



How LKAB gained competitive strength

by Stefan Hellmer

LKAB (Luossavaara-Kirunavaara AB), the iron ore producer in the north of Sweden, has its comparative advantage in the market for pellets. A large deposit of magnetic ore gives LKAB a competitive cost structure in this market and a strong market position in this market. Although the market for pellets is more sensitive compared to the market for fines, LKAB seems less sensitive than its major competitors. The rise of new steel making technologies and their impact on iron ore has, in addition, worked in favor of LKAB.

This paper will focus on LKAB and identify and analyze the internal and external factors that made the successful focusing on the pellet market possible. The paper is based on official statistics, statistics provided by LKAB, and on personal interviews with researchers, managers, and workers within the company.

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The iron ore producer in the north of Sweden, LKAB (Luossavaara-Kirunavaara AB), has managed to find its comparative advantage in the market for pellets.¹ LKAB has a competitive cost structure in this market thanks to its large deposit of magnetite ore. LKAB has also stronger market position in this market and although the market for pellets is more sensitive to changes in the pellet premium and business cycle, compared to the market for fines, LKAB seems less sensitive than its major competitors.² The rise of new steel making technologies and their impact on iron ore has, in addition, worked in favor of LKAB. The trend shows an increasing trade of DR pellet, a market in which LKAB has attained a relatively strong position.

This paper will focus on LKAB and identify and analyze the internal and external factors that made the successful pellet market focusing possible. The paper is based on official statistics, statistics provided by LKAB, and on personal interviews with researchers, managers, and workers within the company.

The paper is built around the "competitiveness framework" provided by Michael E. Porter and starts therefore with a brief overview of these contributions. Then comes a general overview of LKAB in terms of market shares, profit, and number of workers. It continues by describing the deep company crisis in the early 1980s, the reasons behind the crisis and ways of getting through it. This involves describing and analyzing productivity gains and product development. How was the productivity gain possible and why was the focusing on pellet so successful? The paper ends with a summation, a summation that also tries to put LKAB into the Porter framework.

The porter framework

Although the concept of competitiveness or competitive strength is often used in different studies, there exists no clear and unique definition. The definitions being used depends, for example, on what is

being analyzed (commodity), on the level (single commodities, firms, branches or countries), and on the discipline (economics, marketing). The definition of competitive strength being used in this paper is: Sustained ability to profitably gain or maintain market shares in a global market. It is thereby assumed that a company that is increasing its profit and/or market shares is increasing its competitive strength and vice versa, i.e. it is not as much a formal definition as it is an intuitive one.

If the measurement of competitive strength by profit and market shares is straight forward it becomes more difficult to explain why and how a certain company has achieved this competitive strength. Michael E. Porter provides one general way of analyzing this issue.

Porter claims that a firm's survival in the long run, i.e. its ability to overcome the pressures from the "five competitive forces"³, depends on its ability to find a market position in which it has a competitive advantage. Porter identifies two basic positions: lower cost and differentiation. Choosing lower cost means that the firm has an ability to provide its product at lower cost than its competitors. Differentiation represents the ability to provide a unique and/or superior product more efficiently. Porter then adds another dimension: broad target and narrow target. A company that is choosing a broad target is supplying a wide range of products while a company choosing a narrow target supply only a limited number of products.⁴

This results in four different Generic Strategies: (1) Cost Focus, adopting a lower cost position on a narrow target, (2) Cost Leadership, adopting a low cost position on a broad target, (3) Focused Differentiation, adopting the differentiation position on a narrow target, and (4) Differentiation, adopting the differentiation position on a broad target. If a firm can gain competitive strength by choosing the right generic strategy, what is then behind the firm's ability to identify and pursue this strategy?

Also here Porter provides one possible analytical method by emphasizing the role and nature of the firm's home country. Factor conditions and endowments in the home country, domestic demand, relating and supporting industries, and firm strategy, structure and rivalry interacts with the government and "chance" according to a model that Porter (1990) calls the "diamond". This diamond-model is depicted in the bottom of figure 1.

The diamond summarizes the interdependence between the four determinants. The first determinant, factor conditions,

comprise land, labor, natural resources, capital and infrastructure. The second determinant focus on domestic demand assuming this to be more dynamic with respect to higher quality creating global competitive advantage. The third determinant, related and supporting industries, emphasizes the importance of an international competitive supplier industry. The fourth determinant, firm strategy, structure and rivalry, summarize the influence of firm strategy, organization, management, and domestic rivalry on competitiveness.

All these determinants interact and the key words for this interaction are innovation and upgrading. Changing domestic demand puts pressure on surrounding determinants. The ability to adapt to this new domestic demand depends, for ex-

Figure 1. The competitiveness model.

