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IMAC 2006 'Meat' the Vision: Profiting from automation

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1 Executive summary

IMAC (International Meat Automation Congress) is an event that takes place in Europe every 2-3 years that started in 1996 in order to facilitate exchange between users and developers of automation technologies in the meat industry. The idea behind it is having speakers presenting the latest innovative solutions in the processing, handling, packaging and dispatch areas of meat production.

IMAC 2006 took place in Benalmadena, close to Malaga, on November 9th-10th, and it was organised by FAN. The mission of Food Automation Networking Limited (FAN) is to pay specific attention to the growing need for international networking between organizations interested in food automation. FAN tries to bring together companies and solutions at organised events to exchange ideas and to build a market in food automation, creating a worldwide network.

FAN is a company sponsored by Gilde (Norway), ATTEC (Denmark), E+V Technology (Germany), DMRI (Denmark) and FACCSA (Spain), and it has been an initiative mostly driven by Koorosh Khodabandehloo, former Dean of Engineering Research in the University of Bristol in the UK, and initiator of multiple automation projects, including international collaborations between European companies.

FAN has coordinated too the Europe study tour MLA and some Australian processors engaged in from November 6th to November 17th 2006.

This document is a brief summary of all the presentations given during IMAC 2006. The presentations themselves are a complement to this document, and they must be referred to when more details are needed. However, notice that some of the presentations are missing videos that were shown in the congress but that were not included in the electronic hand outs for confidentiality reasons.

The report covering the MLA Europe study tour should also be used as a complement to the IMAC 2006 documents, as some of the companies presenting in the congress were visited during the tour.

Part of the summary for each presentation is a brief description of potential projects and opportunities for collaboration that be derived from each case.

List of Presentations:

DAY 1

1. Pig Slaughterhouse Automation. Overview and implications for management (Claus Fertin, DMRI-DMA Denmark)
2. How to make innovation happen (David Potter, DP Associates UK)
3. Advantages of fully integrated line approach to automation (Petur Gudjonsson, Marel Iceland)
4. Robotics and processing plants for economic advantage (Peter Fornoff, Kuka Roboter and Frank Schmidt, BANSS, Germany)
5. Advances in automated bag loading (Ricardo Evangelisti, Selaed Air, Italy)
6. The user benefits of integrated weigh label and robotic case packing
7. Fostering and facilitating innovation in the red meat processing industry (David Doral, MLA, Australia)
8. Robotic innovations in red meat processing in Australia (Clyde Campbell, MAR, Australia)
9. The smallstock boning room of the future (Andrew Arnold, Scott Automation, New Zealand)

10. Profiting from vision (Horst Eger, E+V Technology, Germany)

DAY 2

1. Improving food quality measurements using multispectral measurements (Jans Petter Wold, MATFORSK, Norway)
2. Advances in automated pork and lamb cutting and packing, giving financial benefits to the end user (Claus Nielson, ATTEC, Denmark)
3. Automated measurement, sorting and yield estimation for efficient meat production (Paul Hosen, Gilde, Norway and Francisco Requena, FACCSA, Spain)
4. Efficiency in operation practices in a competitive and labour intensive sector (Jan Mielnik, ANIMALIA, Norway)
5. Robots in the consumer sector: technology that makes economic sense (Klas Bengtsson, ABB, Europe)
6. Profiting from high speed robotic packaging technology (Alan Law, Schubert UK)
7. Automation for boning of cuts from pigs. Technology and operational aspects (Finn Hansen, DMRI, Denmark)
8. Increasing shelf life using advanced chilling methods (Brian Wood, Supachill, UK)
9. Managing ideas to implementation and opportunities for R&D funding (Koorosh Khodabandehloo, BMC, UK)
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1 Pig Slaughterhouse Automation. Overview and implications for management (Claus Fertin, DMRI-DMA Denmark)

Claus Fertin, the CEO of the Danish Meat Research Institute (DMRI), gave an overview of the organization and presented the progress done so far in their most important initiative in recent times, the automation of pig slaughter houses.

DMRI is the research arm of DMA or Danish Meat Association, a joint technical and administrative body for the meat and livestock organizations in pork, cattle and poultry in Denmark.

The project started around 10 years ago, and the labour shortage was the main driver for it. However, the situation has changed slightly, probably due to some of the Eastern European countries joining the EU (adding more supply of cheap labour), and although labour is still an issue, is not so critical as before.

