4

KONINKLIJKE HOOGOVENS IN ITS TERRITORY: A BIRD'S-EYE VIEW

"On 31 May 1917 a number of leading figures of the manufacturing industry, the transport system, and the banking system entered into the 'Committee for the formation of a Blast Furnace and a Steel and Rolling mill in the Netherlands.' The committee's terms of reference were the establishment of a steel industry in our own country. After the government has expressed interest and, if necessary, its willingness to provide financial support, the necessary steps could be taken to raise the capital required. The amount of capital was estimated provisionally at 25 million guilders." (Annual Report 1918-1919, translated from Dutch)

1. INTRODUCTION

So far, this dissertation has introduced the challenge of explaining the coming into being of a firm's resources within their territory, a conceptual process model facilitating that understanding, and a theory of method for actually confronting this challenge.

In emphasising the formation of a firm's resources within the field of strategic management, the key challenge is that of linking up resource formation both within the firm and between the firm and its territory. An example of the former is the development of a specific process innovation by a steel company. An example of the latter represents the development of the aforementioned specific process innovation in relation to other process innovations in the steel sector and the development of the sector survival path.

Under the banner of the resource-based view, as introduced in chapter 2, most publications theorise at a 'safe' distance from the actual activities of a firm. The word 'safe' in this context means that the scientist does not have to go beyond broad observations such as qualifications of superior resources (valuable, rare, imperfectly imitable, etc.), or qualifications of resource contexts (interfirm heterogeneity, imperfectly mobile resources, etc.).

Explaining the formation of resources demands "deep knowledge" of both the steel and aluminium company and its territory or sectors. This deep knowledge is of course difficult to obtain for an academic researcher with limited time. This does however appear to be the road to travel in order to confront the challenge of the coming into being of resources. This chapter will introduce the firm and sectors that are central to this dissertation.

First (in the second section), the "world of steel" will be introduced to the reader. The central question of this section is: In what way are the steel resources of Koninklijke Hoogovens linked to the steel sector it is in? Because Koninklijke Hoogovens plc is a steel and *aluminium* company, the linkage of aluminium resources to the aluminium sector will be addressed in the third section. This section will highlight the differences between the steel sector and the aluminium sector. A firm's territory (such as the steel sector and the aluminium sector for Hoogovens) is set in interaction with competitors, customers and institutional parties (banks, etc.). These are not given settings, but negotiations of resources-available (to the firm, for example) and resources-needed (to function, to compete in the sector).

In the fourth section a *general* description of the coming into being of Koninklijke Hoogovens plc through time will be provided, touching on its incorporation, major investment periods and turning points. Most of these basic insights were drawn from the analysis of the annual reports. This chapter on Hoogovens within its sectors will serve as a stepping stone for a more *detailed* analysis of the resource formation in the next chapter (chapter 5 "The 'becoming' of Koninklijke Hoogovens plc").

2. The World Of Steel

To a large extent the territory of Hoogovens is made up of the steel sector. Until 1964 Hoogovens was an integrated "steel-only" company, which in the spirit of diversification moved into aluminium, as well as many other activities. This section sets out to introduce and describe the "steel part" of Hoogovens' territory and will highlight characteristics which play an important role in the formation of steel related resources.

The steel sector is a large - ever more global - market in which more than 750 million tonnes of steel are involved (in value more than 375 billion dollars). Technology is very important in this business. The following atmospheric description of a (mini) steel mill by Leonard-Barton (1995:6) might give the reader an idea of the impressiveness of the technology:

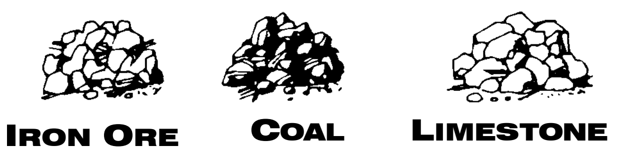
> "Visualize a steel mill: the mammoth hollowed-out foundry building is as big as an airplane hanger. The air is so heavy with the stench of hot steel you can taste iron and carbon on your tongue. Indoor lightning flashes as electrodes liquefy old car bodies into a 3,000-degree-Fahrenheit bath. Burly workers look puny and hellishly vulnerable besides a two-storey high pot of molten metal so hot that a splash would explode if it hit the floor. You are struck by the awesome fury of barely contained churning liquid as it is poured through a constraining, forming mold."

Besides being impressively big, a steel mill is also impressively precise. The production process starts with inputs shipped by bulk carriers (iron ore, etc.); a blast furnace at Hoogovens produces more than 3 million tonnes of iron; and the No. 2 basic oxygen steel plant produces 2.5 million tonnes of crude steel.

However, these large volumes of iron and steel will be "hot rolled" and "cold rolled" to steel strip with a thickness of 0.2 mm or less. Consequently, tiny particles in the blast furnace ultimately will create pinholes in the strip, emphasising the necessity of a "clean steel practice" in a steel strip mill. Another example of steel strip mill precision is the hot-rolling mill where a temperature fluctuation of a few degrees of the steel strip in a rolling train of several hundred metres will produce divergent characteristics in the output. In spite of this, steel has been ranked as a low-tech product. Personal computers, conversely, have been ranked as high-tech. In visiting a steel production plant and a computer production plant, it becomes clear that this distinction is based on output, not on process. Hoogovens emphasises the distinction between high-tech ways of doing v. low-tech ways of doing. This distinction hits home when studying the (high-tech) character of a process industry such as the steel industry (e.g. Porter, 1985). Because of the importance and impact of production process machinery, as shown later in this chapter, technology and strategy within the steel sector cannot be separated. As a consequence, the basics of producing iron, steel and steel products will first be outlined in order to provide the reader with a frame of reference. Without such a frame of reference it is impossible to reason about "real" features of resources in the steel sector.[i] Next, change and continuity within the steel sector *over time* will be highlighted.

2.1 THE "BASICS" OF STEEL

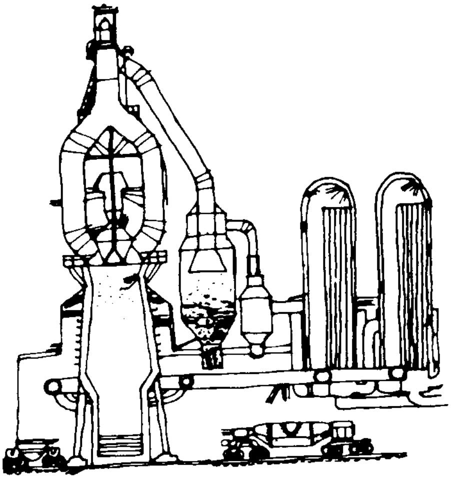
When explaining the basics of steel, it is appropriate to explain the ways of producing steel and steel products. Basically, the traditional route since the 19th century is the *integrated mill*. The adjective "integrated" when applied to a steel mill refers to the full range of production steps needed to convert basic inputs (iron ore, etc.) into end-products (e.g. hot rolled, cold rolled and coated steel sheet). The production process starts with three raw materials, most commonly *iron ore*, *coal* (coke) and *limestone* as the charge of the blast furnace.



