# THE ROLE OF SCIENCE IN THE MEAT INDUSTRY OF THE FUTURE

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## Introduction

This paper focuses on the role of science in the meat industry of the future and speculates as to what may be happening in the year 2020.

The meat industry is one which has undergone radical changes over the last 10 years. More than that, looking back over the last 30-40 the changes in technology within the meat industry, the operating principals for farmers processing companies and the way that staff developed new skills, has been remarkable. There is no reason to suppose that such a level and rate of advancement will not continue we the next century.

The real question is 'where is that advancement likely to occur and how could, and how should the meat industry respond'.

It is as well to remember that there is no value for any industry in failing to recognise there is an in built necessity to change, or in waiting it is five years from a significant turning point in the sector.

Science is about long term investment in a knowledge base. That knowledge base must not be seen simply as learned, written scientific p It is actually knowledge in the heads and in the hands of skilled people, be they scientists, technologists, engineers farmers or plant oper There will be a marked increase in the technology over the period to 2020 with everyone in a company being more aware of technologi how it might be used within their work environment. There will be an immense growth in the application of different types of technologie just related to processing, but technologies that impact on the way that daily business is carried out. In 25 years, business will be fa bound by physical structures and buildings the widespread use of networking among firms will be the norm. They will also have g increased the speed of receiving product orders from the market place. Companies will also see a greater capability at reading weak m signals buried among the mass of data that is often mistaken for information. The time available to position and reposition a company global market will have become shorter and shorter. In that context, science and technology will help us maintain and develop market a and will become a critical issue. In general, breakthrough technologies in a company or even in an industry have often come from outsi those industries. Improvements in tyre technologies did not come from the tyre companies - it came from the development of polye rayon, etc. It can be expected that type of technological crossover is taking place today - more so, it can be expected to take place tomor including the meat industry.
What are the technologies that will maintain market access and will ensure that the New Zealand meat industry is producing the products w it can deliver into niche' global markets? It is hoped of course that this occurs at the beginning of new fads and changes in the market. also hoped that there will be an understanding, as well as the detection of the onset of the changes in the way that the target consumer g uses meat products. By 2020 this will also involve products produced under vastly improved hygiene standards and quality standards. T turn means much better processing and more discernible individualistic on-farm technologies being used. These changes would al certainly foresee a different structure of payment and reward for farmers, for processors, for intermediates in the value added chain through to the consumer.

## The Consumer

This is predicated on the assumption that companies actually know what the consumer wants. Consequently, do the meat companies r know who the consumer of the year 2020 will actually be? I think not! The competition from white meats and fish, to the red meat indu will continue to be intense in traditional markets and yet there are vast areas of the globe where different ethnic preferences exist and where meats would be a novelty- if red meat is seen in the diet at all. Of course in many Asian countries the flavour and texture preference of r food products is quite different from the traditional Anglo-Saxon preference. So what is known about the consumer preferences in t countries, or those ethnic groups. Compared to what we need to know, we know very little indeed.

In the science community an area of expertise with a quite sophisticated capability of doing complex mathematical analysis. In many areas the world, nuances of flavour and texture are very subtle and even beyond, dare it be said, the Anglo-Saxon ability to distinguish characteristics of acceptable products. Scientifically some of those applied mathematical analytical tools, stretch between traditional statist science and sociological variables and will require a much further degree of sophisticated development. Those techniques require dee analysis from competent applied mathematicians and yet in this country there is a dearth of such trained people. Indeed it is one o scientific areas in which an abundance of skills should be available but is where a consistent failure to fund and develop and to encourage nation is seen. Such skilled people move beyond providing simple statistics. They actually contribute by guiding the way that science technology can be used to design and make products for niche markets. They are going to be a vital resource if weak market signals embe in complex consumer preference data are to be reliably interpreted.