Right now, the major drivers for automation are labour productivity and yield improvement, but labour shortage is still a concern as the problem will bounce back in a few years, once the new EU members are fully integrated.

The splitting of pig carcasses was the first task automated in 1998, but others followed, and the project is supposed to conclude in 2007, with the last slaughtering tasks finally automated. DMRI is engaged into extensions of this project to automate cutting and boning too.

Also, some work that DMRI is doing with CT-scanning was mentioned in the presentation. See the tour report for further details.

An extensive summary of this automation project is included the report of the MLA Europe study tour 2006. Please refer to it and to the actual presentation for further details.

Potential projects or opportunities

Beef automation feasibility study

DMRI has in place advanced negotiations with other Scandinavian companies to carry out a study to analyse the different processing techniques in beef, and look for automation opportunities. This should be an across countries study, in search for the tasks which automation can bring more benefits to the national industries of all the participants, as a previous step to start a new technology development. We could argue that this study has already been done in Australia (by FSA concretely), but collaborating in an international initiative like this could complement the work already done, but more importantly, it could position the Australian industry to influence and leverage European funds and development efforts, in order to bring new technologies that will benefit companies here.

Right now, DMRI-DMA has envisioned a project with a €100,000 budget, which will have to be increased if other countries participate, in concrete Australia. However, and even if that budget is doubled, given that MLA would only contribute with part of it, the cost would be reduced for the potential benefit to be extracted from it, not only participating in a future development in this particular area, but also being more in touch with any technological innovation or concept that may show up in related fields. This would be possible simply by putting an Australian team in charge of reviewing the local processes, as the basis for discussion about automation alternatives with its European counterparts.

CT scanning

There is a lot of work to do in this area, in algorithm design and software development, but mostly in hardware development. And of course, the integration of the technical solution and the implications with the way information is used and animals are processed are key to extract all the potential the technology has (yield prediction, breed improvement, payment to farmers based on animal value, maximizing value according to product and customer specifications, etc).

DMRI has done some work already, and they could be interested potential collaborations with other companies. An ideal project would be one where, engaging a multinational team, with a CT scanner manufacturer included, a system is developed specifically for meat processing applications, with EU funding and Australian participation.

2 How to make innovation happen (David Potter, DP Associates UK)

David Potter, a consultant specialised in helping companies to innovate and build innovation processes, gave a presentation about his approach to make that reality.

The whole presentation was given at a very high level, and stressed the importance of culture development and what he called the SCIFI method, Simplify, Collaborate, Integrate, Focus and Integrate.

In summary, an interesting presentation for companies involved in building innovation processes and fostering innovation in general, but not concretely related with developments in automation or any other technology.

3 Advantages of fully integrated line approach to automation (Petur Gudjonsson, Marel Iceland)

Petur Gudjonsson, Director of sales and marketing of the Marel group gave a general presentation of the solutions Marel offers and the advantages of a line approach over a individual machines bought and installed separately.

It is worth mentioning the fact the Marel group includes now 4 companies, Marel, Carnitech, AEW Delford and Scanvaegt. The last two ones were acquired recently, and offer right now similar products in some cases, therefore consolidation in product lines are a likely possibility (see in the Europe tour report the summary of the visit to AEW Delford).

No particular new solutions were shown here, as Marel basically presented examples of their solutions in action

Potential projects or opportunities: Marel has already introduced some of their systems in Australia, and it is eager to do it with other products, coming from the parent company or any other company from the group. Right now there is no particular technology where MLA can see room for collaboration, but Marel was keen during the congress to participate in conversations to articulate proposals for the EU R&D funding scheme FP7.

4 Robotics and processing plants for economic advantage (Peter Fornoff, Kuka Roboter and Frank Schmidt, BANSS, Germany)

In the first half, Peter Fornoff from Kuka gave a general presentation of their robots, with particular attention to the food industry but without expanding into further details. Probably one of the highlights was the entry into the market of small robots for packaging with the new KR 5 6 axis robot.

In the second half, Frank Schmidt from BANSS exposed their latest developments. In particular, he showed 4 robots running right now under normal operational conditions at high speed in the Westfleisch pig plant in Coesfeld, Germany. We had the opportunity to see the robots working when we visit that plant in the Europe study tour.

