

Landwards ^{@IAgrE}

The professional journal for the Institution of Agricultural Engineers

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In this issue...

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- Lean and resilience
- Electric vehicles in agriculture
- The Industry needs its engineers
- The Pledge to Net Zero
- A day in the life of ...



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Editors Welcome



It's great to see how we can adapt to change, whether that's forced upon us, or a deliberate choice. Either way, as the saying goes, what doesn't kill me, makes me stronger!

Whilst there was no planned subject to this edition, change and resilience seem to have emerged as the

dominant and interlinked theme.

With some thoughtful observations from Alastair Taylor on the recent exam results and potential implications down the road in Opinion (p10), and some wise words of counsel from a seasoned agricultural engineering recruiter (p44), Landwards offers some timely advice.

It's fascinating to peer into someone else's world, and this edition's 'A day in the life of..' (p26) is no exception, with an insight into the day to day of William Tuer, an engineer immersed in Anaerobic Digestion, associated farming and its management via apps and data acquisition.

Let's not forget that the Institution has initiated a series of lunchtime lectures this summer, one of which is reported here (p12). You can catch up on others on the IAgRE youtube channel see <https://www.youtube.com/channel/UCCiJwRVj-GizSE3EZ-KQ3uVg>.

[youtube.com/channel/UCCiJwRVj-GizSE3EZ-KQ3uVg](https://www.youtube.com/channel/UCCiJwRVj-GizSE3EZ-KQ3uVg).

This autumn, the annual Landwards conference is a bit different (for obvious reasons) and will be worthwhile to attend. There will be a packed programme across the spectrum of agricultural engineering with speakers' presentations around Lean and resilience virtually via the IAgRE website. See the conference preview for more details (p40).

I wish you well and hope you enjoy this edition,

Andy Newbold

Andy Newbold

Editor

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Agri-tech hackathon seeks solutions to Covid's impact on farming

- Registration opens for agri-tech hackathon
- Hackathon aimed at developing technological solutions to COVID-19 problems
- Focuses on horticulture, livestock/veterinary sectors
- Takes place on 23 and 24 September 2020

Registration is now open for an agri-tech hackathon aimed at developing technological solutions to problems posed by Covid-19. Winners will receive a year of product launch support from experts at Agri-EPI Centre.

The hackathon will focus on the horticulture and livestock/veterinary sectors. Participating teams will be challenged to explore solutions in two areas: the shortage of labour supply for field operations in horticulture, and the restrictions on how vets can travel to conduct farm diagnoses and prescription.

They will have the 12-hour duration of the hackathon, on 23 and 24 September 2020, to come up with proposed technical solutions within



their chosen stream which, if deemed by the judges to have winning market potential, will become the focus of the year-long 'product launch programme' delivered by Agri-EPI.

Agri-EPI's Business Development Director Lisa Williams explained: "We invite any businesses, organisations and academic institutions with an involvement or interest in agri-tech to take part in what promises to be a really exciting event, with the aim of delivering new products that address some of the serious impacts of Coronavirus on the farming industry. Collaboration is key to innovation and we look forward to working with participating teams, and the winners, to develop new ideas.

"The winning teams will have 12 months of access to Agri-EPI's techni-

cal and project management expertise, our world-class research and innovation facilities, testbeds and research assets, and our extensive network, which includes a membership of more than 120 companies across agriculture, technology and the supply chain."

The hackathon is supported by the European Horizon 2020 project Smart AgriHubs. The challenge partners for the veterinary hackathon are Vet Partners, Zoetis, Knowledge Transfer Network and Landmark Systems. For the horticulture hackathon, the challenge partners are Bardsley, Grimme, NFU and Knowledge Transfer Network.

To find out more and register, visit <https://agri-epicentre.com/hackathon-2020/>

Students precisely steering their future careers

Precision farming specialists SoilEssentials, has stepped in to help boost the technical training of the next generation of skilled agriculturalists.



Dundee & Angus College, which is local to the Angus-based firm, successfully applied for a £50k College Innovation Fund award from the Scottish Funding Council to support students who want to pursue hi-tech rural careers. This funding has now partially been used to purchase a bespoke package of industry-leading precision farming guidance equipment from SoilEssentials.

Robert Ramsay, Commercialisation Director with SoilEssentials explains more:

“It’s fantastic to see our local agricultural college benefit from this funding, allowing them to introduce the latest precision farming technology to the curriculum. I believe it’s hugely important to ensure that the emerging farming workforce has exposure to such equipment early in their training

and careers.”

“It has also been a pleasure to work with the college. We discussed with them the wide range of precision guidance and steering solutions available, took on-board their aims and objectives and then presented a bespoke solution.”

“Keith Sinclair, one of our expert engineers has now visited The Glebe, which is the farm associated with the Arbroath college campus, to install Trimble equipment in three tractors. Products supplied and fitted included a Trimble EZ-Guide 250 guidance display and two Trimble GFX-750 guidance displays along with SoilEssentials very own EssentialsNet RTK correction signal.”

Peter Beattie, Agricultural Lecturer at Dundee & Angus College said:

“We’ve introduced Agri-tech and precision farming lessons into our

new courses. It is important that we ensure these courses are not isolated from the ever-changing technology developed and deployed in the wider agricultural industry. We were therefore delighted to secure the Scottish Funding Council grant which has, not only allowed us to purchase bespoke precision tech, but will also support collaboration between the college and rural businesses such as SoilEssentials, for years to come.”

“This equipment and the advice provided by SoilEssentials will ensure that students enter the workplace aware of the opportunities that technology brings to agriculture. It will directly benefit students on our full-time Agri-Skills and Estate Courses, and also be utilised to provide a foundation course in modern farming for up to 20 local secondary schools students annually.”

“The kit will give students valuable hands-on experience and real knowledge that they can utilise in their future careers.”

Dundee & Angus College has limited places still available on its Agricultural Skills course for 2020/21 but there is still time to apply for this and other land-based courses.

The College has also created a video for rural businesses, highlighting options for employees who might wish to study agriculture on a part-time learning basis.

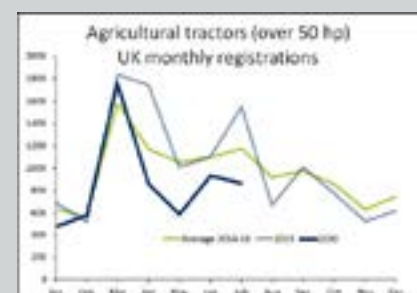
July tractor sales down 44% on last year

July 2020 tractor sales were well below those of the same month in the previous year according to figures released by the AEA.

At 868 machines, the total was 44% below July 2019.

However, Stephen Howarth, AEA agricultural economist comments: “The total a year ago was somewhat inflated by pre-registrations ahead of regulatory changes. Compared with the previous 5-year average, July’s total was down by less than in April and May, although more than in June.”

The total for the year to date has now reached 6,063 tractors, 28% down on the same period last year.



British Library recording



The Douglas Bomford Trusts Emeritus Trustee John Fox, who worked with Douglas Bomford and helped to establish the Trust, was interviewed for the British

Library's National Life Stories series, capturing the development of scientific knowledge and technology in different industries. John and two other well-known IAgRE members, John Matthews and Nick Tillet, were among the 50 people interviewed. The recordings and a summary have now been published in "An Oral History of Farming, Land Management and Conservation in Post-War Britain" (pp20-21), available on line at:

<https://www.bl.uk/projects/national-life-stories>

Major step towards autonomous driving



Valtra and Elisa have joined forces to innovate a 5G solution which enables the remote operation of a tractor with the 5G network and a 360 camera. The solution is the first of its kind in the world.

In March, Valtra and Elisa unveiled a remote-controlled tractor, utilising new-generation 5G network technology. The collaboration was featured at the opening event of the Elisa 5G Showroom. The prototype solution enables the real-time, safe control and operation of a tractor hundreds of kilometres away. "Radio-controlled tractors have been in use for years, but it's

always meant staying within sight of the machine. 5G revolutionises this. Now a tractor can be driven remotely from anywhere," says Mikko Lehikoinen, Vice President, Sales and Marketing Valtra.

"Elisa is a forerunner in 5G technology, both in Finland and internationally. The remote-controlled tractor that's been developed together with Valtra and introduced at Elisa 5G Showroom has generated a lot of interest. 5G services and solutions are going to bring efficiency and innovative new ways of operating for businesses and people. The remote-controlled tractor is a very real example of this, as the driver no longer needs to be physically in the cab. We want to build a sustainable future through digitalisation, and developing 5G services is part of making that a reality," says Kimmo Pentikäinen, Vice President, Business Development at Elisa.

NIAB develops Barn4, an incubator business space for agritech SMEs

Start-up agritech businesses will have access to new work and research facilities, alongside business support opportunities, with the development of Barn4, a purpose-built facility on the outskirts of Cambridge.

The crop research organisation NIAB has been awarded £2.5 million funding from the Cambridgeshire and Peterborough Combined Authority to construct a 375m² business incubator on its Park Farm site in Histon, Cambridgeshire.

Barn4 will be open to tenants from spring 2021 with start-ups and SMEs offered laboratory, workshop and office space, meeting rooms and video-conferencing facilities. In addition, they will be able to get access to NIAB's high performance computing capability, specialist laboratory facilities along with indoor and outdoor growing spaces.

Dr Juno McKee, Director of NIAB Ventures, says that Barn4 will provide facilities for up to 15

companies with 45 staff. "NIAB will work with a network of commercial and academic partners to provide a complete ecosystem within which technology driven start-ups and spinouts can thrive."

The Cambridgeshire and Peterborough Combined Authority Mayor James Palmer says: "Agritech is one of our key growth areas and I am absolutely delighted that the combined authority has enabled NIAB to create Barn4, which will help the sector expand and flourish. I am passionate about supporting innovation and entrepreneurship, and Barn4's nurturing environment for young companies will help ground-breaking start-ups to flourish. I look forward to seeing the birth of world-leading technical solutions to agricultural challenges and opportunities as Barn4 opens and develops from 2021."

The new building will be an addition to NIAB's recently redeveloped Park Farm field research station which



includes two new large research and office buildings (5,500 m²), 2,500 m² of research glasshouses with an additional 300m² planned, 3,000m² protected outdoor growing space and field trial plots.

NIAB's Director of Commercialisation Dr Michael Gifford explains that, in the face of challenges such as Covid-19, Brexit, the new Agriculture Bill, climate change and food security, the UK agrifood industry is under enormous pressure to redefine its farming and food supply chains. One way is to accelerate the pace at which it commercialises and adopts new agritech innovations to deliver sustainable change.

Presidents Musings

Paul Hemingway



Engineering knowledge is critical to everyday life

As we head through the third quarter of the year it's clear that the Covid-19 crisis is far from over with the continuing need to retain vigilance if further outbreaks are to be avoided. This has unfortunately put paid to many shows and promotional events which are part of our calendar and machine manufacturers and dealers have had to devise alternative methods of promoting their machines to potential customers.

The report 'Engineering our way out of a crisis' issued this month by the Royal Academy of Engineering (www.RAEng.org) reminds us of how critical engineering knowledge and capability are to our everyday life. We have to take heart from the fact that whilst our industry has been affected by this crisis, we have not seen, and are unlikely to see, the devastation affecting many other sectors.

The government, whilst still being heavily focussed on Covid-19, will be applying increasingly urgent attention in preparation for completion of the Brexit process. As far as agriculture is concerned the major impact will be departure from the Common Agricultural Policy (CAP) and the

need to establish British farming as an increasingly important contributor to our national food demand, and all this whilst responding to increasing environmental and animal welfare demands. The early draft of the new Environmental Land Management Scheme (ELMS) which is set to replace the Single Farm Payment scheme shows government thinking and this will result in changes in response to policy by farmers.

As an industry we need to be in tune with the latest developments to ensure that we have the products and services to sell which farmers will require on an ongoing basis.

As I write this the first three IAgRE lunchtime lectures have been delivered on-line and have been much appreciated by those who attended. This is a new offering from IAgRE for its members and I would like to thank Andrew Landers, Simon Pearson and Jim Wilson for their time in giving the talks and to Andy

Newbold for hosting them. I would urge any members who feel they have subject matter which could be of broad interest to the membership to contact Sarah McLeod with a view to continuing this programme.

Along the same lines I hope that some of you will be taking advantage of the IMechE training sessions to which you have access through the IAgRE website. Whilst some of these are 'pay to view' others are free and include simple one-hour updates on a variety of topics. I listened to one recently on metallurgy and the content was excellent.

I would urge you, and particularly those of you who are professionally registered with either the Engineering Council or the Society for the Environment, to record your attendance at this sort of event as part of your CPD. Whether you use the 'MyCareerPath' template on the website or a simple Excel spreadsheet is irrelevant. The important thing, as professional practitioners, is that we keep updated and abreast of developments and can demonstrate that we are doing this.

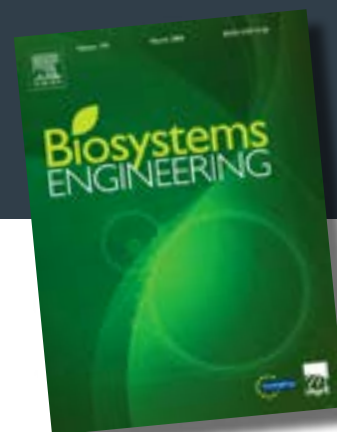
Biosystems Engineering

Biosystems Engineering, owned by the IAgRE, and the official scientific journal of EurAgEng, is published monthly with occasional special issues.

Head to <https://www.sciencedirect.com/journal/biosystems-engineering> to view the full article list of the latest edition and to find out more about depth and breadth of articles accepted for publication.

Reduced subscriptions are available to IAgRE members. Go to <https://iagre.org/biosystemsinformation> for details of the preferential rates for both paper and electronic versions.

The managing editor of Biosystems Engineering, Dr Steve Parkin, has kindly summarised a selection of papers published in the last three issues, which will be of interest to IAgRE members.