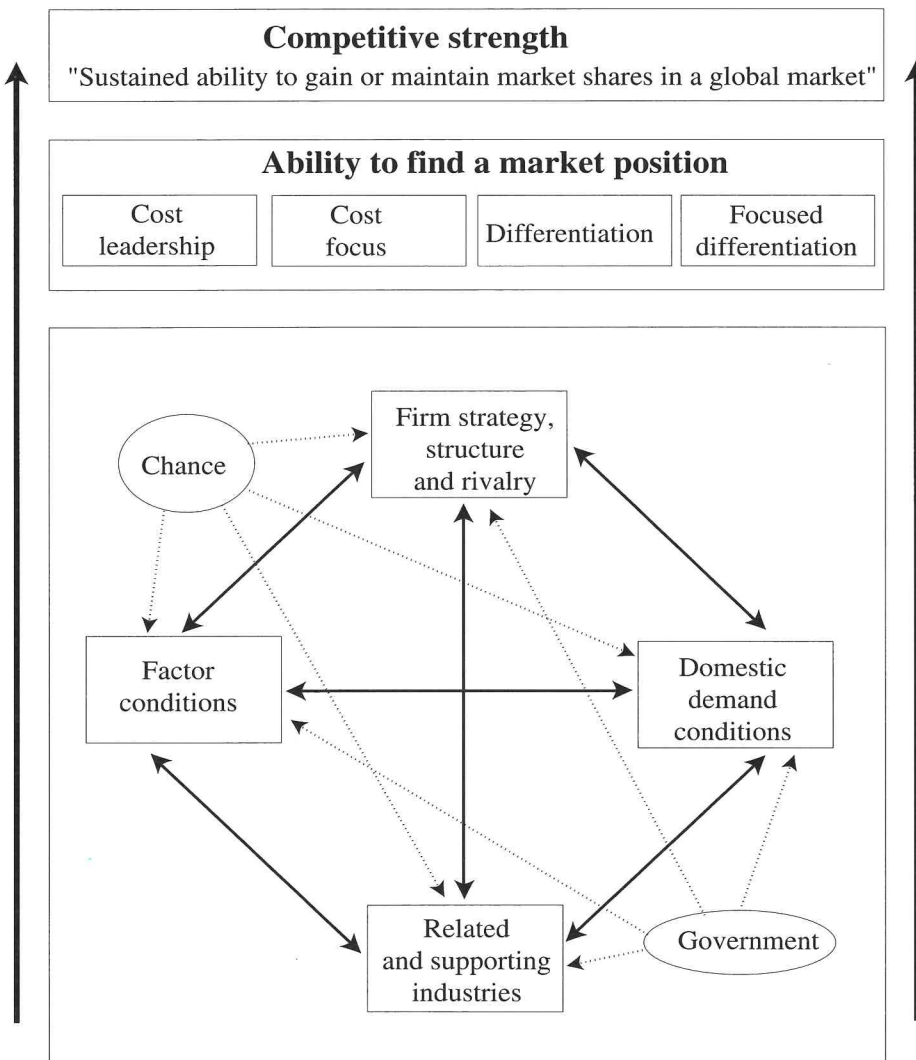


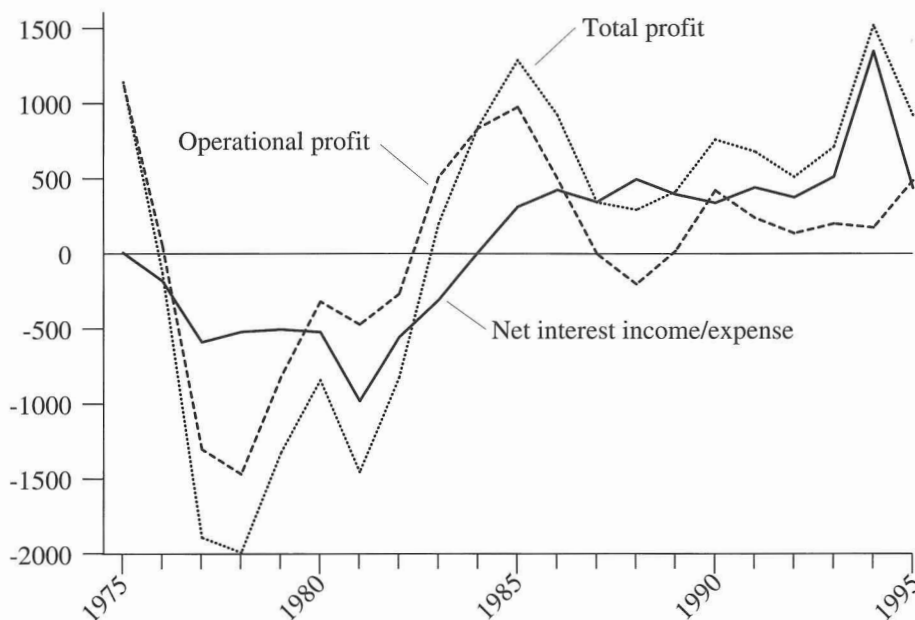
Table 1. LKAB's market shares and profit, 1970 - 1995

Year	Market shares (per cent)			Profit (MSEK)	
	World	EU	Pellets to EU	Nominal	Real
1970	14			223	1303
1971	11			239	1384
1972	10			255	1430
1973	11			202	996
1974	11			360	1368
1975	10		11	330	1147
1976	7		12	16	53
1977	7		8	-416	-1303
1978	6		8	-496	-1469
1979	8		7	-311	-823
1980	8		7	-136	-320
1981	7		5	-218	-473
1982	6		6	-139	-269
1983	4		9	295	509
1984	5	11	11	520	835
1985	6	10	13	635	976
1986	6	10	15	326	501
1987	5	9	14	-1	-1.5
1988	5	9	15	-145	-203
1989	5	9	14	14	18
1990	5	8	17	334	422
1991	5	9	16	191	239
1992	5	9	19	106	136
1993	5	10	21	170	199
1994	4	8	18	155	173
1995	4	9	22	485	485

Note: Nominal profit means here result after depreciation. Real profit is nominal profit deflated using Swedish export price index. 1995 is used as the base year.

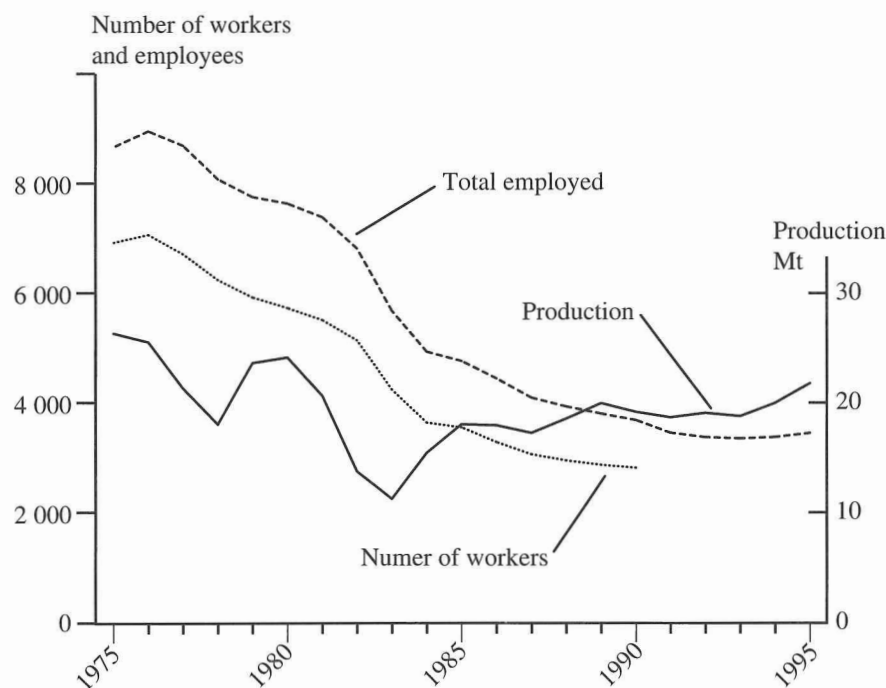
Sources: LKAB's Annual Reports; Johansson (1986); Iron Ore Review; Drewry Report on Iron Ore (1986).

Figure 2. LKAB's operating profit, net interest income/expense and total profit before appropriations and tax, 1975-1995.



Source: LKAB's annual reports, 1975-1995.

Figure 3. Number of employed and production rate (Mt) at LKAB, 1975-1995.



Source: LKAB's annual reports, 1975-1995.

Note: The special recording of the number of workers ended in 1990.

ample, on the ability and possibility to use related and supporting industries to innovate and upgrade the production process. It might also involve developments of new products.

Included in the model are two nodes, government and chance. These influence the determinants but are not, according to Porter, determinants themselves. Chance include events like oil shocks and wars, that change the conditions inside the diamond and put pressure on the determinants. An oil shock, for example, raises input costs, lowers demand, and creates a disadvantage in "factor conditions".

The government node is also outside the diamond. Porter considers the government to be "part of the game" influencing the four determinants with, for example, subsidies, education, and policies related to the financial markets, with its basic role of supporting innovation and upgrading. The government can act as a major buyer of goods influencing domestic demand. It can also use regulations and standards to influence the quality or production process. Substantial changes inside the diamond can also trigger actions from the government. Higher production cost can, for example, lead to a devaluation of the currency.

The generic strategies and the diamond is now combined into one "competitiveness model" depicted in figure 1.

A strong diamond and a strong ability to adjust to new situations within the diamond is thereby assumed to increase a firm's ability to find a market position. A successful positioning is further more assumed to create a certain competitive strength in terms of market shares and/or profit. The analysis will from now on be focused on LKAB. It starts with a general description with respect to market shares and profit. It continues describing the deep crisis and the way through the crisis. LKAB is then put into the Porter framework in a summarizing section.

The company

It is clearly visible in table 1 that LKAB gained competitive strength during the 1980s and 1990s in the market for pellets. The table gives the market shares and profit, the measures of competitive strength, for the company from 1970 to 1995.