In particular, the 4 automated tasks, with 4 robots and 3 laser systems are:

- Front hock (fore paw) cutter
- Bung dropper
- H bone cutter
- Belly and breast opener

The sensing systems were 3 laser profilers to produce 3D maps of each carcass. One for the hock cutter, another one for the bung dropping and the third one collecting information for both the H bone cut and the belly opening with the breast bone cut

These systems are particularly interesting because

- They are based in a similar approach to the technologies being developed here in Australia under MLA sponsorship (usually by FSA) and aimed to automate tasks in beef and sheep processing
- BANSS has proved this approach can provide a fully operational solution at high processing speeds (line running at 620 pigs/hr)

This tells us we are in the right track, and although there are some differences due to the fact they are working with pigs, the variability in sizes and weights (60-110Kg) is wide enough to think a similar solution can work with other species.

You can refer to the presentation for further details. Please note that there is a video embedded at the end of it, which does not seem to work but that can be seen if played directly, that is to say outside the presentation by simply clicking twice the video file in the same folder the presentation is stored.

Potential projects or opportunities: BANSS is trying to make a move in Australia by appointing a representative (Harry Schultz), something that will probably provide opportunities for further collaboration. BANSS is interested in general in accessing the beef and sheep processing industry. They do not seem to have defined plans, and probably the adaptation of some of their pig robotic systems to beef and sheep will be done by other players, but they should be taken into account in any case.

BANSS showed also interest in the work we have done in beef splitting, a task many plants would like to see automated. There may be possibilities to work together in this area.

5 Advances in automated bag loading (Ricardo Evangelisti, Selaed Air, Italy)

In this presentation a brief overview of the company was given, but particular attention was paid to two systems:

Plug and pack system: The automated or semi-automated bag loaders based on the plug'n pack system, use this kind of circular cartridge or coil where a plastic strip is wound, and that when attach to the bags, allow their opening so that an automated can open bags continuously.

Roboloader: This is one of the flagship products in the automation side. It places automatically pieces of meat (up to 15-17Kg) in plastic bags. It can handle 20 pieces per minute (one every 3 seconds), and a cost typically above \$300,000.

Also, some information was presented about current developments:

Multi format automatic loader: development of a modular concept loader able to handle several formats of packaging materials: taped bags, bags on a roll, rolls of films, rolls of tubular materials

Packaging line with information management integration: development of a packing line with traceability functionalities able to collect and manage product information, to be shared in real time with customers information systems. Technologies used here are RFID and laser scanning for product identification and in-line printing for product tracking.

See *Europe study tour 2006* report and www.cryovac.com for further details about Cryovac.

Potential projects or opportunities: although Cryovac seems very active developing new systems, those developments are driven mostly by its consumables division, to encourage sales of bags and similar products. For that reason, opportunities may show up to automate standard operations common to a high number of plants with high consistent throughput.

6 Integrated case packing (Peter Mortimer, Herbert Industrial, UK)

Herbert Industrial is a company specialised in weigh label technology. Typical products developed by Herbert are automated systems capable of processing both fixed and catchweight products at high speeds, placing labels with weight data and securing traceability with prior and aft operations.

The Herbert representative presented information about integrated systems, incorporating:

- Metal Detection/X-Ray
- Print/Apply Weigh Label
- Automated Vision Inspection
- Robotic Case Packing
- Automatic Outer Case Label

Potential projects or opportunities: Herbert Industrial is focused in case ready solutions, probably tailored to specific requirements. Only if a particular and complex new configuration becomes the standard for retail ready Australian plants, some joint development could be considered. Otherwise, there is not much room for R&D initiatives with MLA involvement.

7 Vision systems for the meat industry (Horst Eger, E+V Technology, Germany)

The most important technologies developed by E+V are mainly grading systems and visioning aids for automated cutting systems. Also, some info about defect inspection was presented.