Biosystems Engineering Volume 192, April 2020, Pages 108-116

Numerical analysis of steering instability in an agricultural tractor induced by bouncing and sliding

Masahisa Watanabe, Kenshi Sakai
Tokyo University of Agriculture and Technology, Japan

Tractor overturning is a leading cause of fatalities for farmers. In Japan, small tractors are used for farming on harsh terrain, such as slippery fields and steep slopes. On such potentially dangerous terrain, steering instability induced by bouncing and sliding can cause overturning accidents. Steering instability can also deteriorate the precision of trajectory tracking in autonomous driving tractors. The present study numerically investigated tractor steering instability due to bouncing and sliding. A bouncing model and bicycle model were coupled, based on Coulomb's classical theory of friction, and numerical experiments were conducted using the developed model. In the simulations, the tractor's travel velocity, the static friction coefficient, the bump length, and the turning radius were considered as control parameters. A turning test was conducted to investigate the basic steering performance of the developed model. The numerical results revealed that the bouncing and sliding caused by the disturbance exciter reduced the cornering force to zero, which led to a deviation of the turning trajectory from the desired trajectory. The tractor was then operated on a steep passage slope similar to those reported in accidents in Japan. In the simulation, bouncing and sliding occurred because of the steep slope. The results obtained in this study strongly suggest that bouncing and sliding occurring on specific terrain result in steering instability and are a major cause of overturning accidents.

Biosystems Engineering Volume 193, May 2020, Pages 157-173

Materials with switchable radiometric properties: Could they become the perfect greenhouse cover?

Esteban Baeza, Silke Hemming, Cecilia Stanghellini

Wageningen University & Research,
The Netherlands

Greenhouses shelter the crop from unfavourable environmental conditions and the covering largely contributes to creating beneficial growing conditions inside. There is no perfect greenhouse cover for all combinations of crop and climatic regions. Usually a greenhouse cover has permanent optical properties determining the amount of solar radiation entering the greenhouse. Consequently during crop growth, the amount and quality (spectrum, direct/diffuse ratio) of the solar radiation is not ideal for the crop. Growers try to compensate for this by using different additional techniques such as temporary coatings, screens (mobile or fixed, etc.) and heating or cooling. New materials are currently being developed, whose optical properties can be (almost) instantaneously changed (materials with switchable properties). This will allow growers to gain real-time control on the quantity and quality of the light entering the greenhouse to match crop requirement. The present study uses advanced simulation models to predict the potential of covers with switchable properties to improve tomato yield and use of resources in different climatic regions (mild winter and tropical) and with different greenhouse types (artisan and industrial type). Results indicate that covers with switchable properties have advantages over permanent properties for most combinations of filter type/location. Only in very extreme tropical climates will covering materials with permanent filter properties have advantages. Furthermore, simulation models can play a major role in optimising the switchable filter design.

Biosystems Engineering Volume 194, June 2020, Pages 16-27

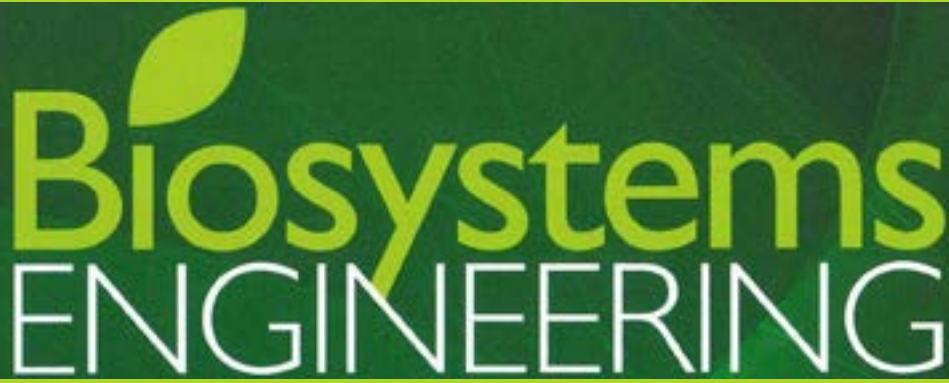
Automatic estimation of dairy cattle body condition score from depth image using ensemble model

Dong Liu, Dongjian He, Tomas Norton
Northwest A&F University, Yangling, China

M3-BIORES, KU Leuven, Leuven, Belgium

Body condition scoring (BCS) gives a relative measure of subcutaneous body fat available as energy reserves in the dairy cow. It is an important management tool for maximising milk production and reproduction efficiency while reducing the incidence of metabolic and peripartum diseases. The feasibility of estimating the BCS by computer vision has been demonstrated in recent research. However, the techniques explored to date may be limited in dynamic backgrounds or in applications for an imbalanced dataset of cows' BCS, which is likely to be encountered in dairy farming. In this study, a dynamic background model (Gaussian Mixture Model, GMM) was used to separate the cow from the background. The results demonstrate that applying GMM on depth images can eliminate the difficulty of object detection caused by background changes. The image processing algorithms can automatically acquire valid images, locate regions of interest and extract image features without any manual intervention. In 5-fold cross-validation, the ensemble model achieved an average accuracy of 56% within 0.125-point deviation, 76% within 0.25-point deviations and 94% within 0.5-point deviations. Especially, the proposed method has a better predictive performance for cows with extreme body condition than is possible with the current state of the art.





Editorial Vacancies: Biosystems Engineering

Senior Editors (≈ 0.5 FTE each post)

Biosystems Engineering is offering an opportunity for two technically experienced researchers with experience of academic publishing to join its editorial team in a senior role. Working for Biosystems Engineering provides a flexible remunerated post with the opportunity to work with the leading scientists in our discipline.

Biosystems Engineering is a peer-reviewed journal owned by the Institution of Agricultural Engineers (IAgrE) and published on their behalf by Elsevier. It is an international journal and the official journal of the European Society of Agricultural Engineers (EurAgEng).

Currently the journal receives around 1200 submissions a year and is staffed by an Editor in Chief and a Managing Editor, assisted by three Associate Editors.

We are looking to reorganise its editorial team to improve its capacity to handle its current and future submissions. Our aim is to improve our editorial capacity by recruiting two Senior Editors to work alongside the existing team.

The Senior Editors will share in the responsibility for the management and strategic direction of the Journal. This is a part-time post and well remunerated.

For more information, and an informal chat, please contact Sarah at IAgrE on;

+44 1234 750876 or email **secretary@lagre.org**

Deadline for applications **Friday 16 October 2020**

The Landwards podcast

A series of podcasts have been commissioned with a monthly news podcast and a monthly interview with an agricultural engineer or influential person in the land based sector. The Landwards podcast is on iTunes, Spotify or click on <https://www.buzzsprout.com/1067353/> episodes for the latest one.



Opinion: Education, the long view



Former IAGRE CEO Alastair Taylor ponders on the long-term impact of Covid-19 and the present cohort of 16 and 18 year olds in the education system.

Putting aside the political storm associated with the predicted GCSE and A level grades for 16 and 18 year olds, we do have to feel sympathy for students, teachers, schools, colleges and universities who have been caught up in this perfect storm. No one could have predicted the Covid-19 pandemic and its impact on those young people at that pivotal point in their career. As a friend pointed out, we are inadvertently living through a huge social experiment and the results will not be fully known for a generation.

What is the impact of this for us agricultural engineers?

I draw on my experience as an education professional who worked in further education for 20 years and as a government inspector who looked at the quality of provision for a further ten. I suppose I am biased

toward the more vocational side of education and training and have been known to be critical of the Tony Blair push to get 50 per cent of school leavers into university.

Whilst I acknowledge that higher education, and education in general is a force for good, I do worry about the impact this has had on those (like me) who followed a more vocational route. A term well known in education circles is 'parity of esteem'. For too many years I have observed young people being pushed towards vocational pathways because 'they are not good enough' for university. How wrong that is. I would argue that it takes twice as much commitment to follow an apprenticeship, combining work and study.

Grade inflation

A term which has been used to describe the current increase in grades

is 'grade inflation' and we are right to question whether a 10 per cent improvement in a single year is realistic. I don't think it is. However, it is what it is and we have to deal with its impact. We hear of young people receiving higher grades than anticipated and 'up trading'. This means that there will be young people who go to university who would not have made it last year, similarly, young people will stay on at schools (who have a captive audience) to study A-Levels when in the past they would probably have gone to a Further Education College or embark on an apprenticeship.

With up-trading, there is a strong risk that those Further Education Colleges offering vocational subjects such as the Extended Diploma in Land-based Engineering and its apprenticeship equivalent will struggle to recruit. They may well take on young people with lower grades as a means of filling spaces.



Former IAgRE CEO Alastair Taylor

In the long run, this is a challenge for employers who, rightly have high expectations of the qualities of young people leaving college. This is at risk. We will only know in two- or three-years' time. What I do know, it that my colleagues in Further Education will move mountains to support young people through this situation. Perhaps us Agricultural Engineers can help them with support and encouragement, and provision of work experience.

Higher education

As for those young people who go on to university and to study A-Levels, it will be interesting to see how this works out. We may see a higher level of drop out and find ourselves picking up the pieces for young people who are looking to flourish in a more vocational setting. There will be young people who make it to university who go on to flourish despite the fact that in previous years they would have been rejected.

Education, attainment and progression is far more complex than a test of knowledge on an arbitrary hot day in June. Is it right that we destruction test young people in this way, but it is not the right approach for everyone.

Predictions

I am pleased that teachers' predications have been accepted. Teachers know their students best. Young people should not suffer during this awful period. They are our future. As employers and mentors, and as a professional institution, we need to do our bit to support the next generation. It is our obligation. Think about how you and your company can do this. Whilst government ministers and quangos do not come out particularly well, I think there is another victim of the situation; the algorithm. I never liked them very much at school and current circumstances challenge their reliability.

Alastair is currently the chief licence reviewer for the Society for the Environment, He is a former CEO of the IAgRE and before that a commissioner for the Commission for Adult Vocational Teaching and Learning, Vice Principal and Director of quality improvement at Hartpury College, an Inspector of Learning and Skills for the Adult Learning Inspectorate and a lecturer in agricultural engineering at Reaseheath College. He has a thing or two to say about education.

It was interesting at the Landwards Conference last year on the subject of Big Data, the point was made that such data needs human input to be reliable. In other words, a soil sensor on its own only goes so far and needs to be backed up by a human being with a spade. An interesting comparison and perhaps a subject for another opinion piece.

Practice: Precision fruit growing

Precision spraying within fruit growing

The first of a series of lunchtime lectures from the Institution happened via Zoom in July, Dr Andrew Landers, a Fellow of the Institution gave insights into the issues of fruit growing and the precision technology in use and being developed.

“You will appreciate, that ‘precision’ means different things to different people,” Andrew began. “For instance, if I were speaking to a group of apple or grape growers, to them precision spraying would mean taking their existing sprayer and fine tuning it to apply the product to the canopy. Whereas to the majority

in the Institution, and the research community in agriculture, precision spraying would refer to electronic sensors and monitors.”

A key focus of Andrew’s appointment at Cornell University was to improve pesticide application via engineering methods.

There were three major thrusts to his work:

- Comparative testing of novel sprayers
- Developing methods to improve deposition and reduce drift
- Extension demonstrations of novel sprayers.



The challenges:

The main aspects of the work were firmly within the context of tackling production challenges of the fruit industry, namely:

- reduction of spray drift
- improved active ingredient coverage
- reduction in spray usage
- Elimination of operator/ machine contamination

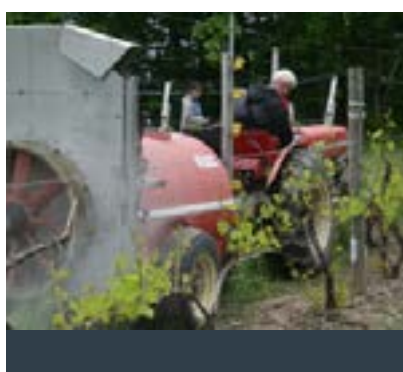
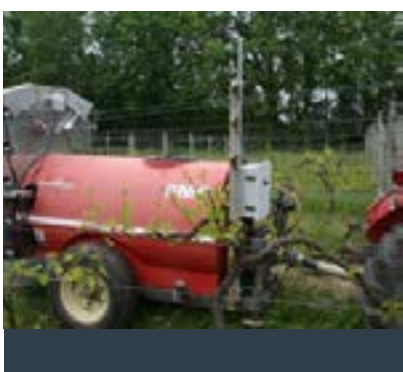
Growers can't lose sight of their first priority - to produce quality fruit. These challenges are not unique to the fruit growing world and many agricultural engineers will be able to relate them.

The initial step is to know your target, canopy variation can be significant and has an impact on spray effectiveness. Fruit trees can have variations of density (of planting), row spacing, narrow canopy and have consistency of row spacing.

Traditional fruit sprayers rely on 1960's based technology of excess air volume and speed, with little or no direction nor any finesse.

Infra-red sensors were used to monitor growth stages and gaps in the canopy, in conjunction with solenoid valve operated individual nozzles these produced a reduction in spray use of between 15 and 40% depending on timing.

Practice: Precision fruit growing



Autonomous farming

From 2009 – 2012 Andrew worked with a \$3.9M USD grant from SCRI on Integrated Automation for Sustainable Specialty Crop Farming, this was used to develop a fully autonomous tractor with sprayer attached to work in citrus, a major crop in Florida and California. The farms are very large, in fact the trials field in California was 13,000 acres without a public highway. So the worries about uncontrolled machines interfacing with the public was less of an issue!

John Deere supplied the tractor and the traditional air blast sprayer to help control citrus greening disease (citrus farms may have to replace up to 15% of their trees annually due to this).

Canopy density

Ultrasonic sensors were used to measure canopy density. Very cheap sensors, easy to use, were tried first in apple trees. Andrew soon discovered that trees are not planted in straight rows, so the idea of ranging is important, to overcome wobbly rows and tractor driving! With apples and grapes there are distinct differences in

crop growth on east vs west sides of slopes and rows (due to light).

