.S.A.		84	89	91	95	96	99	98	97	102
Russia		67	58	49	52	49	48	43	52	59
Germany		40	38	41	42	40	45	45	42	46
Rep.of Korea		28	33	34	37	39	43	40	41	43
Ukraine		42	33	24	22	22	26	24	28	31
Brazil		24	25	26	25	25	26	26	25	28
India		18	18	19	22	24	25	24	24	27
Italy		25	26	26	28	24	26	26	25	27
World total		**720**	**728**	**725**	**752**	**751**	**799**	**775**	**788**	**847**
As % of world total		**70**	**70**	**69**	**69**	**69**	**69**	**69**	**70**	**70**

Source: International Iron and Steel Institute Reports

During the 1990s, China emerged as the largest steel producing nation in the world, with a striking cumulative increase in steel production during the 1990s. Japan has maintained its position as the second major steel producing country, although the decline in output in 1998 and 1999 was a consequence of the slow-down in the Japanese economy during this period. While the USA remains a major producer of steel, with a long established industry, in recent decades it has experienced considerable change, particularly with the development of mini-mill production from the mid-1980s onwards.

These patterns are further illustrated by Figures 4 and 5.

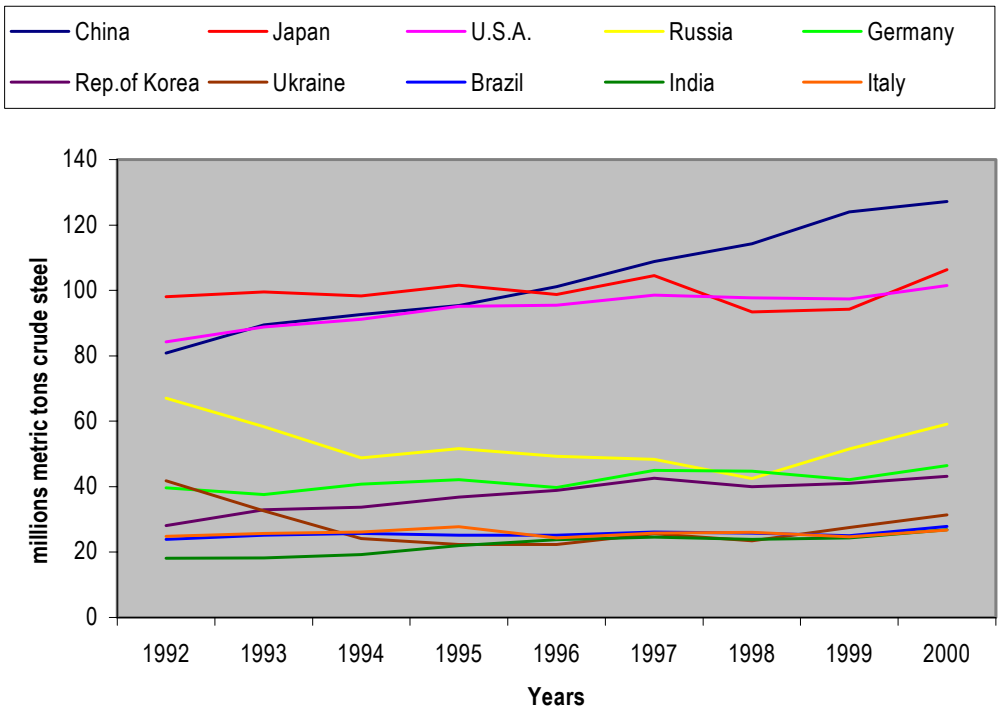
Figure 4: Steel Production in the Ten Largest Steel Producing Countries, 1992 – 2000



Source: International Iron and Steel Institute Reports

As indicated, the ten largest steel production countries are located in each continent, with four located in the Asian region.

Figure 5: Steel Output Trends among the Ten Largest Steel Producing Countries, 1992 - 2000



Source: International Iron and Steel Institute Reports

Of the ten countries, China shows a pattern of continual increase in output during the 1990s.