The presentation dealt mainly with the following products

- Pork carcass grading: video imaging to predict yield (lean %) of pig carcasses
- Pork cutting systems: sensing system based on video imaging to determine the cutting positions in the automatic primal cutting system of the Danish company KJ Maskinfabriken
- Pork robotic cutting systems: also known as scribing system, this system was seen in action in the Gilde's plant in Rudshogda visited during the tour (see tour report). The system is based on a Kuka robot, an E+V visioning system and Freund blades that have done already thousands of cuts without sharpening problems, without producing defective cuts or bone chips. The E+V vision system can size cuts based on a library of more than 3000 carcass forms, determining the cutting path to be followed by the robot.
- Pork primal grading: 3 camera system for acquisition of pig halves ham silhouette and bone side information. In particular this system provides information about weights and yields of the value determining parts (ham, chop, tenderloin, belly and shoulder), type evaluation and fat thickness.
- Beef carcass grading: automatic acquisition of halves information, integrated into the slaughter line to determine conformation and fat class, weight and yield of the value determining big parts (sirloin, shoulder, etc.), amount of meat (classes I, II, and III), lean %, length, widths, angles, areas and volumes.
- Sheep/Lamb grading: 2 camera system for automatic acquisition of the carcasses in the side and back view, integrated into the slaughter line (800 hds/hour), determining, conformation, fat class, weight and yield of the most valuable cuts. This system was seen running too in the Gilde plant visited in Norway during the tour.
- Poultry grading & defect inspection: similar technologies, including defect inspection, for poultry.

The E+V representative also talked about some new developments

- Robotic beef cutting: similar system to the pork robotic cutting system (automated pork scribing). It performs primal cuts or pre-cuts on vertical beef halves, where a 2 camera system automatically acquires halves images and transmits the data to another pc, where the cut path is determined with high based on the specific anatomic features of every half and according to customer requirements and market conditions. This is a similar philosophy to the one under development by MAR and currently being tested in Northern Co-Op. in Casino. There are however some differences between, mostly in the backing board (stabilisation system) and the visioning technology, that makes the one developed by Mar more suitable to Australian operations.
- Pork tracking system. Automatic marking of carcasses with a binary code. The marking can be done with an ink jet system or with a laser maker. A vision system reads the binary code and a software package decodes it, transferring the information to the IT system.
- Burger inspection system, to detect defects and measure features.

Notes about E+V beef grading systems: There are studies available that compare the three similar grading technologies, BCC2 from SFK technologies, VBS2000 from E+V and VIAScan. The results said that VBS2000 performed best predicting conformation (86.4% correspondence to reference measurement in 5 point scale), BCC2 performed best predicting fat class (72.2%

correspondence to reference measurement in 5 point scale) and the three of them performed similar in saleable yield prediction (residual standard error $rsd=1.2\%$). About this last result is worth mentioning that similar saleable yield predictions were obtained combining the 15 point scale prediction with weight. Also, similar primal yield predictions were obtained with the three systems, with rsd ranging from 1.5 to 1.56. There were variations in the results depending on the type of animal graded, i.e. sex, age, etc.

In any case, those systems try to predict average or overall yield measurements, and provide less accurate information about yields in particular cuts (5-8% and higher, depending on results), something other technologies will do much better in the future, like CT scans. Also, remember the results mentioned above were comparisons between the predictions and the reference classification, which was the consensus of one classifier and two inspectors and which accuracy is determined.

See http://www.eplusv.com/start_E.htm for more information.

Potential projects or opportunities: Until now we have seen only limited adoption of the imaging technology E+V and others (BCC2 from SFK and VIAScan from Sastek) use to grade carcasses and cuts, and we should expect probably more companies interested on it. There could be room to progress in further developments, but this technology may have reached already its full potential, and apart from helping plants to familiarise with the current solutions, we consider there is more value in investing in R&D in other technologies that can deliver more in the future, like CT scans for instance.

8 Improving food quality measurements using multispectral measurements (Jans Petter Wold, MATFORSK, Norway)

Two Norwegian research institutes (MATFORSK and SINTEF) have developed a system to measure water content on fish, based on NIR spectroscopy. There is already a system in the market commercialised by a Norwegian company (Qvision), mostly directed to quality on line measurement for fish, but there can be multiple applications for this technology on the meat industry.

MATFORSK and SINTEF have managed to determine the water content of split cod (dried, salted, used for bacalao), using transreflectance of near infrared (NIR) light, that is a technique by which the light is forced into the sample, the surface contribution is suppressed and the light that has first penetrated the product, and second been reflected, is analyzed to extract information about the internal contents.

The big advantage of this technique is the access to information of the internal composition of the product. Also, the spectral image provides more information on each pixel than regular imaging. The fat content prediction in salmon with this technique achieved an accuracy finer than 1%, and a similar approach can be applied to meat grading. They have done some tests to measure fat content in packed mince meat and they have achieved a prediction error of $\pm 1\%$. Similar tests have been carried out with steaks and loose trimmings, with prediction errors around $\pm 1.4\%$.