During the work the effect of hail storms was noted by the drop in crop canopy density results from monitoring conducted post-storm.

Growers add a host of ingredients to sprays including adjuvants, liquid fertilisers, etc which can mess with nozzles and reduce spraying effectiveness.

The team considered airflow and its effect on treating varying canopies.

Varying canopies affect airflow and spray drift.

- Adjust airflow to match canopy size, based on canopy density.
- No fan adjustment means coverage on next row, flow through canopy and drift
- Correct airflow adjusted for canopy coverage ensures spray cloud hovering in the canopy.

This is just a very light summary of some key points, for the lunchtime lecture see

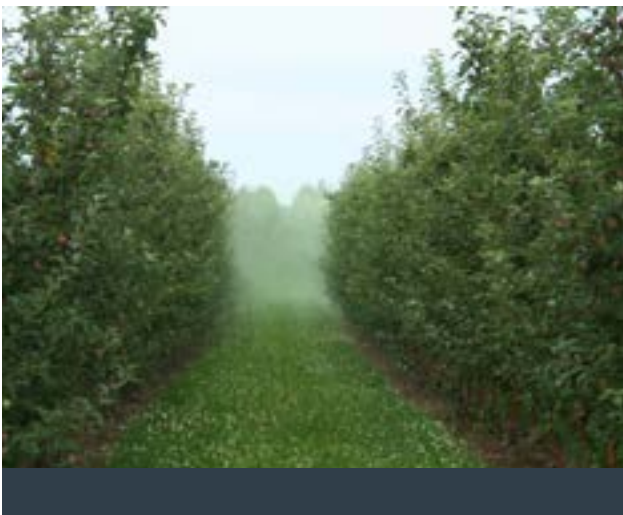
<https://www.youtube.com/watch?v=Tg-iNBoU6vo>.

Andrew Landers - a brief bio

Dr Andrew Landers studied and taught agricultural engineering in England. He joined the faculty at Cornell University in 1998, and was based at the New York State Agricultural Experiment Station in Geneva for 20 years. He directed the international application technology program and his teaching/extension/research appointment involved the use of engineering solutions to provide effective spraying. His research group worked with application systems in fruit production across the world and he believed in a multi-disciplinary approach to pesticide application, working with biologists to ensure engineering techniques were biologically effective. He retired from Cornell in 2018 and now runs the consultancy company Effective Spraying.

In 2007 he was presented with the College of Agriculture & Life Sciences at Cornell University award for outstanding accomplishments in extension and outreach. In 2010 the New York Wine and Grape Foundation presented him with the Research Award for major contributions in research and education. In 2011 he was presented with the NY IPM award for his research and extension. He is a Fellow of the Institution of Agricultural Engineers and a Fellow of the Winston Churchill Memorial trust.

Andrew Landers is the author of three books: Farm Machinery Investment and Management; Effective Vineyard Spraying; and Effective Orchard Spraying, published by Effectivespraying.com. Dr. Landers is frequently invited to speak at orchard and vineyard conferences around the world. He is renowned for his informative presentations that are delivered with a captivating style.



Practice: Precision fruit growing



Professor Simon Pearson FIAGrE

Professor Simon Pearson gave a fascinating lunchtime lecture on the work that Lincoln University has been doing with the NFU on the automation of soft fruit picking. This is a very difficult area to automate and it was interesting to hear of the challenges and pitfalls as well as the progress being made in this field.

Professor Pearson is the Founding Director of LIAT, the Lincoln Institute of AgriFood Technology, whose key research themes include agricultural robotics, digital technology to underpin the food supply chain, greenhouse engineering, sustainable farming systems, agri-food manufacturing and productivity.

See <https://www.youtube.com/watch?v=CGvUtahuEz8> for the full lecture.



Tuberzone CropCast – a growth model for potato yield – Jim Wilson Soil Essentials.

Jim Wilson, Managing Director of SoilEssentials gave an excellent technical talk on the development of Tuberzone CropCast. This is a simplified growth model that predicts potato crop yield, size distribution and crop value weekly through the season to enable harvesting at the peak crop value.

The 12-month Tuberzone initiative, based in the East of Scotland, trialled new precision agriculture tools to predict tuber size of seed and salad potatoes and accurate burn down time for growers to maximise yield and profit.

SAC Consulting, part of Scotland's Rural College (SRUC), partnered with precision farming company SoilEssentials and farmer-owned cooperative Grampian Growers to support the uptake of the innovative Tuberzone potato technology among growers from Angus to



Aberdeenshire and the Black Isle.

Using a combination of satellite imagery, Unmanned Aerial Vehicles (UAVs) and GPS to monitor growth from crop emergence through the growing season to burn down, Tuberzone successfully predicted the graded-out size of Gemson, a salad potato variety owned by Grampian Growers, within 90% accuracy, for the majority of growers.

Jim said: “The challenge of seed and salad potato production is knowing exactly when to stop the crop

growing and a few days either way can make a big difference to the total value. Tuberzone allows us to see what is going on under the ground and aids the decision on haulm destruction by giving an individual yield and size distribution for each crop over the next two weeks. This helps decide what date to burn down taking into account forecast weather conditions and how quickly other potato crops are developing.”

Currently the only method is to make random test digs through the season, then weigh and measure

tubers manually. Growers are still strongly advised to carry out test digs, but Tuberzone can make these less frequent and better targeted within the field.

See <https://www.youtube.com/watch?v=1rkdX0LGzm0> for the full lecture.

Jim is still a farmer with a working farm and has built his business, a mixture of agronomy, machine control, software and development projects, in order to make farming better.

Profession:

Lessons from
Automotive



Pre-lockdown, Jonathan Lodge from City Farm Systems joined fellow members of the Institute of Directors on a visit to the BMW Mini production site at Cowley, Oxford. The author often finds such events thought-provoking despite, at first glance, there being no apparent relevance to his work.

JIT is not always just in time

JIT is synonymous with modern car production but is it right to claim this? LEAN, 6 Sigma and TPS (Toyota Production System) are all about optimising complex production processes to improve efficiency ... or should this be effectiveness? Quite rightly BMW is proud of matching individualised production with their 1000 cars a day target. They talk of assembling each body in 6.5

hours, taking it through the paint line in 13 hours and through final assembly in another 6.5 hours. That is 26 hours from the first welding of metal panels pressed elsewhere to the finished car being driven to final quality control. One could ask why a UK customer has to wait three months for their car?

Each customer order is turned into a production data package and programmed onto an RFID tag. These

are placed on one of the three body types as they are completed – 19.5 hours from being a finished car. At each significant point along the assembly line automatic readers scan the tag to ensure the right parts are added. Apparently, there are more possible variations than the number of cars they have built.

Obviously with 80% of production being exported there are huge complexities. Cars leaving by train



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Profession:

Lessons from Automotive



(two a day) can wait on site up to two days – during which time another 2000 cars will be built.

BMW work with suppliers constantly to ensure truckloads of parts arrive within an allotted two-hour timeslot. Complex sub-assemblies such as power/transmissions and front bumper/light assemblies are brought together in supplier facilities a few miles away. Suppliers of all key components mount them onto trollies that go onto the assembly line before delivery. Components are planned for each assembly station and placed in the order the cars will come past. Components such as brake master cylinders and servos may appear identical but have internal settings to suit individual cars. These local suppliers only need a few hours' notice to place components in the correct order.

Robots

The tour guide (a retired motor industry professional) said building the car bodies used 1000 robots but the vehicle assembly line only had 12. This raises an interesting point about what makes a robot. The body line uses 'robotic arms' that are very precisely programmed for each task and have no autonomy. The vehicle assembly relies heavily on autonomous vehicles. Dashboards are assembled in a side area and mounted individually on a carrier that takes it to the correct body shell. We lost count of how many of these carriers we saw. Just like the carriers which operate in sweet pepper glasshouses these sense and follow a wire buried in the floor. They follow a set path but travel independently. Those at Mini go a stage further and pause at

charging points along their journey. The important point is they can react to what they 'see', and stop should something block their path. It could be argued the assembly line has many more robots than the body plant.

Applying LEAN / 6 Sigma principles to growing short cycle crops

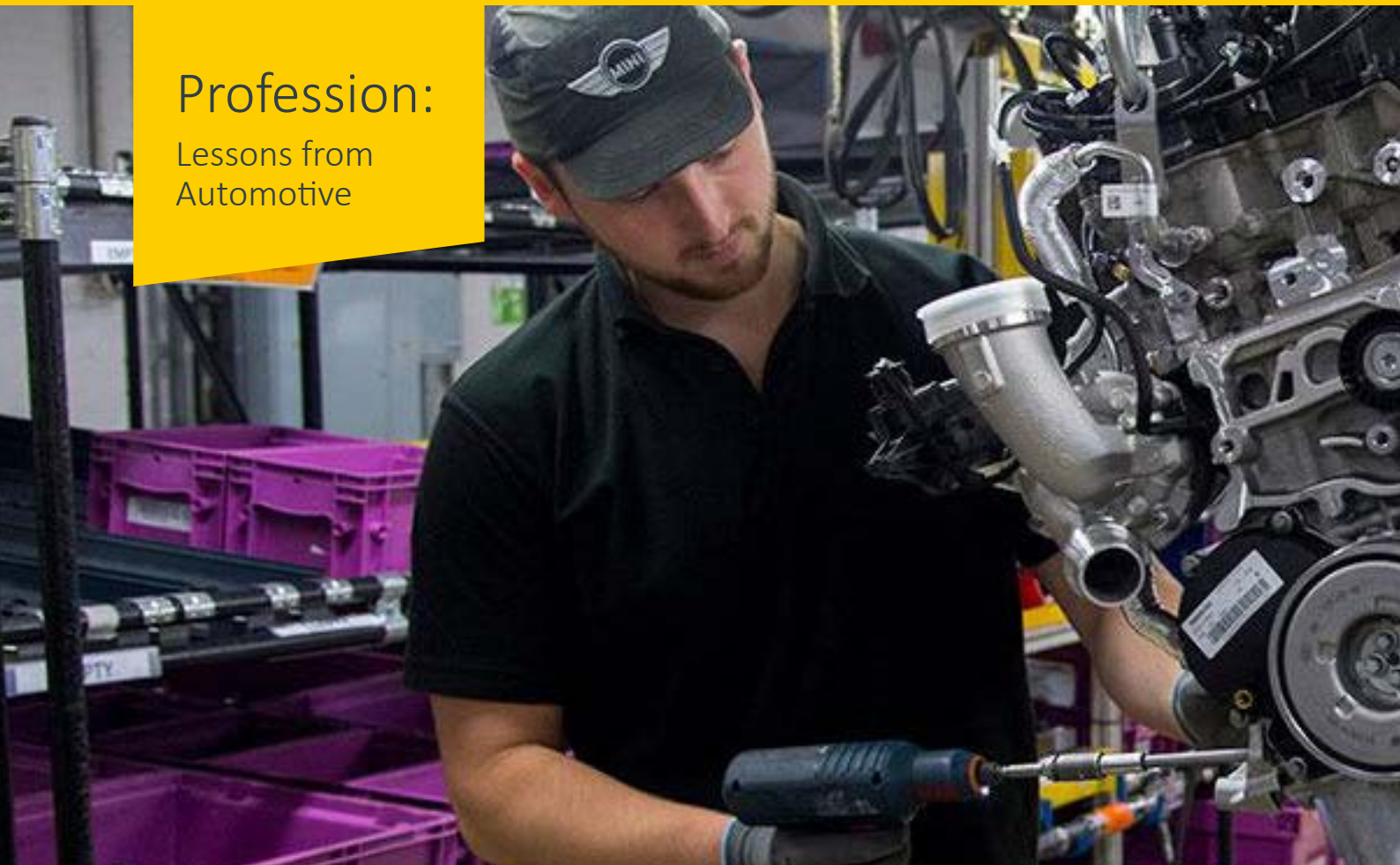
City Farm Systems use these principles growing short cycle crops. In their CloudGro® automated greenhouses they use RFID tags. Each crop tray has a tag but, rather than tell each point of the production line what should be added to a car, the tag is read, relevant data recorded and, just like BMW, camera images saved for quality control purposes. AI analysis then adds the correct nutrients and water for that stage of growth.



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Profession: Lessons from Automotive



Counter intuitively the system uses one of several variables to slow crop growth to match short term demand changes and harvest to order rather than let excess crops go to waste.

Frequently such slowing of growth can improve quality and even increase overall yield. Most vertical farms boast about the ability to grow at full capacity all year round but miss the fact that UK demand for salad crops halves in winter. Demand variation is by no means a UK only issue. In Florida demand plummets in the heat of summer as locals choose to holiday in cooler climes. Growing with hugely inflated costs encourages them to maximise production but cannot cater for significant demand variation.

As a generalisation agriculture only looks at supply side data. Whilst this makes sense for once a year harvesting of grain it doesn't work effectively for short cycle crops or meat production. Retailers work on the demand side and expect suppliers to match their needs



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without any data sharing. This can work for FMCG such as cans of beans, tins of cola and chocolate bars but creates waste elsewhere.

Some vertical farmers claim to work with data but, despite working in near laboratory conditions, often only record environmental data and fail to collect as much crop specific data as field-based agriculture. Far too many, working with short cycle crops or livestock, follow the broadacre business model. They aim to produce at maximum capacity and then sell all they can. This is the starting point for much food wastage and there needs to be a shift in focus from yield to delivered quantity.

Comparing car production with agriculture.

Being old enough to have heard about the many difficulties that blighted the Cowley plant's history the author can see many parallels for our sector. It occurs that many vertical farms or factory farms not only base their

facilities on warehouse racking our grandparents would recognise, they also lock themselves into work practices which large scale manufacturing facilities have long since left behind. Far too many vertical farms depend on single speed monoculture, manually collected plant data and poor manual handling techniques. These make it much harder to avoid waste, error and poor quality. Often the cars coming out of Cowley were reasonable designs poorly executed.