While steel production among the ten largest steel producing countries has been increasing during the 1990s, this pattern has not meant a greater concentration of steel production among these countries. In fact, the concentration has remained more or less constant during the last decade, as indicated in Table 11:

Table 11: Percentage of steel produced in the ten largest steel producing countries, 1992 - 2000

		Percentage of Steel Produced								
Country	**Year**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
China		11	12	13	13	13	14	15	16	15
Japan		14	14	14	14	13	13	12	12	13
U.S.A.		12	12	13	13	13	12	13	12	12
Russia		9	8	7	7	7	6	5	7	7
Germany		6	5	6	6	5	6	6	5	5
Rep.of Korea		4	5	5	5	5	5	5	5	5
Ukraine		6	4	3	3	3	3	3	3	4
Brazil		3	3	4	3	3	3	3	3	3
India		3	3	3	3	3	3	3	3	3
Italy		3	4	4	4	3	3	3	3	3

Source: International Iron and Steel Institute Reports

The overall concentration of production has remained almost constant at the 70 % of total steel production worldwide. Nonetheless, during the 1990s, China increased its production output in a marked way by 4 percentage points during the decade and it is likely that in the near future there could be a further concentration of steel production amongst this group. Such a development is more likely if India and Brazil realise their potential as steel producing nations and expand their production levels. However, it is also possible that the output from the US could decline, depending on the outcome of the current attempts by the US administration to support domestic production (www.steelbb.com *Steel Business Briefing*, 6 March 2002). There is also uncertainty about Russia and the Ukraine, and whether steel production in these two countries will continue to decline.

Thus, the major steel producing countries in the world are China, the US and Japan, with China emerging as the world's top steel producer during the 1990s. What is notable is that only two of the EU nations are among the ten largest steel producing countries, Germany and Italy.

Consumption by Country

The principal countries for the consumption of steel are China and the USA, followed by Japan, as indicated in Table 12.

Table 12: Ten Largest Steel Consuming Countries, 1994-2000 (m/t)

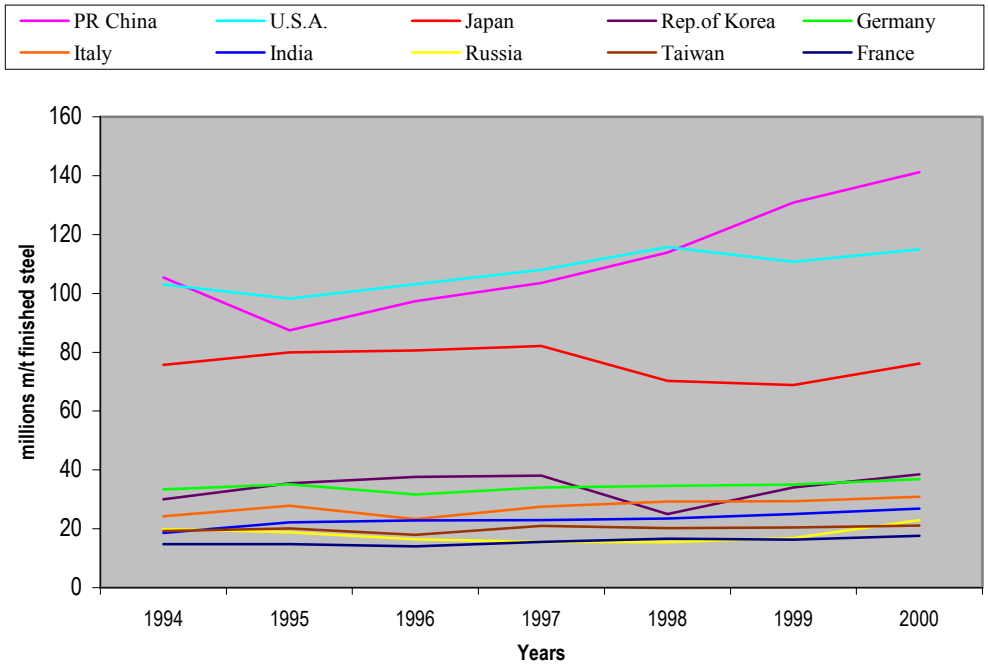
		Consumption (million m/t)						
Country	**Year**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
PR China		105	87	97	104	114	131	141
U.S.A.		103	98	103	108	116	111	115
Japan		76	80	81	82	70	69	76
Rep. of Korea		30	36	38	38	25	34	39
Germany		33	35	32	34	35	35	37
Italy		24	28	23	28	29	29	31
India		19	22	23	23	24	25	27
Russia		20	19	16	16	15	17	23
Taiwan		19	20	18	21	20	20	21
France		15	15	14	16	17	16	18
World Total		**635**	**648**	**655**	**697**	**693**	**713**	**769**

Source: International Iron and Steel Institute Reports

The steel consumption patterns more or less mirror the production patterns, with the largest producers accounting for the major areas of consumption. Nonetheless, Taiwan and France appear in the ten largest consuming countries although they are not among the largest steel producing countries.