The major limitation of this technology is how deep the NIR light can get into the product. With salmon, preliminary tests say that the limit depth is 25 mm, but if the required accuracy is worse than 1% (for instance $\pm 2.5\%$, which is the accuracy we must provide to substitute a human grader) this could be a potential solution to automate on line grading of loose trimmings.

It can also offer opportunities to measure outer layers of fat.

Additional applications are temperature measurements, based on water peak shifts to shorter wavelengths as temperature increases. This application can be very useful to provide automated temperature feedback from carcasses for chilling systems, as well as ice fraction content in super chilling.

Another technology presented and its corresponding application was qualification of collagenous connective tissue in beef with fluorescence spectroscopy.

Potential projects or opportunities: We consider there are multiple interesting applications for this technology, among them:

- Fat-Lean ratio (CL content) of loose trimmings on a conveyor belt. NIR spectroscopy gives very accurate results up to 20mm deep. In this case, we will need to analyse much thicker products, probably up to 100mm, but we don't need such a high accuracy. Actually, $\pm 2.5\%$ in fat content could be enough to prove the technology useful. The key aspect here is the cost, as we are looking for an affordable system (that is why accuracy is not critical) which price should not be higher than \$150,000, and less if possible.
- Hand probe to measure external fat layer in carcasses. Australian processors are interested in this application, as they have issues with the Hennessy probe used currently and its pay-per-carcass-measured business model (see Hennessy specs in <http://www.hennessy-technology.com/techspec/>).
- Whole carcass grading. This is definitely a long shot and we do not expect to have a system running in the short term, but for us it is one of the areas where we have to progress in order to materialise our vision of the future processing plant. One approach here is to use a probe to measure fat depth in several points and estimate with that overall fat content. This is something done already, but not very accurately, and it would

be a natural application of the probe mentioned above. The other approach is to get the whole carcass scanned, obtaining a more accurate number, and maybe a map of fat/lean content of the whole carcass. There are many challenges here, and that is why this a long term project, but if there is any chance to come up with a solution, we would be willing to invest the money and time needed for it.

- Temperature feedback for chilling systems: if a probe is developed to measure fat layer in carcasses, a similar application could be developed to measure temperature, to monitor it in carcasses in chilling rooms, to optimise the chilling process and avoid issues like cold shortening.

9 Advances in automated pork and lamb cutting and packing, giving financial benefits to the end user (Claus Nielson, ATTEC, Denmark)

Claus Nielson from ATTEC gave a presentation about ATTEC automated cutting systems and their financial implications and the value maximizing derived from accurate cuts and the higher value of primals.

In the section highlighting the financial benefits of automated pork cutting, it was exposed how the higher accuracy can bring savings of €0.45 per carcass, which become yearly yield savings of €332,000 , plus labour savings of €94,000 per year (2 labour units), based on a 400 hds/hour, 37hr/week, 50 week 1 shift operation, with a total cost per operator of €47,000.

Particularly relevant is the semi-automatic cutting line for lamb, which can cut up to 600-720 units/hour. They claim this cutting system do not produce bone dust or smearing, and the savings derived from higher yield can reach 1-2%, providing a 1 year pay-back.

ATTEC has also a middle cutting machine for lamb, capable of processing 600-900 units/hour, which does the splitting and the cutting of flanks. This system has been already tested in New Zealand with limited success, and ATTEC is working to improve it. This is one of the reasons why they appointed recently a representative in Auckland (see <http://www.attec.co.nz>).

Please refer to the Europe study tour report for more information about ATTEC, as well as the IMAC presentation and their website <http://www.attec.dk>.

Potential projects or opportunities: Probably one of the first areas where ATTEC technology can be tested for adaptation to the Australian industry is the middle processing machine. Although it has already trialled in New Zealand with very limited results, there is potential for collaboration and improvement of the technology to run here. There can be other opportunities, and collaboration with Scott Automation in any joint development for lamb could be another option. In any case, ATTEC is a company that should not be overlooked, as the impression from the visit to their facilities is that we are dealing here with a very efficient organization.

10 Automated measurement, sorting and yield estimation for efficient meat production (Paul Hosen, Gilde, Norway and Francisco Requena, FACCSA, Spain)

This presentation is the summary of a joint initiative between Gilde and FACCSA, under one of the EU programs, to develop optimisation models, although from different perspectives.

Gilde was more focused in the optimisation of the supply chain, in order to optimize the flow of product and efficiently link animal supply (with their different producers-farmers-members), processing facilities (their different plants), storage, transportation and customers, and maximize profit.