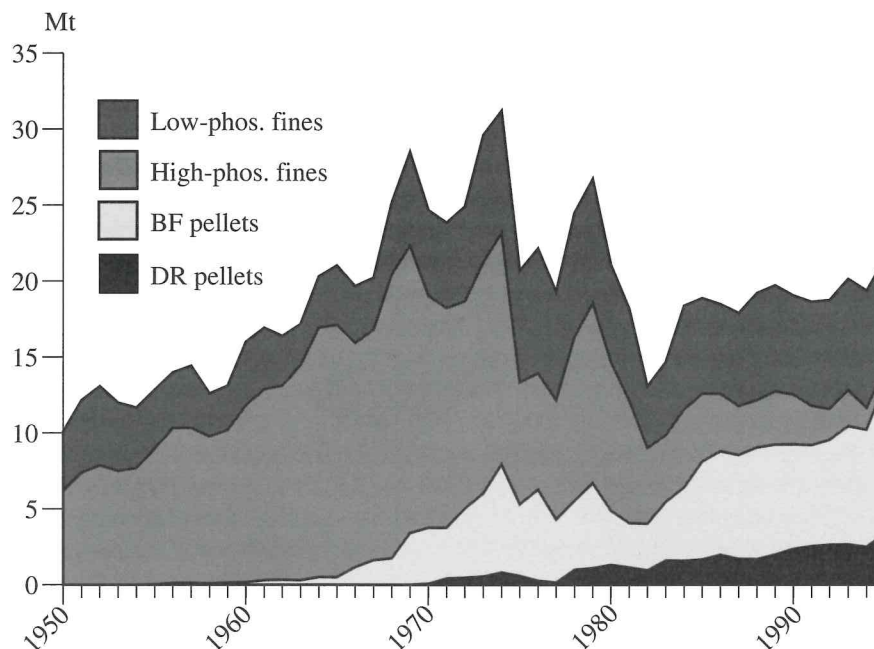
The crisis, starting in 1977 and ending in 1982, can be seen in terms of significant losses of both profit and market shares. Although LKAB's market share in the world market for iron ore continues to fall after 1982, there are significant increases in the European pellet market share and the profit. The profit in table 1 is defined as result after depreciation and is a measure of the operating profit, i.e., the profit from the production and selling of iron ore and pellets. Figure 2 shows, in addition to this operating profit, the financial result measured by the net interest income/expense, and the total profit before appropriations and tax.

When adding these measures of profit it becomes clear that the deep crisis during 1977 to 1979 is created primarily by "the operation". The crisis in 1981 is, on the other hand, primarily a financial crisis. The upturn of profit in 1983, and two years after, is created by the operation, but the financial gains thereafter surely helped to keep up the total profit. A major explanation behind this is the future sales of pellets and ore at a fixed dollar exchange rate in times when this exchange rate was falling.

The number of employed and the production rate from 1975 to 1995 can be seen in figure 3.

The number of employed decreased especially during the "second" half of the crisis, i.e., after 1980. The number of employed have continued to decrease, but apart from the years following 1980, this has been done without any special notification. The continuing decrease of employed in combination with the increasing production after 1983, imply a significant increase of the productivity. This productivity increase, and its source, will be further elaborated below.

Figure 4. LKAB shipments 1950–1995, divided on main products.



Source: LKAB.

The 1977–1983 crisis

The 1977–1983 crisis is of crucial interest. LKAB's production, product mix, and general company performance are very different before 1977 and after 1983, indicating that the crisis and the handling of the crisis, is of significant importance for the survival of LKAB.

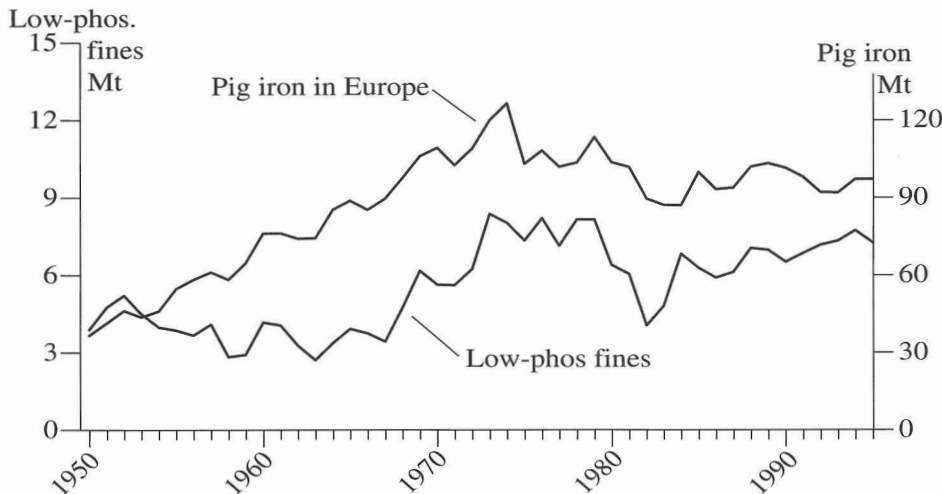
A deeper analysis of figures 2 and 3 indicates that LKAB during the period 1977–1983 actually experienced two crises instead of one. The first crisis started in 1977 and was predominantly created by a downturn in the business cycle that, in fact, started before 1975 when the demand for steel decreased. This recession would later be proven as being far more serious than a general cyclical downturn. When the metal markets started to recover it failed to recapture the old growth rate, and according to Tilton "it is now generally agreed that something more permanent, more structural, than just another cyclical downturn occurred".⁵ One serious effect of this was that it created a huge surplus of capacity in the metal

markets with depressed prices for more than a decade.⁶

For LKAB, production dropped from 25.5 Mt in 1976 to 21.3 in 1977 and was down to 18 Mt in 1978. The assertion that this first crisis was the result of a drop in the business cycle is further supported by the profit figures. The loss in the beginning of the crisis can mostly be explained by losses in the operation (see figure 2).

Production increased and the company's loss decreased in 1979. This positive trend was, however, immediately broken, and the "second" crisis started, the crisis that must be denoted as the most severe one of the two. Production dropped gradually down to 11 Mt in 1983. The number of employed dropped from just above 7 000 in 1980 to 5 000 in 1983, and the increased losses have to a large extent financial explanations. This second phase in the period can also be explained by a general drop in the business cycle, but has structural explanations as well. Up to 1977, LKAB relied heavily on sales to steel mills using the Thomas process

Figure 5. LKAB shipments of low-phosphorus ore and the European production of pig iron, 1950–1995.



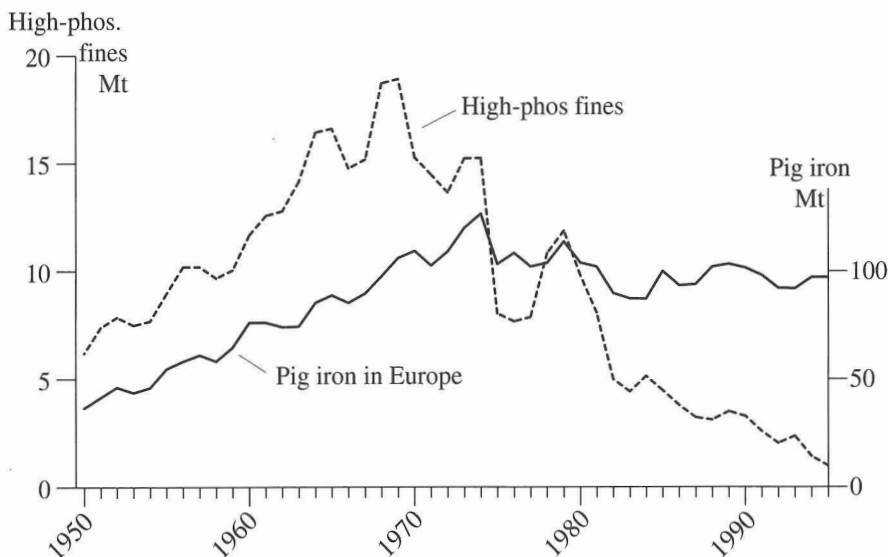
Sources: LKAB and *Iron Ore Review* 1987–1995.

which demanded LKAB's high-phosphorus ore. Mining high-phosphorus ore was the core of the company's activities, which generated the high profits during the 1960s and early 1970s. A significant restructuring shifting the global steel industry away from the Thomas process in the late 1970s and early

1980s, led LKAB into a deep structural crisis. Apart from the phosphorus problem, LKAB also had problems with the alkali content, which further led to lower demand of its ore.

