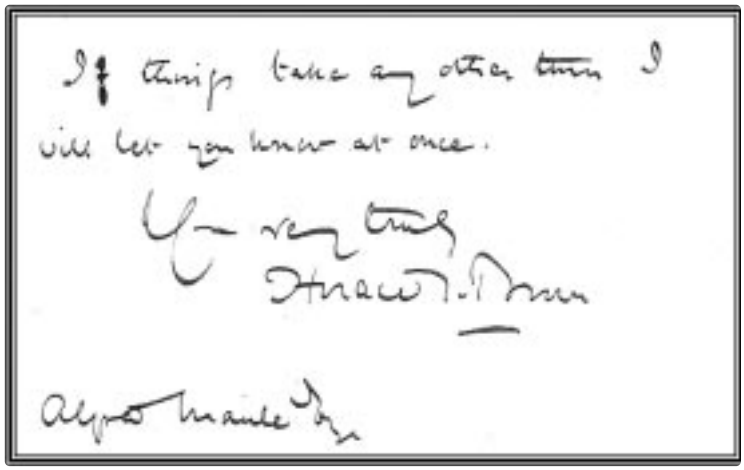
50 years in the brewing industry

Horace Tabberer Brown was one of the original members of the Laboratory Club, which became the Institute of Brewing and was President of the Institute in 1891–92. In 1916 at a London Section meeting he read a paper "Reminiscences of 50 years experience of the application of Scientific Method to Brewing Practice".
As I have also been in brewing for 50 years – and my family 200 years in total – it seemed appropriate to do the same.

By **Lionel Maule**



Part of a letter from Horace Brown to Lionel Maule's grandfather.

"Post WWII the industry was not in good shape in many countries. In the territories where the war was waged, the industry must have almost had to rebuild from scratch. For others, the inevitable restrictions of wartime had left the industry in need of an upgrade. In UK, the situation that faced many brewing companies is typified by the experience of Greene King, a regional brewer. Wilson, in his history of the company, says that there were three areas requiring immediate attention: the beer, the brewery itself and their tied properties (pubs)."

Horace Brown was a good friend and business associate of my grandfather, Alfred Maule, who was the brewer at Tamplins, Brighton. Alfred also had a strong working relationship with consulting chemist Edward Moritz, who was in partnership with Brown at one stage. In 1893 Moritz wrote to Maule commending him on the way he developed his pupils at the brewery; it is strange that I ended my career doing much the same people development work. Perhaps, after over 100 years it is "not what you know but who you know".

Introduction

In this review of the past 50 years, I will first look at the pattern of beer production volumes over this period and the changes – only partly in reaction to this – in the industry itself. I will then discuss changes in raw materials, brewing/packaging and production management. From this, I will examine how skills requirements have changed over the years and the way these challenges are being met. Finally I will look at how the Institute has adjusted to these changes and consider the challenges ahead.

Much of this will be a personal view, influenced by having worked in England (a mature industry) and Southern Africa (a fast growing one). If I am able to remind some of you of changes that have taken place and make younger members aware of these, I shall have succeeded.

World beer production

How has this changed?

World beer production has increased nearly four times from 1960 to 2004 (figure 1). Production for five areas of the world is shown in Figure 2. Among the leading producers are countries that were badly affected by World War II; Germany, UK, Russia, Japan and USA. They showed slow recovery in the 1950s followed by strong growth in the 1960s and into the 1970s, after which growth slowed down.

The most striking aspect of this graph is Asia; from being the same volume as Africa in 1960, it is now challenging Europe and the Americas and is set to overtake them in the next five years. This has been driven by China, growing from half a million hl to 291 million hl.

Africa has nevertheless grown eleven-fold during this period. In South Africa the repeal in 1962 of the prohibition of the consumption of any alcoholic products other than sorghum and maize beer by black South Africans unleashed unprecedented growth, resulting in South African production rising from 12% of total Africa in 1960, to 35% in 2004.

For each of the five major areas, the percentage share of world beer production has been close to the area's share of world GDP.

The top ten countries by production volume in 1960 produced 66% of world volume. By 2004 the top ten shown below only produced 49% of world volume:

Top ten 2004 (Million hl)

China	291
USA	233
Germany	106
Brazil	86
Russia	85
Mexico	68
Japan	65
Great Britain	59
Spain	31
Poland	28

The brewing industry

Post WWII the industry was not in good shape in many countries. In the territories where the war was waged, the industry must have almost had to rebuild from scratch. For others, the inevitable restrictions of wartime had left the industry in need of an upgrade.

