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Abstract

The performance of the manufacturing sector has been a major factor contributing to Sweden's economic growth. This paper comprises eight short cases describing a range of Swedish organisations together with the principal features of their production function. The cases are intended to generate discussion and provide a greater understanding of the technical and organisational factors which influence the efficiency of production systems.

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Bo Strömgren	AB Bygg-och Transportekonomi
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Introduction - background to the Swedish industrial situation

Sweden's industrial performance since the beginning of the century has been impressive and the Swedish approach to industrial development is often regarded as a model for other industrialised countries. In little more than half a century Sweden has been transformed from a largely agricultural nation to head the OECD table in terms of per capita income.

The reasons for this situation are many and various, but it is not the intention here to analyse and speculate on the factors contributing to the country's overall success.

It is however worth noting that Sweden's position has become more vulnerable in recent years, due largely to increases in labour and fuel costs (Swedish industry is highly energy intensive and more oil per capita is imported than by any other Western country). Coupled with this, many developing countries have now started to move into Sweden's export markets making cost differences even more apparent.

Sweden is a country with a population of eight million which is concentrated largely in the south. Successive socialist governments have built up a sizeable welfare state and public employees represent nearly 30 per cent of the workforce. There is however very little state ownership of industry, private firms being generally left alone and financing public expenditure through taxation.

The socialist ideal has however influenced the development of industrial relations and industrial democracy in Sweden. In the early 1970s legislation gave the right for two workers to join the board of large companies, with the same rights and obligations as other directors. In January 1977 the traditional agreement on the employer's right to direct and allocate work was abolished and a number of other rules were introduced instead.

These new provisions stress negotiations before any change in management, and the Act on participation in decision making extended the right of unions to collective agreement when decisions are being made in such areas as organisation, project development, personnel management and supervision.

The cases

The situations presented are intended to illustrate current production management practices within eight Swedish manufacturing companies. Each case comprises a background to the organisation concerned and a section describing the principal features of the production system. The cases are short and by no means comprehensive. They are intended to provide the reader with an appreciation of current thinking and the "state of the art" relating to technology and organisation. All the information was collected during visits to the companies in October 1980 so the situations described relate to the immediately preceding period.

It is hoped that the cases provide sufficient information to promote discussion and that, after further research, a greater understanding will be gained of the factors which determine the efficiency of production systems in post-industrial economies.

Case 1: **SKF, Gothenburg**

Company background

AB Svenska Kullagerfabriken (SKF) was set up in 1907 by a Gothenburg textile company. They had previously granted research facilities to one of their maintenance engineers, Sven Wingquist, in order that they could overcome serious problems being encountered with imported ball bearings used to support overhead transmission shafts. The product he developed, a single row deep groove ball bearing, proved to have many times the life of its imported counterparts.

Today, SKF is the world's largest producer of ball and roller bearings, supplying one fifth of World demand. The Group has some 75 plants, 177 companies, and approximately 55,000 employees. Annual turnover is around SKr 10,000 million and approximately 500 million bearings are currently made each year.

The SKF Group headquarters are located in Gothenburg as is the main Swedish production unit. However, Sweden now only ranks number five in terms of production and SKF factories in West Germany, Italy, the USA, and France all have greater output.

At Gothenburg approximately 3,300 persons are employed in the manufacture of spherical roller bearings ranging in diameter from 30 mm to 2180 mm. The turnover of SKF Gothenburg is approximately SKr 1,000 million.

The largest bearings are made in the "C" Factory which employs approximately 100 skilled craftsmen who, because of the complication and precision of their task, have a good knowledge of the trade and often have long experience with SKF.

At the other end of the scale, the smallest and simplest single row deep groove ball-bearings are made in SKF Gothenburg's most modern plant, the "E" Factory. These bearings, used almost exclusively by the automotive industry, have been rationalised into the seven most popular sizes and are produced on automated lines with the 500 employees mainly involved in machine supervision inspection, and service.

Built in 1974 the "E" Factory is equipped with many modern features including, for environmental reasons, water-cooled motors, noise abatement screens, and a ventilation system in which fresh air is brought into the factory via 7,000 holes in the floor, while stale air is expelled by fans in the ceiling.

Also at Gothenburg is the Bearing Components Factory which employs approximately 700 people in the manufacture of balls and rollers for subsequent assembly into bearings. Here wire is cut and pressed into shape followed by hardening and progressively finer grinding until a mirror-like finish is obtained.