What is of equal interest is that four of these countries have increased their consumption of steel to a marked extent, China, USA, Japan and South Korea, as indicated in Figure 6.

Figure Six: Consumption Trends for the Ten Largest Consuming Countries, 1994-2000



Source: International Iron and Steel Institute Reports

The dip in consumption for both Japan and South Korea in late 1990s can be accounted for by the economic reversal in these economies during that period.

Trade

These patterns are further complicated when trade patterns are considered. The major exporting countries are Russia, Japan, Ukraine and South Korea. The focus of Japan and South Korea, in particular, is on the USA and China. In turn the major importers of steel are the USA and China, followed by Italy and Taiwan. There was a sizeable trade surplus in Eastern Europe and the CIS and North America had a large trade deficit. States such as Taiwan, Hong Kong, Singapore and the Philippines represent another area where imports exceeded exports, and the countries that make up the Asian region, excluding Japan and China, constitute a significant market for steel producers in Eastern Europe and the CIS. Taking the analysis a step further, these trade flows reveal net trade surpluses on the part of Russia, Japan, Ukraine and South Korea, and a very large net deficit for the USA (for further details, see Sadler, 2001).

The emergent pattern of trade relations in steel between countries indicates the relatively precarious state of the industry. It is in this dimension that the importance of steel for particular national economies is revealed. It is also here that the consequences of over-production and the importance of trade relations for employment become apparent.

Employment

Not surprisingly employment patterns in the steel industry reflect the production patterns, as indicated in Table 13.

Table 13: Ten Major Steel Employing Countries, 1974 to 2000 ('000s)

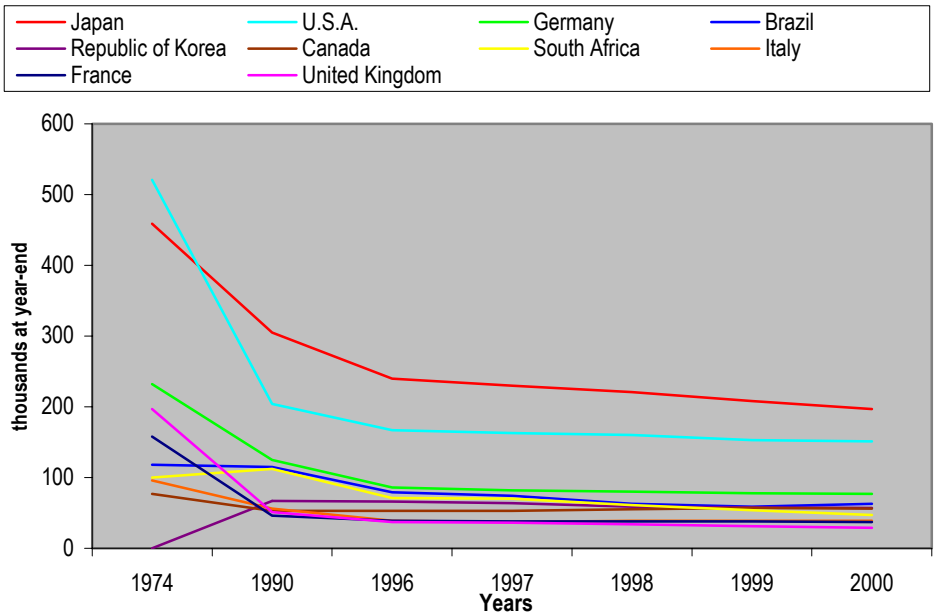
		Employment ('000s)						
Country	**Year**	**1974**	**1990**	**1996**	**1997**	**1998**	**1999**	**2000**
Japan		459	305	240	230	221	208	197
U.S.A.		521	204	167	163	160	153	151
Germany		232	125	86	82	80	78	77
Brazil		118	115	79	74	63	59	63
Republic of Korea		N/A	67	66	64	59	58	57
Canada		77	53	53	53	55	57	56
South Africa		100	112	71	70	61	54	47
Italy		96	56	39	37	39	39	39
France		158	46	39	38	38	38	37
United Kingdom		197	51	37	36	34	31	29
World total		**2,355**	**1,388**	**1,019**	**985**	**946**	**908**	**885**

Note: The figures for China are unavailable.