Figure 4 shows the delivered amounts of iron ore from LKAB during 1950 to 1995. It clearly shows what significance

Figure 6. LKAB shipments of high-phosphorus ore and the European production of pig iron, 1950–1995.



Sources: LKAB and *Iron Ore Review* 1987–1995.

Table 2. Shareholder's contribution to LKAB, 1977–1983

Year	Operating profit (MSEK)	Shareholder's contribution (MSEK)
1977	-416	0
1978	-496	500
1979	-311	440
1980	-136	340
1981	-218	2 250
1982	-139	1 000
1983	295	0

Source: LKAB annual reports, 1977–1983.

the high-phosphorus ore had in LKAB's activities during the 1960s and first half of the 1970s. The figure also shows that shipments of pellets started to play a significant role only after the crisis in 1983.

Figures 5 and 6 illustrate how the second phase of the crisis was caused not only by a downturn in the business cycle, but also have structural explanations. Figure 5 shows the shipments of low-phosphorus ore together with the pig iron production in Europe from 1950 to 1995. It shows clearly that there is a "business cycle" element in the second crisis, but that the shipments (and demand) of low-phosphorus ore recaptures its markets when the production of pig iron increases 1983.

Figure 6 shows LKAB's shipments of high-phosphorus fines and the European production of pig iron from 1950–1995. Here it is clearly visible that LKAB tried to recapture some markets after the first phase, but that the high-phosphorus fines did not make it through the second phase of the crisis.

This is referred to as the structural part of the LKAB crisis. The demand for the former core of LKAB's production decreases fast. It is instead DR-pellets, low-phosphorus fines, and especially BF-pel-

LKAB, Kiruna.

lets that increase their share of the company's shipments.

The total production from the mid 1980s to the mid 1990s has, however, never again reached the levels from the 1970s. The total production is, in 1995, down to the same level as in the beginning of the 1960s, the era of continuous expansion. Managers in LKAB claims that the crisis meant that the company went from being a production orientated company before the crisis to a product and quality orientated company after the crisis. The question is how LKAB managed to get through the crisis and what factors that contributed to the turnaround.

Getting through the crisis

Looking back at the crisis, and interviewing researchers and managers involved in LKAB during that time, provide a number of explanations to why LKAB managed to survive. All from speculation of the possible positive and negative effects on LKAB that could be the result from the canceling of "Steel Plant Project 80" (Stålverk 80) in the late 1970s to speculation of the effects of a new government in the beginning of the 1980s. From all discussions and analysis there evolve, however, three highly significant reasons to why LKAB is still in business. First the Government grants⁷ given to LKAB through a couple of years during the crisis. Second the productivity gains during the period together with the "new" way of working within the company. Third the focusing on pellets.

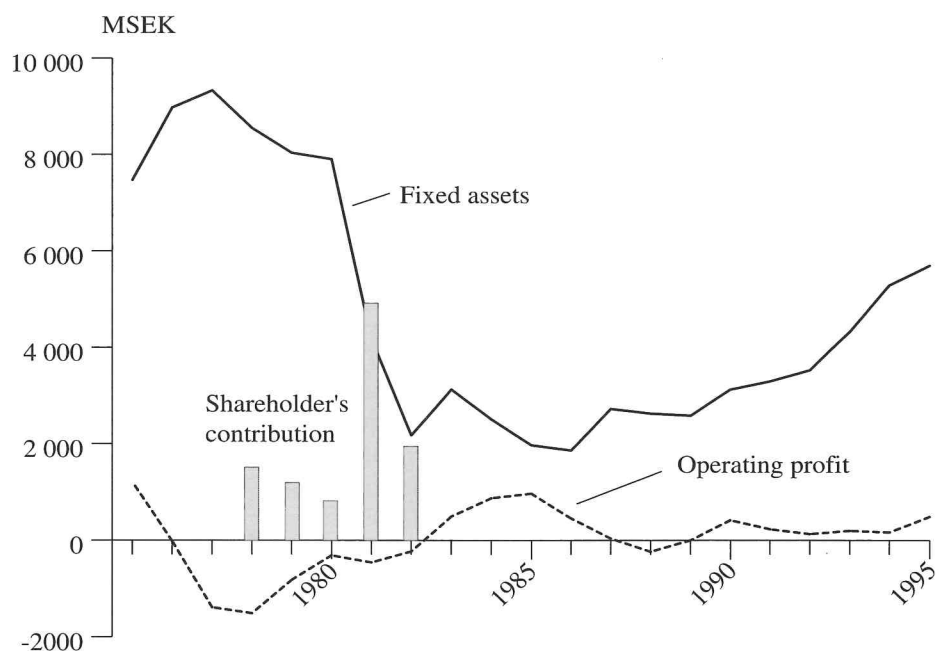
Following the analysis so far it is clear that it is within the market for pellets that LKAB has achieved a strong position in both the European and more distant areas. The first and second point given above are, however, most probably a precondition for achieving a strong position in the market for pellets, and will therefore be elaborated below.

Government grants

LKAB received Government grants on a yearly basis from 1978 to 1982. These



Figure 7. LKAB's operating profit, fixed assets, and shareholder's contribution in constant 1995 SEK, 1975–1995.



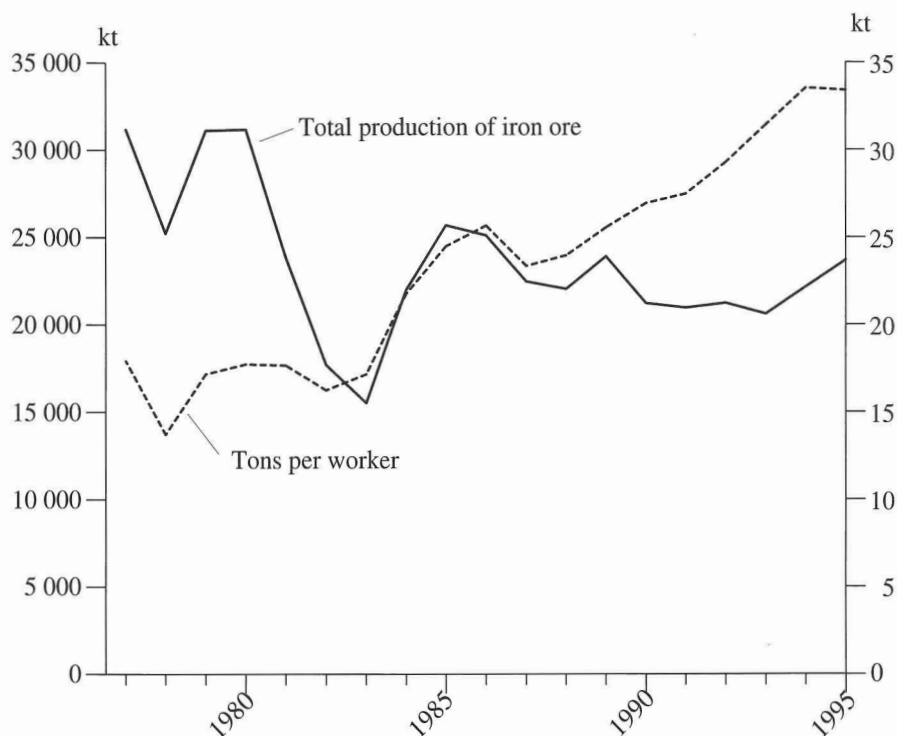
Sources: LKAB's annual reports, 1975–1995 and Swedish statistical yearbook, 1980–1995.

grants can, together with LKAB's operating profit for 1977–1983, be seen in table 2. The grants provided in 1978 to 1980 were aimed at reducing the company's problem created by the relatively large operating losses. The two substantially higher grants provided to LKAB in 1981 and 1982 were motivated for other, more structural, reasons. The idea that LKAB's capacity was too high for its market potentials was accepted during this period, and the purpose of these two last grants was to let LKAB write off some of its fixed assets, thereby reducing its capacity.