SKF - principal features of the production system

Perhaps the most significant threat to the traditional bearing industries in Western countries comes from imports from other parts of the World. The main sources of these are Japan and the Eastern European countries such as the German Democratic Republic. Eastern European manufacturers compete in the main on price but their quality, for the moment at least, is reckoned to be inferior. However Japan is able to supply high quality bearings at competitive prices and therefore presents the most serious source of competition.

To date this competition has affected mainly the smaller, high volume bearing sizes where the advantages offered by economies of scale can be derived. It was in this sector that SKF was particularly at risk. Traditional batch methods of production were highly labour intensive and it took months to turn raw materials into finished products. In comparison, large bearing production remained competitive because the smaller quantities involved, the unavoidable dependence on experience and skill, and the low levels of absenteeism due to the higher degree of job enrichment, all combined to keep SKF efficient.

The company's solution as far as the smaller bearing sizes were concerned was to concentrate on a programme of rationalisation together with the application of line flow techniques.

To facilitate rationalisation SKF developed a global forecasting and supply system (GFSS) which forecasts worldwide bearing demand, based in part on reports received from all its companies. This then allows production of the five major European SKF bearing manufacturing companies to be co-ordinated, enabling each plant to manufacture fewer sorts of bearings, but in greater quantities using line production methods.

The "E" Factory at Gothenburg is a prime example of this approach. The use of lines of automatic machines has enabled good quality bearings to be produced at an extremely high rate, while the raw material to finished product time averages less than two days.

One point should be stressed however about SKF's attitude towards automation. The company recognises that line speed is not necessarily the only factor which determines the total output and every effort is therefore made to maximise utilisation rather than to maximise production rate. Reliability and material availability is regarded as extremely important and the company is currently designing systems which will allow non-stop production with limited supervision during unsocial hours.

Case 2: <u>**SAAB Cars**</u>

Company background

SAAB, Svenska Aeroplan AB (the Swedish Aeroplane Company) manufactured their first aeroplane, the Saab 17, in 1940. Since that time they have become one of Europe's leading manufacturers of military and commercial aircraft with products including the Viggen, the Safari, and the Saab-Fairchild commuter airliner. Today the SAAB-Scania Group employs 39,000 people and has annual sales amounting to SKr 13,400 million. Apart from the Aerospace Divison (which manufacturers monitoring and control equipment as well as aircraft) the company comprises three other main divisions, namely Scania (manufacturing trucks and buses), Saab Cars (manufacturing passenger cars), and Nordarmatur (manufacturing process control systems). Associated companies include, for instance, Datasaab AB (which manufactures computers). The Group headquarters are located in Linköping, as is the main production unit of the Aerospace Division. The majority of SAAB - Scania's factories are based in Sweden, with only 7,000 people being employed in other countries.

Saab Cars, employing about 11,000 people, has four manufacturing sites in Sweden. The main development and production unit is situated at Trollhättan in a factory which had previously undertaken aircraft manufacture. At Trollhättan production is concentrated on the 900 series of passenger cars, 49,000 of which were manufactured in 1979. The Trollhättan factory comprises firstly a press and body plant where different types of body (Sedan, Combi Coupe, two-door, four-door, etc.) are assembled, finished and painted. Secondly there is a final assembly plant where finished cars are completed on a single, moving conveyor type, assembly line fed with components and sub-assemblies.

Saab - principal features of the production system

In the early 1970s Saab, along with numerous other Swedish companies, experienced labour turnover and absenteeism problems where flow lines were being used. In the body shop at Trollhättan labour turnover averaged about 50 per cent per annum in the four years from 1971 to 1975. Worse still, absenteeism rose steadily in the same four years from 15 per cent to 23 per cent so, since every person on a production line is an important link in the chain, on some days it was virtually impossible to build a complete car.

Saab's approach to the problem was to change the organisation of the body shop in order to create "autonomous" working groups. Saab-Scania had successfully employed the group assembly system since 1971 in its petrol engine plant at Södertälje and small groups had also been established at Trollhättan on a trial basis with satisfactory results. In 1975 therefore the production line in the welding and grinding department was replaced by work stations in which the body remained stationary during all the operations allocated to the department. Each station was manned by a group whose members had a wider range of duties than in the past. Using an advanced electronic system, each group could route the bodies to and from its station.