Source: International Iron and Steel Institute Reports

The striking feature of this history is the massive reduction in steel employment in these countries between the 1970s and 1990s. This trend is presented in Figure 7.

Figure 7: Trends in Employment in the Ten Largest Steel Employing Countries, 1974 - 2000



Source: International Iron and Steel Institute Reports

These trends are particularly marked in the established steel producing countries of USA, Japan, the United Kingdom. In contrast the developing countries have been expanding steel employment, and by implication steel production during the same period, especially in Brazil,

South Africa and South Korea. Nonetheless, these last three countries were also sharply effected by the economic uncertainty of the 1990s, reflected in marked declines in the numbers employed in the steel industry.

Section Three: World Steel Companies

The production of steel has largely been organised by major steel producing companies, most of whom were originally country based. Over the last decade and in line with the embrace of neo-liberal economic policies many steel companies have begun to reposition themselves as international companies, principally via merger and acquisition.

The ten largest companies in the world are listed in Table 14.

Table 14: The World's Ten Largest Steel Producing Companies, 1999 and 2000
(Millions metric tons crude steel output)

Company	Country of Origin	Crude Steel Output 1999 (million m/t)	Crude Steel Output 2000 (million m/t)
Nippon Steel	Japan	25	28
POSCO	Korea	27	28
Arbed	Luxembourg	22	24
Ispat International	N/A	20	22
Usinor	France	22	21
Corus	UK/Netherlands	21	20
Thyssen Krupp	Germany	16	18
Shanghai Baosteel	China	17	18
NKK	China	13	16
Riva	Italy	14	16
Group Total		**197**	**211**

Source: International Iron and Steel Institute Reports

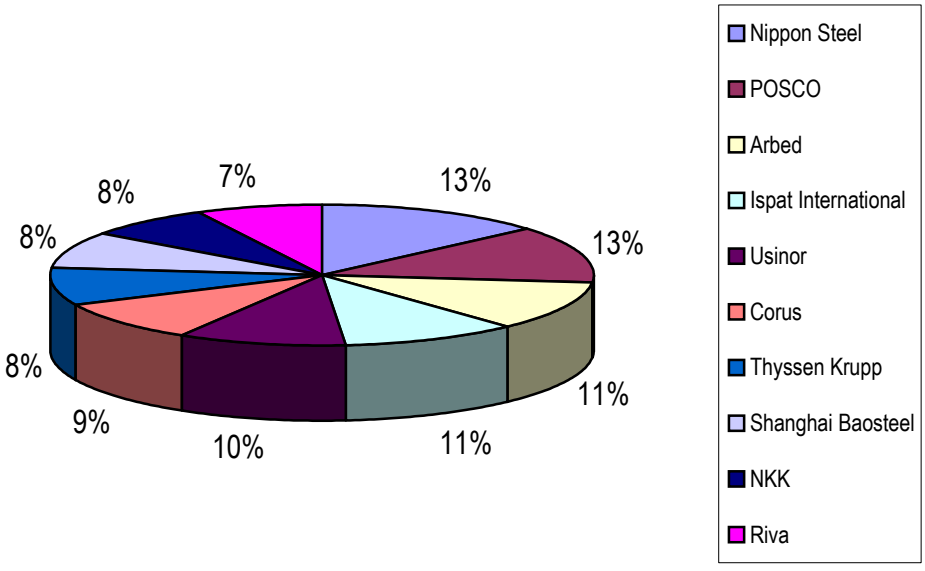
These companies have broadly similar outputs, as depicted in Table 15 and Figure 8.

Table 15: Total Crude Steel Produced by the Ten Major Companies Worldwide, 1999 and 2000 (million m/t)

	Steel Production (million m/t)			
Company	**1999**	**Rank**	**2000**	**Rank**
Nippon Steel	12	2	13	1
POSCO	14	1	13	2
Arbed	11	3	11	3
Ispat International	10	6	11	4
Usinor	11	4	10	5
Corus	11	5	9	6
Thyssen Krupp	9	8	8	7
Shanghai Baosteel	8	7	8	8
NKK	6	10	8	9
Riva	7	9	7	10

Source: International Iron and Steel Institute Reports

Figure 8: Total Crude Steel Produced by the Ten Major Companies Worldwide, 2000 (%)



Source: International Iron and Steel Institute Reports

The striking feature of this sequence of data is that the largest companies are located principally in Asia (four companies) and Europe (five companies), and ISPAT standing to one side. These companies are either country or regionally based, as is the case with Arcelor (Arceralia, Arbed, Usinor), Thyssen Krupp and Corus. The one exception to this pattern is that of ISPAT, which

unlike all other major steel producers is an international company, organising and operating as such. It appears moreover, that there is no longer a strong correlation between the size and coverage of company and country of origin, as both a producer and consumer of steel. It would appear to be the case that the largest steel producing companies are in the early stages of extending their activities beyond their original home bases.