FACCSA instead, tried to develop models for controlling quality-based yield optimisation processes using vision, ultrasonic and robot technologies, and implement a system to produce identical meat packages adapted to customer requirements. Their basic goal is the substitution of the current procedure, i.e. a human classifier at the beginning of the line, by an automated system based on software, so that the grading process and the link between animals, cuts and customers can be as objective as possible, and can be sustained without relying on human input.

The scope of both projects were very interesting, as well as the job done, however the presentations were very technical, particularly in the FACCSA case, and only useful if interested in the algorithm developed and implemented to generate the information sought.

Potential projects or opportunities: There is a lot of potential on these optimization models, either to streamline a given supply chain or to develop algorithms to predict grading measurements. These solutions are particularised to each company operations, and they have been developed internally, so there is no possibility to access the services of any technology provider here. However, the relationship has been established, and there are chances to access to more information about these initiatives if we considered they are worth replicating here in Australia.

11 Efficiency in operation practices in a competitive and labour intensive sector (Jan Mielnik, Animalia, Norway)

Jan Mielnik from Animalia centered his presentation in a rotating table, initially designed for poultry processing to maximize processing efficiency with mostly human operators, though there could be possibilities to use the table in an automated system.

The same system has been used for cutting and de-boning pork hams and even pig halves, and some production line concepts based on it have been already proposed.

Please refer to presentation for more information.

Potential projects or opportunities: We do not expect this technique to be adapted to beef, lamb or goat processing, but contacts with Animalia are already in place, in case some Australian plant finds the system interesting.

12 Robots in the consumer sector: technology that makes economic sense (Klas Bengston, ABB, Europe)

Klas Bengston from ABB exposed the case for robotics in food processing, arguing that probably it is the time for this industry to catch up with other sectors like automotive, based on the reduction in cost robots have been through in the last years, and the labour shortage problems.

The central point of his presentation was the Justification for Robotics, needed if we want to take any automation initiative to any processing plant. Among the different points to consider when assessing the case for automation, the following were cited:

- Direct labour savings
- Cost of quality: rework
- Cost of quality: scrap
- Cost of quality: warranty
- Floor space savings
- Capacity gains
- Worker compensation savings
- Reduced turnover (due to hiring and training activities)
- Customer relations

The applications mentioned were mostly in picking, packing and palletizing. From the examples shown, the most relevant ones for the red meat industry are the picking and packing robots, exemplified by the AEW Delford system (refer to the tour report for more info about AEW Delford).

Potential projects or opportunities: ABB is a primal supplier of robots, and as such it deals mostly with automation companies that integrate systems, building solutions made of robots, end-effectors or tools, sensing and control devices. There are only limited opportunities to interact with ABB, as we deal more naturally with technology integrators than with primary manufacturers.

13 Profiting from high speed robotic packaging technology (Alan Law, Schubert, Europe)

Alan Law, an engineer from Schubert's UK division, showed several examples of Schubert's systems. Schubert is a German company specialised in developing big picking and packing systems. The videos shown on the presentation, and included in the CDs handed over (look in 16. DAY2 Alan Law folder where you can find some videos) give an overview of their capabilities, with really ingenious configurations.

Schubert seems more specialised in the confectionery industry, but they have also some applications for processed meats like sausages.

A particularly interesting vision of the plant of future was shown in an animation (see Zukunft_englisch Short.wmv in the same folder as above), where robots not only will do simple tasks like picking and packing, but they will also inspect products, cope with production variability, auto diagnose and even replace other robots when there is any malfunction.

Potential projects or opportunities: Though Schubert's systems are definitely impressive, they seem too specialised in the sectors they are serving to dedicate any effort to the red meat industry. They seem to deal only with high throughput and structured problems, where complexity is very present but not so much variability. We only expect any work to be done with Schubert if a solution to a complex problem with high throughput in case ready packing is needed.

14 Automation for boning of cuts from pigs – technology and operational aspects (Finn Hansen, DMRI, Denmark)

In another presentation from DMRI, in this case Finn Hansen talked about the development to automate the boning of pork hams, and the process followed in the project.

For this application DMRI decided to design a specific machine for the task, and not use a robot as not such flexibility was required. They followed an innovative approach by using CT-scans as a design tool, to produce 3D maps of bones, and define the cutting paths based on the actual bones profiles, looking at different bones and animals to cope with variability.