This, and subsequent changes in body shop organisation, led to a reduction in labour turnover to 14 per cent by 1978, the most significant drop in the Trollhättan plant. Abstenteeism in the Groups was also significantly lower than for departments organised on a line basis.

The change in organisation in the welding and grinding department meant that the cycle time of three to six minutes on the conventional driven line was replaced by a 45 minute work cycle with the body in a stationary position. The eighteen workplaces in the system were divided up between six groups with three workplaces to each group.

Every group comprises eight members of whom one is designated the liaison man and another a stand-in (in the event of illness), the other six work in pairs at the workplaces. Duties are rotated within the Group. The Group should produce 150 bodies per week or ten to eleven bodies per workplace per day and the output of the Group can fluctuate by plus or minus three bodies per day and plus three per week. Production over and above this limit will not result in higher wages so the Group does not feel the stress usually associated with piecework. Indeed it is often the case that a group will meet the target early on Friday and will be allowed to stop work for the rest of the day.

The idea of group work has been extended into other areas of the Body Shop although this has not excluded the possibility of using automation. In fact, the spot welding tasks have now been almost completely automated by including a line of ASEA robots to complete the hundreds of welds required on the body. Wherever automation has been used however a special point has been made not to tie the operator to the machine cycle and "freedom from the technical system" is always maintained using such devices as magazine loaders etc.

In the area of final assembly Saab have not yet applied the group work principle because of the material management and handling problems which arise in complex assembly work. However changes in design and the method of assembly have allowed the use of groups for sub-assembly work and hopefully this approach may eventually be extended to all stages of final assembly.

Case 3: **AB Mekania-Verken/Skandia Fabriken AB**

Company background

Mekania and Skandia are two separate companies, although for all intents and purpose they are operated almost as a single unit. It is a small, private, family-owned business engaged in sub-contract parts manufacture and, to a lesser extent, production of finished goods. Two factories are situated on opposite sides of the road in a small industrial estate at Mullsjö, which is a small village near Jönköping in Southern Sweden.

Approximately 80 people are employed in one of the factories making mainly metallic parts while about 75 are employed in the other which is mainly involved with injection moulding of plastic components. The products made in the first plant are mainly for the automotive industry and include such vehicle components as gear levers, oil tubes and dip sticks, foot pedal brackets etc. Some miscellaneous items of a "non-engineering" nature are also made in this plant such as projector screens and electric heating elements for car seats. The factory is fairly modern and contains a high level of investment.

The second factory is equally modern and contains, in the main, up-to-date injection moulding equipment. Motor vehicle components again prevail (for example mud flaps, dash board components, bumpers, etc.) although again a number of miscellaneous items are made such as paint trays and rollers, handles for chain saws, venetian blinds etc.

All the commercial office accommodation (including a small IBM computer) is located in the first plant which also houses a well-equipped toolroom.

Mekania/Skandia - principal features of the production system

Mekania is primarily a sub-contractor and, as with any such company, is tied to the trading success of its customers. Moreover if a customer changes its supplier it will have a profound effect on the sub-contractor's activity.

bumpers, mud flaps, etc. Here the manufacture of paint trays and rollers is a good example of diversification into a totally different market (in this case the more buoyant home decorating field) while still employing the traditional skills and processes of the company.

Case 4: **Stiga**

Company background

Stiga AB was founded by Stig Hjelmquist from whose name that of the company is derived. The products manufactured vary enormously. Internationally, Stiga is probably best known for their table tennis tables and equipment which is used in many major tournaments around the world. Other products include lawnmowers, cultivators, snow blowers, exercise bicycles, leisure games, air gun pellets and "snow racers" (a child's sledge).

Today the founder owns 65 per cent of the company's shares while a bank, Sveriges Investeringsbank AB, owns the remaining 35 per cent. Sales income in 1979 was SKr 212 million.

All the company's production facilities are situated at Tranås. A new factory and office complex houses the majority of parts production which includes a large press and fabrication department together with a painting facility and toolmaking department. Here, the majority of assembly work is also carried out.

An older factory, situated in close proximity, houses plastic moulding facilties together with the manufacture of table tennis bats and tables, air gun pellets and "snow racers". The company currently employs 680 persons.

Stiga - principal features of the production system

One of the major factors influencing the production system at Stiga is the seasonality of most of the products. Of course this is particulary the case with lawnmowers which still represent one of the company's major sources of sales income.