The Mini production shows how mass production has moved on from building thousands of identical error prone cars to processes that allow each car to be unique and pass quality control. In our systems we swap individualisation for variable harvest times to match short term demand changes.

An interesting point is that livestock farming goes to great lengths to encourage each animal to fit a narrow range of parameters. Most

significant is the penalty a farmer suffers if a beef animal is bigger than the abattoir can handle easily. Sharing supply and demand data fully should mean animals can go to the abattoir according to size rather than age without needlessly consuming expensive feed. Costs for excess crop treatment or animal feed have huge implications for agriculture.

The emphasis needs to move from farm yield to delivered food. There is no point producing what we should know will end up wasted. Getting this right is more important for agriculture than for cars. By definition grain harvested once a year is stored on average for six months. We used to hear of cars waiting in parking lots for as much as three years before being sold as new. Now, however, they are built to order and whilst a Mini can be three months old at registration they have all been sold.

Short cycle agriculture frequently talks of growing for a particular customer but doesn't know what the

Profession: Lessons from Automotive



final order quantity or the price paid will be. Whilst the cars didn't decline too quickly in the car lot, short cycle crops can reach the end of their shelf life before arriving at their destination. We hear a lot about retailers being expected to reduce what goes to landfill by donating excess stock to charities. This is like a car dealership selling an unsold car at a discount. These are only what we see as the tip of the iceberg and does not address the problems behind the scenes. Meat can be stored in a freezer but many fresh produce items are simply wasted.

Environmental concerns

Much effort is devoted to a healthy working environment. By separating tasks into differing environments body production and paint can be contained to prevent dirt and dust in the assembly line. The author didn't once notice the distinctive smell of a new car. The only smell we noticed was a slight whiff of petrol near the fluid filling station. Even this will disappear with the coming electric version. What was perhaps most noticeable from my perspective was the amount of natural

light coming from the rooflights. This is essential for a healthy workforce. BRE at Watford and several others work on the need for humans to see natural light and, of course, there are the well-known issues suffered by night shift workers.

This is, too frequently, a failing of artificially lit farming facilities. The author was part of a group tour of LED-lit growing facilities where almost half the group were feeling uncomfortable and wanted to get out after only a few minutes. Yet these manually intensive facilities rely on workers remaining in such poor conditions for whole shifts. Interestingly the same light problems apply to plants. We have both developed over many millennia to take advantage of natural sunlight that changes during a day. Like us plants have circadian rhythms. Most react to light during the day. Sunlight is stronger in the red spectrum at the ends of the day whilst blue and UV light are strongest at midday. Seasonal day length changes are also responsible for some aspects of plant growth. These variations trigger

changes in the way a plant grows yet are usually ignored in artificial lighting.

Carbon / CO₂

Commercial glasshouse growers need to add CO₂. Without this crop growth slows or even stops as they consume what is available. Background levels are now above 400ppm. Without adding CO₂ a closed environment facility will drop to 200ppm at which point growth stops. Many glasshouse growers talk of increasing CO₂ to 11-1200ppm as the ideal level to maximise speed of growth. Unfortunately, this is the level at which workers become noticeably slower as they get drowsy. Offices are beginning to measure CO₂ levels which can rise alarmingly in poorly vented conditions as our exhaled breath is typically 30,000ppm. Whilst not a legislated measurement CO₂ has a serious impact on productivity. The pressure is on to reduce carbon wherever possible yet, for closed environment agriculture, operators have to find and pay for a reliable source. Many will run gas boilers for heat and CO₂ all year even if it means dumping excess heat. Meanwhile their

customers are also running gas boilers and all heavily occupied buildings pay to dump CO₂ that we breathe out.

Moving from the mass growing of one or two varieties at a remote facility to a peri-urban warehouse will reduce food miles. However, these will always be the lowest cost miles. The supply chain carbon reduces slightly but the facility now incurs huge rent and rate bills. In contrast City Farm Systems can install a low-cost automated facility with the ability to grow a wider range of crops to order at the point of need cuts carbon at many points. Many salad crops cost more to deliver than to grow.

This is rarely acknowledged because the cost of transit-only packaging is not often acknowledged as a cost of distribution. When installed on a retail roof there is no need to load produce onto a truck...which means there is no need for transit only packaging or for a truck.

Opportunities

At one point in the Mini tour the group passed buildings that have nothing to do with building a car. Our guide spoke of facilities for welfare, healthcare and other support services to help their workforce build cars. He spoke of the site being like a small town of 5000 people.

We often hear of 'Smart Cities' but rarely about their need for food. It would only take a small rooftop system to grow more herbs, salads, small fruit and vegetables than this small-town needs on a daily basis. Adding to their Corporate Social Responsibility and staff welfare responsibilities such a system could help provide meals at work and offer the freshest produce they could take home for their families. As seasonal variations reach extremes a CloudGro® system could use spare capacity to grow ornamentals and bedding plants for the site or homes.

This would cut huge amounts of carbon from supply chains, consume some of the carbon the site emits and, take a number of trucks off congested roads. All of this can be achieved whilst reducing costs and offering better quality produce.

About Jonathan Lodge



With roots in rural Devon Jonathan's inspiration for City Farm Systems came while staring at the back of a supermarket lorry metres from a store. His resource efficiency background suggested expensive to deliver fresh produce was losing shelf life while empty shelves lost sales. Why waste cash and carbon growing, packing and delivering food data knows will be wasted? CFS now holds patents for automated greenhouses that can be installed on a warehouse roof. This data driven approach grows a wide range of crops to order at point of need – a significant step towards Net Zero from Farm to Fork.



Contact details

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Profession: A day in the life of



A day in the life of William Tuer

Agricultural engineer William Tuer tells us a little more about his typical day, be it out on farm, running not one but two AD plants or developing apps and monitoring software.

William grew up on a family beef and sheep farm near Penrith in Cumbria. Following a HND in agricultural engineering at Harper Adams, William spent the next nine years with John Deere in a range of roles starting as sales instructor for amenity equipment in charge of demonstrations for UK and Ireland. He progressed through the service department as technical specialist for harvesting products before moving into sales as territory manager for the North of England and Southern Scotland.

Since 2014, William has been involved in the anaerobic digestion industry. His first step was to gain the WAMITAB – AD & Waste technical

competent manager qualification, to be able to work in the AD industry. He then became involved in the development of AD plants across the UK. The role involved negotiating grid connections directly with Distribution Network Operators (DNOs), site planning, installation management and accreditation with OFGEM.

This has evolved into William running his own company WST Rural Limited which provides contract management services for two AD plants (one in Cumbria and one in Scotland) alongside AD consultancy and software applications. He is also developing a business in discreet investment advice within agribusiness.

Variety is the spice of life

The first thing to say is that no two days are the same for William.

With overall management responsibility for the Dumfries AD site, and a support role at Carlisle, before he has left the house, the operating data for both plants will have been checked for anomalies. If any issues are flagged up, via the self-designed monitoring software, these are followed up as a matter of routine. (insert Screen shot)

Next William jumps in the car and will visit one plant or the other to monitor feedstocks and plant efficiency.



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Jim Clark

Meeting protocols

In the current climate of Covid-19, William is limiting his site time to necessary visits only with most

meetings being conducted online.

The exception is visiting fields to check the condition of growing feedstock crops, such as rye, grass, wheat and maize, where the agronomist will usually join him in a socially distanced manner to check progress.

Likewise, as crop harvest progresses time is spent with the contractors to ensure a smooth flow of incoming crop at the right energy value and % dry matter which pays dividends later with plant performance and efficiency.

Plant maintenance

A big part of the weekly plant visit is to routinely monitor plant condition and ensure that all planned maintenance occurs. This involves ensuring that all parties are aware of their roles and when they should happen. The plant monitoring software throws out anomalous readings which can be indicators of future maintenance issues.



Data

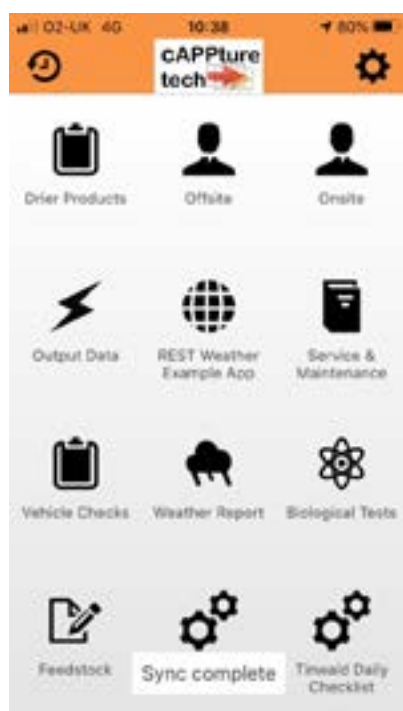
All plant monitoring data is shared with relevant stakeholders, including the business owners, the contractors

Profession: A day in the life of



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responsible for 'feeding' the plant and third party maintenance contractors as appropriate.



William's monitoring system has the ability to pick up and generate meaningful data from approximately 800 data points at the Dumfries site, including the plant, feedstocks and electricity output. The system records and date stamps daily checks and maintenance points with relevant GPS locations to ensure that all operations are fully accounted for.

Trend analysis

Working automatically through Google Data Studio Analytics, the data is analysed in real time to generate warnings if any stage of the process is outside of normal operating parameters.

In practice the system can send text message or email alerts to various stakeholders as appropriate and





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it generates an automated report every morning for review.

Natural fertiliser

William has partnered with the owner of the Carlisle AD plant to develop and market natural plant foods. This is a way to add value to an existing fertiliser product from the process. They recognised the value of the product in its raw form as digestate.



Following a five year development cycle, the digestate is refined and split into solid and liquid fractions, prior to packaging and marketing.

Farming and tourism

Alongside this frantic activity William can also be found helping his parents at the family farm. Alongside sheep, beef and cereals the main focus is tourism with self-catering accommodation, camping pods and a campsite.

Extra-curricular activity

When not making energy or helping on the farm, William is a director volunteer of Yadmoss Ski Club, which is England's premier (only) Pennine ski resort. This involves managing maintenance and operation of its 800m Poma button tow lift (apparently the longest in England) alongside operating a Pistenbully piste grooming machine.

He is also vice chairman of the Crosby Ravensworth Agricultural Society. William is a very busy chap!



Key learning for ag engineers:

William has looked beyond the day job and recognised that the skill set he has acquired during his earlier career is highly transferrable.

These include:

- Being able to handle a range a people with a spectrum of emotions;
- Industry technical knowledge that is growing daily;
- A strong network of contacts and reliable sources;
- The ability to make connections between stakeholders and add value to their operations.

In his own words: "Don't undervalue yourself, your skill set is wide and varied and you have great versatility and problem-solving skills as an engineer, use them to your best ability".

In conclusion William feels you can be almost self-sufficient in terms of knowledge and network to support your next steps in career progression.

Practice: Pledge to Net Zero



The challenges and opportunities of Net Zero for agricultural engineering

Nicholas Corker C.Env explains what needs to be done.

Introduction

Predicting the future is difficult, some things will be the same others may be different. The commitment of achieving Net Zero emissions of Greenhouse Gases (GHG) by 2050 became law in the UK and devolved administrations in 2019. Thirty years does seem a long way off, but this commitment has been set to grow into, to re-tool with appropriate R&D investment and reshape how business is done. Firstly, we need to establish what exactly Net Zero GHG land use policies may look like. Second, paraphrasing Clayton

Christenson, agricultural engineers need to ask the question, what are the jobs to be done?¹

Jobs to be done?

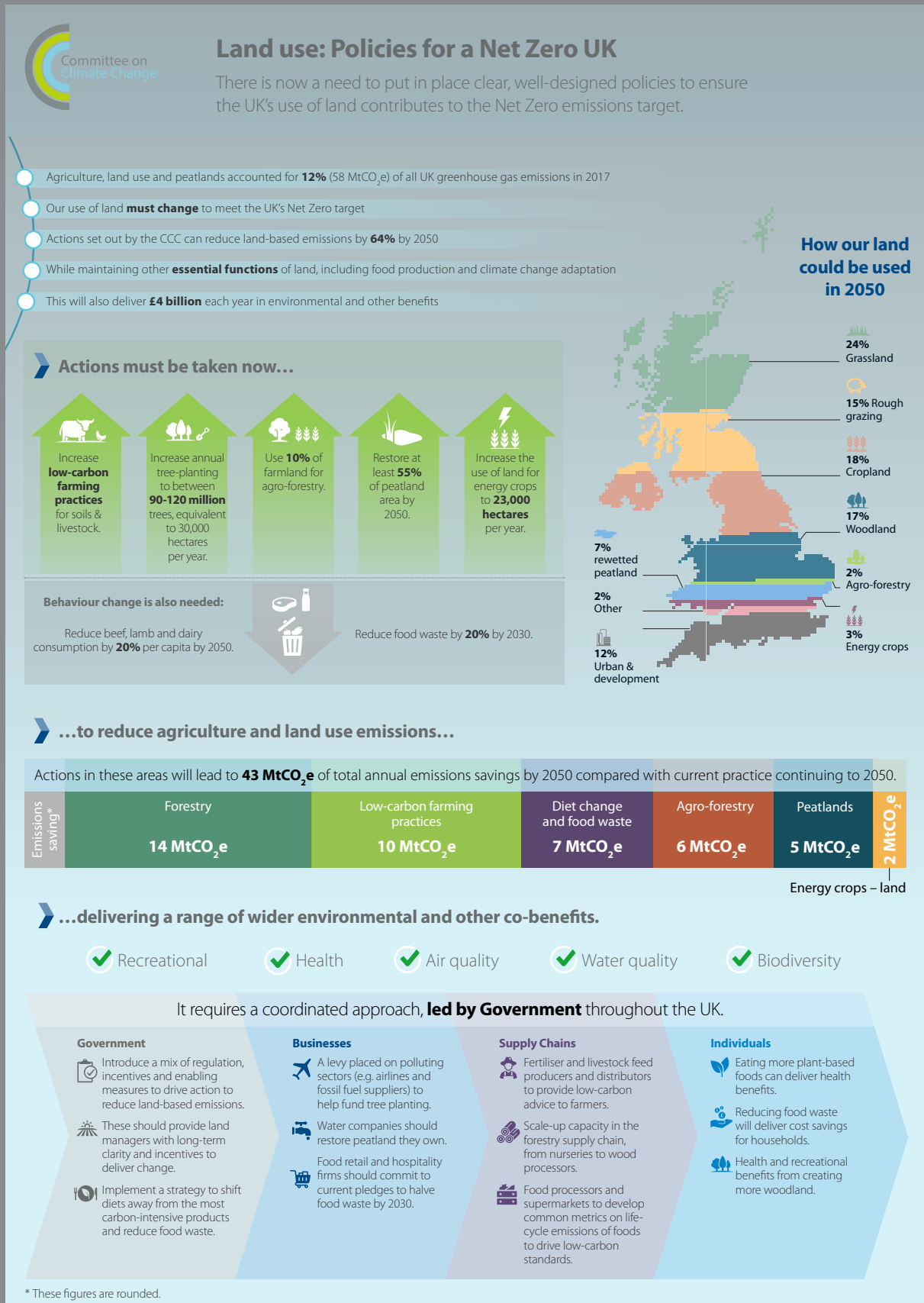
It is important to note that the CCC report, though detailed and evidence-based, is illustrating options, the shape of which may change but the direction is clear and the rate of movement, with the NFU setting a goal of 2040, only 20 years away.³ Looking at the Committee's infographic priorities are advised all within the broad church of agricultural engineering, and

innovation is going to be needed at every stage of the value chain.