ISPAT International is international in the sense that it is not tied to any one country in terms of production and nor does it have an historical national steel base, as does every other major steel producer. It is a company that is transnational to the extent that it meets the following criteria:

- Controls economic activity in more than two countries
- Maximises the comparative advantage between countries
- Has geographical flexibility
- Operates on an international rather than a national basis, with respect to financial, component and operational flows (adapted from Cohen and Kennedy, 2000,: 121)

In all other cases, the major companies fail to move beyond the first two criteria, especially the two Chinese companies, both of which operate only in China. However, it is likely that with increased mergers and acquisitions, a feature of the EU industry, companies will begin to approach the model transnational company, as they consolidate and extend their market reach, both geographically and in relation to the composition of steel output.

Summary

The level of internationalisation must not, however, be over-stated; it is primarily a 1990s phenomenon. Indeed, when we consider that the top ten largest steel operators account for less than 30 per cent of world steel production, whereas the ten largest producers of household appliances turn out 80 per cent of production and the ten largest automobile groups turn out up to 95 per cent, then the consolidation of steel production through internalisation is put into context. However, steel production is becoming concentrated amongst fewer (international) companies and that this type of 'internationalist' activity is becoming more widespread. This move towards centralisation is part of a wider process of restructuring, diversification and down-streaming activity in the steel industry, and in this regard steel producers have looked to develop more responsive and flexible operations.

Section Four: Technological Innovation and Adaptation in the Steel Industry

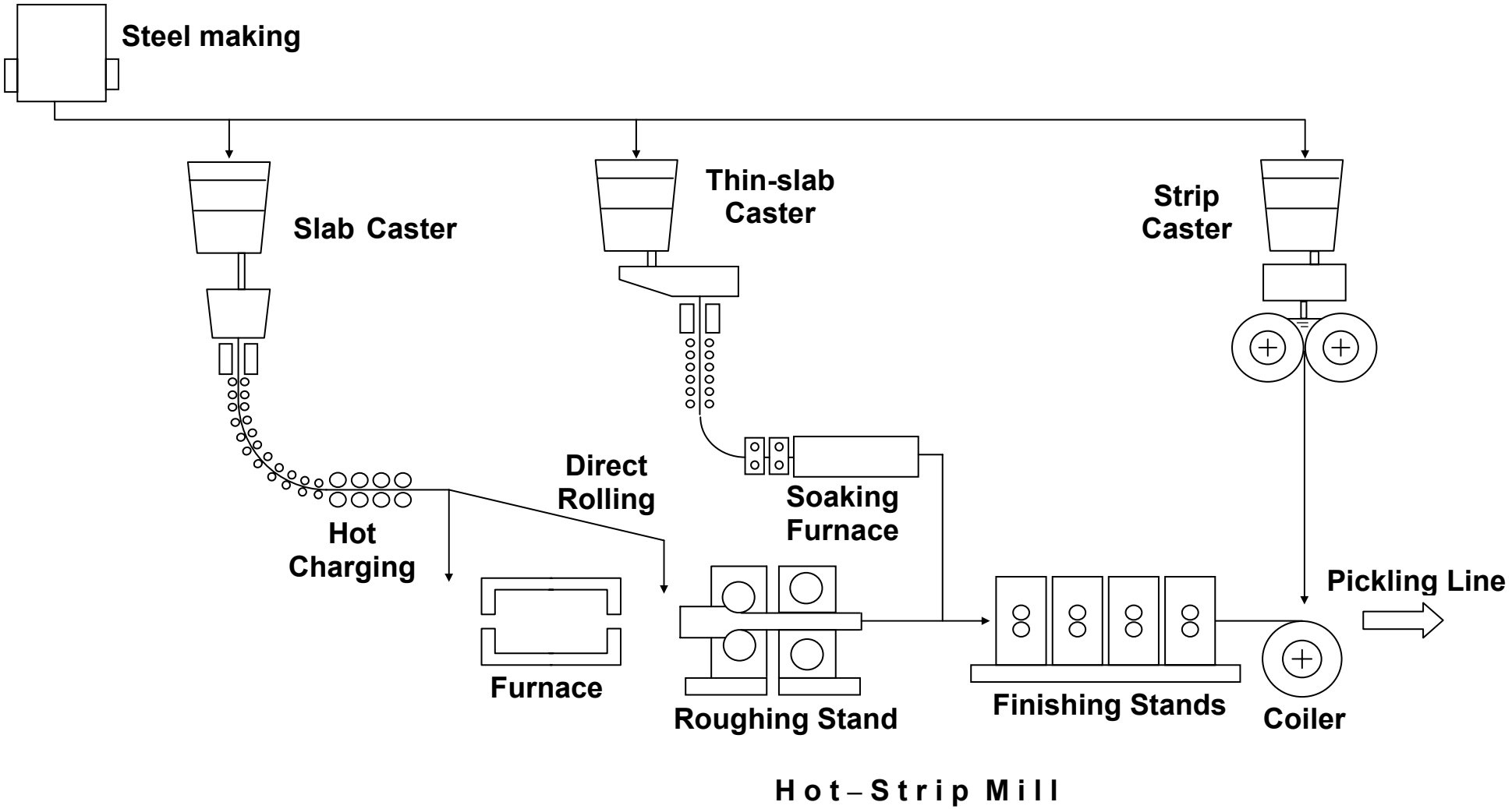
The other side to the changes taking place in the steel industry is that there is evidence that the industry is going through a period of substantial technological innovation, with the development of new casting processes, which will result in financial savings for companies and which has stark implications for employment levels in the industry.