Potential projects or opportunities: This system is a machine specifically designed for pork ham processing, and as such, of limited application for beef and sheep boning. However, and as highlighted in the comments to the first DMRI presentation, we are establishing now channels for communication and collaboration between MLA and DMRI, which hopefully will bring new joint developments in the future.

15 Increasing shelf life using advanced chilling methods (Brian Wood, Supachill, UK)

Supachill is a company which has developed a high speed freezing system based on immersion of the product in liquids maintained at very low temperatures, similar to liquid N2 refrigeration but with better quality results. Brian Wood, president and CEO of the company gave an overview of the technology, claiming to reduce cell damage and eliminate ice crystal formation, with a temperature decrease of 0.12C per minute, reaching the freezing point in 10-15% of the time needed to do freeze product with conventional ways as blast freezing.

He also claimed that Supachill eliminates cold shortening, limits damage to sarcoplasmic reticulum, maintains calcium and ATP levels as well as myoglobin and pH, and reduces drip loss.

Another big benefit is increased shelf life: as the tissue suffers less damage, bacteria contamination has more difficulty to enter the product and shelf life is increased, in at least 2 days.

Agresearch in New Zeland has developed a technology based in chilling immersion, although it is aimed to chill cuts of hot boned meat, while Supachill seems more suitable to freeze product that is already chilled.

Potential projects or opportunities: Supachill seems to have developed a technology in line with AMPC strategy to explore alternatives to current mainstream technologies in chilling and freezing. The first step to bring this technology to the Australian market may be the initiation of evaluation trials to asses its potential in red meat freezing, before a full scale application is attempted.

16 Managing ideas to implementation and opportunities for R&D funding (Koorosh Khodabandehloo, BMC, UK)

Koorosh Khodabandehloo, basically the one man behind BMC, has been involved in the development of automated and robotic systems for more than 20 years, and he holds several patents in the field, like the RoboPrint (automated stamping of pig carcasses currently running in Gilde plant in Rudshogda, Norway, visited during the Europe study tour), the pork scribing system seen in the same plant (joint project with BANSS and E+V) or the Roboburger.

He has been working very actively in several automation projects in the last two decades, and he is very familiar with the European R&D funding scheme, the Framework Program. He also provides consulting service to the meat processing industry, to improve processes and automate tasks.

Additionally, he has been the organiser of the IMAC congress since it was created 10 years ago, and recently incorporated FAN (Food Automation Networking), the UK entity officially in charge of organising IMAC 2006, and which objective is to promote similar initiatives in the future. FAN is supported by Gilde, ATTTEC, E+V, DMRI, BMC and FACCSA.

Potential projects or opportunities: Recently, a new funding round for European R&D projects has been opened by the EU, the 7th Framework Program or FP7. This scheme offers more than €30 billion for a whole range of technologies and areas (9 main themes, one of them is *Food, agriculture and biotechnology*), and encourages international collaboration, not only with other EU members but also with countries like Australia. Koorosh Khodabandehloo has coordinated in the past other projects under previous FP rounds, and he can be a very valuable resource to help us find a place in this program for international collaboration. Initial talks started during IMAC 2006 to set up the scene for joint projects, and IFFA 2007 will be the next event where interested parties will get together again to define how those future initiatives will take shape.

17 International Networking Opportunities (Lisa Martin, FAN, UK)

Lisa Martin is the appointed person in charge of coordinating future events like IMAC, under Koorosh Khodabandehloo supervision, and the legal entity incorporated for this purpose is FAN, Food Automation Networking.

FAN organised IMAC 2006, and coordinated the Europe study tour for MLA, which was delivered very professionally, achieving all the defined objectives very satisfactorily and exceeding expectations.

Potential projects or opportunities: There are a few options where FAN could provide similar services in the future

- IFFA 2007 networking sessions
 - An initiative has been suggested, where all the participants would fill form with their wish list of interesting technologies and companies, so that round tables or targeted meetings could be organised in advance, with all the relevant parties involved.
- Next Study tour
 - A general tour like the one completed recently (which was very well regarded by the participants), could take place again in the future, but there can be also opportunities for theme tours, where a particular subject (traceability, lamb processing, case ready, packaging, etc.) is the core of the tour.
- International Meat Conference
 - Potential conference in late 2007 or early 2008 in Sydney, with international speakers and 200 attendants, to bring to Australia the latest developments in relevant areas for the industry and all the networking possibilities events like this can provide.