As Christenson points out though the means change, most jobs stay the same (we need food, water, shelter, air, communications etc.) and understanding the job to be done in new contexts is central to successful innovation. So if a new job is introduced, an overarching priority of reducing GHG, how is this to be achieved from land use (water, soil, air, biology and sunshine) in ways that help the farm and customer toward meeting Net Zero obligations?

Land use: Policies for a Net Zero UK

In January the Government's independent adviser The Committee on Climate Change (CCC) published detailed reports on how a Net Zero target will require a transformation in land use across the UK.² The report sets out a detailed range of options to drive emission reductions in England, Scotland, Wales and Northern Ireland. The scale and range of change in land use and some of its spatial implications are illustrated in the infographic.



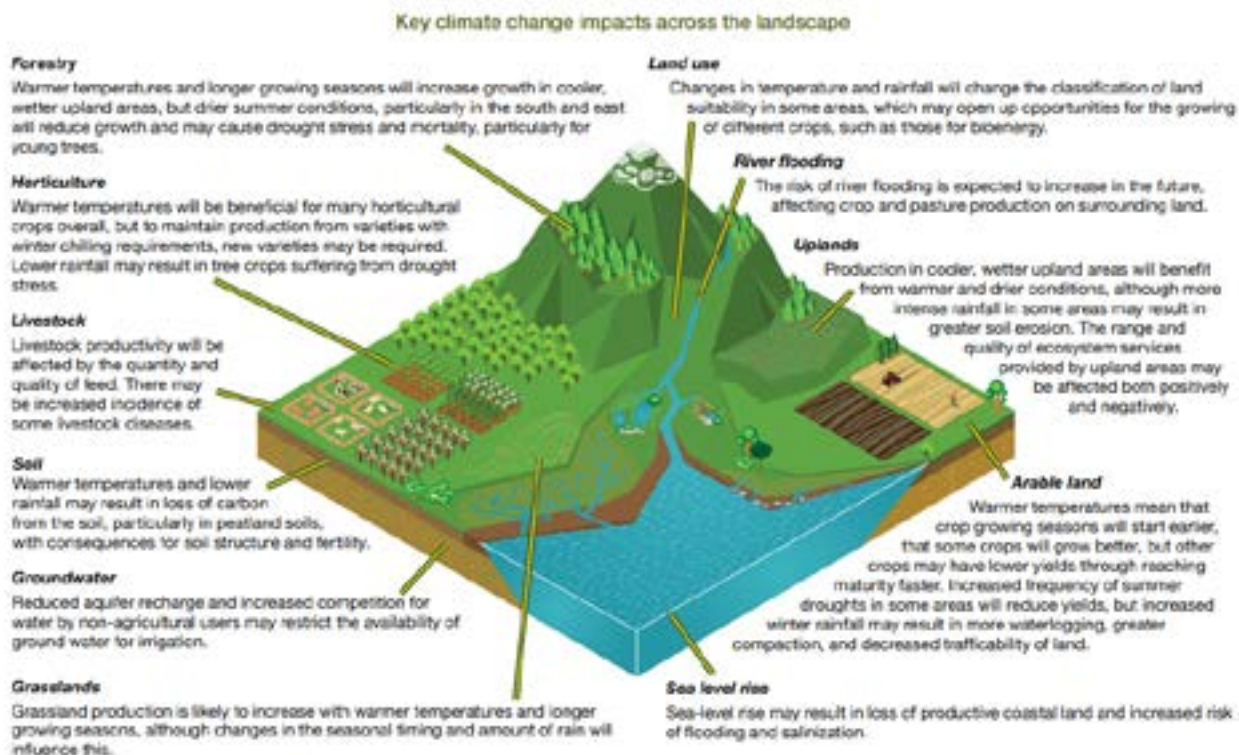
Practice: Pledge to Net Zero

Future mix

Part of the future mix of activities is likely to be familiar. Management tools utilising data from earth observation and sensors such as: GHG auditing, farm assurance, input efficiency, better pasture utilisation, no and

min-till, renewable energy production, farmer co-operatives, new annual but increasingly perennial crops, precision agriculture and wider use of field robots and electrification.
⁴ However, as the climate establishes new operational parameters these activities will be applied at the system or landscape level as sustainable intensification, agroforestry, afforestation, re-wilding, catchment-based management and wet farming (Box 2)⁵

Innovation thrives in an information rich environment and the opportunities for innovation within the context of an emerging green economy are manifold, aspects of which are being addressed by the research councils (NERC & BBSRC funded ASSIST project) and new calls to the community for research priorities eg., EPSRC Net Zero Agriculture. The transfer of information from data and R&D that can be acted upon requires intermediaries and the role of bodies such as the IAgRE as agents of transition will be increasingly important.



¹ Harvard Business Review Sept 2016:
<https://hbr.org/2016/09/know-your-customers-jobs-to-be-done>

² The Committee on Climate Change January 2020:
<https://www.theccc.org.uk/publication/land-use-policies-for-a-net-zero-uk/>

³ NFU Achieving Net Zero: Farming's 2040 Goal (2019):
<https://www.nfuonline.com/nfu-online/business/regulation/achieving-net-zero-farmings-2040-goal/>

⁴ Living with Environmental Change report card: Agriculture & Forestry Climate Change Impacts (2016) NERC:
<https://nerc.ukri.org/research/partnerships/ride/lwec/report-cards/agriculture/>
New Climate New Crops (2008) Defra:
http://randd.defra.gov.uk/Document.aspx?Document=AC0302_9199_FRA.pdf
World's first electric digger wins MacRobert Award for UK engineering innovation:
<https://www.raeng.org.uk/news/news-releases/2020/july/world-s-first-electric-digger-wins-macrobert-award>

⁵ Achieving Sustainable Agricultural Systems ASSIST :
<https://assist.ceh.ac.uk/>
Wet farming and the Great Fen project:
<https://www.greatfen.org.uk/big-ideas/wet-farming>

⁶ Net Zero Agriculture, A Survey to investigate the potential Engineering and Physical Sciences contribution, EPSRC., (2020):
<https://epsrc.ukri.org/funding/calls/net-zero-agriculture-a-survey-to-investigate-the-potential-engineering-and-physical-sciences-contribution/>



The history of the Pledge

The Society for the Environment co-founded the Pledge to Net Zero initiative in November 2019 alongside AECOM, the Association for Consultancy and Engineering (ACE), The Environmental Industries Commission (EIC), The Institute of Environmental Management and Assessment (IEMA) and WSP.

Pledge to Net Zero is an initiative which sees organisations commit to reducing their greenhouse gas emissions via the setting of science-based targets, to which they must publicly report their progress towards meeting each year. Fifty-three organisations have made the pledge to date, including environmental consultancies, professional bodies, public sector organisations and non-consultancy companies working in fields such as contracting. They also vary in size from locally-based SMEs to UK-based but internationally operating organisation, reflecting the wide impact of the initiative.

More information and guidance on making the pledge can be found via the website www.pledgetonetzero.org



Dr Emma Wilcox, Chief Executive at the Society for the Environment, said:

“At the Society for the Environment, we are all about championing professionalism and encouraging organisations to be part of the solution to the Climate and Environmental Emergency. To achieve the UK Government’s commitment to Net Zero by 2050, we know that professionals must take a united leading role; taking strong action, sharing their expertise, and encouraging others to do the same.

That is the basis behind the Pledge to Net Zero initiative. In encouraging organisations to address their environmental impacts, the initiative provides a platform from which organisations can lead action on achieving net zero and in doing so showcases the difference organisations can make.

We would encourage all organisations to sign up to the pledge before the next sign-up deadline of the 15th October and showcase your commitment and leadership in delivering net zero.”

Book Club



Electric Vehicles in Agriculture: Now is the Time

Cars electrify, now farm vehicles. The new 215-page IDTechEx report, 'Electric Vehicles and Robotics in Agriculture 2020-2030' explains. Even in the most advanced countries, few farms can provide the power to fast-charge a Tesla or an electric tractor, let alone large farm vehicles.

All the same, many agricultural vehicle makers are going electric because the charging capability, affordability and other factors are rapidly falling into place just as they are for road vehicles.

For example, farm electricity can now follow the robots. Renovagen sells a microgrid that, from the back of a farm truck, unrolls its solar cells like a carpet along a field and

eWind develops tethered drones generating similar 30kW levels of electricity from the wind, specifically targeting farmers.

As with cars, we have had the phase of electric variants of farm vehicles based on existing platforms and therefore not very successful but Kubota and John Deere now have 'born electric' concept tractors that play to the strengths of being

robotic with triangular tracks.

Cost of ownership

Lower cost of ownership is compelling but lower up-front cost is the killer blow, part of the reason why small outdoor and greenhouse agrirobots are all electric: price parity comes first with small vehicles. They pick fruit more gently, minimise poisons, increase yields. The report



commercial, not academic.

The 34 page Executive Summary and Conclusions is sufficient for those in a hurry, with a critical appraisal listing 14 forces on the industry, seven reasons for going electric being compared, two infographics of the farm of the future, detail on main trends such as precision and ultra-precision farming, 18 primary conclusions brought alive with tables and graphics, adoption timelines, patent trend graph. See 16 categories forecasted by units, unit price and market value 2020-2030.

The Introduction looks at problems, needs, emissions, water shortage, food demand increase and change in mix, regional differences in crops and approaches, crop yield and farmer age, wage and tractor purchasing trends. Here is the electric vehicle powertrain choice emerging and types becoming favoured in agriculture all mainly presented in pie charts, graphs, tables and infographics.

UK vs Japan

Chapter 3 concerns Opportunities. See the example of UK compared with Japan, the economics of agricultural machines, the interest in small, even swarming robots in fields and precision forms indoors. The value chain and robotics as a service

are analysed. Chapter 5 brings it alive with over 70 organisations making, or developing, electric and robotic vehicles for agriculture, forestry, turf electric vehicles compared. Specific comparisons include lawnmowing robots and weeding robots for farms. Electric tractors are a particular focus with seven illustrated case studies. Planters, transporters and forestry are also illustrated with critical comparisons throughout.

Chapter 6 scopes the six key enabling technologies. The seventh chapter looks at autonomy. 'Electric Vehicles and Robotics in Agriculture 2020-2030' will be the industry's reference book, updates being regularly incorporated as the subject is now changing rapidly. For those wanting deeper technology analysis and forecasts for certain aspects, there is the IDTechEx report, 'Agricultural Robots, Drones, and AI: 2020-2040: Technologies, Markets, and Players'.

For more information on this report, please visit;

www.IDTechEx.com/AgriEV

or for the full portfolio of research available from IDTechEx please visit;

www.IDTechEx.com/Research.

embraces farming, forestry and turf care in the form of manned electric vehicles and robotics. See new infographics, graphs and timelines for the present - including much news from 2020 - and future. Grasp the challenges of this industry from Japan and China to the UK and USA, the remarkable new technologies and systems approaches being adopted and what comes next.

Value chain

This report assists all in the value chain. Electrification and robotics go together. Their effect is pivotal. Up-to-date interviews, analysis and forecasts were prepared by multi-lingual IDTechEx analysts at PhD level across the world. Presented without equations, the emphasis is

About IDTechEx

IDTechEx guides support strategic business decisions through its research, consultancy and event products, helping readers profit from emerging technologies.

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Bomford Trust



Behind closed doors

Alan Plom, Secretary to the Douglas Bomford Trust, looks back over another three quiet months, although a lot has happened behind closed doors.

Keeping up appearances

The awards ceremonies and other opportunities, when we normally meet our sponsored students face to face, have either been deferred or held 'virtually'. These are the highlight of the academic year when their hard work (and their tutors') is recognised and rewarded.

Cranfield's annual ceremonies were held via Zoom in June and after an introductory video from Director of Education Tim Brewer and a welcome by Programme Director Monica Rivas Casado, sponsors and prize winners were invited to say a few words. At least I could congratulate Naomi Sandford-Dequincey who received

our prize for 'the best student on an environmental theme course who best demonstrated the application of engineering and technology for sustainable agriculture'. Unfortunately, I was unable to 'present' our equivalent prize for an agricultural theme student to Inga Ósk Jónsdóttir due to a technical problem. We wish them successful careers.