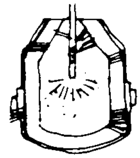
adapted from Hogan (1987:16)

[i] This firm assertion is based on the influence of this (technological) frame of reference on the entire argumentation of this dissertation. The concepts of strategy path and sector survival path are based on exploring the ways of producing and selling iron and steel in the steel sector.

Adding to the complexity of the process, a key element in the performance of a blast furnace is the composition and fragmentation of its charge. Iron ore, coke (produced from coal in a coke plant), and limestone will be sintered in order to standardise fragmentation and proportion of iron[ii].



BLAST FURNACE

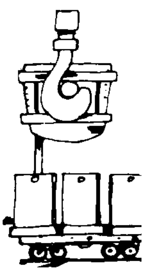


BASIC OXYGEN FURNACE

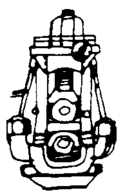
adapted from Hogan (1987:16)

Nowadays, the preparation phase of an average integrated mill will consist of a sintering plant, a pellet plant, coal-crushing plants (for pulverised-coal injection in blast furnaces), and coke plants. The well-prepared inputs are loaded into the top of the blast furnace by large cranes.

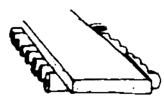
A *blast furnace* is a large vessel in which iron is reduced from iron ore. At the bottom of the vessel liquid iron is tapped from the taphole into a torpedo, or wagon train, and transported to the basic oxygen plant (in some integrated mills there are also electric arc furnaces).



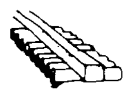
INGOT CASTING



SLABBING MILL



SLAB



BILLET

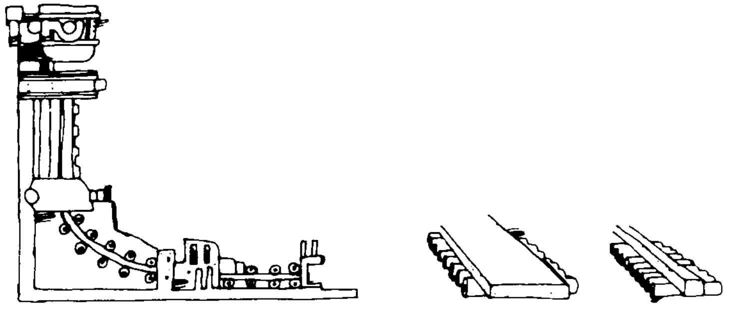
adapted from Hogan (1987:17)

[ii] Sinter is produced in a sintering plant by way of "baking" ferriferous breeze (iron ore), limestone grit, and coke breeze into a cake. This cake will be broken into pieces. Iron ore can also be crushed to breeze and consequently bound into pellets (balls) in order to advance the blast furnace process.

In the *basic oxygen plant* steel scrap and liquid iron are loaded into a large converter (300 tons) and subsequently pure oxygen is blown into the converter through an oxygen lance in order to lower the carbon content to create steel.

Until the end of the 1960s, steel used to be cast into ingot moulds. Once these had sufficiently cooled (which took a day or two) they were reheated and rolled into *slabs* or *billets* by a *slabbing* or *ingot breakdown mill*.

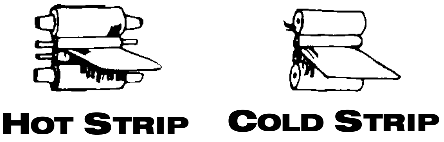
Since the end of the 1960s/early 1970s *continuous slab-casting* has become a genuine alternative to ingot casting and subsequent slabbing. Although continuous casting has been present since the 1950s (e.g. Ghemawat, 1993; Nijman, 1993) it was not a feasible economic alternative for a brown-field situation (existing integrated plants).



adapted from Hogan (1987:17)

Only when Nippon Steel adjusted the process and corrective actions such as surface adjustments were no longer needed did it become a valid alternative for steel strip mills. At this moment about 90% of steel production is continuously cast (Hogan, 1994:3). Ideally, the (red) hot slabs coming out of the continuous caster will be immediately hot rolled: a so-called hot-link. However, in many brown-field situations this has been difficult to create because a hot rolling mill, for example at Hoogovens, is a factory plant 800 metres long. Hence the location often prohibits a “hot link”.

Consequently, in many integrated mills slabs are reheated before entering the hot-rolling process and subsequently rolled from about 22 mm to 1-2 mm. The quality and the character of the steel strip coming out of the hot rolling mill are mainly determined by the computerised and manual tuning of the different roll stands with reference to rolling speed and temperature. Consequently, hot rolling is not only designed to flatten steel slabs to strip but also to create typical steel characteristics. The hot rolling mill is a spectacular power phenomenon. Hot steel strip “doing” 80 kilometres an hour at the end of the plant all at a perfectly controlled constant temperature illustrates the high-tech method of producing steel. Hot-rolled products are considered the first category of "end products" of an integrated mill. However, a large percentage of hot strip will be cold rolled as well.

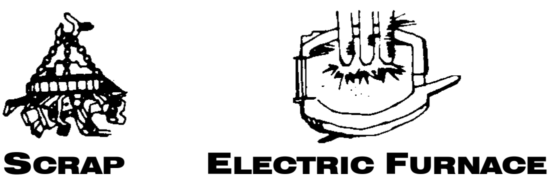


adapted from Hogan (1987:17)

Compared with the hot rolling mill, the cold rolling mill is a less spectacular process. Here the fine-tune-rolling takes place in order to produce steel strip for higher grade applications (automotive, can stock, etc.). Cold-rolled products represent the second category of "end products" of an integrated steel mill. Nowadays, ever more cold-rolled products (strip) (>65%) will be coated with zinc, chromium, or organic coatings in order to protect steel from corrosion.

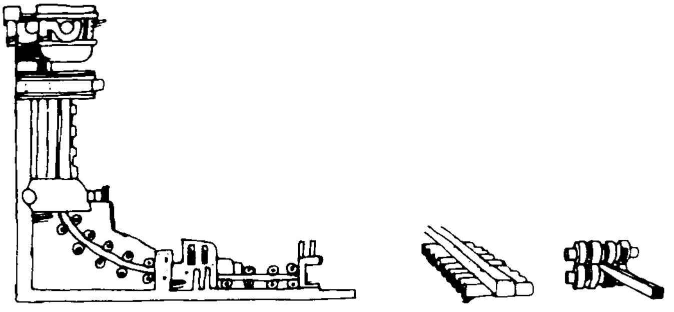
The integrated steel mill is a large capital intensive configuration of factories, which as a whole form the production process of transforming raw materials into (intermediate) steel products, such as iron, steel (slabs), hot strip, cold strip and coated hot and/or cold strip.