In the early years of the company the problem of seasonality could be managed by simply hiring and dismissing labour as demand fluctuated up and down. However, recent times have brought about greater job security for workers so a different approach has had to be adopted. Although some balance has been achieved by exploring overseas markets (e.g., Australia) to create a "winter" demand, the main thrust has been to diversify, where possible, into products which have different seasonality cycles.

This has led the company into the leisure goods market. In the main the sales of Stiga's leisure goods (the ice hockey game and "snow racers") occur around Christmas time whereas lawnmowers mostly sell in the Spring and Summer months. This strategy has not, however, completely eliminated the production problems because stocks still need to be produced and kept prior to the start of the season in anticipation of the initial demand. Since materials comprise around 80 per cent of the manufacturing cost of the products this represents a heavy financial investment and on the balance sheet, stocks represent 54 per cent of the total assets (compared with 38 per cent for both Electrolux and Volvo for instance). It was the need to finance this stockholding which among other things led to the injection of capital by the investment bank, who also insisted on taking over control of the company's affairs.

A further difficulty associated with producing different products at different times of the year was the changing over of production facilities. When the facility takes the form of an assembly line the changeover time could be several weeks. Stocks of parts and sub-assemblies have to be changed and new work stations have to be arranged to maximise line speed and efficiency. For this reason in about 1978, Stiga went over to the use of groups for assembly work. Since groups are more flexible and autonomous than flowlines, changeovers could be effected within only a matter of days, even between products as dissimilar as lawnmowers and hockey games. Changes between different models of lawnmowers could be made in only ten minutes.

Although the decision to change to group working was driven primarily by the need for flexibility, it was found from subsequent studies that productivity using groups has increased by 30 per cent. The incentive scheme used is that groups are paid per piece up to a certain maximum.

Elsewhere at Stiga emphasis has been placed on production engineering and manufacturing methods. For example, plastic figures for the hockey game were at one time each painted individually in "team" colours. Now, using a novel process invented by the company, three different colours of plastic can be injected into the mould simultaneously, thereby eliminating painting altogether. Another production engineering example is the automated assembling of the levers for the hockey game; here an expenditure of £25,000 saved fourteen people for the three and a half months per year during which this activity was carried out. A third example is the company's plan to completely re-arrange the main factory area in order to simplify the material flow.

In summary, it can be said that Stiga's formula for survival and growth is to remain flexible, to try new ideas and to always review the current way things are done. It should be noted that, far from losing labour, the company had increased its workforce by about 180 during 1980 because of a large increase in sales turnover.

Case 5: <u>BT Lifters</u>

Company background

AB Bygg-och Transportekonomi is a manufacturer of a wide range of material handling equipment.

The company was formed in 1946 and in 1950 moved to its present location of Mjölby, a small town in Southern Sweden with a number of new industries located in a planned industrial area.

The factory space has been progressively increased since that time until, at present, there are 330,000 sq. ft. of manufacturing facilities and 110,000 sq. ft. of offices. At the time of writing a major new factory extension is being completed and further expansion is planned. The Mjölby factory employs 1,200 people, and another handful are employed at a very small plant in Northern Sweden making container handling equipment.

BT is part of a co-operative whose interests include a large supermarket chain.

The company's product range has grown in recent years and now includes sophisticated computer-controlled stacker cranes and automatic truck systems as well as more conventional manual and driver operated lift trucks. The company's original product, the manual pallet truck, is still most important in volume terms and 60,000 of these are made per annum. However, greater revenue is obtained from the more complex trucks of which 15,000 are made per annum.

BT Lifters - principal features of the production system

BT is in many ways a typical batch production engineering company and faces all the well-known problems of keeping down set-up times, minimising the levels of work in progress, avoiding unnecessary material handling, and minimising delivery lead times.

The approach BT has taken to these problems has been largely one of thinking carefully about the design of the production system and applying the company's own knowledge of material mangement based on experience with its own products.

In the parts production area this system design has taken the form of a "flexible manufacturing system" which basically is a group of machines which can completely produce a variety of different components automatically. The concept of "flexible manufacturing systems" stems from the idea of "group technology" where families of components are made in cells or groups of manned machines. The advantage of this approach over using a functional layout (where batches of components are routed from one functional department to another) is that set-up times may be reduced due to commonality, batch sizes may be decreased, and work in progress and lead times can be kept down.

BT had for some years operated such a cell (comprising milling machines, pillar drills etc.) being served by one of their own fork-lift trucks, thus halving the amount of work in progress.