In UK, the situation that faced many brewing companies is typified by the experience of Greene King, a regional brewer. Wilson, in his history of the company, says that there were three areas requiring immediate attention: the beer, the brewery itself and their tied properties (pubs).

Just producing enough beer was made harder by Government limitations on production and materials, introduced during the war and generally maintained until 1951. Additionally there were critical shortages of hops, sugar, bottles and

casks, electricity, oil and coal for much of 1947. The demand for bottled beer rose, at the expense of cask, putting a strain on packaging facilities. Lastly, a 10% reduction in gravities was ordained.

All of this and other factors, contributed to a national decline in UK beer production which only turned the corner in 1960.

What happened then?

Steady growth was maintained, in the middle of which another hurdle appeared – mergers. Before the war these were 'inevitably conducted in an amicable, gentlemanly fashion'. After 1950 this mood began to change and in the UK the industry 'then witnessed intense concentration amongst its firms, brought about by amalgamations which were amongst the most spectacular and fiercest fought in the history of limited companies.' Smaller companies struggled to maintain their independence and this was not confined to UK.

In recent years the move has been towards globalisation, to the point where the top ten global brewers now produce around 60% of the world's beer.

Deutsche Bank expects a handful of global brewers and brands to continue to widen the gap between themselves and the rest of the pack, with the key success factors being:

- A brand which is capable of being a global brand. The focus is on premium brands, but real winners will produce global mainstream brands.
- Strong management and the willingness to relocate to emerging markets.
- A portfolio of strong or dominant local mainstream brands, as a base from which to grow.
- Significant emerging market exposure.
- Access to capital.
- A desire and strategy to expand globally by acquisition.
- Strong local partners, particularly in emerging markets.

So, it seems that most brewing companies can perhaps be classified as either Predators or Prey.

Other challenges

The industry is also facing changes in customer preferences:

- different beer types (ales to lagers in UK)
- demand for premium brands
- packs for off-consumption
- flavoured alcoholic beverages
- wines and spirits

– and there has been increasing pressure from legislation. Issues such as health, safety, labelling requirements, environmental concern and protecting one's trademarks have led to changes in the way the industry does things; drink-and-drive laws have had a marked impact on patterns of consumption.

Lastly, the whole approach to production management has changed and this will be addressed later in this article.

Myethi Mpofu, a Chairman of the Africa Section of the IBD, talking to delegates at the Nairobi conference.

Raw materials

Horace Brown was a pioneer in the study of the composition of barley, its relation to the quality of beer and nitrogen in general. However, the period up to the 1950s saw very few changes in malting technology, or indeed barley varieties (with a few notable exceptions). Since then change has taken place at a fast pace.