Having to deal with several conditions such as capital intensity, time-lag and economies of scale, a new "reality" emerged within the steel sector in the 1960s: *the minimill*. The minimill refers not so much to the scale of its operation as to the fact that a minimill's production entails only *part* of an integrated mill's operation (Smith, 1995). A minimill uses steel *scrap* as its raw material instead of iron ore, coke and limestone as in an integrated mill, thus skipping this first capital-intensive production phase. However, the quality of the steel of a minimill is largely dependent on the quality of the steel scrap, and the quality of the steel scrap is related to the price of the scrap.



adapted from Hogan (1987:10)

Until 1987, minimills were unable to produce quality steel strip. However, minimills did take over a large share of the integrated mills in the so-called long steel products, a product category in which surface quality is secondary to strength. In a minimill, so-called billets are hot rolled to bars, rods and structural shapes. In the USA between 1960 and 1993, integrated mills lost one third of their market share to minimills, hence illustrating the success of the minimill (Smith, 1995).



adapted from Hogan (1987:10)

In the 1980s, the leading minimill corporation Nucor, USA (Ghemawat, 1993, 1995) entered the strip market by way of a new innovation called "thin slab casting". It started off producing a relatively low quality strip, but quality has increased ever since. The minimill serves as a good example of a distinctive cognitive reality (see chapter 2, §3.3.2) which consequently changed much of the objective reality as well!

Because of inroads made by minimills, there is a growing trend towards more flexible lower-volume plants, such as smelting-reduction and near-net shape casting (technologies capable of shortening the process route). Until now, efficient integrated steel mills have needed a volume of between 5 and 6 million tonnes. The adoption of new technology by integrated mills might move the efficient scale towards 2.5 million tonnes of capacity[1].

2.2 CHANGE AND CONTINUITY IN STEEL

One might wonder if the aforementioned Nucor minimill for steel strip is a sector development or a firm-level success. Ghemawat (1995) explains Nucor's success as a firm-level success (i.e. created by management) and not by way of "an aggregated explanation" (industry or strategic group) because Nucor's performance is the *exception* to the stable industry rule. Ghemawat (1995:688) argues

> "Nucor's superior financial performance is better explained at the strategic group (minimill) level than at the industry (steel-making) level but mostly remains unexplained, implying the importance of firm-level differences".

Taking an American view of the sector, Ghemawat's conclusion would appear correct. However, taking a more global view might add to the explanation of Nucor's performance and the performance of the US steel sector. Nucor and other minimills have been far more successful in the USA than in Europe and Japan. An alternative explanation might be the "sloppy" performance of "US Big Steel.

Change in the steel sector and the possibility - and the ease - of changing steel-related resources are closely connected. Leonard-Barton (1995) illustrates this well in her book *Wellsprings of knowledge: Building and Sustaining the Sources of Innovation*. Reasoning about resources is often connected to reasoning about the strengths or capabilities of the firm, not its weaknesses. Leonard-Barton also explains the flip side of capabilities: rigidities. The steel sector had and has its share of in-built rigidities. Some of these rigidities are institutionalised at the sector-level, some at the firm-level.

Sector-level rigidities are closely connected to the capital intensity and the life-span of integrated mill assets. Choosing the "wrong" innovation (i.e. not the one that becomes an industry standard) might hurt a company for the next decade or two. Ghemawat (1993) explains that from a decision-theory perspective there is what has been called a cannibalisation, or replacement, effect for an incumbent firm, which makes it difficult for a decision once taken to be reversed. In other words, a certain innovation might be very feasible and profitable when reasoning from a greenfield situation (an entrant company), while at the same time it remains out of reach in terms of economic feasibility for the incumbent firm because of the sunk costs of previous investments. This is an important reason why change in the steel sector is often initiated by relative outsiders or entrants (e.g. South Korea's POSCO) and why strategic groups and localities change over time (e.g. Tushman & Anderson, 1986).

Change in these strategic or geographic groups has several dimensions. Strategic groups have been defined as "a group of firms within the same industry making similar decisions in key areas" (Reger & Huff, 1993) or having similar assets, strengths and competencies (McGee et al. 1995). Räsänen and Whipp (1992) added to this that these kind of groupings are a historical formation often linked to certain geographic locations. Besides being a global market, the steel sector has several distinguishing geographic groups.

Although different business recipes have emerged in different geographical groups within the steel sector, a technological view shows a greater degree of uniformity within the steel sector. Moreover, there are interactive aspects between technological and geographical groups in the steel sector.

Several propositions concerning the question in what way are a firm's resources linked to the sector it is in, explain "parts" of the influence of the sector. We have seen that the steel sector prescribes a number of essential resources, but that it also enables a firm if it is willing and transformative to act otherwise, as was the case with Nucor. Over time, however, some interesting dynamics come to the surface concerning the path of the coming into being of a firm's resources. During a firm's specific commitment to a certain type of production technology resources will be developed automatically because of learning and repetition. As mentioned above several characteristics of the steel sector lead to a long-term commitment by a firm to a certain strategy and sector survival path.

2.2.1 Structural Dynamics Of Steel

Traditionally, the steel-based literature is divided between the Industrialised Countries (North America (USA and Canada), Japan, and the European Union (EU)), the Communist Block (Soviet Union and several Eastern European countries) and the Developing Countries (Brazil, China, India, South Korea, Taiwan, and Turkey) (e.g. Hogan, 1994).

Considering all the political and economic change that has taken place, this division is no longer relevant because “developing” countries, such as South Korea, Taiwan and Brazil, have also become industrialised in terms of a steel production and are very competitive in the steel sector. For example, the South Korean steel company POSCO ranks among the largest in the world. Figure 4-1 on page 97 illustrates this process of industrialisation, as well as the opposite process of the former communist bloc in percentages of world production of crude steel. China (included among the developing countries) is also a fast-growing steel-producing country. In 1995 China was the third-largest steel-producing country in the world; in 1997 the largest.

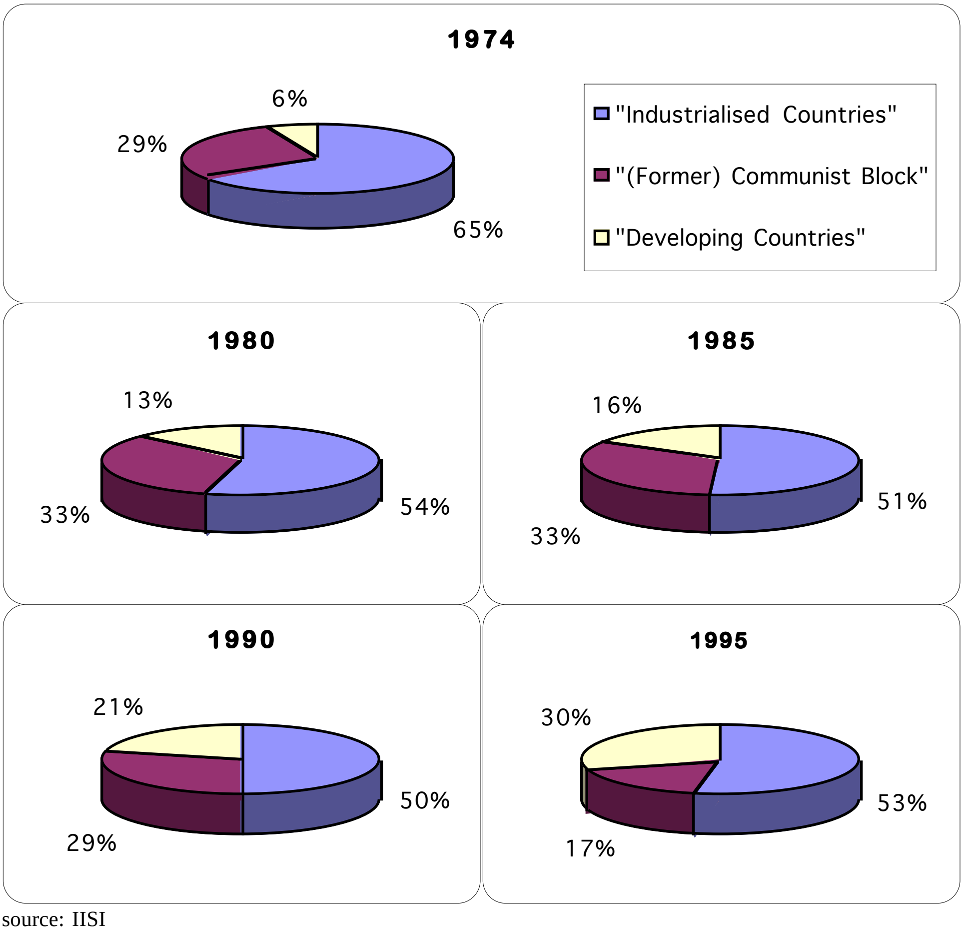
National industrial growth and the national steel-producing capacity seem to be closely related. Industrial growth depends vitally on steel products and a number of other “essentials” to which a country will normally wish to have easy access. Consequently, steel industries have been the focus of political interest (e.g. Oberender & Rüter, 1988). The foundation of Hoogovens in 1918 was also initiated under the banner of national industrial growth and the necessity of having a national steel industry (De Vries, 1968). In 1967, when both the U.S. Export/Import Bank and the World Bank concluded that it was too early for South Korea to start a steel mill, Korea’s government decided to start it anyway (Hogan, 1994; D’Costa, 1994).