However, in 1976 the demand for BT's products had grown so much that a new system was planned. Aims for this system were flexible and automatic handling of pieces and materials since the company was also considering the purchase of an unmanned machining centre. After examining several proprietary work handling systems it was decided to again use one of BT's own products, but this time a computer-controlled stacker crane. This serves up to twenty numerically controlled machines (lathes, millers, borers etc.) as well as the unmanned machining centre and, as with the previous system, uses conventional pallet storage racks for work-in-progress storage.

Benefits have been reduced floor space, less work in progress and greater output. Moreover, the mini-computer which controls the system can provide up-to-date information regarding the progress of orders. The payback period is two and a half years for the investment which was £120,000 on the crane, racking and mini-computer and a further £200,000 on the machining centre.

Elsewhere in the plant, where volumes are higher, automation has been approached in more conventional but less flexible way. For example, forks on the manual pallet trucks (which at two per truck total 120,000 per annum) are made using a special purpose piece of equipment which is operated more-or-less continuously.

In the stores area too, BT's experience in material handling is apparent. The work-in-progress stores for instance comprises 11,000 pallets held on rows of racking served by a BT stacker crane.

The versatility and speed of access of this system coupled with good material management means that work-in-progress stocks are turned over five times per year; far better than the situation in most other similar engineering companies.

Case 6: **Electrolux, Motala**

Company background

AB Electrolux is Sweden's second largest company employing in 1979 82,000 people, 28,100 in Sweden and the remainder in nearly forty countries throughout the world.

The company has grown to this size by a programme of expansion and acquisition which most recently involved a restructuring of the Electrolux Group commencing in the latter half of the 1960s and continuing through the seventies.

Growth took place in Scandinavia as well as in Europe and the USA, and was principally concerned with finished products in the household appliances sector. Major acquisitions which brought the company into new fields included that of Facit (bringing Electrolux into the office equipment market) and Husqvarna (creating a "motor products" sector producing chain-saws, lawnmowers and motorcycles).

The Motala organisation comprises the Motala plant itself employing 2,300 people, together with plants at Strömstad (employing 450) and Torsvik, Huskvarna (employing 400).

There are basically three activities carried out at the Motala plant.

Firstly, the manufacture of caravan refrigerators and domestic cookers carried out in an integrated unit extended in 1974 to its current size of 460ft by 1675ft. In addition to final assembly other departments in this unit include sheet metal fabrication, painting and enamelling, and cooling unit production.

The second activity is plastic moulding which includes the production on three extruders of 15-20 tons of plastic sheet per day for vacuum forming of refrigerator parts. The main moulding shop houses about seventy injection moulding machines making plastic components for refrigerators, cleaners, dish washers etc.

The manufacture of plastic components for the Electrolux factories in Sweden has been centralised at Motala and the plastic moulding factory is probably the largest of its type in Europe.

Lastly, at Motala all the steel wire shelves and baskets are made which are subsequently used in all Swedish made Electrolux refrigerators and freezers.

Electrolux - principal features of the production system

The most significant factor influencing individual Electrolux plants has probably been the Group's policy of expansion and the search for economy of scale. This influence may be well demonstrated by the organisation at Motala.

It is firstly not by coincidence that Motala specialises in plastic moulding and wire basket manufacture. By centralising these activities the company is able to achieve the lowest unit cost of production and since in both cases the product is lightweight and stackable, the transport costs to the assembly plants where they are used is negligible. Motala's location is also fairly central within the industrialised part of Sweden.

When examining the plastics and wire baskets factory the benefits of scale are immediately apparent. A single point for the purchasing and storage of material obviously avoids unnecessary duplication of administration and excessive safety stocks. A co-ordinated control system ensures long production runs and high machine utilisation (plastic moulding machines for instance may be set up for anything from one week to three months). In one area, therefore, 22 machines require only two setters per shift and in another area 20 machines only require one setter per shift.

Centralised purchasing can also ensure that a common make of machine can be used thereby standardising on spare parts and maintenance (nearly all the moulding machines are made by Engel in West Germany).

However, the most significant feature of both factories is the use of robots. In the plastics factory these are used primarily as devices for unloading machines, freeing the operator to inspect and pack. One operator will be responsible for two machines and tools are usually designed so that parts are delivered with any waste already removed.

Parts are delivered onto a slow moving conveyor belt from which the operator can remove them at leisure thereby creating a buffer between operator and machine and providing freedom from the machine cycle.