Encourage young people into agricultural engineering

To encourage young people to consider a career in agricultural engineering the Trust sponsors IAgRE membership for more than 300 students each year. These include

postgraduate researchers and our Arkwright Scholars and we encourage them all to attend local Branch meetings. Barnabas met IAgRE's President Paul Hemingway at the Western Branch AGM and enjoyed a technical talk on combine harvesters, so intends to retain his IAgRE membership.

The Trust is also looking for manufacturers to offer visits for our Arkwright Scholars (when permitted), or even discussions with company representatives, to give them an early insight into the industry. If your company can help, please contact the Secretary (details on page).

The Arkwright Engineering Scholarship Scheme



Sustainable agriculture was the theme of an interesting paper by Barnabas Pickford, one of our A-Level students sponsored through the Arkwright Engineering Scholarship Scheme. His thorough research and detailed report belied his age and stage of education. It is available on our website as an example of the quality of work being produced by our younger scholars. He maintained this high standard in his A-level project, designing and making a model of a 300-cubicle cow shed for his father's dairy farm. This will stand him in good stead for his MEng studies at Nottingham University and he believes our support helped him to gain his place.

As if remote schooling and waiting for A-level results to be adjusted were not enough of a mountain to climb, during lockdown Barnabas cycled the equivalent of the height of Everest (8848m), by riding up and down the hill near his school in Bath, in a single activity, without sleep.

Coincidentally, Trustee Richard Robinson has also ascended this hill (on foot!), so appreciates the sustained effort required over the 16 hours it took his 'Mentee'. He raised over £2.2k for the charity 'Farm Africa'.

(See: <https://www.justgiving.com/fundraising/Barneys-EV-Attempt> .)

Mentoring

An important objective of the Trust is to help individuals develop and acquire knowledge, new skills, techniques and capabilities, as well as to maintain professional competencies. Trustees are allocated as mentors to all major projects and draw upon their industry expertise and knowledge to advise students (and their supervisors). They also hold review meetings periodically to monitor progress against agreed deliverables and milestones (assisted by the Secretary) to ensure 'value for (our) money'.

These meetings are being held virtually, and mentoring is not only carried out 1:1. For example, we held fortnightly (on-line) meetings with six Cranfield MSc students carrying out a Group 'horizon-scanning' project aiming to identify future innovations and priority topics for the Trust to consider funding. These culminated in another first for the Trust - a virtual 'Dragon's Den' when they had to 'sell' their findings to all our Trustees. They all admitted benefiting from the challenge. We look forward to working with next year's group on Phase Two.

The new aide-memoires developed to ensure consistency in selection and monitoring projects is reflected in the guidance on our website, explaining what we look for in applications. The assessment criteria and areas of interest were also publicised recently in an article highlighting sources of funding for postgraduate research projects in UK - see

<https://www.researchprofessional-news.com>

Trustees are mindful of the significant impact on individuals and academic institutions over the past nine months and as the potential for continued disruption worldwide is unknown, we will continue to be flexible on commitments in terms of outputs and completion dates.

Professional:

Douglas
Bomford Trust



Meet a Trustee - Professor Mark Kibblewhite

As a long-standing Fellow and past President of IAgRE, Mark needs no introduction, but did you know he has also been a Douglas Bomford Trustee since 2014? This means he will have to stand down at our AGM in November, so now is an ideal time to say 'Thank You'. As our 'resident academic' on the Board, his wealth of research and business expertise has benefitted many students from around the world and he will be missed.

Mark's degree in chemistry, PhD in soil science and MBA from Cranfield University, led to a distinguished academic career. He became Professor of Applied Soil Science, Head of the Natural Resources Department and Director of the National Soil Resources Institute at Cranfield and is now their Emeritus

Professor of Soil Science. He is also Emeritus Research Associate of Landcare Research in New Zealand and well-known worldwide as a Chartered Environmentalist, Chartered Chemist and Fellow of the Royal Society of Chemistry. He chaired the European Soil Bureau Network of the EC Joint Research Centre and has authored more than 100 research articles, book chapters, technical commentaries and published reports.

On the business front, he was Head of Land Quality at the Environment Agency and MD of the Environment Division of Hyder Consulting Ltd (now Arcadis) in a former life, and is now a Director of his own company (MK Soil Science Ltd). His recent work has included technical support on soil management for the FAO

Global Soil Partnership, the European Commission, the European Environment Agency and the UN Economic Commission for Europe.

Mark would need an A4-sized business card to squeeze that lot in, but somehow he still found time between being a Trustee and vice-chair of the Dorset local Wildlife Trust and enjoying sailing to demonstrate a high level of commitment to the Trust and many of our sponsored research students. His own research is very relevant to many of our applicants and he has always been a quietly reassuring, positive and helpful mentor. We hope to be able to say 'farewell' to Mark at the next Board meeting in November.

Update on ex-Trustee, David White



We also hope to meet our ex-Trustee David White when (if!) we hold the Board meeting in November at Harper Adams, where he is a Senior Lecturer. Although David completed his term as a Trustee in November 2018, he is still acting as a project mentor and liaises with colleagues and students at HAU on our behalf.

Unfortunately, David suffered serious injuries in June, when he was hit by a car that had collided with another car further up the road. David was literally an innocent bystander - standing in a layby feeding his Shetland pony! He sent out this typically under-stated message from hospital soon after: "A bit crook but I am lucky to be alive. Broken arm and fractured ribs and sternum so replies from me might be a bit slow!" We later heard that he also suffered concussion, a

nasty compound fracture and nerve damage to his arm, as well as broken bones, ligament and soft tissue damage to his foot that may take six months to heal.

David is widely respected. In 2017 he received IAgRE's prestigious Award for his 'Contribution to the Land-based Sector', recognising his (then) 35 years' work in education, training and research. During this time and since (including through the Trust), he has influenced many young agricultural engineers who have gone on to play key roles in design and management positions throughout the industry worldwide.

We are sure they will all join us in wishing David a speedy recovery. It will be a long time before he is 'firing on all cylinders' again, but he is already working with his students. Respect!

Twittering on.....

Please follow us on Twitter (**@BomfordTrust**) to keep updated, with links to relevant tweets, articles, webinars and other events.



Our website <https://www.dbt.org.uk/> has also been updated with our latest guidance on applications and new 'drop-down' menus to help access information on recent research and other activities.

You can also contact the Secretary by email:

enquiries@dbt.org.uk

or phone:

07951 527051

Landwards: Conference preview



Lean Agricultural Engineering and Resilience in the Supply Chain

This year will, understandably be a little different. With limited opportunities for face to face interaction, the conference will happen virtually with a series of pre-recorded presentations from the speakers, followed by a live panel discussion with all participants on Wednesday 4 November.

Date: Throughout the summer and on Wednesday 4th November 2020
Location: Online via YouTube and Zoom, logon to lagre.org for more details.
Cost: FREE to IAgrE Members

This year's Landwards conference tackles the potentially conflicting requirements of lean principles and 'just in time' manufacturing with the real world need to have resilient supply chains.

The Covid-19 pandemic has

stretched supply chains to their limits (and beyond in some cases). Thus the conference is a timely opportunity for delegates to reflect on what worked, what didn't and how organisations and businesses have adapted to flourish in this

new landscape.

The panel of speakers represents the world of food supply and distribution, alongside international agricultural machinery manufacture and the UK dealer supply chain.

Pre-recorded Online Programme

**Introductory remarks and lean principles -
Paul Hemingway – President IAgRE**

**Lean & resilience – The international manufacturer's perspective
Martin Hamer, Fendt – Confirmed**

In his role as sales manager, UK, Ireland and the Netherlands, Martin will be discussing how Fendt has flexed to accommodate different working approaches. This has protected the workforce whilst ensuring consistent product supply and support during the Covid-19 pandemic. Martin will also consider how the changes have now embedded in the business and what this means going forwards.

**Lean – A dealer's perspective
Richard Halsall, Ripon Farm Services – Confirmed**

As group sales manager for one of the UK's largest John Deere dealers, Richard will be looking at how the company manages inventory, deliveries and the interface between customers and company personnel. Given the context of a global pandemic, the lessons learned, and new ways of working will be of particular interest to delegates.

**Lean in agriculture
John Shropshire, G's Fresh Produce**

Lean principles revolve around ensuring efficient delivery of services and products. Given the 'just in time' nature of the fresh produce business and the need to plan growing, whilst still taking account of the weather, changes in demand etc. John looks at how the business manages these demands. Alongside an insight into how this has changed due to the global pandemic and lessons which the business has learned from this.

**How you can learn from other organisations in times of difficulty
Dr Mark Cooper, independent safety engineer**

Covid-19 has made many businesses reflect on their resilience and preparedness. Two concepts are outlined. Firstly, Toft & Reynolds (2006) offer a socio-technical systems approach to learning from disasters and this has much to offer in this reflective phase. Specifically, that similar patterns of behaviour can be identified in biological, mechanical, electronic etc systems. What has been termed isomorphism.

Secondly, how we deal with Black Swan events (Talib, 2001). This paper outlines the key characteristics of Black Swan events and how they can be coped with, including the characteristics that make organisations resilient to them. This includes distributed and diverse systems.

This paper advances the argument that features which enhance resilience may be at odds with lean and streamlined approaches.

**Lean supply chains -
Professor Simon Pearson, Lincoln Institute of AgriFood Technology**

Simon will frame the discussion by covering his background, history and work journey around ag engineering and the industry.

He will then look at the work which LIAT is involved and how it relates to food supply efficiency, resilience and change management.

Simon will close with suggestions of how agricultural engineers will factor the pandemic into contingency planning going forwards

Live Q & A Session - 4th November 2020

Landwards: Conference preview



Paul Hemingway CEng FIAgrE

As president of the Institution of Agricultural Engineers (IAgrE), Paul is delighted to introduce the Conference.

A native of west Wales Paul studied Agricultural Engineering at Newcastle University and having graduated spent two years in Cornwall working for Fulford Trumps, a Ford tractor and New Holland machinery dealer as a branch Service Manager. In 1978 he joined the Engineering Department at Harper Adams Agricultural College (as it was then) as the college embarked on education of agricultural engineering students at HND and later degree level. Paul joined JCB in 1989 as Service Manager for what was to become the JCB Fastrac. He spent the next 29 years at JCB in a wide variety of management roles in Service, Parts, Training, Sales and Product Marketing. This included a 3-year period living with his wife in New Delhi working with JCB India as Vice President - Service, which he looks back on as a particularly varied, challenging and enriching part of his life. He retired from JCB in 2018 and today has come full circle acting as a Visiting Lecturer in Engineering at Harper Adams University.

A little about the speakers:



Martin Hamer

Martin is currently Fendt National Sales Manager looking after the sales and marketing of the full line of Fendt Tractors and Machinery for the UK, Ireland and the Netherlands.

His responsibilities include around 1500 tractor unit sales together with a further 1000 units of other machines from mowers and grass equipment, through to combine harvesters and self-propelled sprayers. This amounts to some \$200 million of sales at retail value a year. These sales are conducted via two distributors and 26 franchised dealers; managed by a team of 14 Fendt staff which includes marketing, retail management, commercial management and sales support which fall under Martin's management and control.

He has been in this role for the past six years but has worked for AGCO for nearly 25 years holding roles in MF and Challenger sales, marketing, sales engineering and training where his roles were national and international.

Martin studied Agricultural Engineering at technical college and gained City & Guilds qualifications before commencing a career in machinery dealerships and then switching to manufacturer.

Being a dairy farmer's son and continuing to manage the family beef and arable farm keeps his feet in the heart of the business. He has a keen understanding of the agricultural cycle and the part which machinery has to play in developing agriculture. He is also chairman of his local NFU branch.



Richard Halsall

Richard Halsall is currently Group Sales Manager at Ripon Farm Services where he is responsible for the Agricultural and Horticultural Sales Departments.

Ripon Farm Services are one of the largest John Deere dealerships in the country covering Yorkshire, North Lincolnshire, North Nottinghamshire and Teeside with 12 Agricultural depots, one Groundscare, two trailer centres and a Paint & Body Facility. Alongside John Deere, other major brands include Kramer, Kuhn, Bailey, Ifor Williams, HiSpec, DalBo & Stihl.

Prior to joining Ripon Farm Services in 2018 Richard held a number of positions within John Deere over a 15-year period, including UK Training Centre Manager, Division Manager EAME for Forage Harvesters, Product Line Manager & Territory Manager.

Richard has always been involved with Agricultural Machinery, working in the family dealership from a young age before going on to study Agricultural Engineering at both Reaseheath and Writtle College and then embarking on a career with manufacturers.

Richard lives in Nottinghamshire where any free time is spent cycling with the family, house renovations and taxiing children between sporting fixtures.



John Shropshire

After gaining a BSc Hons in Agriculture at Newcastle University in 1976, John joined the family farming and marketing business which had been founded by his father in 1952.

John is CEO of the G's Fresh group of companies which now has sales of £500m per annum in the UK, Europe and the USA. Integral to its business, is its expertise in growing and together with the members of the G's Growers Producer Organisation, grows 13,000 hectares of salads and vegetables in the UK, Czech Republic, Poland, Spain and Senegal.

The group employs over 8,000 people and has won several national industry awards recognising its progress in technical and product innovation, exports and environmental management.



Dr Mark Cooper

Dr Cooper is a chartered Agricultural Engineer with a long career advising companies on strategies to ensure safety at work and also acting as an expert to identify what went wrong. Dr Cooper is a Fellow of the Institution of Agricultural Engineers; he is the country's leading expert on tractor overturns on slopes and is a workplace transport and accident investigation specialist.

His specialism is in the management of risk. He was formerly a Research Fellow at Aston University and Programme Director for its MSc in Risk Management and Safety Technology.



Professor Simon Pearson

Professor Simon Pearson is the Director of the Lincoln Institute of Agri-Food Technology (LIAT), which sits within the College of Science at the University of Lincoln.