Having a national steel industry would it seems still resembles a “batch” of industrialisation. For example, the first reason given for the enormous growth of Chinese steel capacity (from 21 million metric tons in 1974 to 92 million metric tonnes in 1995) was: “China is going to be a modernised country” (Hogan (1994:48) quoting a speech given by Wang Gong Cheng in 1993) implying the relationship between being modern and having a steel industry.

The question, however, pertinent to this dissertation’s fascination with the coming into being of resources is: How is it possible to start a steel industry from scratch, when there are already very experienced steel companies close by? There are a number of answers to this question from several disciplines, such as economics, sociology and technology, etc.

The main obstacle or entry barrier to entering the steel sector is capital or access to capital. Building integrated steel capacity is a capital intensive activity. Once capital is available there are several specialist companies (for example: Hoogovens Technical Services Ltd.[iii]) that build modern steel plants and train personnel in operating these steel plants. Furthermore, in building these steel plants in a greenfield situation an ideal production lay-out can be achieved, thus promoting the competitiveness of the new steel plant in terms of cost efficiency. In the national, "company friendly", environment the national steel industry will be able to mature. This example illustrates the difficulty of the "experienced" steel companies of these world. The accessibility of mainstream technology in the steel industry is a definite drive to conform.

FIGURE 4-1 STEEL PRODUCTION IN 1974, 1980, 1985, 1990 & 1995[iv]



source: IISI

World-wide, the past 10 years have seen a rather stable market share for the integrated mill, with its Basic Oxygen Furnace (BOF), a growing market share for the minimill (EAF) and a fading market share for the Open Hearth

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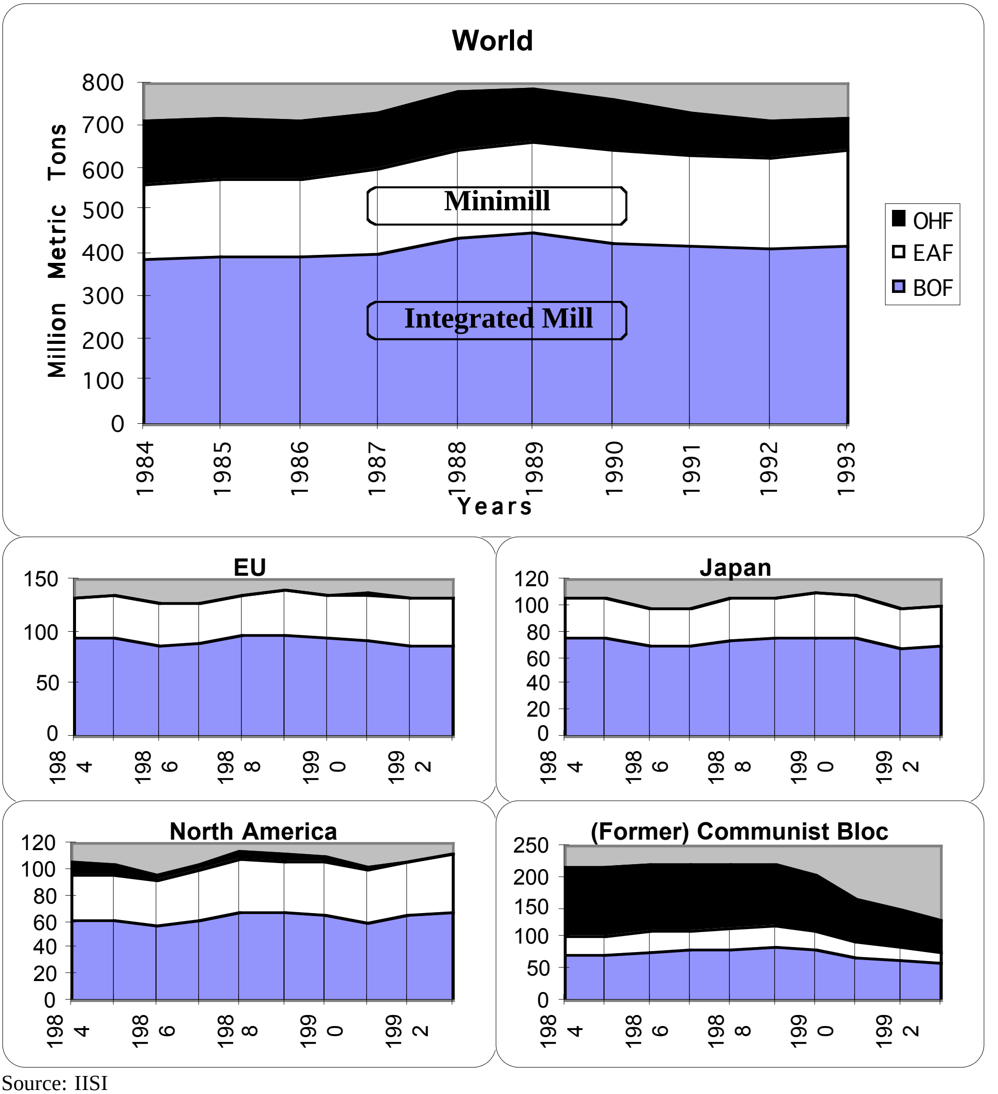
[iii] Hence illustrating the openness of the steel sector. In answering the question: why help creating new competitors, Hoogovens' answer is: "if we don't do it, somebody else will!"

[iv] The year 1974 has been chosen instead of 1975 as the latter proved to be a major economic downturn.

Furnace (OHF). The latter is a steelmaking technique of olden days and is technologically speaking a dead-end street.