The timing and size of these grants also supports the idea that the crisis had two sides. First, up to 1980, the crisis was believed as being created by a deep, but general cyclical downturn, with grants covering the losses. After 1980 it is accepted by LKAB, and its owner, that it in fact is a deep structural crisis and that the probability that LKAB again could reach the production levels of the 1970s is practically zero. LKAB was too large for the new market condition.

All these grants are of course of crucial importance for the survival of LKAB. The company was on the edge of bankruptcy in the beginning of the 1980s. It is generally believed among managers in the company that LKAB would not have made it through the early 1980s without these grants. The most crucial period was in 1981–1982, a period when LKAB received more than 3 billion SEK. As pointed out above, it was during this period LKAB realized that the crisis was structural rather than created by a downturn in the business cycle. The demand for high-phosphorus fines was not expected to come back to former levels, and it became obvious to the company that its production capacity was too high with regard to its potential markets. LKAB used these grants to write off a substantial part of its fixed assets. The mine in Svappavaara was, for example, closed down. The aim was to reduce the company's capacity from 30 Mt annually down to almost 15 Mt an-

Figure 8. LKAB productivity and total production, 1977–1995.



Source: Statistics of the Swedish mining industry 1995.

nually. This in order to have a capacity more adjusted to the new situation, with almost zero demand for high-phosphorus fines. Figure 7 shows the operating profit, the fixed assets, and Government grants for the years 1975–1995 in constant 1995 SEK.

It becomes clear from figure 7 that along with the grants, especially the ones in 1981 and 1982, is a dramatic decrease of LKAB's fixed assets. These are, in constant SEK, in 1982 almost one fourth of the fixed assets in 1977, and the production capacity is half of the capacity in 1977. The fixed assets has, since 1986, increased steadily together with production, a result of continuous investments in new capacity, processing facilities, and pelletizing plants.

These grants are of utmost importance for LKAB's survival. Without these the company, or at least the operation in Kiruna, would probably not even exist.⁸ The question now is how LKAB managed to profitable stay in business after

these years of crisis and how the company was able to increase its competitive strength as indicated in table 1. This question involves analysis of productivity gains and product development. Productivity gains that have been necessary in order to offset the disadvantage of underground mining. Product development in order to meet the market's new requirements when high-phosphorus fines got almost zero market value.

Productivity

LKAB realized that its productivity had to increase if the company in the future should be able to compete with the vast open pit mines in Australia and Brazil. Although LKAB is situated close to its major market in Europe, this competitive advantage had continuously decreased thanks to lower transportation costs, and there was an obvious risk that the situation would be even worse if LKAB didn't increase its productivity. The survival of the company was at stake.

The sub-level caving used to the mid 1980s was more or less the same method that had been used in the 1960s. This sub-level caving at a height between 12 and 16 meters yielded approximately 1 000 ton material per blast. Sub-level caving at a height between 22 and 27 meters started to be developed in 1985 and is since 1987 in use. This "higher" method yields instead approximately 10 000 t of material per blast. New explosives and methods of charging was developed in the process.

This new method that yields higher amounts of material per blast demanded development of new drills and drilling machines. The capacity of loading trucks had also to be increased. All this developments of new equipment was of course done in collaboration with different external companies. Swedish companies for machinery and drilling equipment, and Finish companies and universities for loading trucks and communicating system.

Figure 8 show how the productivity in t per worker have developed from 1977 to 1995. The figure also shows LKAB's total production of iron ore.

Although there was a drop in productivity in 1978, due to a drop in total production, the productivity was more or less stable up to 1983. The productivity increased together with production from 1983 to 1986, and has, although the total production is stable, increased since. This correlates well with the introduction of higher sub-level caving.

Cultural revolution

Another thing that is emphasized by workers, managers, and researchers in LKAB, is the "new" way of working that started in early 1980s. They all say that it is almost like LKAB has become an entirely different company after the crisis compared to before the crisis. It is claimed that it is mainly the effects of the last Government grant in 1982 when the Government clearly stated that this is the last help the company will receive. You will get this last grant to help reduce the operation, but from 1982 an on, you are on your own. Up to this point much of the time was devoted to negotiations between the unions and mangers about production quotas, working conditions etc.

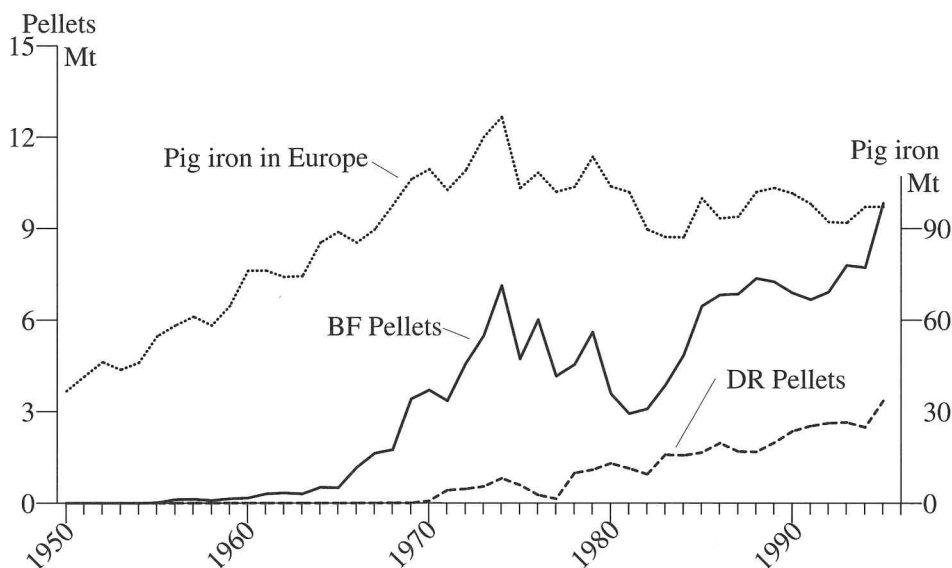
People at all levels in LKAB claim that this time felt inefficient and can be characterized as a "we-against-them" situation between workers and managers.

The following years it was implemented, and accepted, among the workers at all levels, that LKAB was a company working in a competitive market and that profitability, productivity, and efficiency were to become the key words in the operation. The number of manager levels were reduced from seven to four and the number of foremen down in the mine were reduced from between 60-70 down to less than 20. This program was carried out with the help of internal education, information, and increased responsibility at each level. The workers feel that no information is withheld from them, and the managers feel that no information from the mine is withheld from the main office. All levels in the company underlines the fact that the "union fights" have decreased substantially compared to the 1960s and 1970s.

It seems that the change from being a production oriented company before the crisis, to become a product and quality oriented company after the crisis, have been well implemented among the workers and managers in LKAB. This has been achieved with the help of education and information about the financial status of the company and the importance of quality. Many of the workers have also visited the customers in Sweden, Finland, and in Europe, to communicate directly with the customer and to understand their role in the process of turning iron ore into steel.