Casting Processes

The broad pattern of change is that the established continuous casting processes, which have characterised steel production since 1936, are likely to be supplemented and replaced by two new technological processes that have been developed. These two processes are in the course of being introduced to steel plants around the world. The first is thin slab casting lines, using thin slabs of steel to produce the coil. This involves a shorter line than was the case in the past. The

second is strip casting where the previous processes of rolling and finishing are eliminated from the process of production. Both processes are depicted below in Figure 9:

Figure 9: Development of Continuous Casting Technologies



Source: Gibellieri, E. *The Future of Steel in Europe: A general overview of main trends, privatizations, mergers, technologies*, Presentation to Steel Conference, Cardiff University, April 2002

These new forms of hot strip steel production has resulted in substantial differences in this output of these two technologies and the production costs associated with them.

Table 16: Hot Strip Production - Comparison between Conventional and Thin Slab Casting Technologies

Steel Plants	Specific Investment Costs US $/tonne	Work Productivity Staff hours/tonne	Energy Consumption kw hours/tonne
Conventional Integrated Steelworks	875	2.5 - 1.5	465
Thin Slab Casting Mini-Mill	200	0.6 - 0.3	105

Source: Gibellieri, E. *The Future of Steel in Europe: A general overview of main trends, privatizations, mergers, technologies*, Presentation to Steel Conference, Cardiff University, April 2002

The investment costs associated with this form of technology are substantially lower than for a conventional integrated steelworks. To an important extent this reflects the size and scale of the two types of plants. In terms of production there is a marked difference between productivity levels. The thin slab mill consumes fewer staff hours per tonne than a conventional integrated steelworks. Similarly the energy consumption in the thin slab casting mill is less than a quarter of that consumed in the conventional integrated steelworks. However, rather than see these technologies as characteristic of different plants, a number of companies are introducing these new procedures in conventional integrated steelworks, as part of the overall production profile.

The scale of the introduction of thin slab production processes is depicted in the following tables.

Table 17a: Thin-Slab Casting Plants in Operation in North America, 2000

Country	Location	Company/ Company Base	Technology	Start-up	Capacity (Mt/y)
USA	Crawfords Ville	Nucor/USA	SMS – DEMAG	1989/7 – 1994/4	1.8
USA	Hickman	Nucor/USA	SMS – DEMAG	1992/8 – 1994/5	2.0
Mexico	Monterrey	HYLSA	SMS – DEMAG	1995/2 – 1998/9	1.5
USA	Mansfield	Armco	VAI	1995	0.8 - 1.2 SS
USA	Warsaw	Gallatin Steel	SMS – DEMAG	1995/4	1.0
USA	Butler	Steel Dynamics	SMS – DEMAG	1995/12 – 1998/5	2.2
USA	Riverdale	Acme Metals	SMS – DEMAG	1996/10	1.0
USA	Berkeley	Nucor/USA	SMS – DEMAG	1996/10 – 2000/4	2..4
USA	Delta	BHP/Australia	DANIELI	1997/1	1.4
Canada	Sault Ste Marie	Algoma Steel	DANIELI	1997/10 – 1997/10	2.0