In the wire basket factory the trays for refrigerators are also made using robots. Wire is loaded onto a rotary table which leads to a transfer line. All the welding, bending and assembly work is carried out automatically with the trays being passed from station to station by the robots. One tray is produced every 15 seconds.

The third factory, making cookers and refrigerators, provides yet another example of the benefits which can be achieved through scale. Here again robots are evident, this time in the department which makes refrigerator cooling units. On this occasion they are used to replace jobs which are not only repetitive but also environmentally unpleasant. The first application, in 1974, was for welding caps onto tubes. Following the success of this installation a line was set up in 1965 for the complete manufacture of cooling condensers with presses, bending machines, assembly etc. all linked up by robots and having a 30 second cycle time.

In the refrigerator and cooker assembly areas the benefits of economy of scale are once more demonstrated. Altogether nine separate assembly lines are used, three for cookers and six for refrigerators. In the case of cookers production is at the rate of about 500 per eight-hour shift, small cookers require 1.1 hours assembly work and large cookers require 1.4 hours.

So far the assembly areas at Motala have not adopted the "group" approach which has gained so much popularity in recent years. However, this situation is to be reviewed following the acquisition of Husqvarna. This is because Husqvarna cooker production, which is currently being carried out on a group basis, is to be moved to Motala.

Case 7: <u>AB Orrefors Glasbruck, Orrefors</u>

Company background

The lead crystal glass industry is one of Sweden's oldest industries. As a craft crystal glass manufacture has been practised for some 6,000 years, probably having originated in Egypt or Babylonia, but it was in the Fifteenth and Sixteenth Centuries that the industry spread throughout Europe.

In Sweden, as in other countries, crystal glass has traditionally been made in small units most of which are located in the South East in a region known as Småland.

In recent times the traditional hand-made crystal glass industry has suffered due to the availability of cheap machine-made products and the state of the World economy at large (the industry depends heavily on the export market).

At the present time, therefore, the number of Swedish crystal glass making factories has diminished to just over twenty. About ten of these now belong to two groups, namely Kosta Boda AB and Orrefors Glasbruck who together account for almost 70 per cent of employees in the Swedish glass industry.

Of the six glassworks in the Orrefors group the largest by far is the Orrefors glassworks itself (the others being Sandvik, Alsterfors, Flygsfors, Gullaskruf and Strömbergshyttan). Established in 1898, the Orrefors works employs approximately 350 people and manufactures full lead crystal domestic, art and lighting glass.

Orrefors - principal features of the production system

The glass works at Orrefors manufactures hand made, full lead crystal glass. This description in itself imposes perhaps the greatest constraint on the production system. Firstly, the basic materials in crystal glass manufacture are sand, red lead, potash, and saltpetre and international standards require that the lead content must exceed a prescribed limit in order that the words full lead may be used. Secondly, for the words hand made to be allowed the glass must be gathered from the furnace and blown by hand and any subsequent cutting of the pattern must also be carried out manually.

These factors mean that any manufacturer of hand-made full lead crystal is prevented from economising on materials and is limited in the amount of mechanisation they can employ.

Moreover, crystal glass is a "luxury" commodity bought usually as a gift, and therefore, usually suffers from a fall in demand in times of economic recession.

The problem faced by Orrefors, therefore, is to improve productive efficiency and to control costs while, at the same time, maintaining the image and reputation for high quality that has been built up over the years.

Productive efficiency in the crystal glass industry depends very much on the morale and motivation of the workers and Orrefors has gone to great lengths to maximise the contribution made by the direct operators.

To this end a new building was constructed in 1966 which housed all the glassblowing and annealing facilities under one roof. The design of the building provided a light and pleasant working environment compared with the conditions previously prevalent in the industry.

Following the traditional practice, glassblowers work in teams headed by a master craftsman who has at least ten years experience. Teams vary in size according to the item being manufactured (for example, it requires a team of seven to make wineglasses) and the product is passed from one team member to another for the various processing operations.

Orrefors give every team complete autonomy by providing each one with a separate furnace and work area. The furnace has two pots so one can be used while the other is being serviced.

Worker autonomy may also be demonstrated in the glass cutting department and particularly in engraving where each engraver is provided with his own room in which he works with complete freedom from interference.