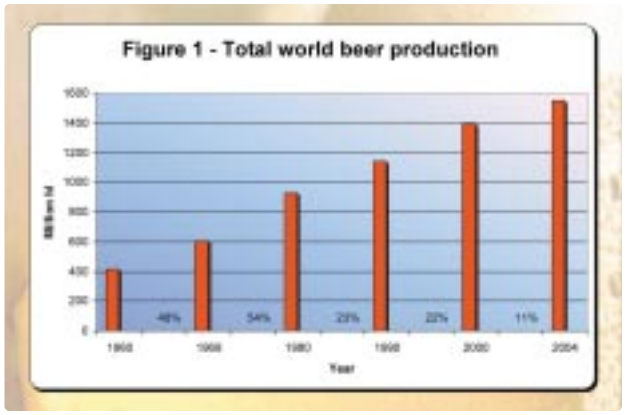
Barley

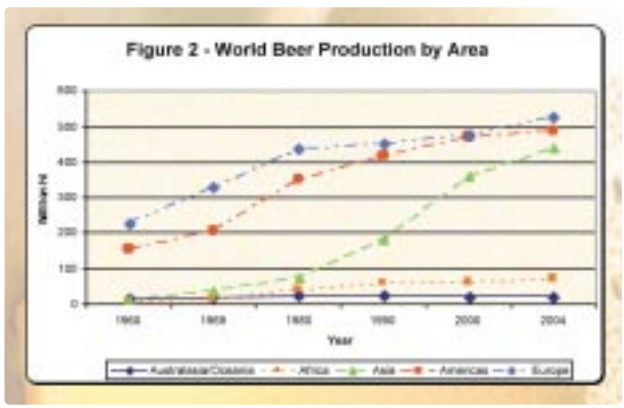
The favourite UK barley was Chevalier in the 1880s, followed by the first hybrid varieties Plumage Archer and Spratt Archer. These lasted as the preferred varieties until after World War II, when Proctor arrived in 1953. The introduction of Plant Breeders Rights in 1956 then led to an explosion of new varieties, most with a short commercial life.

The variety Golden Promise is interesting. A recent *Economist* article mentions that this mutation was brought about by irradiating a sample of Maythorpe barley at Britain's Atomic Energy Research Establishment. The article goes on to say that this sort of mutation breeding is used today without any safety tests and nobody protests. This points to the irony that genetic modification was invented in 1983 as a 'gentler, safer, more rational and predictable alternative to mutation breeding'.

Many changes have taken place in the malting process:

- understanding of dormancy and water sensitivity led to changes in steep vessel design and steeping practice.
- better understanding of germination and modification led to the use of gibberellic acid to reduce malting time, with bromate added later to restrain proteolysis.





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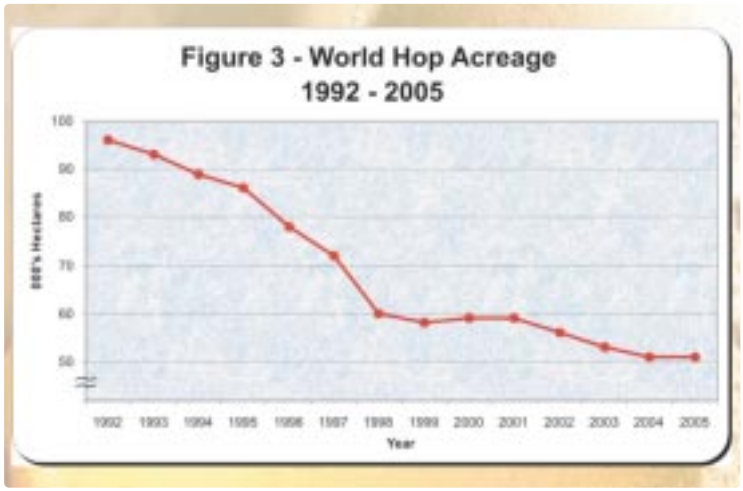

- a better understanding of malt's impact on the brewing process has led to new analytical measures and malt specifications, requiring adjustments to the malting process.
- The drive for greater efficiencies and increased capacity has seen a move from floor maltings to drum, saladin box, *Wanderhaufen* (moving bed), circular vessels and combined operations in one vessel. Many of these changes also gave better process control.
- Focus on health hazards led to the move from direct fired kilns to indirect firing. Green issues have led to minimal use of fungicides, pesticides and processing aids.
- Brewers' insistence on the same standards of hygiene in maltings as they were striving for in breweries, led to a general clean-up in many maltings.
- Energy conservation led to changes in kiln design.

Aalbers and Van Eerde wrote: 'the times are long gone when the brewer resolved malt quality problems by corrective measures during the actual brewing process . . . modifying by sense of touch is no longer feasible in this age of computerisation . . . this means that malt quality has to be tailor made to exact specifications to ensure the processing thereof is problem-free'.

Adjuncts

There has been much research into the impact of adjuncts on mash and wort viscosity, foam, fermentation, flavour and colloidal stability. This has led to the better control of the use of adjuncts. The use of syrups has increased, as has the use of enzymes in the mashing process, though the move to being 'natural' has put a brake on this in some areas.

The ability to handle barley has improved and indeed brewing with barley and sorghum (as the main source of extract, rather than as an adjunct) is being practised. Sorghum was being used in USA as early as 1943 at a time of raw material scarcity (sourced from Central America) and has recently been used in Nigeria following a government edict.

Proposals for concentrated syrups to replace malt (1960s) and producing malt and adjunct worts separately (1970s), the latter not needing maturation, came to nothing.

Accra brewery of Accra Breweries Ltd, Ghana.