Table 17b: Thin-Slab Casting Plants in Operation in Europe, 2000

Country	Location	Company/ Company Base	Technology	Start-up	Capacity (Mt/y)
Sweden	Avesta	Avesta-Sheffield	VAI	1988	0.5 SS
Italy	Cremona	ISP Arvedi	SMS – DEMAG	1992/1	0.7
Italy	Terni	AST/Italy	SMS – DEMAG	1992/12	Speciality Steels
Spain	Bilbao	ACB	SMS – DEMAG	1996/10	0.9
Czech Rep.	Ostrawa	Nova Huta	VAI	1997	0.8 - 1.0
Germany	Diusburg	Thyssen Krupp Stahl/Germany	SMS – DEMAG	1999/3	2.4
Netherlands	IJmuiden	Corus (Hoogovens)/UK	SMS – DEMAG	1999/10	1.5
Italy	Sabolarie	ABS	DANIELI		Test Plant

Table 17c: Thin-Slab Casting Plants in Operation in Asia, 2000

Asia	Location	Company/ Company Base	Technology	Start-up	Capacity (Mt/y)
Korea	Asan Bay	Hanbo Steel	SMS – DEMAG	1995/6 – 1995/9	2.0
Korea	Kwangyang	Posco MM 1/South Korea	SMS – DEMAG	1996/8 – 1996/10	2.0
China	Zhujiang	Zhujiang Steel/China	SMS – DEMAG	1998/8	0.8
Thailand	Chomburi	NSM Chomburi	SMS – DEMAG	1997/11	1.2
Malaysia		Megasteel	SMS – DEMAG	1998/12	2.0
China	Handan	Handan I & S	SMS – DEMAG	1999/12	1.2
India	Dolvi	Nipp. Denro Ispat*	SMS – DEMAG	1998/4 – 2000	2.0

Table 17d: Thin-Slab Casting Plants in Operation in Africa, 2000

Africa	Location	Company/ Company Base	Technology	Start-up	Capacity (Mt/y)
South Africa	Saldanha	Saldanha Steel	SMS – DEMAG	1998/6	1.4
Egypt		ANSDK	SMS – DEMAG	1999/12	1.0

Notes: * Consortium, country base refers to the dominant/majority partner.

Source: Gibellieri, E. *The Future of Steel in Europe: A general overview of main trends, privatizations, mergers, technologies*, Presentation to Steel Conference, Cardiff University, April 2002

The introduction of thin slab casting processes into steel plants is proceeding at an increased pace. After a relatively slow beginning, in 1988 (Sweden) and then Nucor (USA) in 1989, such plans have been established in the key areas of steel production in the world.

In contrast, the strip casting method of production has its origins in the Asian region in the mid-to-late 1990s. This area is now central for the practical implementation of this new technology.

Table 18: The Development of the Strip Casting process, 2000

Country	Location	Company	Type	Thickness (mm)	Weight (tons)	Speed (m/min)
North America						
USA	Lockport	Allegheny/VAI	TdR	1-3	18	9-72
Europe						
France	Isbergues	Ugine	TwR	1.5 – 4	90	10/70
Germany	Krefeld	Thyssen Krupp Stahl-USINOR (now Arcelor)-VAI	TwR	No data	No data	No data
Germany	Unna	Thyssen Krupp Stahl	TdR	1.5 – 4.5	1	5-60
Italy	Terni	AST/CSM/VAI	TwR	2 – 5	60	50-80
Sweden	Luleå	MEFOS	SB	7 – 15	4	12-30
United Kingdom	Teesside	BS-Avesta	TwR	2.3 - 5.5	No data	20
Asia						
Japan	Hikari	NSC/MHI	TwR	2 – 5	60	30/80
Japan	Kawasaki	Nippon Yakin	TwR	1 - 2.5	No data	40-50
Japan	Chiba	Kawasaki	TwR	1 – 3	3	10
South Korea	Pohang	POSCO RIST	TwR	2 - 6	10	40-70
Australasia						
Australia	Port Kembla	BHP/IHI	TwR	2	25	12-25

Notes: TwR=Twin Rolls; TdR=Two Rolls of unequal diameter; SB=Single Belt Roll

Source: Gibellieri, E. *The Future of Steel in Europe: A general overview of main trends, privatizations, mergers, technologies*, Presentation to Steel Conference, Cardiff University, April 2002

The two principal regions where strip casting procedures have been introduced are Europe and the Asian region. Given the logic of the production processes involved in this new procedure there are likely to be further savings and efficiencies for companies with this technology as there was for the thin slab casting in relation to the continuous casting processes.