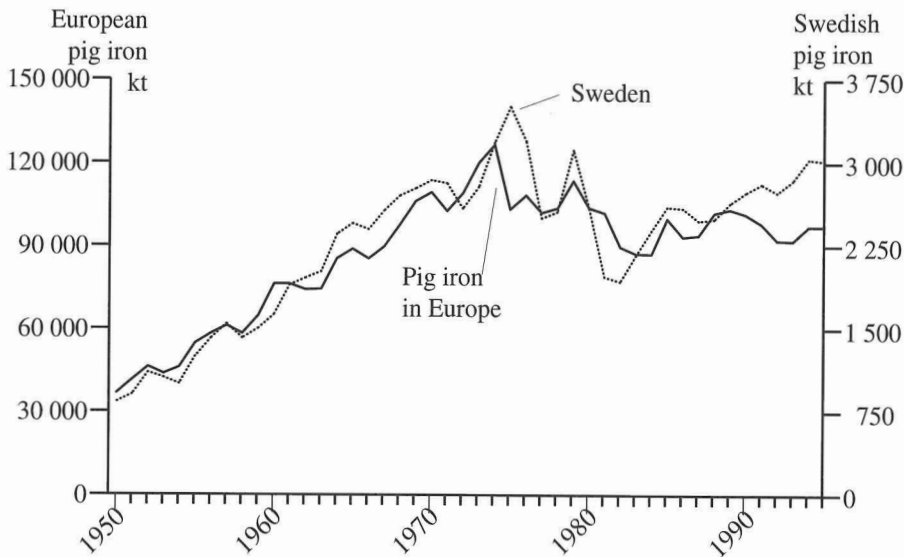
It is difficult to value this changing ways of working into changing productivity and to its contributions in keeping LKAB profitable in business. To scientifically value its contributions is even more difficult and it is beyond this paper to place any scientific value on the changing ways of working at LKAB. It did strike me, however, when talking to workers under and above the ground, that they were all very informed and interest-

Figure 9. LKAB shipments of BF- and DR-pellets and the European production of pig iron, 1950-1995.



Sources: LKAB and Swedish Geological Survey.

Figure 10. Swedish and European production of pig iron, 1950–1995.



Sources: LKAB and Swedish Geological Survey.

ed in every matter that involved the iron ore market. Almost all the workers know about the financial status of the company, they know about its competitors and about LKAB's position in the market. The guys at the drilling machines, the loaders, and other workers down in the mine know the customer for each particular shift, as do the workers at the processing facilities and pelletizing plants. Not only do they know who is the customer, they know also the particular demand with regards to quality this customer has.

It is, at least within this paper, impossible to quantify the effects of this into productivity. I will just end this section with the words of a mining worker at LKAB: "Suddenly I woke up one morning in 1983 and found that I was no longer a worker, I had become a co-worker, a contributor to make LKAB one of the most efficient, quality oriented, and profitable iron ore mines in the World".

Pelletizing

If high-phosphorus fines was the core of LKAB's activities during the 1950s to the late 1970s, pellets has to be regarded as the core of LKAB's activities from the mid 1980s and on. Figure 9 shows LK-

AB's shipments of BF-pellets and DR-pellets and the European production of pig iron from 1950 to 1995.

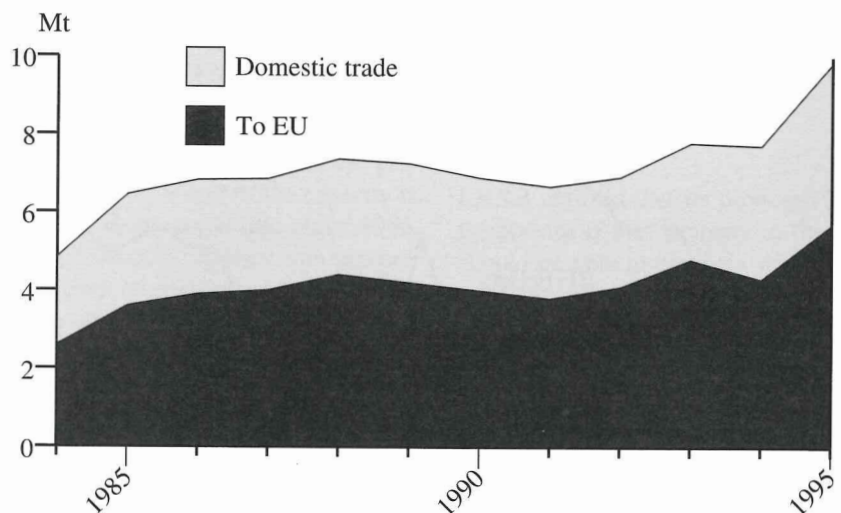
LKAB started to produce pellets in the mid 1950s, but it was not until the late 1960s that it started to expand significantly. The increased shipments of pellets followed the increasing production of pig iron in Europe to 1974, and fol-

lowed it down from 1975 to 1982. After that the shipments of pellets from LKAB increased at a faster pace than pig iron in Europe, and pellets started to take market shares from fines. It is also obvious from figure 9 that LKAB started to ship DR-pellets in the beginning of the 1970s, but also here the expansion took place in the 1980s.

The pellets produced in the 1950s was so called cooling pellets used as cooling product in blast furnaces. It was first in the 1960s that LKAB started to produce pellets for direct steel production use. During this time LKAB started its product development. It became clear that the era of high-phosphorus fines would come to an end due to new steel making technologies developed in the 1950s. LKAB was, however, unsure when this would happen, but did start its product development. According to the R&D department it was already then clear that pellets could become LKAB's major product after the high-phosphorus fines.

The high production of steel during the 1960s to the mid 1970s, made it impossible for LKAB to perform any large scale test of their products. The pellets sold at that time, the acid quartzite pellets, was

Figure 11. LKAB shipments of BF-pellets domestically and to Europe, 1984–1995.



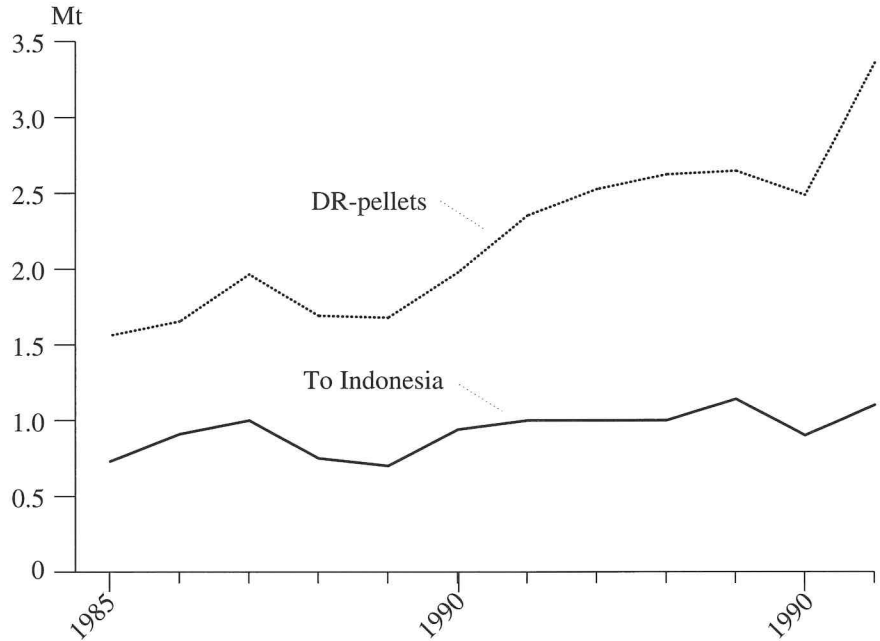
Sources: LKAB and Swedish Geological Survey.

Remote control of trains on the 1 045 m level in the Kiruna mine.

developed inside the company in small laboratory tests. Although LKAB claims that it knew about the future disadvantage of the high-phosphorus fines, the high production of steel meant a high production of iron ore with a production pressure so high that the development of new products became too slow. The sinter at that time were of better quality than the pellets, the pellets were a reserve (or swing) material, which can be seen in figure 9. The shipments of pellets showed a substantial business cycle sensitivity, especially between 1974 and 1982.