A recent book by Anthony Avis gives a fascinating glimpse into the brewing world of the 1890s and the attitude to adjuncts. It is based on a set of diaries kept by the partners of the Tadcaster Tower Brewery Company, where my grandfather was the Brewer 1884–1890:

Maule the Brewer was discovered to be using maize malt (sic) *without telling anybody; he was reprimanded". However, two months later "it was recorded that they were to give white maize malt a trial, as the cost of extract was 37% less.*

Seven months later, Maule was *applying for a second underback, for iodine showed the presence of crude starch with the use of rice or maize. Agreed to write to Briggs & Co. for a quotation.*

An example of resistance to change, followed by an over-riding financial decision, leading to unforeseen capital expenditure at a later stage.

On another amusing note: *Maule requested that a telephone be installed in the brewery. The partners were happy to comply with the request and told him that he could pay for it. It was installed and the following day the partners were on the phone demanding various details. "Maule had cause to rue the day he put into their minds the great advantage of the telephone. His private world of command and control had gone. Such were the unforeseen consequences of scientific progress.*

Little did they know that the mobile phone was coming.

Hops and hop products

Many new hop varieties have been developed, either for increased yield per hectare, for higher bittering value or for resistance to disease. The alpha acid content in percentage for aroma varieties has remained fairly steady; that of bitter varieties has risen steadily with a current high of over 17%.

In the same period, an increase in percentage utilisation of alpha acids, with perhaps also a slight drop in beer bitterness levels, has resulted in a steady fall in world alpha acid production (4.5g/hl predicted for 2006) and in a steady drop in world hop acreage, as the graph for 1992 – 2005 shows (Figure 3).

Although this shows a drop of 47% over the period, due to increased yield per hectare the world crop has only fallen by 25%.

This increase in utilisation has been helped by the development of pellets

and improvement in extracts. 29% of the crop was used as cones in 1983. In 2005 it was just 4%. Extract usage has increased slightly with pellets now 64%. Pellets became practical once a way to combat the oxidative effects of air was found, using barrier type flexible packs combined with vacuum packing. Later variants have been standardised pellets and isomerised pellets. The use of pellets facilitated the use of whirlpools, eliminating the traditional hop back.

In the 1970s a focus on the possible health effects of solvent residues in food and beverages resulted in the introduction of liquid carbon dioxide or ethanol as the preferred solvent, replacing methylene chloride.

Brewing

Horace Brown was a keen observer in his travels around breweries. In a visit to USA in 1897 he noted chilling to 0°C after fermentation, holding in a cellar at 0-2°C, adding beech chips at the krausening stage, filtration (Enzinger pulp filter – still in use into the 1960s and beyond) followed by carbonation. So what has changed?

When I started brewing in the 1950s, I felt that plant and process parameters had been determined some decades ago and that the main concern was to produce a consistent operation and product in the time-honoured way. The industry was still recovering from WWII; older brewers, who had been kept on during this period to allow younger men to go to war, were only just making way for bright young scientists and brewing school graduates. The world was about to change.

In the 1950s there were two sorts of brewhouses; those that brewed around the clock, with four brews a day and those where there was one brew a day (common in UK) which could be any size from a small single set of vessels, to one with several mash tuns and wort kettles which were operated in parallel, producing parti-gyles in large volume. Dry milling was common practice. Worts were boiled for 100 minutes, with 15% evaporation. Cooling was through open coolers. Fermenting vessels were generally open, with refrigeration. Maturation was a lengthy process, with distinct secondary fermentation. Filtration was mostly pulp and sheet.

The changes

Probably the most significant event, at least in my experience, has been the introduction of high gravity brewing in the 1970s, up to 44% being common now. Brewing around the clock is normal. Changes have taken place, driven by the need for high output, reduced process time, cost reduction (energy, labour etc), high and consistent quality, sometimes with a move to 'natural'.

Milling now involves steep conditioning in order to minimise husk damage. For mash filters – which have been re-engineered for clear worts and more flexibility – a finely milled husk is needed.

For mashing and lautering, vessel design is such that oxygen pickup is minimised, also shear forces. Lauter tun cycle time has been reduced through careful rake and run-off design combined with automation and fast spent grains removal.

Boiling has been reduced to as low as 50 minutes, giving energy saving. Heating has moved from internal to external, with a return to internal recently by at least one manufacturer. Current developments are aimed at reduction of thermal stress, with compounds that affect flavour and foam stability in mind.