FIGURE 4-2 GEOGRAPHICAL DISTRIBUTION OF PROCESS TECHNOLOGY



Source: IISI

Figure 4-2 on page 98 illustrates the differences in market share of these three techniques with reference to four geographical groups. A striking feature is the large market share of OHF in the former communist countries and the relatively large share of EAF's in North America. A possible explanation of the former is the centrally planned economy (until 1990). A possible explanation of the high share of EAF's in North America might be the previously mentioned sloppy state of the integrated mills, as well as different production factor conditions (scrap prices, etc.). However, Figure 4-2 shows two relatively large and consistent *sector survival paths* that are "accessible" in the steel sector.

2.2.2 Steel Sector Survival Paths

The geographical distribution of process technology clearly illustrates three "forces" of the sector, as defined in chapter 2, §4. The steel sector was *enabling* or conducive towards the electric arc furnace in minimills. It is perhaps somewhat *limiting* or restrictive with respect to the stabilisation of the integrated mill, but imposes ever greater pressure (*enforcing*) for the replacement of the open hearth furnace.

A sector survival path, as put forward in chapter 2, is a sector's course through time based on the fusion of the objective reality of resources, the cognitive reality of perceptions and the interactional reality of collaborative and competitive relationships. The most basic "decision" in the steel sector comes down to the choice in favour of either the blast furnace-based integrated mill or the EAF-based minimill. Other key decisions are the choice in favour of basic oxygen steel, continuous-casting and product category (long products or flat products[v]), etc.

The differences between the integrated mill and the minimill are manifold. First, the capital intensity of an integrated mill is much higher. Secondly, the number, capacity and complexity of integrated mill plants are much higher. Thirdly, the expansion of integrated mills is only possible in large inflexible increments. And fourthly, integrated mills have a large product-range. Minimills, on the other hand, have the qualities of a small entrepreneurial company: small, fast, flexible, innovative. Recently, European integrated mills changed their large hierarchical functional organisations into smaller business unit organisations with more qualities of entrepreneurial organisation. However, the integrated mill and the minimill form two distinct sector survival paths leading to success.

Furthermore, there are important contextual variables, such as the local prices of inputs (scrap, natural gas, electricity, and/or coal), location (seaport or not), capital market and growth perspective influencing the possibility and profitability of a sector survival path.

Besides these "objective" arguments the choice for either minimill or integrated mill refers also to "cognitive" arguments. US-based literature on the steel sector (e.g. Hogan, 1987, 1994; Barnett & Schorsch, 1983, Stubbart & Ramaprasad, 1988, etc.) takes the minimill much more seriously than European and Japanese-based literature (e.g. Hudson & Sadler, 1989; O'Brien, 1992; Takeuchi, 1992). In a research project involving the analysis of schematic knowledge of David Roderick (Chairman of the integrated steel manufacturer

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[v] In this dissertation the focus will be on flat products. In the market of long products the market share of minimills is higher.

U.S. Steel/USX) and Kenneth Iverson (CEO of the minimill Nucor), Stubbart and Ramaprasad (1988) illustrated that a company's environment cannot be separated from the observer. Their research concluded in both qualitative and quantitative terms that Iverson's public speeches "attribute much more control to domestic steel companies", whereas Roderick's public speeches considered domestic steel companies as nearly helpless and argued: "their fate is controlled by distant, malevolent forces" (1988:157).

Leading integrated mills in Europe seem to be much more confident about their fate. In all the 78 annual Hoogovens reports, the term "minimill" is referred to only twice and then in a neutral, non-threatened way:

> "a business unit called 'Hoogovens Long Products' was formed as part of the EMP [extra package of measures]; this will enable the company to operate more effectively in the market and to strengthen its competitive position vis-à-vis the western 'mini-mills'." (Annual Report, 1992)

> "In addition, Hoogovens is closely associated with the new technology of thin slab casting and rolling (often associated with 'mini-mills') through a joint venture with the only European operator of a plant of this kind." (Annual Report, 1994)

In taking a cognitive view of the steel sector, the minimill and the integrated mill form two distinct "recipes" for success.

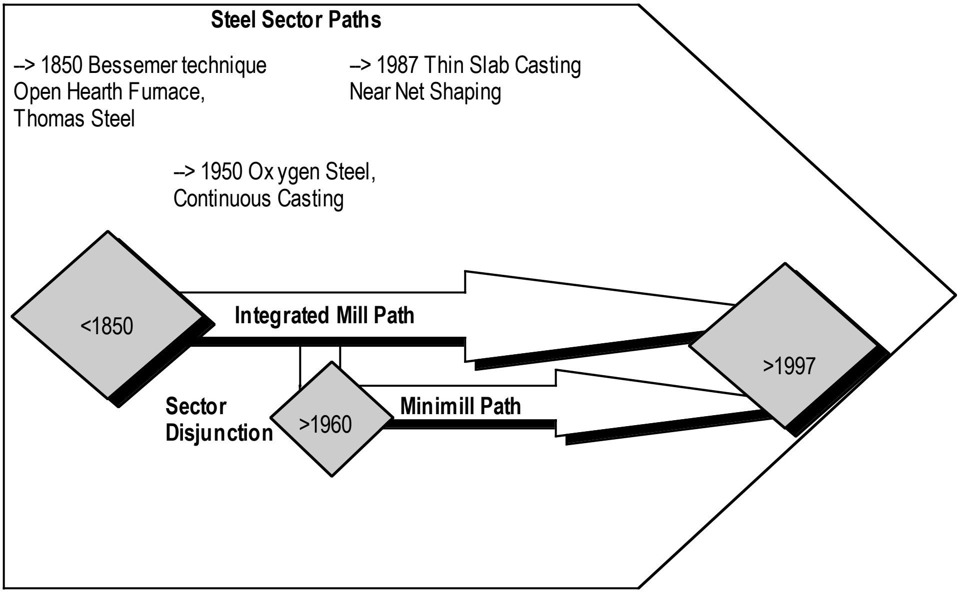
These recipes for success are reinforced by the openness between steel companies. The "academic" exchange of new technological knowledge at conferences and institutes such as Eurofer and the International Iron and Steel Institute (IISI) form an active platform for exchange, tuning and linkages. Within these networks there is also a distinction between integrated mills and minimills. On the stock markets there is little evidence of minimill activity because most minimills are privately owned as opposed to integrated mills. In terms of industrial relations minimills also occupy a different position. Smith (1995:292) explains that:

> "The industrial relations system and the work organisation in USWA [the international union]-organised minimills differs radically from those in USWA-organised integrated facilities. Minimill bargaining is decentralised and follows the pattern established in the non-union minimills rather than in the integrated sector."

Joined together, these three approaches towards the concept of survival paths in the steel sector draw the picture of the integrated mill survival path and the minimill survival path as shown in Figure 4-3 on page 101.

It has become clear that there is a large difference between the two distinctive steel sector survival paths. This difference is much more than just technology (electric arc furnace and thin-slab-casting) and economics (small scale, efficiency). It is very difficult and perhaps almost impossible for steel companies to change paths. They are deeply embedded in the sector in both cognitive and co-operative terms. It is safe to conclude that a steel company moving on the integrated mill path will develop resources in a different way from a steel company on a minimill path. This dissertation will focus on the development of resources of an integrated mill (Hoogovens).