The crisis that did start in the late 1970s, much due to the decreasing demand for high-phosphorus fines, didn't come as a total surprise, but the company wasn't ready to launch new products fast enough. Up to 1975 there had been no full scale blast furnace test of the pellets, but with the downturn, both at LKAB, and in the production of steel, came the opportunity to perform these tests. LKAB had the pellets capacity with three pelletizing plants in operation, one in Kiruna built in 1965, one in Svappavaara built in 1968, and one plant in Malmberget built in 1973. The decreasing produc-

Figure 12. LKAB total shipments and shipments to Indonesia of DR-pellets, 1984-1995.



Sources: LKAB, the TEX report "Iron ore manual 1993", and Swedish Geological Survey.

tion of pig iron in Europe and in Sweden meant an over capacity in the blast furnaces, see figure 10.

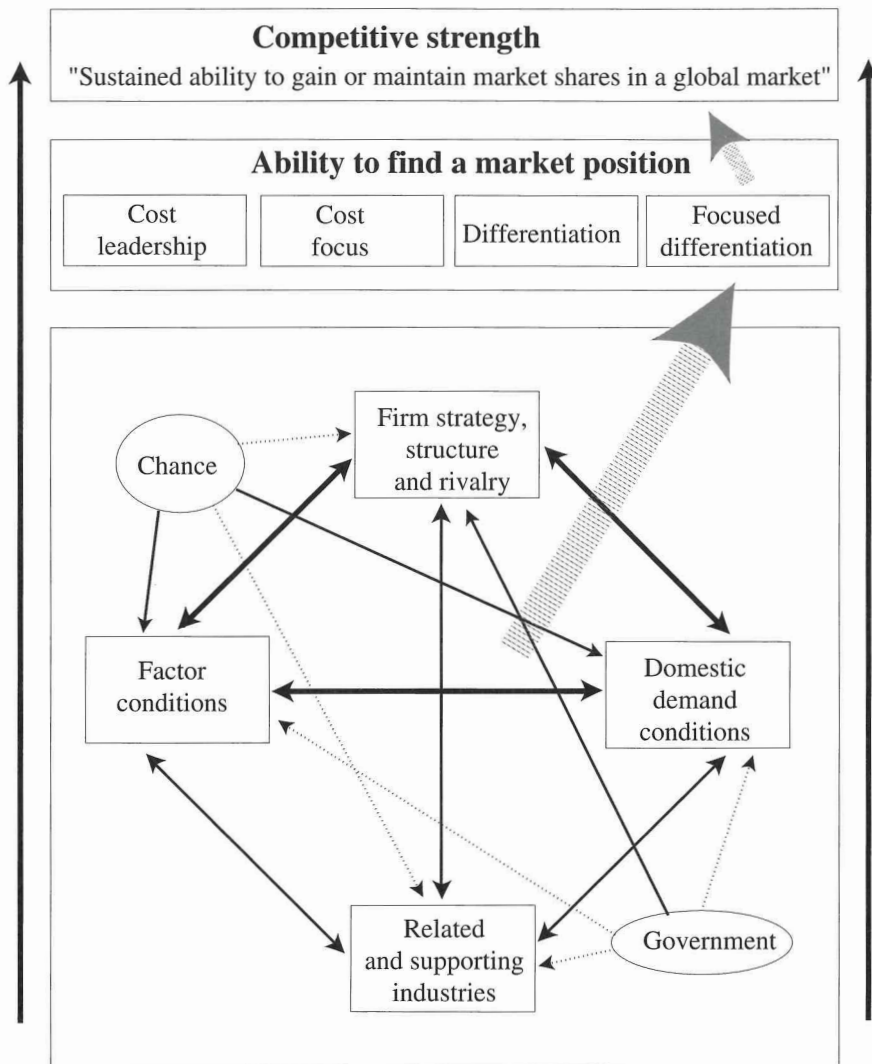
The Swedish steel producer, SSAB, is of special interest for LKAB. Especially SSAB in Luleå, which long has been LK-

AB's largest customer, is totally supplied with iron ore and pellets from LKAB's operation in Malmberget. It was also here, at the SSAB operation in Luleå, that the later abandon project "Steel Plant project 80" was supposed to have been built. LKAB's operation in Malmberget is close to SSAB and to the harbor in Luleå. A 260 km railway, with frequent iron ore transports, connects the operations. The close distance and size of trade have established a close relationship between SSAB and LKAB, both in terms of business and product development, and it is the later relationship that is of crucial interest.

SSAB in Luleå had, around 1970, invested in blast furnace number 2, and had low sintering capacity using old sintering technique that was relatively expensive. Excess capacity at LKAB combined with excess capacity at SSAB and SSAB's need of a new, and better pellets, started the close cooperation between nearby seller and buyer. LKAB performed in total 11 full scale blast furnace tests between 1975 and 1980. Not all test were



Figure 13. LKAB gets out of the crisis.



performed at SSAB in Luleå, but the driving force in this product development process was the excess capacity in these two places. Parallel with these tests, which were all not very successful, LKAB did some laboratory tests adding olivine as a binder. These olivine pellets were tested at SSAB in 1982 and proved an immediate success. The olivine pellet quickly became fully accepted as a complete substitute for sintered fines, and the good results from SSAB could be used in LKAB's marketing of the product. Germany became the next large customer of pellets. Two steel mills, one

with an old sintering plant and one reconstructing its production, started in 1984-86 to use pellets as their major feed. Figure 11 shows clearly the effects of this on LKAB's deliveries of pellets.

With these "base" customers, in Sweden and Germany, using pellets as their major feed, LKAB was found to be less sensitive to business cycles and had now the opportunity to sign long-term contracts.

The DR-pellet was also developed almost parallel with the BF-pellet. It came out 1982 and it was also here the general downturn and a chance of close collabo-

ration with a steel mill that triggered this development. LKAB lost German market shares before 1984 and was afraid to build its activities with one product only, the olivine pellet. In cooperation with a steel mill in Indonesia, who offered opportunity to perform full scale tests, a DR-pellet with dolomite instead of olivine as binder, was proven to be efficient. Figure 12 shows LKAB's shipments of DR-pellets for 1984-1995. The figure also shows the amounts that went to Indonesia.

Up to 1989, approximately half of LKAB's total shipments of DR-pellets were exported to Indonesia. This dependence decreased after 1989 when the shipments of DR-pellet increased although the shipments to Indonesia stayed at an almost constant level. See Hellmer (1997) for a more extensive description of LKAB's shipments of DR-pellets.

Summation, LKAB in the Porter Framework

The crisis that LKAB experienced between 1977 and 1983 has both a structural explanation and a business cycle explanation, of which the structural crisis became the most severe one. The former core of LKAB's activities, production and export of high-phosphorus ore, did put LKAB in jeopardy when the demand dramatically shifted from high-phosphorus fines to low-phosphorus fines and pellets. Production and shipments from LKAB decreased fast, the company experienced heavy losses and went almost bankrupt.