Although it was previously implied that "mechanisation" was not appropriate in the manufacture of crystal glass, there may still be applications in the area of indirect work. An example of this at Orrefors is the widespread use of material handling equipment to transport items quickly and at low cost. For instance a system of roller conveyors is used in the glassblowing area to transport blown glass to the annealing ovens where they are stress relieved.

Another interesting feature of the approach to production management at Orrefors is the recent history relating to incentive schemes. After many years of piecework incentive the company went over to using a daywork scheme whereby workers were paid a monthly salary. However pressure from the workers themselves demanded a return to piecework which was accepted by Management.

In summary, therefore, the approach taken by Orrefors has been to maintain product quality and brand image while at the same time looking closely for opportunities to remain competitive by exploiting the full potential of the labour resource and by cutting down indirect costs.

Case 8: **Volvo BM AB, Brååas**

Company background

The Volvo Group of Companies is Sweden's largest industrial concern employing 44,500 people in Sweden itself and nearly 17,000 in other countries.

Volvo is probably best known for its passenger cars, production of which numbered 320,000 in 1979 (of which 90,500 were built in the Netherlands and 37,200 in Belgium). However, in addition to cars Volvo also manufactures marine and industrial engines, earthmoving, agricultural and forestry machines, aircraft engines, hydraulic machinery, engine heaters and recreational products.

The Group as a whole manufactures some 100 different products, most of which relate to the transport sector.

Volvo BM, with headquarters in Eskilstuna, is the construction equipment, farm and forest machinery division of Volvo. The name derives from Bohlinder Munktell, a company taken over by Volvo in order to enter this particular market sector. Originally Volvo BM was primarily involved in the manufacture of farm machinery (tractors, harvesters, etc). However over the past ten to fifteen years the emphasis has shifted towards the more profitable construction equipment market (especially wheeled loaders and dumpers). The tractor business has also been sold to Oy Valmet, a Finnish company, and the harvester business sold to Electrolux.

The Brååas factory is one of Volvo BM's smallest and was taken over in 1974. A separate company had previously manufactured dumpers at Brååas which were then marketed by Volvo BM. Since 1974 the Braas site has become completely integrated into the Group and has been modernised and enlarged. There are currently two main facilities. First there is the component manufacturing plant (together with office accommodation), this is the original factory and employs 240 people. Secondly there is the assembly plant, employing 150 people, which is located approximately one mile away having originally been opened in 1975 and subsequently extended in 1979.

Volvo BM - principal features of the production system

Prior to the Volvo takeover in 1974 the factory at Bråås concentrated on the production of a well established off-the-road dumptruck, the 860 (slightly modified later to become the 861). Shortly after the takeover however it was decided to manufacture, in addition, an entirely new and larger truck the 5350.

Technically, the Bråås factory was capable of building both the old and new truck. Over 60 per cent of parts were purchased and in-house cutting, welding, machining and assembly facilities were well provided.

The biggest problem encountered in the development and manufacture of the new truck, however, proved to be organisational in nature.

Firstly the 5350 was designed largely at Volvo BM headquarters at Eskilstuna, some considerable distance from Bråås. This obviously caused problems of liaison between design and manufacture.

Secondly, the internal production organisation at Bråås together with management difficulties exacerbated the problem of introducing the new model by the date planned.

At the top of the company, changes in Managing Director added to the problem since this obviously created changes in policy. Mr Lihnell, who was the old owner of the factory, left the position of Managing Director in 1976 and his successor then only stayed with the company for two years.

It was therefore not until 1978, when the present Managing Director was appointed, that stability began to be established. The unique management style of this new Chief Executive, which often conflicted with traditional practice, was designed to create an atmosphere in which the new truck could be introduced without the constraints of a traditional structure.

A change in production organisation was introduced which involved firstly disbanding quality control as a separate function and secondly the setting up of two completely autonomous units for parts manufacture and assembly.

These two units were headed up by managers whose previous experience was in theory not appropriate to the jobs they were given. However, personality, initiative, and managerial skill were considered more important in the special circumstances which prevailed. Thus the previous Purchasing Manager was put in charge of parts manufacture and the previous Quality Control Manager made responsible for assembly.

Under the new structure, manufacture of the 5350 truck has gone far more smoothly and the Company planned to produce twice as many during 1981 as in 1980.

Now, with the easing of the organisational problems, the company is in a position to start to look at technical ways of improving production by, for example, installing new numerically controlled flamecutting equipment and machine tools and employing robots for such tasks as sandblasting.

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