FIGURE 4-3 STEEL SECTOR SURVIVAL PATHS



3. THE WORLD OF ALUMINIUM

As mentioned before, Hoogovens is first and foremost a steel company. Its aluminium operation started in 1964, but only after the takeover of Kaiser Aluminium Europe in 1987 did it became an important "second" activity. Describing the world of aluminium from the Hoogovens' point of view, there are two "camps": those who emphasise the similarities and those who emphasise the differences[2]. However, nowadays the "similarity camp" prevails, as illustrated by the corporate slogan: "The Best of Both Metals".

With a primary aluminium production of between 14 and 15 million tonnes (value based on LME price 1996Q4: ± $ 2.1 billion) the aluminium sector is much smaller than the steel sector but aluminium is growing. In line with the description of the steel sector this section will discuss the basics of aluminium, and its continuity and change over time.

3.1 THE "BASICS" OF ALUMINIUM

Besides being a metal, there are many other similarities between aluminium and steel. In the aluminium sector there is also the distinction between integrated mill and minimill and many corresponding sector characteristics. On the other hand, differences are found in metal characteristics, such as a much lower specific gravity and melting point, and in certain features of the sector (e.g. less openness).

An integrated mill in the context of the aluminium sector is not as straightforward as in the steel sector. The aluminium integration rate has been much higher than in the steel sector. Bauxite mining and alumina refining (alumina is the raw material for the primary aluminium process) are mostly included in the "standard" integrated aluminium mill. The vertical integration rate has therefore until recently been a hundred percent.

By integrating vertically, firms internalised the "market" between the different stages of the business system (Stuckey, 1985). Recently, the rate of integration has been decreasing, creating different rates of integration within an integrated aluminium mill. Here the integration of primary smelting and fabricating will be taken as the basic definition of an integrated mill, because primary smelting/fabrication integration is taken to be important for large (i.e. "integrated") plants producing sheet and plate (Stuckey, 1985).

In these integrated mills, alumina is reduced to primary aluminium, which is obtained by electrolysis using anodes. Primary aluminium will be cast into slabs which are directly chilled (DC). These slabs will be hot rolled and cold rolled in much the same way as steel. Consequently, the production of *primary* aluminium is really distinctive compared with steel. Also, *alloys* play an important role in aluminium. Every aluminium product is an alloy of aluminium and a relatively large amount of another metal. In steel, alloys play a much smaller role. Techniques common in steel such as continuous casting are less common in the aluminium industry because of the many kinds of alloys. As a consequence the aluminium sector is much more fragmented in terms of end-products. Continuous casting is a preferred technique in larger volumes of an identical alloy. It turns out that primary aluminium slabs form the great dividing wall between completely standardised products traded as a commodity and diversified products (alloys).

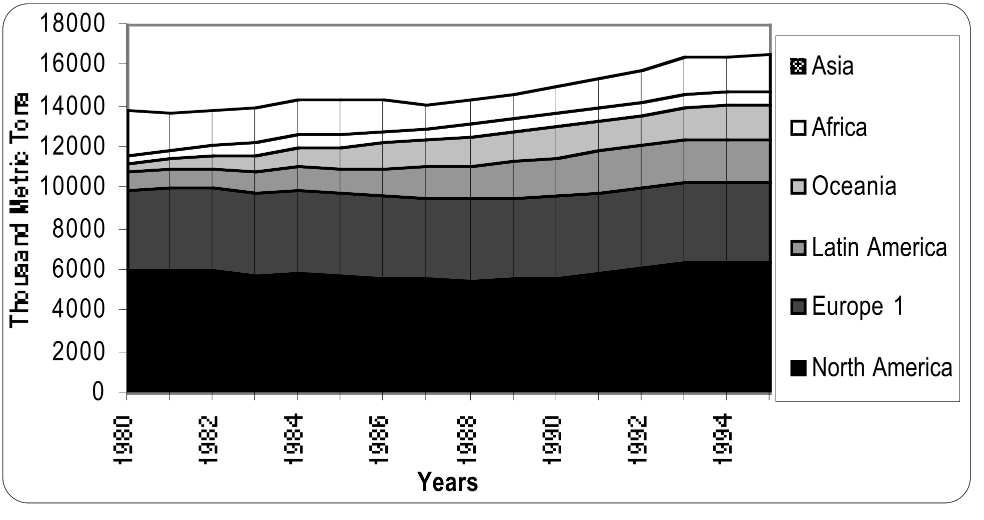
The minimill concept as it is relatively common in the steel industry is also invading the aluminium sector. Usually, the minimill production process involves sorting and preparing scrap (receiving, shredding, storing and delacquering), melting, continuous thin slab/strip casting, direct hot rolling, and cold rolling. However, for some product categories, such as foil, minimills also use primary aluminium because of the thinness (0.006 mm)[3]. Scrap usage for aluminium minimills is common for the product categories of building products, canstock and standard material.

3.2 CHANGE AND CONTINUITY IN ALUMINIUM

Much of what has been said in section 2.2 regarding changes in the steel industry in general and change in steel-related resources in particular also apply to the aluminium sector. Within the aluminium sector there is also a trend towards larger volume aluminium production in former developing countries (see Figure 4-4 on page 103).

There is also a trend in aluminium towards fewer process steps (continuous thin slab/strip casting) and consequently towards a faster production process (e.g. Diener, 1994; Pieters, 1996). Although the USA also leads in the production volume produced by minimills in the aluminium sector, the situation differs from the steel sector. In aluminium, the leading integrated mills are North American (Alcoa, Alcan) and the minimills are not a result of an integrated-mill innovation gap. Moreover, it seems that the distinction between integrated mills and minimills in aluminium is less straightforward than in steel and distinctions are based mainly on the scale of production (large-scale for integrated mills and smaller-scale for minimills) and type of product (primary aluminium (or "hand-picked" scrap) for sheet or foil; scrap for standard products, etc.). Nevertheless, there still remains what can be called two aluminium sector survival paths: the integrated mill and the minimill.

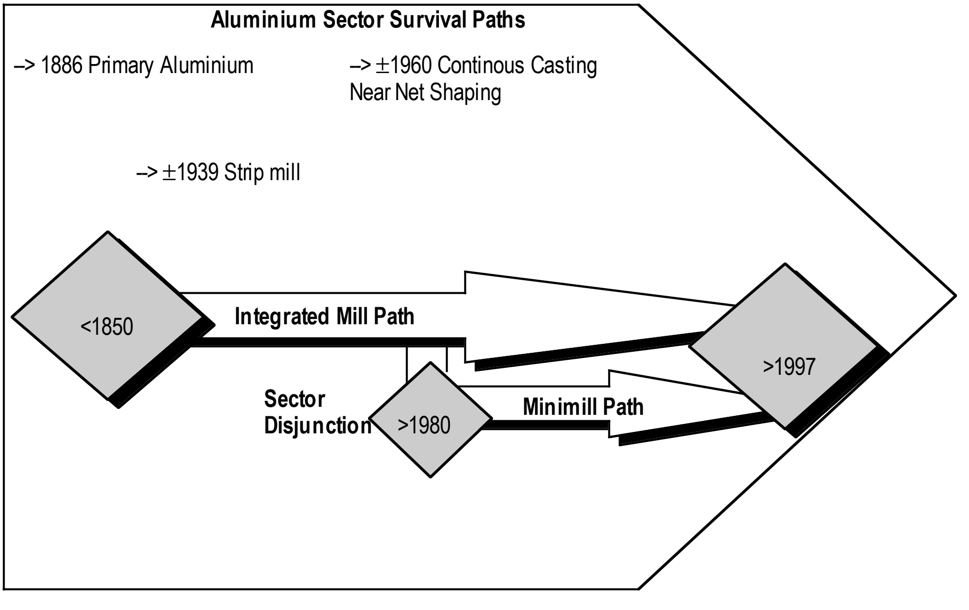
FIGURE 4-4 GEOGRAPHICAL DISTRIBUTION OF PRIMARY ALUMINIUM