There is now improved control of fermentation through better understanding of yeast performance, with new parameters such as diacetyl, acetaldehyde and DMS (unknown to the brewer in the 50s).

Cellar vessels are now generally cylindro-conical, some designed for unitank operation. Flavour issues are usually expected to have been sorted out by the end of fermentation and so-called maturation – much reduced in time – is more of a stabilisation period.

In the service area, water treatment has become more rigorous as incoming water quality declines. There has been a move from coal fired boilers to oil, gas and even electric units.

In summary

Brewing in the 1950s was a fairly natural process. As new demands on the process were introduced, process aids were developed, to overcome problems or to enhance quality. With a move back to 'natural' in some countries, their use has been curtailed and it could be said that we are "back to the 50s" though at a higher level.

Flavour and clarity stability have become key issues, as brewers look for longer shelf life for their beers and factors affecting these throughout the process from brewhouse to packaging have come under close scrutiny.

Variation in fermentation still occurs and management of fermentation is one of the main challenges for a brewer. Barley and yeast are both living organisms, reacting to the environment in which they find themselves - for barley, changing weather patterns also – and it is this that will continue to make brewing interesting and ever changing.

Packaging

Draught beer has moved from being a labour intensive activity using wooden casks, to mechanised and automated lines using metal kegs.

In many countries there has been a shift from draught to bottles/cans, often driven by a move from on-consumption to off-consumption, with beer becoming available in supermarkets.

Packaging lines have grown in capacity to the current 70,000 bottles per hour level. The design and engineering of equipment has become more and more sophisticated, aiming for reliability, minimal maintenance and quick change-over. With automation, the manpower need has been drastically reduced, from thirty down to three or four people per line. Flexibility is essential in order to react quickly to changing market demands.

Filler design has successfully addressed the issue of oxygen exclusion; sophisticated conveyor design is close to eliminating bottle damage and the jamming of containers; labellers, which can handle self-adhesive or glued labels, are designed for flexibility and quick change-over and the array of outer packaging equipment that can be found post-labeller was generally unknown in the 1950s.

PET bottles are now said to be 40% of the international beverage market, mainly soft drinks but 5% beer and growing. Heineken Russia sells 45% of its beer in the medium price segment in PET.

Packaging is the predominant area within a brewery for the introduction of world-class manufacturing thinking and techniques.

Production management

When in USA, Horace Brown also noticed that – 'although they don't worry much about first principles' - he was impressed with their use of

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the best labour saving machinery and appliances and the way they could readily adapt processes to changing requirements. He contrasted this with 'the very painful slowness with which any new idea is turned to practical account in UK'. The first signs of world class manufacturing?

When I joined the industry in 1954 consistency of operation, rather than change, was the main focus. Change was coming however and when I moved to Africa I joined a company that was just starting the change process. I believe my SAB experience may well be typical of many companies.

Firstly, the brewing process was standardised and optimised; quality control measures refined and a Central Laboratory was established, which later became a fully fledged R&D Department. In the early 1960s attention turned to production efficiencies and consistency; work study appeared on the scene, together with production control forms, standards and control limits, together with job 'breakdowns'.

The next focus was people management with the result that a large Human Resources Department came into being. Job descriptions, aptitude/IQ testing and job evaluation were introduced; all management went through inter-personal relationships courses. This was at a time when industrial relations were going through a tricky period.

By this time, the company was growing (1 million hl in 1961 – 25 million hl in 2001) and needed some systems and tools; MBO, problem solving and decision making techniques as well as negotiation skills were introduced.

In the early 1980s computerisation came in and produced programs that also contributed to the management of production.

The breakthrough

In the late 1980s, a drive to improve production efficiencies was not producing the desired results in spite of much effort. This led to two things: the introduction of World Class Manufacturing (WCM) thinking and the replacement of MBO by a new way of looking at work-related goals through focus on outputs, not activities, in a performance management system which fits well with the WCM philosophy of everyone being MD of their own work area.

These principles are being applied in a spirit of continuous improvement and the company is developing as a learning organisation.

Supply chain management is in fashion at the moment, with 'value chain' being preferred by some (adding value to inputs before passing on outputs to the next in line). Gemini Consulting feel: "It is better to think of the process as taking place within a conduit, rather than along the links of a chain . . . what matters is not the tube's structure but the freedom with which material and information flow within it" – Value Flow Management.

