The theme ‘Lean brewing for large and small’ provided an excellent insight as to how performance can be optimised from craft brewers upwards. Eric Candy from the UK’s Brewing Engineers Association gives an appreciation of the papers presented.

Meura’s continuous brewhouse - Dashen - 3 million hl/year
Claude Bauduin of Meura S.A. put forward the case for continuous brewing. Prerequisites include the need for a high-gravity mother wort to be used to produce several types of beer. Continuous processes are: more energy efficient, easier to control, lead to a lower production cost, reduced peak consumption of utilities and lower space requirements. The under-construction Ethiopian Dashen 3 million hl/year continuous brewhouse design approach was reviewed. Two worts will be produced, one from 100% malt, the other from 70% malt, 30% barley. The wort flow out will be 248hl/hr at 16°P during phase 1 rising to 20°P during phase 2 to produce beers of sales gravity 11.5°P.

Dry milling uses the Meura Classic hammer mill followed by mashing through the Mechamasher to produce a lump-free thick mash into the mash conversion vessel. The mash is heated by direct clean steam injection using AFLOS jet nozzles (Anti-Fouling LOw Shear forces). Converted mash is transferred into one of three Meura 2001 Mash filters which produce the high-gravity wort with no weak worts. The continuous boiling process is in three stages; formation step (a rest at 100°C without evaporation), clarification step in the Clarisaver followed by the Stripping step in the Ecostripper, a packed column.

Monsville For craft brewers
David Clifford, of Meura (Brewery Equipment) Ltd, spoke of its recent development – the Monsville skid-mounted wort production system. There are two variants: Monsville 50 and 100 producing 50hl and 100 hl brew lengths respectively capable of 4 to 5 brews per day. The skid comprises; Classicmill Junior (hammermill), mash conversion vessel, Meura 2001 Junior mash filter, Combi-kettle adjunct cooker/wort kettle, whirlpool, hot water and chilled water tanks. The main advantages include; an ability to brew with any kind of adjuncts, in any proportion, high-quality wort (low oxidation, low turbidity, fast sparging leading to low leaching effect), higher yield than a lautering run (at least 2 to 3%) and dry spent grains (up to 30% DM).

Brewhouse technology and optimisation
Independent Brewhouse Consultant Roy Wilkinson talked on how brewhouse optimisation involves balancing performance to give the highest extract efficiency, shortest cycle time and best wort quality. ‘Size doesn’t matter’ as process optimisation will recoup benefits (quality, economically and commercially). As plant size reduces the ratio of surface area to volume increases, so wetting losses (minimal) and heat losses (significant) increase the heat losses, unless controlled, can influence results. Each brewhouse system should be examined on its own merits with the optimisation addressing each of the ‘unit-operation’ steps i.e. Malting/materials handling, milling, mashing/conversion, mash/hot wort filtration, wort boiling, hopshot/break separation and wort cooling/aeration. Some optimisation guidelines for mash conversion vessel design include vessel ‘aspect ratio’ (H/D) ideally 0.6, agitator 0.85D, off-set 0.05D, maximum tip-speeds 3.0m/sec (hammer milled grist), 3.8m/sec (roller milled grist) and 4.3m/sec (coarse grits), average heating rate of 1.0 °C/minute with zoned steam jackets. For wort boiling ‘vigour-of-boil’ is movement defined as the ‘total wort contents’ being passed over the heating surface, with ‘6-10 times contents/hour’ being the target.

Lean brewing for large and small, small & mid-size lean brewing concepts
Musk Engineering’s Matthew Hadwen started by saying that small breweries often do not know the difference between cheap and well-designed plant. New projects are often bought at lowest price, rarely encompassing lean brewing technologies. It is too expensive.
for a professional brewery engineering company to commission retrofits to existing breweries as overheads and site visits outweigh the savings. Lean brewing techniques in small breweries must be specified at the time of original purchase. In small breweries no amount of efficiency increase will result in a labour savings when only one or two men are on site every day, regardless. Automation can produce labour savings at 50L brew length. The Musk approach to specify a mid-size lean brewing brewhouse is to tune the recipe models to reflect the optimum brewhouse vessel design by optimising by design; vessel diameter, turnaround time, extract performance combined with accurate; process system sizing, flow and liquor dilution predictions.