Within the steel sector the difference between an integrated mill and a minimill boils down to the difference between a blast furnace-based production route and a scrap-electric arc furnace-based route. In the aluminium sector this difference comes down to the *scale* of production. In this respect the word "mini" refers to the size of the production plant as opposed to the steel sector where the word "mini" refers primarily to only a part of the production process. In the aluminium sector, some even see the emergence of a micromill with an even lower volume size (45,000 tonnes per year) (Pieters, 1996). Kaiser has been developing this micromill concept using a thin-strip casting and rolling mill producing strip only 38 centimetres wide. However, the foundation of both the minimill and the micromill is the relatively low capital cost, high efficiency and the advantages of using scrap as raw material. These aspects refer to the objective reality of the minimill path (e.g. steel minimill path). However, another important feature of aluminium integrated mills is that these mills were already dealing with small batches because of the many alloys.

In a way these integrated mills include characteristics of minimills as well. This explains why in spite of innovations such as continuous casting and near net shaping at a much earlier point than steel, the aluminium minimill sector survival path did not emerge before the 1980s. However, perhaps because of the relative closeness of the aluminium sector the distinction between the two aluminium survival paths is less forceful than that in the steel sector. This, in turn, might add to the explanation of the question of the influence of sector survival paths on the development of resources. As opposed to the steel sector, both paths need to be taken into account when analysing Hoogovens' aluminium resources because of the less forceful distinction between the paths (see Figure 4-5 on page 104 concerning aluminium sector survival paths).

FIGURE 4-5 ALUMINIUM SECTOR SURVIVAL PATHS



Until now in this chapter has described the territory of Hoogovens - the world of steel and aluminium. Both show evidence of having two sector survival paths: an integrated mill and a minimill. Over time a firm's territory can be enforcing, as in the case of the aluminium sector in the 1960s with respect to production knowledge. On the other hand, there are also times when a sector is enabling, such as the steel sector during the 1980s for minimills (for steel strip) or limiting such as the recession years during the 1970s.

A bird's eye view of the Dutch steel and aluminium company Koninklijke Hoogovens plc will be provided in the following section in order to get an idea of the major episodes and investment decisions, etc. of its development over time. Just as a sector has episodes of enabling, enforcing or limiting, so also a company has distinctive periods of either a transforming mode or a reproductive mode. Section 4 will serve as a *stepping stone* for the reader in order to be able to comprehend the more detailed chapter 5.

4. A Bird's-Eye View Of Hoogovens

At the start of Koninklijke Hoogovens plc, in 1918, and even before that during the time of the founding committee, the aim was to establish an integrated steel mill, including blast furnaces, a steel mill and a rolling mill[4]. Because of changing circumstances beyond Hoogovens' control - the First World War and worsening economic conditions, such as rising prices - the original plan for an integrated mill was no longer currently feasible[5]. Instead, the first phase of an integrated mill - the blast furnaces - was initiated and the next phases at the chosen business site were postponed. In order to provide a broader product-range, however, participating interests were taken in a Dutch steel-casting plant (Demka) and a German steel plant (Phoenix). Furthermore, pig iron was exchanged for rolling mill products from other companies[6].

Trading in the market for pig iron, Hoogovens faced the national protectionism common in those days[7]. With only a small home market (the Netherlands), this was a major disadvantage. More than eighty percent of its production was exported abroad (De Vries, 1968:297). Already in the first few years, Hoogovens' management was planning more "downstream" activities in order to better secure demand (De Vries, 1968:370).

In order to enhance the development of Hoogovens into an integrated steel company, a Steel Study Centre was founded in 1931[8]. An important development generated by this Steel Study Centre was the decision to move downstream into the open-hearth technique of steel manufacturing instead of the Thomas process or the Bessemer process (De Vries, 1968:389-391). With the addition of steel mills, Hoogovens' original Dutch company name was justified: "Royal Dutch Blast Furnaces and Steel Mills" (translated from Dutch).

Until 1945, Hoogovens remained an inconspicuous iron and steel producer following the lines of the steel sector. However, almost immediately after the war, a committee was installed by the Minister of Economic Affairs in order to advise on the further development of the steel industry[9]. A direct effect of this committee was the joint development by the Dutch government and Hoogovens of a large strip mill including hot rolled, cold rolled and a tinning mill. This became feasible because of the Marshal plan (De Vries, 1968:552). In

June 1950, a new company was established called “Breedband”[10]. In 1965, Breedband amalgamated with Hoogovens for a payment of seven times the initial Government investment[11].

Taken from an innovative point of view, the decision for basic oxygen steel-making in 1956 was even more daring than the aforementioned strip mill[12]. The basic oxygen steel-making process was invented in 1938 but was not used for the first time commercially until 1952 by the Vereinigte Österreichische Eisen- und Stahlwerke (Oberender & Rüter, 1988). Hoogovens became one of the very early adopters of the basic oxygen steel-making technique, a technique which became the industry standard. The decision was difficult to take, because Hoogovens had already built six open-hearth furnaces. Consequently, the choice was between a seventh very familiar open-hearth furnace or a very new, unknown though promising, new steelmaking technique[13]. Before this, in 1950, the European Community for Coal and Steel was founded. The ECSC’s (ultimate) goal of free competition, the annual report of 1959 concluded, had a long way to travel[14].

The development of the production installations of Hoogovens accelerated even further during the 1960s. With the rising demand, ever increasing investment plans were implemented[15]. It had become necessary according to the management to spread risks[16]. An initial move, in 1960, in this line of reasoning was the decision to invest in installations for non-flat steel products. In 1962, a second move was made towards a collaborative investment in a primary aluminium plant, together with the companies Billiton and Alusuisse[17]. Besides spreading the risk, the reasons for investing in aluminium were the rise of this metal in the world, its relatedness to steel operations, and the relatively inexpensive energy source in the north of the Netherlands (Dankers & Verheul, 1993:280-282). On top of this, Hoogovens moved downstream with its aluminium operation in order to establish an integrated aluminium plant. For this, in 1970, Hoogovens exchanged shares with a Belgium aluminium rolling mill, Sidal[18]. Besides this co-operation, Hoogovens also needed to move more upstream towards alumina and bauxite extraction in order to become an integrated aluminium mill. A move much in line with the sector recipe of aluminium.