As for quality, six-sigma, with its concept of concentrating on out-of control results, however few, and its associated bag of 100 tools (many are old statistical techniques recycled) raises the QC bar.

It is all of this that has led to today's automated plants, with computerised production control programmes and information systems.

Organisation structures

Brewery structures have changed, reflecting the new management style. WCM thinking has led to operating staff having more autonomy and responsibility for their area, carrying out many QC measurements at the workplace. Multi-skilling is growing.

As a result of automation; de-layering; and outsourcing whole activities; numbers of employees have been drastically reduced; for those who are left, higher levels of education are called for.

Skills

'There is no question which excites a greater or more general interest in this country at the present time as education. Our whole educational system is on trial and much of our future national prosperity depends upon the manner in which this re-modelling of that system is undertaken.'

This sounds like South Africa today – and maybe other countries – but it is not. It is a statement made by William Frew at an Institute meeting

BELOW: Brewing vessels at the SAB Miller Training Institute.

BELOW RIGHT: The entrance to the SABMiller Training Institute at Kyalami, Midrand RSA. Inside there is an illuminated panel stating "The idea was conceived by Lionel Maule, who spearheaded its design and development." It was officially opened in 1992.

in 1898, shortly before the Birmingham School of Malting and Brewing was founded – beating Heriot Watt (1903) by a few years. Where have we come from and what future challenges face us?

Operating level

At this level, formal records of job content, operating procedures and training based on these, only started in the early 1960s (certainly in South Africa). These were called job breakdowns: short learnable segments, with safety aspects being stressed. Initially there was little attempt to evaluate whether what was being done was optimal; however consultants, on their visits to breweries, would check to see whether the job breakdowns reflected current practice, manualised procedures and so on.

Nevertheless, until recently it could be said that increasingly sophisticated machinery was being operated by a relatively unskilled and poorly educated workforce – in the developing world at least – which had little or no responsibility for aspects of quality control, maintenance, problem solving and general operational control.

By the late 1980s there was a growing awareness that the roles or outputs of operating staff needed redefining. Skills profiles, job models and performance criteria have been developed, incorporating learnings from WCM and other initiatives. In some countries there has been integration with National Qualification Framework networks.

Training has been redefined and aligned with the requirements for effective adult learning; most breweries have established training departments. During this period suppliers have increased both the quality and quantity of their training input.

Management level

Management skills were not catered for so well in the 50s. It was normal to confuse leadership and management ability; there was little of the management expertise we talk about today.

This soon changed, with Graduate Trainee Programmes within companies; short courses led by experts; overseas study trips; attendance at Conventions and a growth in management studies offered by Universities and Management Institutes.

The future?

As major brewing companies become increasingly multinational within the global economy, they search for competencies in their employees that will give them a competitive edge. These are seen as key assets in leading companies and are valued along with other assets such as brands and financial soundness.

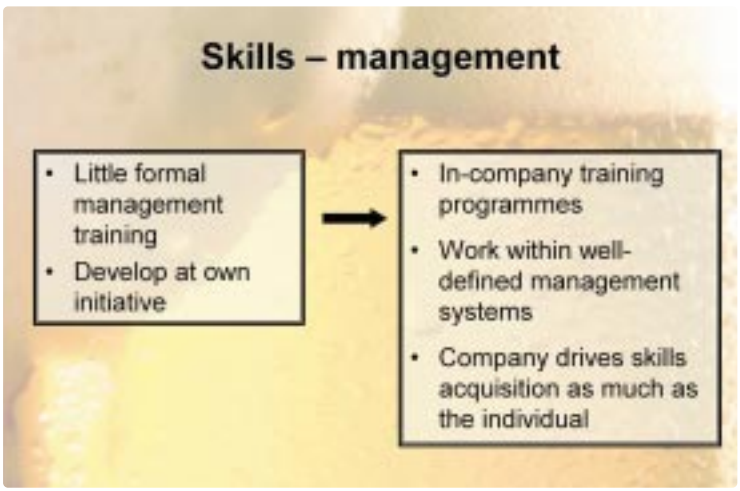
Integration of manufacturing centres has resulted in increased levels of automation and technology throughout the supply chain; from suppliers, through the production process, to the customer in the market place. Employees must be able to manage these complex interrelationships. Skills and competency development programmes are now including manufacturing management, supply chain management as well as new and more searching ways of gaining improvement.