As Director of LIAT Simon helps develop and run cross disciplinary research projects on behalf of the agri-food sector. This includes a large focus on the use and deployment of agri-food robotic systems, including robotic crop harvesting and food processing systems, use of autonomous vehicles in the agri-food sector, the application of actuators within agri-food robotic systems.

Simon's research interests include; a diverse range of agri technology applications including robotic systems, automation, energy control and management, food safety systems and novel crop development. The environmental physiology of fresh produce and ornamental crops, including impacts on crop quality and development. Post-harvest physiology of vegetables, fruits and cut flowers, including the use of modified atmosphere packaging. The effects of light manipulation on crop growth and development, including the development and application of greenhouse spectral filters and LED lighting systems. The development of on farm decision support systems from remote sensing information. The development of pre and post farm gate supply and demand forecasting systems.

Prior to joining Lincoln, he was the CEO of a large UK farming company, worked for Marks and Spencer plc in a technical role and as a scientist at the University of Reading.

The Landwards podcast

A series of podcasts have been commissioned with a monthly news podcast and a monthly interview with an Agricultural Engineer or influential person in the land based sector.

The Landwards podcast is on iTunes, Spotify or click on <https://www.buzzsprout.com/1067353/episodes> for the latest one.



Profession: Careers advice



Stuart Goodison

The agricultural industry still needs its engineers

Despite reports of job losses and staff on furlough among the engineering sector, Stuart Goodinson, Managing Director of employment specialists De Lacy Executive says there will still be a large demand for engineers as the agricultural industry readjusts to the aftermath of Covid-19, the imminent impacts of Brexit and the on-going need to drive more sustainable production methods.

"Agriculture is increasingly a high-tech industry driven by innovation and the uptake of new technologies and I see no other future than one where the rate of change increases," he comments. "Farming will be all about making full use of data, data interpretation, artificial intelligence and new engineering technology methods to support high production while driving down the environmental impacts of farming in both the arable and livestock sectors.

"At the heart of this future must be

engineers who can help develop the practical application of technologies like robotics, drone applications, GPS systems and driverless tractors and even more importantly keep them running efficiently if we are to maintain and increase the global efficiency of UK agriculture."

Uncertain future

He admits that the current situation can look uncertain, saying that no-one knows what 'normal' will look like as we begin to move towards

the 'new normal'. Recovery rates will vary by sector but in anticipation of a return to more normal circumstances, businesses will be reviewing new ways of working as industries get back to full capacity as well as assessing what this means for people and teams.

He believes that broadly, agriculture has been less badly affected than other UK industries. Businesses across farming and the agricultural supply chain have shown considerable innovation to keep the industry functioning effectively. But they

have had to make changes to remain viable and inevitably some have involved employees being furloughed or even made redundant.

“Gradually, however, we will see a return to more normal working. With this will come opportunities for those affected by the short-term measures to minimise the business impact of the pandemic. At the same time, talking to many employers across the agricultural supply chain, they have been looking long and hard at how they can best meet the challenges faced and the sort of products they need to develop. Many of these require innovation – and innovation needs engineers.

"The objective now must be to make yourself stand out in the job market, so you are well placed to grasp the right opportunity. A new survey, recently carried out, suggest there are signs of a greater degree of unrest and uncertainty.

Time for a change?

"Twelve months ago, 41.3% of candidates on the De Lacy database were actively looking for a new position with the balance happy in their employment. But now over 73% are looking for something new."

This means there are larger numbers of people in the employment marketplace and this is why you need to highlight your profile in the right places.

Mr Goodinson says there will be a variety of reasons. The survey pointed to the fact that people are concerned about the future of their current employers, given projections of significant economic downturn. They may have been unhappy, and the pandemic has increased the desire to do something about it.

“At the same time, we know that unemployment is rising in other sectors, meaning there may be people from outside the industry looking at agriculture more favourably.”

Direction of travel

For engineers currently in the industry and perhaps those who started in agriculture and then moved away, he

advises looking at the new technologies that will be growth areas such as tractor analytics, image technology, drone and GPS analysis. Where are the likely jobs going to be and how can you demonstrate the skills required? Perhaps you can undertake some short course training to add to your skill set?

Mr Goodinson suggests this is particularly important for engineers who have been made redundant or furloughed.

“What is clear at the moment is that any advertised jobs will generate considerable interest. We have all heard about 400 applicants for a bar worker job and recently I heard of 200 people applying for an agricultural marketing assistant role. So, you need to make sure you stand out.

“For example, flexibility is a good thing including the willingness to relocate and adopt flexible working. Also being flexible about the sectors you will working in is valuable and most engineering skills are transferable between sectors.

Get the basics right

“Get your CV sorted out and up to date. While it needs to be comprehensive, it must be easy to read so that it gets read by the people deciding if you will get the interview or not.

“Then remember that your CV is not the only way you promote yourself. If you haven’t done so yet, get your profile up on LinkedIn. Keep it current and refreshed and consistent with your CV. Then be active on the platform, posting material and

comments on your areas of interest. These will possibly be seen by people you apply to, but might also be seen by others looking for people leading to a direct approach.

“Follow companies in your sector or the sector you are interested in on social media, so you know what they are up to. And they will probably spot that you are following them if you apply for a position.

“With increasing applicant numbers, more companies are making use of professional recruitment consultancies such as De Lacy Executive. De Lacy know the jobs that are coming up before they have even been advertised. It is our job to match the right people to the right jobs. If you register with De Lacy you will receive direct and relevant job adverts as soon as they come up.

"We can help match you to the right opportunities and the more we know about you and work with you, the greater the prospects of finding the right position. And many of the positions we fill are often not advertised – the days of the job pages in the farming press are numbered in our opinion as employers go for a more targeted search process.

“Our expectation is that we will be placing more engineers in important roles that help shape the future of UK agriculture. And equally our experience is that a background in engineering helps pave the way for many senior management positions,” Mr Goodinson concludes.



Membership Matters

Western Branch

AGM & Evening meeting on the Ideal combine harvester, David Chell, Massey Ferguson. Lackham College. Report by Mike Whiting

With a return to Lackham College in Wiltshire during early March, we enjoyed hearing the timeline development of the AGCO IDEAL combine harvester. Delivered by David Chell, Sales and Support Specialist with Massey Ferguson, the presentation covered all aspects of the project's initiation from 2011 to date.

With a \$200M dollar budget, the development team had the competitors' machines set firmly in their sights. The decks were cleared of any previous harvesting concepts, to start from a blank piece of paper.

Where do you start with such a mammoth engineering challenge? Customers across the world were interviewed. A succinct list provided the catalyst and a vital aide memoire;

- i) Ability to harvest all cereals, pulses, varieties of grass, flowers, grain maize and whatever other crop has the potential to go through a combine.
- ii) Versatility on terrains and during road transport.
- iii) Maximising crop threshing whilst retaining straw quality.
- iv) Reduced level of complexity for the operator.
- v) Fuel efficient operation.
- vi) Ease of maintenance and reliability during long and arduous harvest schedules.

Globally, combine marketing specifications are ranked according to the horsepower bracket. The project encompassed three machines with the highest capacity IDEAL 9 allocated to the class 9 group. This sector covers machines

up to 650hp. A reliable and popular machine, the Delta range was Massey Ferguson's current highest output offering to farmers and contractors, which sported the hybrid threshing system. Focusing on the IDEAL, 'smart' principles were applied ensuring that engineering, manufacturing, purchasing, quality and technical service were all in tune with the process. This ensured that new components could be purchased within budget and the manufacturing facilities re-aligned to build the units. AGCO has a well-established stable of brands and technical expertise, which were exploited in pursuance of the IDEAL combine. The North America locations of Fargo and Jackson delivered the advanced electronic design and track running gear respectively. Moving further south, Canoas in Brazil provided the development for crop entry via the feeder house and handling of residue at the rear. Closer to home, the Randers division of AGCO in Denmark focused on the heart of the combine; processor and cleaning design. The team effort culminated with a €10M capital investment at the assembly location in Breganze, Italy to roll out fully assembled harvesters.

Crop ripe, time to go combining

Getting to grips with the IDEAL, the header retains the existing high performance from established power flow principles. With such a

high volume of material, feeding the crop head first into the threshing mechanism is achieved by the reel 'sweeping' the knife, explained David. The header can be adjusted instantaneously from the cab, reacting to laid crops and undulating ground conditions. Up to +/- 6° pitch is achieved via the use of two single acting hydraulic cylinders located at the base of the feeder house. Reactive forces provided by springs result in a simple and effective mechanical counter force. The 76cm diameter auger keeps material flow consistent before presentation to the feeder section. When the going gets tough, mechanical transmission provides reverse drive for the header, clearing the table and preventing blockages.

Cleaning up the sample

Delivering a clean sample into store is a requisite of modern combines, with David continuing his detailed explanation of the IDEAL's design. The grain pan is fully loaded at the front, aided by an additional containment section. This ensures the full length is utilised preparing material for the grain shoe. This results in heavy grain settling through the bottom, with lighter material on top. Airflow movement initiates trash removal, maintaining the IDEAL principles of exploiting every area of grain handling capacity within the frame. The combination of plastic curved pan profiles and high dividers reduces cleaning shoe



grain loss when on 15° inclines. David reminded us of the key principles for air movement within a harvester, aim for low pressure and high volume.

Many hours of testing were undertaken to verify the resistance from various seed sizes. AGCO's research and development confirmed that efficiency is improved with a longer sieve/chaffer compared to a wider one.

Technological advancements have been applied to identify reduced quality such as cracked grain. Data captured via 'Mass Acoustic Detection Sensors' (MADS) is fed to a microprocessor where algorithms evaluate the level of imperfections and 'material other than grain' (MOG) in the sample. The versatility of these monitors means that they can be positioned within areas of high volume flow without producing adverse results.

Grain delivery

The clean grain elevator has a massive 200t/hr capacity. A yield and moisture meter provides real time data, accurate to 98%, delivering data through to yield mapping via ISOBUS. A key element of the IDEAL's marketing campaign has been the rapid unload rate of the grain tank. Referring back to the specification, holding capacity options are the standard 12,500 litres and the market leading Streamer 210 with 17,100 litres. Material exit from the hopper base is controlled via two powerful hydraulic actuators which adjust the plates above the cross augers. From the cab position the driver can select 25%, 50%, 75% or 100% discharge settings. Additional finite control for trailer filling can be achieved via dial adjustment, moving the auger forwards or backwards. The 480mm diameter auger ensures transmission can be engaged when either full or empty, via soft start principles.

Powerhouse and operator comfort Keeping in line with engine emission regulations, the IDEAL 9 combine is powered by a 647hp, 15.2 litre MAN engine. Ticking the box on the development programme, MAN already provides the unit to AGCO

for the 1000 series FENDT tractors. Taking the heat out of the engine bay is a priority. The AIRSENSE cooling system inverts air flow direction to blow chaff and dust away, with automated activation controlled by temperature and time. In addition, engaging threshing, grain tank unload or road mode will invoke the redirection of air. If for any reason the combine was idling with none of these functions activated, the AIRSENSE cooling system will operate every 15 minutes.

David Chell's presentation was very much appreciated by the IAgRE members and visitors. We will welcome David to future events and thank Lackham College for its hospitality. The Western Branch will track the next UK IDEAL demonstration roadshow and kindly request if it's possible to ascend the steps and 'go combining'.

Northern Ireland Branch

Soil science explored and reducing compaction on a Tyrone dairy farm

This IAgRE, Northern Ireland Branch technical meeting featured presentations dealing with both soil science and practical experiences to reduce soil compaction on a working Co Tyrone dairy farm.

The first speaker was Professor Jane Rickson (our then IAgRE President and Professor of Soil Erosion

and Conservation at Cranfield University's Soil and Agrifood Institute). She described how a healthy soil is the basis for satisfying increasing worldwide demand for safe, nutritious and affordable food. But land is also in demand for other applications such as biofuel production, urban development and infrastructure projects. Crop production can be increased by managing inputs, such as fertiliser and irrigation, but yield response is limited without good soil health and structure. The choice of aids to control competitive weeds, pests and diseases is being reduced by the review and withdrawal of some commercial products. Soil degradation and loss by compaction and erosion, aided by extreme and variable weather events, is of concern. A 2006 EU study assessed the true cost of soil damage and loss in England and Wales alone to be around £1.2 billion per year. By contrast, some of the general public's lack of appreciation of the huge value of soil to human health and well-being is indicated by the casual use of terms such as 'dirt', 'soiled' and 'mud'.

As well as being the base for crop growth, soil is essential for water storage management, carbon storage and landscape aesthetics. Land covers 26% of the earth's surface but only around half is suitable for agriculture of which just 3% is arable. Prof. Rickson used the graphic image of the limited amount



Membership Matters

of good topsoil on the earth as like the thin skin covering on an apple.

Soil texture includes a range of particle sizes (in various proportions) ranging from fine particle clays (less than 0.002 mm), silts (0.002 mm to 0.06mm) to sands (over 2 mm). Typical make-up of a soil includes 45% minerals (clay, silt and sand), 25% water, 25% air and 5% organic matter. The ideal open soil structure permits excess water to move freely and provides access to air and nutrients which support plant root growth. Excess water reduces the loading capacity and can cause the structure to collapse under compaction or cultivation. A well-structured soil should provide the **3 Rs of Receiving, Retaining and Releasing** water at the appropriate rate. Recently Defra revealed that, of 300 farms surveyed, only 40% had good soil structure. Compaction damage caused an estimated loss of yield worth £481m per year in England and Wales.

Mechanical surface loosening techniques can assist but it is always preferable to check first (using simple hand spade-dug inspection pits) to check if this is really needed. Ploughing for routine reseeding is effective in dealing with surface compaction on grassland. In severely impeded drainage locations field drain renewal or moling / sub-soiling may be appropriate.

Andrew Wright is a young farmer from Co Tyrone. He described how he has been working on his family dairy farm to monitor and minimise compaction, within affordable systems, to maintain and improve grassland output.