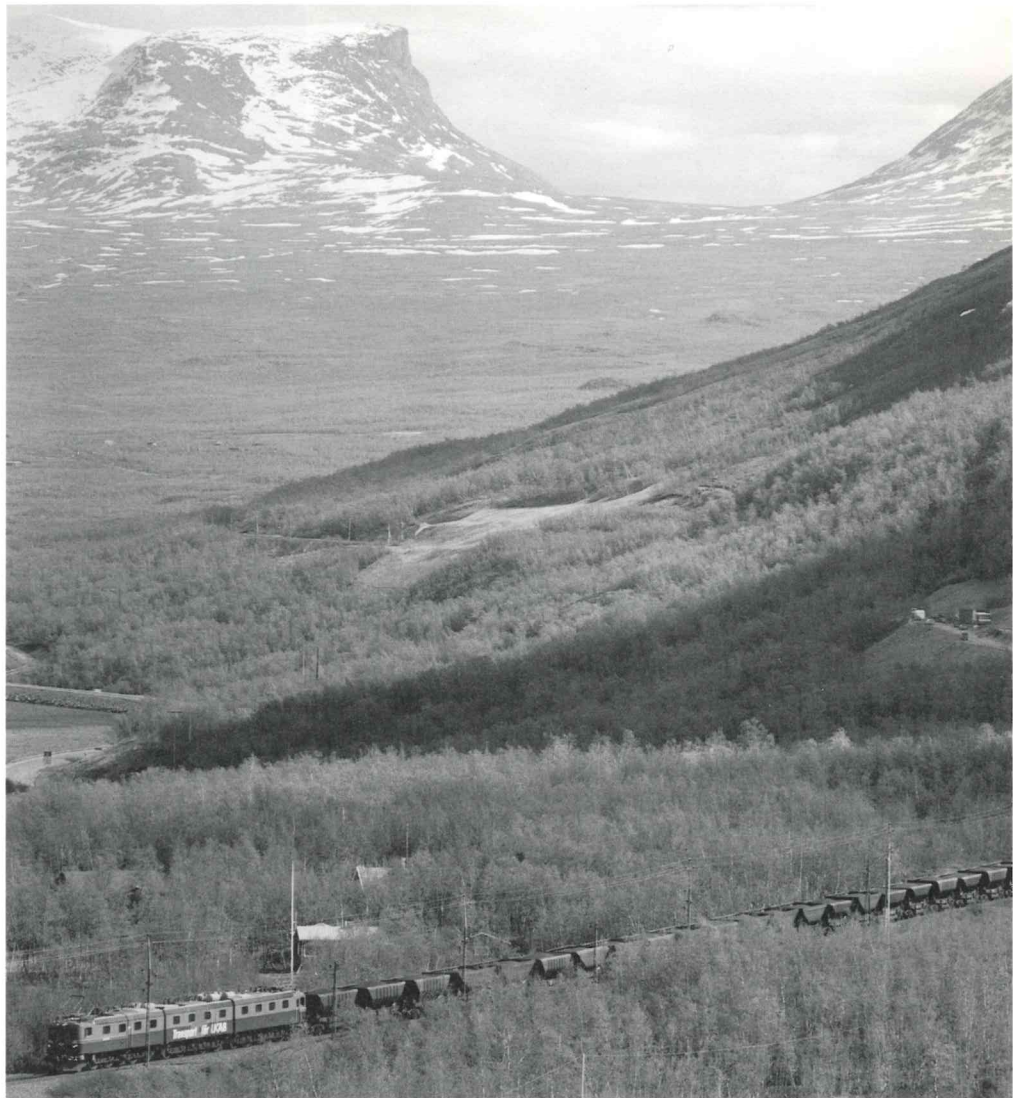
The Government grants given to LKAB in the late 1970s and early 1980s are of utmost importance for LKAB's survival and profitability after 1983. The company would probably not have made it through the 1980s without these grants. These capital infusions were primarily used to write-off a large proportion of LKAB's fixed assets, enhancing the company's capacity to adapt to the new situation in the iron ore market. LKAB's capacity was reduced from 30 Mt in the

Pellets from LKAB on their way to the port in Narvik.

end of the 1970s down to approximately 15 Mt by 1982. The number of employed was also reduced in this process, the total working force was over 7 000 in 1979, and was in 1983 down to approximately 5 000. The number of employed have continued to decrease. In 1995 it is down to just above 3 000.

LKAB was, however, not saved permanently with the help of these grants. Other measurements had to be taken in order for the company to stay profitably in business. LKAB was able to increase the productivity from below 20 000 t per worker in 1983 to almost 35 000 t per worker in 1995. This was mainly carried on with the help of higher sub-level caving and higher capacity loading trucks. The new ways of working, described in the text, is also emphasized by workers and managers within the company. These are examples of how LKAB have tried to strengthen its diamond with the help of "related and supporting industries" and "firm strategy, structure and rivalry".

How LKAB has used "domestic demand" as one of the most important ways of improving its diamond, is demonstrated by its product development which surely has affected the potentials of LKAB significantly. The development of the olivine pellets and the dolomite pellets has meant that LKAB now have new products as their core instead of the former high-phosphorus fines. Although LKAB started to develop its pellets during the 1960s, it was the general recession in the early 1980s that triggered this development. This recession created free capacity both at LKAB and, most importantly, at the Swedish steel mill in Luleå, SSAB. Not only did SSAB have free capacity, the low installed sintering capacity at the company, meant that it, for the future, needed a new and better blast furnace ready product, pellets. LKAB could therefore develop its olivine pellets together with SSAB and run a couple of full scale tests in SSAB's blast furnace. The tests became a success and SSAB started to use the olivine pellets as its in-



put. Reconstructed steel mills in Germany started after this also to use the olivine pellets as their major input.

The DR-pellets with dolomite instead of olivine as a binder was developed in the same way although it was a steel mill in Indonesia that was LKAB's partner in the process.

In relation to figure 1 it is clear that LKAB has gained competitive strength by becoming a focused differentiator. This has been made possible thanks to two strong determinants in the diamond: Factor conditions and endowments, and Domestic demand. LKAB has also strengthened its "Firm strategy, structure and rivalry" determinant thanks to the government grants, which reduced the operation, and thanks to new organization of the work.

Domestic demand played an extremely important role in the process, that would have been difficult without SSAB's demand for a new product and without the possibility of testing this new product in SSAB's blast furnace. LKAB could per-

haps have been able to launch its olivine pellets without SSAB, but it would surely have taken more time and the volumes would certainly have been smaller today without SSAB's help.

The determinant "Related and supporting industries" has played a smaller part in the process. There is, according to LKAB, no close relationship between any of the suppliers and LKAB. The dependence is here probably reversed. Atlas Copco, for example, is more dependent on LKAB for its development of mining equipment than LKAB is dependent on Atlas Copco. Atlas Copco can therefore be said to have improved its diamond with the help of its domestic demand.

LKAB's strongest determinant is, however, "factor conditions and endowments". Without its unique deposit of high grade magnetite ore, none of this would have been possible.

Chance has also surely played a part in LKAB's life. The two oil shocks and the following downturn triggered the LKAB

crisis, and this "chance" created the opportunity to perform full scale tests of the olivine pellets. Figure 13 gives a summation of the model seen from LKAB's point of view.

What about the future? There is no doubt inside LKAB that the future growing market will be the market for DR-pellets, predominantly in Asia and the Middle East. LKAB will also in a close future (1997) try to increase its product varieties with the help of its own test blast furnace. It is therefore possible that in the future we will see LKAB broaden its target and become a differentiator instead of a focused differentiator. LKAB will try to achieve this by using its strongest determinant "Factor conditions and endowments", and by strengthening the determinant "Firm strategy, structure and rivalry".

Notes

1. Hellmer, 1997.
2. Hellmer, 1997.
3. For a description of these five forces, see Porter 1990, 35.
4. Porter, 1990.
5. Tilton 1990, p. 3
6. See Tilton, 1990, for a more extensive discussion of the causes and effects of the dramatic changes in the metal markets during the 1970s.
7. In its annual reports, LKAB refers to this as shareholder's contribution. LKAB is 100 per cent state owned, so the actual word you use can be discussed. I will use "Government grant" in the text and "shareholder's contribution" in the figures, thereby avoiding the political meaning of the concept as such.
8. The operation in Malmberget serves LKAB's largest customer, SSAB in Luleå. According to some managers in LKAB, this operation had probable survived a major reconstruction, perhaps even with SSAB as the dominant owner.

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