The ISO-MIX system: speeding up the fermentation process
Alyce Hartvigsen & Mikkel Nordkvist, of Alfa Laval Tank Equipment A/S, presented the company’s ISO-MIX system. It is based on rotary jet heads originally developed for cleaning in place. Two or four nozzles rotate around two axes, covering the entire tank volume several times per minute. Liquid drawn from the tank bottom is pumped through the rotary jet mixer. Gas and liquid can be added into the loop as can a heat-exchanger. Benefits with ISO-MIX include:
- The initial lag phase of fermentation is reduced or removed and earlier production of carbon dioxide.
- Diacetyl produced/removed earlier.
- Improved fermentation consistency; improved wort nutrient uptake, complete attenuation, reduction in CO2 super-saturation, homogenous temperature between top and bottom probes.
- Improved fermentation quality; reduction in acetaldehyde, sulphur dioxide and hop losses, increased ethanol levels with no reduction in taste scores.
- Impact on Yeast; no decline and often an improvement in yeast quality, no decline in foam stability, increased yeast growth (can be controlled) and yeast crop consistency unchanged.

Downsizing/rightsizing of a medium-sized brewery, beer membrane filtration providing sustainable, de-free filtration, turn-key solutions
Roland Steinl, Florian Unseld of Pentair Südmo Projects, and Richard Smethurst of Pentair Beverage Systems told us that German beer consumption per head has dropped circa 24% from 1985 to 2013. Ganter brewery, trying to plan its production strategy in this market place, was looking for investment with ROI < 5 years to improve brewery operational costs. Pentair Südmo provided a project to install fermentation, maturation, yeast handling, cross-flow filtration and bright-beer storage. Benefits of the Pentair Südmo concept included; capacity calculations for the brewing technology, dimensioning of the components used, compact and space-saving installation, total production on one level, short paths for employees. This resulted in cost reductions of 48% in personnel, 50% in energy and 70% with maintenance.

Improvements from cross-flow filtration using Pentair polyethersulphone membranes compared with diatomaceous earth (DE) filtration were reported to include: better taste and foam stability (average 10 seconds improvement by Nibem), turbidity values 90° turbidity 0.1-0.2 EBC below DE, 25° Turbidity < 0.1 EBC, reliable retention of yeast and strong reduction of beer spoiling bacteria.

Delivering low capital cost breweries using lean & green approach
Doug Nicholls of Process Technology Solutions Ltd, suggested making a start with benchmarking against other breweries including; capital costs/hL, brewing waste %. energy MJ/hL, water hl/hL, BOD mg/l, productivity hl/person. Considerations to build into the design are shown as follows.

The lean aspects of Kobayashi’s 20 keys to world class manufacturing (Figure 3) need to be used to take account of these considerations. These aspects are: eliminate or reduce storage (key 4), eliminate non-value added steps (keys 3 and 4), eliminate movements (keys 2 and 4) and shorten process times (keys 2, 4, 5 and 7), move as close to continuous as possible and always look at the knock on consequences of plant choice. Application of these principles can yield the following:
- Organise to reduce movement; reduce pipe runs (sizes, pumping distances), decentralise utilities get close to end user, centralise control (Scada) and laboratory (yet close to end users), store materials close to points of use.
- Block Layout; centralise where helps teamwork, de-centralise where improves efficiency.
- Rationalise the system; standardise equipment (reduces training, maintenance costs) and control systems (reduces operator interfaces, reaction times, training), automate (reduces maintenance costs, improves reliability/ repeatability), rationalise processes, eliminate transfers/ storage.
- Build for team work; laboratory, control room, utilities operators, mirror packaging lines allowing operators to run across several machines and work as mini teams, locate administration close to the action.
- Reduce Inventory; optimise brewing processes, e.g. very high gravity brewing, uni tank, eliminate storage, late-customise where possible, ideally post BBT.
- Quick Change Overs; reduce cleaning down times via expert systems, design and organise for fast changeovers, rationalise container shapes/sizes.
- Zero Monitor Manufacturing; not about lots of inline measurement systems but all about repeatable processes and consistent quality inputs, automation key role.
- Maintenance, automated equipment more reliable, less people = less abuse, design for accessibility, design in reliability – buy the best.
- Eliminate waste, conserve energy and materials; design out people, energy, water and chemical usage.
- Technology Advances worth reviewing, claimed benefits not always correct. Some technologies have huge efficiency and quality impacts, big not always beautiful. Modern designs not always efficient but might be low capital cost.

BEA Technical Day 2015
“Clear and Clean” is the title of next year’s event. “Clear” will look at current best practice for clarification using different filtration methods and centrifuges, “Clean” will look at Cleaning in Place and how to achieve optimal results in energy, water usage and chemicals. The event will be held on Thursday 12th March 2015 at The National Brewery Centre, Horninglow Road, Burton-on-Trent DE14 1NG.
To register contact Karen Foreman, Engineering Department, Greene King PLC KarenForeman@greeneeking.co.uk for details.