Near Net Shape Production

These recent developments in steel production are complemented by move towards adapting and extending production output toward near net shape (NNS) products. This is the production of goods in a tailored form for the customer; for example the production of car body blanks for more immediate use by automobile producers.

These developments have the advantage of achieving cost reductions for manufacturing, within the process of steel making and manufacture. Such innovations enable manufacturing times to be reduced, as well as machining and fabrication of products (Folonari, 1998: 315).

Such forms of production are likely to increase as major steel companies look to embed their output in relation to highly competitive markets in manufacturing. The advantage of this form of downstream activity is that it both removes the requirement, previously born by the manufacturer, of machining and fabrication before use and it enables more rapid manufacture of goods.

The production of net shape parts by steel producers requires further attention to the final production areas in steel plants. Such developments will result in more complex and technologically rounded processes of production, with implications for workforce skills, the organisation of production, and relations with the purchasers of steel products.

Summary

Technological change and adaptation in itself does not herald a new or different industry. What is important in the world steel industry is that the recent changes in the technology of productions take place in the context of a very different economic and political world in the 1980s and 1990s when compared with the earlier period. Steel producing companies now operate as international companies, although by and large not as global companies. Part of this change has been a recognition of the importance of market relations, and in particular the destinations for steel goods, within manufacturing. It is in this constellation of relations that the recent technological developments in casting and the increased attention to downstream activity acquire significance for the future.

Section Five: Assessment

The world steel industry can be characterised as international in form but national in substance. From a background where most companies were state-owned, where the steel industry was seen by governments as a strategic industry, and where the industry was regulated as a national industry, it has been privatised and deregulated. This development, throughout the 1980s and into the 1990s has created the conditions for an increasingly international industry. In this respect, it is an industry where export and import has become a marked and increasing dimension of the world industry.

These developments have occurred in the context that there is a concentration in steel production in a relatively small number of countries. While this concentration has been stable over the last decade it can be expected that it will begin to change, possibly becoming more concentrated rather than less as company mergers and acquisitions increase. The drive towards an industry characterised by international trade relations comes from the period when the nationalised and regulated steel companies were privatised and de-regulated. This development provided the impetus for these companies to look beyond their national boundaries for markets. Since it is a relatively labour intensive industry, the pressure has been on companies to increase productivity, and to consider mergers and acquisitions as a way of extending the production base for these companies, as well as opening up other national markets. The corollary of these developments is that there has been pressure on companies to create the conditions to further automate and mechanise production as

well as centralise production in to fewer facilities than was the case in the previous period. As a result from the 1980s onwards there has been a major reduction of steel work employment, particularly in the advanced industrial countries but also in the former Soviet Union, with devastating consequences for steel workers and their communities.

What this pattern of restructuring amounts to is an increasingly internationalised industry but one where companies have tended to reorganise in terms of regional trading blocs, rather than as genuine transnational companies (Dicken, 1992: 47). One consequence of this pattern of change is that the potential for state regulation of trade relations to protect national companies remains high, illustrated by recent initiatives by the US Administration. The USA industry has undergone extensive changes over the last two decades, with the emergence of mini-mill production as a major component of steel production in the USA and an integrated steel production segment, where there has been limited technological modernisation. An outcome of the stagnation of the industry has been that the large integrated mills are threatened by cheap imports, particularly from the Asian region, resulting in the US Bush Administration imposing three-year tariffs of 30% on imports most flat steel products in early 2002 to protect the industry (Steel Business Briefing, 6 March 2002). This decision will mainly impact on imports from the Asian region, but will have knock on effects on the European steel industry

Thus while the world steel industry is becoming international in its focus and trade relations, companies remain geo-regional in their organisation and operation. In this respect the EU steel industry is at the centre of the changes that are taking place. These changes are the subject of Report Four.

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