The move made by Hoogovens in the 1960s towards oil and natural gas extraction and for example nickel represented a move away from steel as well. Towards the end of the 1960s, ever more business activities were entered into by Hoogovens, much in the spirit of the age[19]. These activities were labelled diversification because the argument for “spreading risk” appeared more important than that of relatedness to its initial steel operations.

Meanwhile, flat-steel operations continued to grow in volume and technological level during the 1960s. Whereas the steel capacity was 1377 metric tonnes at the start of 1960, this had increased in 1972 to 5250 metric tonnes (+ 380%) (Dankers & Verheul, 1993:603).

Hoogovens' No. 6 and 7 blast furnaces became operative in 1967 and 1972 respectively. In 1967, the No. 6 blast furnace was one of the most modern blast furnaces in the world[20]. Number 7, commencing only five years later, had an even 30% higher capacity, thus illustrating the pace of technological development and growth. At the end of 1972, the No. 1 and 2 blast furnaces were closed down after almost 50 years of production[21].

The chief *limitation* to growth, however, during the 1960s was neither capital nor technology, but the scarcity of labour[22]. In order to enlarge production, Hoogovens engaged employees from Spain, Italy, the former Yugoslavia, and Turkey.

In 1972, as an effect of a long-standing time partnership with a German steel company Hoesch, a merger between Hoogovens and Hoesch made them the second largest steel company in the EC[23]. The merger lasted for ten years, when it was reversed partly on account of the severe economic downturn but primarily because of the subsidised national steel industries in Europe during the seventies[24].

During the ten year merger period only the first three years showed a profit. The net loss in the last year was almost 700 million guilders and equity dropped to only 13.5% of the balance sheet total[25].

Estel consisted of Hoogovens, as the superior "front", upstream, steel business located near the coast, and Hoesch, as the superior "rear", downstream, business located in the middle of the market[vi]. After the merger ended, Hoogovens was severely unbalanced, in terms of both production capacity and financial structure. It took another ten years to readjust the scales to a more reasonable balance. To recover from the imbalance after the merger, a large investment and reorganisation project was decided upon in 1982. This plan[26] consisted, among other things, of a production line for electrolytic chromium/chromium oxide-coated steel (commencing in 1988[27]), the renovation of the hot-rolling mill (modern process control and conversion towards a walking beam furnace)[28], a continuous casting machine and a hot-dip galvanising line (commencing in 1989)[29]. Organisationally, Hoogovens moved towards a product-unit organisation (in 1995 business units were introduced)[30]. However, even in 1997 Hoogovens' iron capacity outnumbered the capacity of downstream operations[31] (now in 1998 there is a shortage of iron capacity!).

Hoogovens' first continuous-casting machine did not come into operation until 1980. After the merger, in 1986, another continuous casting machine came on stream[32]. The continuous casting technique was a major episode in the history of Hoogovens. Not because Hoogovens was a forerunner: on the contrary, it had become a widely accepted innovation within the steel sector[33].

[vi] It struck me, that what was called "front" (upstream operations) and "rear" (downstream operations) I, as a layman to the steel industry, intuitively turned around. The fact, that the "front" of the steel company is made up of large, impressive blast furnaces and steel mills might say something about the position of technology here.

The development of the aluminium operations was also slowed down. In 1976 a rolling mill came into operation[34]. Starting from 1977, Hoogovens was trying to find a financial partner for its aluminium business[35]. Talks were being held with Kaiser Aluminium Europe, but a merger or takeover did not commence[36]. However, ten years later, in March 1987, Hoogovens took over Kaiser Aluminium Europe, which doubled the aluminium activity[37].

Diversification was probably the only division during the 1970s and early 1980s which grew, that is in terms of volume of activity. Hoogovens moved into mining, industrial automation systems, environmental systems, insurance, etc.[38] With the weak demand for its steel and aluminium activities it moved into other - more promising - activities.

The period 1972-1987 proved to be difficult and "heart-breaking" for Hoogovens. Difficult in terms of struggles for survival and "heart-breaking" because the reversed merger left painful scars, easily observable 15 years later in 1997. Concerning the quest for survival, Hoogovens faced yet another even harder hurdle in the early 1990s. The period 1988 - 1997 started off with three reasonably "good" years, followed by some very difficult years. A long-established "by-product activity" cement factory (Cemij) was sold[39], thus demonstrating an emphasis on metal-related (steel and aluminium) businesses and finished products with a higher added value. Interestingly, the diversification division ceased to exist[40].

In 1990 "events with world-wide repercussions occurred" (the fall of the Iron Curtain) leading to the adjustment of the objectives and strategy concerning Hoogovens as a two-metal enterprise supplying a wide range of high-quality steel and aluminium products[41]. Thus, the objective of focusing on the core businesses was amplified by the economic and political circumstances[42]. The "Measures packages", though painful, rationalised the two-metal business of Hoogovens[43].

The period 1992-1993 was characterised by a severe economic downturn that brought Hoogovens to the edge of bankruptcy. With improved economic circumstances in the 1994 and following an impressive organisational transformation, Hoogovens virtually rose from the ashes[44]. In developing its flat steel operation, Hoogovens first rationalised its operations by way of reducing cost and "slack" and then improved them by the innovation of its core technologies (blast furnaces, oxygen steel, continuous casting, rolling equipment and coating equipment).

After the purchase of Kaiser Aluminium Europe, Hoogovens' Aluminium operation also went through a rationalisation and modernisation process[45]. "Non-core" companies were sold, the hot rolling plant was modernised and a new smelter in Canada was built (a 20% participation)[46].

In 1997, Hoogovens is a relatively healthy two metal company showing good financial, operational and organisational progress[47]. Having learned from its recent survival operations, the management embraced an ongoing strategy of rationalisation, quality improvement and capability enhancement in the hope of being ready for an inevitable future market downturn.

5. Conclusions

This chapter introduced Hoogovens in a bird's-eye view and presented basic characteristics of its territory: the steel sector and the aluminium sector. Understanding the coming into being of a firm's resources demands a detailed understanding of the "social becoming" of these resources. This chapter served as a stepping stone for a more detailed analysis of the process of becoming in the next chapter.

Strategy research reveals that a firm's resource make-up reflect its history in many ways. First, starting from its incorporation, a firm develops by way of a "local search on a rugged landscape" (Levinthal, 1995:27), implying that the past lives on in the future. Secondly, resources develop automatically following a commitment because of learning and repetition (e.g. Grant, 1991), i.e. the resource make-up results from a firm's common business activity. Third, a firm's activities are highly interdependent with the sector's ongoing affairs (e.g. Håkansson & Snehota, 1989).

Hoogovens started off being a *transformative* actor in the way it designed its company's production process. The (steel) sector, however, did not permit (enable) this to take place: a so-called *sector-blocked ability* of Hoogovens leading to a blocked strategy path (cf. chapter 2, §4). As a consequence, Hoogovens had to develop along a *convergent path* by conforming itself to the sector. Almost 30 years went by along these lines of forced conformity. Meanwhile, Hoogovens managed to stay transformative (entrepreneurial) as it seized every opportunity. During the 1950s Hoogovens' territory became more permissive and development went along a *released strategy disjuncture* (*firm-released ability*).

This very interesting process will be discussed further in a detailed analysis of Hoogovens in the next chapter.