It is worth noting some behavioural aspects. A focus on continuous improvement, benchmarking, right first time, best operating practice and effective problem solving will only be effective within a learning organisation that has a questioning culture, with participative management/employee involvement and employees who can handle change.

A survey into training effectiveness in manufacturing, carried out by the Graduate School of Business, University of Cape Town, found that commitment from management, pre- and post-training support of the traineetogether with alignment with manufacturing strategy are considerations that can make or break the effectiveness of training. In other words, excellent training interventions can be ineffective in a non-supportive environment.

Thus there are people and relationship issues that impact. Skills profiles and training interventions should recognise this.

Lastly, to be able to function internationally, management needs to be skilled in adapting to different cultures and have a wider portfolio of beer and other drink types. Brewers, who in the past, have complained about there being too much ale brewing in the Institute's examinations may find themselves running an ale brewery.



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The Institute

How has the Institute contributed to all this, remembering that the Guild also brought many assets when the new Institute was formed?

There is a good suite of qualifications, from GC level – despite an earlier view that nothing was needed below AME – to Master Brewer and now including distilling. The numbers of exam candidates are growing with qualifications being incorporated into NVQ frameworks.

Frew in 1898 said that "it is no good just having an examination system without an educational system to back it up". This is the direction in which the Institute is going, as reflected in its mission statement.

There are short IBD seminars all over the world on specific topics as well as the more formal Global Study Course and Study Tours.

Support activities

Support material for examinations is paramount. Lectures and publications should keep members up to date – fellowship activities which the President, Ewart Boddington, in 1974 described as 'acting as a technological club to its members' are also important. Services include:

- Section meetings, dinners, visits
- Blue books, which are being replaced by CD-ROMs.
- CD-ROMs to all candidates for GCBP and GCDi.
- *JIB*
- *The Brewer & Distiller*
- Conventions and Symposia

Through the BRi and bodies such as Malting Barley Committees and the Joint Development Projects scheme, the Institute was heavily involved in the past. This is no longer the case, again in line with the Mission Statement.

The Institute has gone from being UK-centric to international in outlook – there are three overseas sections, overseas Presidents and internationalised GCDi. This is appropriate for a body that has over 40% of its members outside UK.

The author on the verandah of his home in Hout Bay.

The challenges ahead

I see the following challenges and opportunities for the Institute:

- Growth in the industry will be more in developing countries than developed ones. The Institute will need to be active in these areas, with products that are relevant to their needs.
- The Institute needs to anticipate change rather than react to it. Through the BRi and other bodies the Institute used to be a change agent. This is no longer the case so it needs to have an intelligence network, listening to those who lead change.
- It must penetrate the global Distilling industry.
- It must retain members post-examinations. Continuous learning is the only way a person can remain employable and competitive and the key outputs for this include the development of thinking, questioning people who are multi-skilled and multifunctional.

However, how do you measure success – is it in numbers of members, or in market penetration for Institute products?

Qualifications must be recognised both nationally and internationally and – as there is no longer life-time employment in an industry – they should give flexibility.

Packaging is already included in the various qualifications, however its separation from brewing at the General certificate level has led to some interest in having a Diploma Packaging qualification.

In most large companies there is a focus on effectiveness of production; thus away from the scientific and technical (still there of course) to supply chain management /WCM concepts. Also, new developments are coming less from scientific research and more from the world of manufacturing technology.

A brewery has many people at different levels of production management, only some of whom function as brewers as we used to know them. While all need to understand the science and technology of brewing and are a significant market for the Institute, they also need production management skills and ideally all of this would be captured in one qualification which is recognised nationally and internationally.

Professor Kasra Ferdows (INSEAD and Georgetown University), who helped steer SABMiller towards World Class Manufacturing, sees four cornerstones for WCM:

- Quality
- Dependability/reliability
- Productivity/cost efficiency
- Flexibility/innovation.

Surely that is also what brewing is all about?

This may seem 'outside the envelope' to the Institute; yet there may be benefit in exploring how the Institute could contribute, either on its own or in co-operation with other bodies. We are the Institute of Brewing & Distilling, not Brewers & Distillers. ■