Footwear manufacturing systems continue to develop. The last fifty years have seen some significant milestones and new techniques are being developed for the 21st Century.

Steps into the millennium

M minus 50

It is the late 1950s. The United Shoe Machinery Corporation has just demonstrated an automatic Goodyear welt production line at its Beverly, Massachusetts, facility. After the upper is lasted, the bottom is filled and the shoe placed on the transport system. The leather sole is attached, rough rounded, trimmed to the prescribed dimension, and finally stained and polished.

This is a fully automatic system using the geometric last and a key plate around the spindle hole. The system works, but is destined not to be commercially successful because of the prevailing costing and royalty system.

Additionally, new soling technology is coming onto the market, which includes direct injection and unit soles.

M minus 40

A decade later and the Toyota-developed upper stitching system has begun to affect shoe manufacturing methods. The Suave Shoe Company in Miami, Florida, is reportedly producing 90,000 pairs of athletic footwear a day. Its modern plant uses a production line technique borrowed from the motor industry as straight-line layouts carry materials and sub-assemblies from cutting through bottoming, each line producing a different type of shoe. In a central area the bottoming materials are stored in large silos which feed all the injection moulding machines. It has been described as the 'plant of the century'.

M minus 25

Today, the rink system is making an impact on a number of manufacturing units. International Shoe Machinery Co is a leader in the technique, though Schoen and other firms have demonstrated a prototype system at recent IMS Pirmasens fairs. They use a transport system to carry the last to the two-man lasting system and then automatically move the upper to bottom roughing and bottom cementing. The shoe is then taken to either cement lasting or direct attachment.

Ecco of Denmark operates a plant in Portugal where it produces a substantial number of comfortable casual shoes. This manufacturing unit is ahead of its time because it takes unfinished leather and finishes it to the desired colour on the premises, with impressive savings and flexibility.

M minus 15

This is a Pirmasens fair in the mid-1980s, and Schoen has just introduced a new method of digitising a split and positioning the patterns to obtain the most cost-efficient cutting figures. It is a prototype system and leaves much to be desired, but it works.

Subsequently Orisol will introduce its vision stitching program whereby a camera can identify the positioning of the parts and guide the sewing heads to ensure accurate assembly. The follow-through development of computer controlled stitchers is mainly for decorative sewing, but rumour has it that, with the development of pallets, join and sew operations will become much simpler.

M minus 5

As we move even closer to the 3rd millennium, a new era of cutting systems - waterjet and knives rather than cutting dies - all advance the industry towards greater technological integration. USM, Micro Dynamics, Gerber, Bata, and Clarks have all recently introduced computerised technology for the creation of styles and the grading of uppers. Incoming IT developments are taking the footwear industry into its most exciting era as their adoption, even though they may overlap in some instances, reduces costs by eliminating waste and speeding the production process.

Millennium

Today designers can create products on computers without cutting a piece of leather or fabric. They can revise style lines, change colours, surface textures, modify sole and heel profiles, while retaining exact last lines.

They can grade the parts and send the

Top left: Perseus from Rollerblade.

Water power from Killerloop.

information to sample cutters, to a last turner, to a stitcher and to a bottoming program, whether direct injection or the production of unit soles, and they can be quite sure that the shoe will fit.

Much has been written about the concept of mass customisation. As far as the footwear industry is concerned the early programs left much to be desired and were not very successful, but the bugs are being worked through.

A simple mass customisation program has been recently introduced by the footwear division of Nike. Customers connect up to the company's web site, select the shoe model, and then the colours and where they should be placed. Thus, the customer has their own, value-added, version of a shoe for a modest premium. This is being expanded into clothing stores by jeans manufacturer Levi Strauss. Customers visit selected stores and undergo a body scan. The results are digitally encoded, and a pair of jeans is made to individual fit. Does it cost more? Yes. But the purchaser will have a pair of jeans that fit. Furthermore, they can reorder at any time and know that the garment will continue to fit (barring any involuntary alterations in physique).

Today there are more accurate scanners using lasers to digitise both feet, one foot at a time. Cameras give better side and top contour profiles, and a pressure plate on the base defines the bottom contour of the foot. Following this process, the information is sent to a last turner, a sample cutter, a computer-controlled sewing machine, and then to the bottoming operation. Does it work? Yes. Though it is still limited to what are considered 'normal' feet. There are programs being developed that will cope with deformation, arthritics and the problems caused by diabetes.

At the last SIMAC fair there were three companies showing new vision technology, which helped speed production while assuring accuracy. In these systems the operator would place a sole, to be roughed and then cemented, into a prescribed area of a machine. A camera would identify the bottom unit and its positioning, and then realign the roughing and cementing programs so that the work would be performed correctly.

To meet the needs of shoe manufacturing in the future, some modifications will certainly have to be made. Through feed machines must be developed so that the operator handles the soles only once. The soles could be fed onto a conveyor to take them to the bottoming area where the adhesive is automatically reacted and the operator positions the lasted upper to bring both sub-assembled units together in the sole press.

One of the problems often mentioned in the context of computer stitchers is that the stitches do not form a correct line on curved surfaces; they are slightly off centre from one another. A research organisation in Pirmasens has developed a sewing system where the device holding the upper actually turns in relation to the sewing direction. Thus, all of the stitches are in perfect alignment.

M plus 0.25

Now we are in the new millennium and there is so much technology coming on line that the industry is getting closer to the point where the hide can be thrown in at one end of the building and a shoe come out of the other. To some degree this is an existing concept. Those companies which specify exotic leathers often use the service of the leather supplier to cut parts.

Today tanners are tanning and cutting leather to specification for the automotive industry. They are beginning to actually measure leather using SATRASumm to meet the needs of the shoe manufacturer. The next step is for the tanner to cut the actual parts so that the manufacturer needs only to site a stitching operation within a modest delivery distance of the tannery.

Without the cost of the cutting room and the need to dispose of leather waste, shoe manufacturers can concentrate on designing and sewing uppers. The elimination of in-production waste is an on-going process, and damage has been minimised - and almost eliminated - by the adoption of sewing machines controlled by visual identifying systems. The uppers are easily transported to the soling facility where new technology of bottoming materials and machinery produce accurately finished footwear. The 20th century theory that hides can go into one end of the building and cut, or cut and sewn, uppers can come out the other is now a reality.

Reality

Will it happen? Yes. Soon? Perhaps not, but possibly within 15 years we shall see the beginning of this program. Will it work? Yes, because nesting programs and cutting systems already offer accurate control by computers and developed programs.

Pallets on a constantly moving carrier move the parts to the sewing system where an automatic stitcher is enabled to be in constant operation. One person loads the carriers for several machines, while another unloads and sends the uppers to lasting.

New materials help to make this possible and as SATRA recently noted, some of those which are replacing leather will make cutting more efficient since the raw materials are in roll form and can be cut in layers by waterjet. This facilitates more styles and a greater use of color. Additionally, centralised cutting services are able to take advantage of cutting uppers for many factories basing the activity on computer generated information supplied via the internet.

The new millennium will see the 'factory of the future' come closer to reality, and while they may be smaller, they will be more versatile and, through better communications - more flexible in what they produce. Retailers will be constantly offered fresh new styles that they will be able to view online in a range of colours and colour combinations. In turn this activity, and the ability to develop what any individual customer may require, will generate more retail sales.

Jim Sutton

Diagram courtesy of ARCO Chemical Company.