As the result of visually observing reduced grass yields and hearing the results of scientific investigation around the subject of soil compaction elsewhere, he decided

to measure, from 2016 onwards, how much wheeling is done during field work. He based this on GPS records of tractor / implement travel during both fertiliser and slurry spreading. Impressively, as an IT enthusiast, he was able to design and custom build his own GPS satellite guidance and recording system avoiding the expense of purchasing proprietary items. This included writing his own software, custom making all his GPS components (including etching the printed circuit board and 3D printing). The assembled information, including both steering guidance and a field mapping record of tractor movement, is displayed on a 10" touch screen mounted in the tractor cab. He went on to further refine positional accuracy by adding his own home built RTK base station system for less than £100! The total area covered by wheelings is derived from electronic addition of the distance travelled using the digital field map information. The first map analysis showed up to 80% of the field surface covered by wheelings. Subsequent careful use of the system to guide fertiliser spreading reduced this to 37%.

It was decided to separate slurry haulage from slurry spreading by using a larger 2750g tanker for transport only and off-loading its contents to a top-fill 1600g single-axle tanker for field spreading. The load is restricted to around 1200g to minimise the axle load. At this stage the tractor's rear radial tyres run with 16 psi inflation pressures and the tanker tyres at 18 psi. These are within the tyre manufacturers' recommendations for the axle loads and travel speed in the field. The original spread plate on the tanker has been replaced with a Moscha oscillating unit: (a) to increase spread bout width to around 18m and (b) to reduce atomisation and drift from its reduced-pressure spread pattern. Its wag-tail action (as originally designed by a German farmer) is powered by the slurry passing through it.

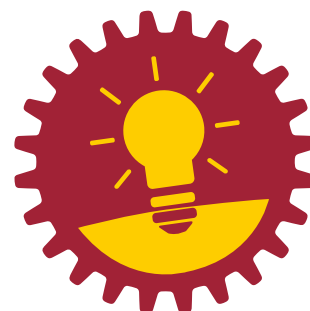
High rainfall conditions during 2017 were challenging for travel on the heavy loam soils. By contrast, the

drought conditions of 2018 were much easier with the added bonus of resulting soil shrinkage cracks continuing to assist drainage in subsequent years.

Andrew had previously tried some sub-soiling but felt that, in his conditions, it had not improved grass yield. He favours the 'try to reduce it before trying to remove it' approach to compaction and believes that his soil structure has improved. At this stage, he aims to minimise wheeling's from his existing equipment rather than take on a more expensive option.

The chairman closed the meeting with thanks to both speakers for their clear and most informative presentations.

Events and branch meetings



The current programme of IAgRE events and branch meeting is suspended due to COVID-19, pending changes in government advice. The IAgRE is working hard to develop a programme of online resources and virtual meetings to help fill this gap. If you have any suggestions or would like to help please contact

Sarah McLeod

Secretary@iagre.org

Obituary



**Dr Michael (Mike)
John Hann CEng, CEnv,
FIAGrE**

Mike sadly died on the 29th of June 2020, a 54 year member of the IAGrE. He was born in Bristol, on 4th February 1942. After attending Brymore School in Cannington, Somerset he obtained a National Certificate in Agriculture and a National Diploma in Agricultural Engineering from Writtle College. Followed by both a

HNC and HND in Civil Engineering from Reading Technical College and a BSc in Engineering from the Open University. In 1984 he was awarded a Master of Science degree in Soil and Water Engineering from Silsoe College of Cranfield University and in 1995 a PhD for work on mole drainage. Mike received the Shepperson Memorial Trophy for his Master's thesis entitled 'An investigation into the mechanics of tines with a power driven leading face'.

He established his early career working for agricultural engineering and civil engineering contractors on drainage and earth structures including the first Severn Bridge project. Mike then worked as a Lecturer and Engineering Consultant at Plumpton Agricultural College and Rycotewood College in Thame, Oxfordshire. In 1985 he joined the staff of Silsoe College, as sequentially a Lecturer, Senior Lecturer and Reader in Soil and Water Engineering until his 'official' retirement in 2007. However, like many in the profession, Mike did not make a clean break when he retired but continued to deliver his knowledge and expertise to students at Cranfield University on a part-time basis for many years. During which time, he was also Patron of the Land Drainage Contractors Association and External Examiner to Harper Adams University.

In addition to his teaching and supervisory duties at Silsoe College, Mike worked extensively both in the UK and internationally on development and consultancy projects relating to soil and water conservation engineering and management, soil erosion conservation measures, land drainage, habitat creation and restoration, pipeline restoration and soil management in the built environment. His areas of expertise also extended to soil engineering and waste engineering for agronomically and environmentally acceptable application of rural and urban bio-solids to land. His job was so important to him: whether it was soil surveying in a muddy field in Bedfordshire or engineering pipeline corridors across bandit country in Azerbaijan.

Mike was an inspiring teacher: with patience, enthusiasm and a gentle humour that amused students very much. He had a strong affinity with all students, best expressed by a former student: "Mike, thank you for everything you have done for me and the other students. I feel blessed for becoming your friend and truly appreciate your time given to me. Both my personal and professional life would have not been the same without your caring friendship. You had time to cheer us up, to joke and help us, whatever was needed. You knew what was needed better than us!"

As a result of the above he received the IAGrE 'Contribution to the Land Based Industries Sector' Award in 2005, for his sustained contribution to agricultural engineering. He served the IAGrE both as a Member of the Editorial Panel and subsequently as Honorary Treasurer.

As Silsoe College applied its expertise in soil and water management to the specialist area of sports surfaces, Mike was in his element combining his professional expertise with his love of sport. His key sport was rugby and he would relate almost unbelievable stories about his and his teammates antics earlier in his career. He spoke of his spirited conversation on the field of play with the referee, who re-emerged later in his career as the Vice Chancellor of Cranfield University, who thankfully had either forgotten or forgiven the earlier conversation.

Many members of the IAGrE who were his former colleagues and students at Plumpton Agricultural College, Rycotewood College, Silsoe College and Cranfield University will remember him for his larger than life personality.

His wife Valerie predeceased him in 2009, their son Andrew and daughter Claire, to whom we send our condolences, survive him.

Dick Godwin, Jane Rickson and Paula Misiewicz

Membership Change

1/05/20 to 31/07/20

Admissions

Fellow

Member

Associate Member

Mr Christopher Cunningham
(East Midlands)

Associate

Affiliate

Mr William Parry (Wrekin)
Mr Alan Holmes (S Eastern)
Mr Bernard McCloskey (Northern Ireland)
Mr Elliott Robson (Southern)

Technician

Mr Gregor Forrest (Scottish)
Mr John Sellars (Yorkshire)
Mr Christopher Jones (Wrekin)

Technician

Mr Gregor Forrest (Scottish)
Mr John Sellars (Yorkshire)
Mr Christopher Jones (Wrekin)

Student

Readmission

Deaths

We have recently learned of the death of the following members and we send our condolences to their family and friends:

Dr M J Hann, CEng CEnv FIAgrE
(Southern) a member since 1966

Mr F J Pirie IEng FIAgrE
(Scottish) a member since 1965

Mr A E L Walker IEng FIAgrE
(Scottish) a members since 1962

Transfers

Fellow

Member

Associate Member

Miss A Warrington (Western)
Dr B Chunga (Malawi)

Affiliate

Engineering council

Registrations

CEng

IEng

EngTech

Mr Christopher Jones (Wrekin)

Society for the environment

CEnv

Long Service Certificates - July to September 2020

60 years

None

50 years

Mr GER Blakely IEng MIAgrE	23/07/2020
Mr DG Bedingfeld CEng MIAgrE	23/07/2020
Mr E Kramer AIAgrE	23/07/2020
Mr CR Whetnall IEng CEnv HonFIAgrE	23/07/2020

35 years

Mr CA Morse CEng MIAgrE	12/07/2020
Mr SJ Bamford CEng MIAgrE	24/07/2020
Mr SJ Scoones CEnv MIAgrE	08/08/2020
Eurlng RM Hay CEng HonFIAgrE	26/09/2020

25 Years

Mr AG Robbins CEnv MIAgrE	10/08/2020
Mr CM Bentley CEnv MIAgrE	15/09/2020
Mr JE Gibbs AIAgrE	18/09/2020

* Please note due to the Secretariat home working there is a delay in sending out Long Service Certificates, once the team are back in the office, this will be dealt with.

Academic Members

Berkshire College of Agriculture

Hall Place, Burchetts Green,
Maidenhead, Berks, SL6 6QR

Bishop Burton College

York Road, Bishop Burton, Beverley,
HU17 8QG

Brooksby Melton College

Asfordby Road, Melton Mowbray,
Leics, LE13 0HJ

Coleg Sir Gar

Gelli Aur Campus, Llandeilo,
Carmarthenshire, SA32 8NJ

Cranfield University

Cranfield, Bedfordshire, MK43 0AL

Duchy College

Stoke Climsland, Callington,
Cornwall, PL17 8PB

Easton & Otley College

Easton, Norwich, Norfolk, NR9 5DX

Greenmount College

CAFRE, 22 Greenmount Road,
Antrim, Northern Ireland, BT41 4PU

Harper Adams University

Newport, Shropshire, TF10 8NB

Hartpury College and University

Gloucester, GL19 3BE

Institute of Technology

Tralee Clash, Tralee, Co Kerry, Ireland

Lincoln Institute of Agri-Food

Technology, Lincoln University,
Lincoln, LN6 7TS

Manchester University

School of Electrical and Electronic
Engineering, C39, Sackville
Street Building, Sackville Street,
Manchester, M1 3WE

Myerscough College

Bilsbarrow, Preston, Lancashire, PR3
0RY

Newcastle University

King's Gate, Newcastle Upon Tyne,
NE1 7RU

Pallaskenry Agricultural College

Co Limerick, Ireland

Plumpton College

Ditchling Road, Lewes, East Sussex,
BN7 3AE

Reaseheath College

Reaseheath, Nantwich, Cheshire,
CW5 6DF

Royal Agricultural University

Cirencester, Gloucester, GL7 6JS

Sparsholt College

Sparsholt, Winchester, SO21 2NF

SRUC – Auchincruive

Auchincruive Estate, Ayr, KA6 5HW

University of Manitoba

Winnipeg, Canada, MB R3T 2N2

Warwickshire College Group

Warwick New Road, Leamington Spa,
CV32 5JE

Wiltshire College Lackham

Lacock, Chippenham, Wiltshire,
SN15 2NY

Commercial Members

Ace Aquatec Ltd

16B City Quay, Camperdown Street,
Dundee, DD1 3JA

Agri-EPI Centre

1-4 Bush House Cottages, Edinburgh,
Technopole, EH26 0BA

Agricultural Engineers Association (AEA)

Samuelson House, 62 Forder Way,
Hampton, Peterborough, PE7 8JB

AGCO Ltd

Stoneleigh, Abbey Park, Kenilworth,
Warwickshire, CV8 2TQ

Alvan Blanch Development Co

Chelworth, Malmesbury,
Wiltshire, SN16 9SG

Autoguide Equipment Ltd

Stockley Road, Hedington, Calne,
Wiltshire, SN11 0PS

BAGMA

225 Bristol Road, Birmingham,
B5 7UB

Briggs Irrigation

Boyle Road, Corby, Northants,
NN17 5XU

City and Guilds

1 Giltspur Street, London, EC1A 9DD

City Farm Systems Ltd

25 Hepplewhite Close, High
Wycombe, Bucks, HP13 6BZ

David Ritchie (Implements) Ltd

Carseview Road, Suttieside, Forfar,
Angus, DD8 3EE

Douglas Bomford Trust

The Bullock Building, University Way,
Cranfield, Bedford, MK34 0GH

DSL Systems

Adbolton Hall, Adbolton Lane, West
Bridgford, Nottingham, NG2 5AS

NFU Energy Services

Stoneleigh Park, Kenilworth,
Warwickshire, CV8 2LS

Fullwood

Grange Road, Ellesmere, Cheshire,
SY12 9DF

Househam Sprayers

Roughton Moor, Woodhall Spa, Lincs,
LN10 6YQ

HSS Hire

25 Willow Lane, Mitcham, London,
CR4 4TS

JCB

Rochester, Staffs, ST14 5JR

John Deere Ltd

Harby Road, Langar,
Nottinghamshire, NG13 9HT

Marks & Clerk LLP

90 Long Acre, London, WC2E 9RA

Mastenbroek Ltd

83 Swineshead Road, Boston, Lincs,
PE21 7JG

National Fluid Power Centre

Carlton Road, Worksop, Notts,
S81 7HP

Orby Engineering

Craigmore Road, Newry, BT35 6JR

Reesink Turfcare UK

1-3 Station Road, St Neots,
Huntingdon, PE19 1QH

PlantTech Research Institute

Bay of Plenty, New Zealand

Shelbourne Reynolds

Shepherds Grove Ind Estate, Stanton,
Bury St Edmunds, Suffolk, IP31 2AR

SSAB Swedish Steel Ltd

Narrowboat Way, Hurst Business
Park, Brierley Hill, West Midlands,
DY5 1UF

Teagle Ltd

Blackwater, Truro, Cornwall, TR4 8HQ

TeeJet London Ltd

Headley House, Headley Road,
Hindhead, Surrey, GU26 6UK

Witham Oil and Paint Ltd

Outer Circle Road, Lincoln, LN10 6YQ

Landwards Conference 2020



LEAN AGRICULTURAL ENGINEERING AND RESILIENCE IN THE SUPPLY CHAIN



We are delighted to announce that the IAgrE will still host an annual conference this year. The topic will be the Application of Lean Principles in Agricultural Engineering, with expert speakers covering the supply chain, dealers, the farming perspective as well as exploring the principles of Lean Manufacturing.

A virtual conference delivered during 2020 culminating in live Q & A with all the speakers on Wednesday 4th November 2020.

For further details:

• www.iagre.org • secretary@iagre.org • 01234 750876