However, flavour and texture are but two small aspects of product preference differences which many products experience, when mo between national or ethnic groups. In addition, just the straight presentation of a product, is very different in China, Japan, the United St Australia, etc. If the industry is in a global market place and if it isn't now, it will be, then companies must be able to handle these subtl and have a structure and capability to address such issues. In short, in 2020 the industry will face a world of a collection of very differ niche product areas - a niche' in terms of the type of product characteristic as defined by its quality, texture, flavour, presentation, hygi social status and nutrition.

Isn't this just what happened with Kobe Beef in Japan. Perhaps the origins of such a market preference can be argued about, but the fact of life in business terms, is that Kobe Beef is the high value product in Japan. It's a niche' market product in global terms.

There is no reason to suppose that other niche market products have a place elsewhere in Asia or indeed in America. So a question that should be answered is - how do we go about defining products that are required in these markets and how is the development limit of a product recognised early enough e.g. how could the fact that the life of the frozen carcass was ending? So between now and 2020 the problem of how to determine what it is that consumers generally want must be addressed. What is meant by a convenience product? In truth, are we actually telling the market what we think they need in a meat product and that therefore it is a convenience product? Or are the consumers asked what it is that they actually want out of red meat products - the way it is presented, the time it takes to actually prepare a meal and indeed how do consumers view the experience of sitting down to meat and two veg? Do they see it as an entertainment? An experience? Do they see it as just a novelty, as a one off? Does it actually generate excitement that will encourage the 'I want to try it again and again and again phenomena?' How much does the industry really know about the consumer use and perceptions of meat products. It is probably very little. By the year 2020 the meat industry moves from being a commodity supplier, to being a highly sophisticated niche' market supplier of convenience foods a lot more must be known. By 2020 should the meat companies be focusing primarily on supplying meat or multi-component foods?

These issues and questions are complex and not new. It is often difficult even to define what the right question is, let alone measure what the response is and what it means. Science can help and it often steers, rather than dictates answers to such questions. In 25 years, it will offer the primary way by which this help is given to companies. The associated computation power in this type of analysis is no longer a problem - what is a problem is the ability to analyse weak signals in noisy data It is also about being able to define the right question, after thinking through the complex, inter-related aspects of peoples responses and technologies in order to find solutions for which business can capitalise and earn money.

The use of science by the year 2020 for the meat industry must be supplying information which gives the industry a much, much, much stronger grasp on what the consumer needs are. The industry will have in place systems and an analytical capability which can pick up subtle shifts within small populations with rapidly changing demographics. This means that systematic methods must be in place and given the size of our meat industry by the year 2020, will be sharing much of this basic information, and sharing much of the analysis over integrated networks. For this to happen there will have to be much closer sharing of information between processing companies, between companies and farmers, between companies in the market place and producers / processors and, companies and legislators in various countries. That is not to say this is not already in place, but by the year 2020 this will occur extensively and in a highly sophisticated manner that is undreamed of now. Who would have thought we would have been shipping chilled meat 25 years ago in the quantities that we do today?

**Trade Access**

Having access to consumers and having a knowledge of their preferences, of their wants, their needs of a meat product is only part of the story. What of trade barriers, for it's one thing to say consumers want a product, it's another to get it across the border. Despite the WTO agreements agricultural products will probably, continue to be the subject of barriers to trade. Not crude import barriers and quotas based on arguments for the protection of local industry, but subtle barriers based on science and technology issues, myths, prejudices. You name it - it will be there, for human beings are human beings and vested interests will occur no matter what international agreements exist. What science will contribute to these arguments will be factual rational argument. It can expose unfounded fears and prejudice. Such a scientific contribution cannot change political decisions with regards to international barriers but it can actually show what they really are.

For New Zealand as a primary exporter of natural products, science's role has to be very significant in the establishment of free trade practices. For that reason science will be a Government tool. When I say science, I mean not just scientific information, but scientists will be the tool of Government for making sure that rational arguments pervades in discussion of subjects of national interest. These will range from introduced pests to bacterial contamination, to product deterioration, to environmental effects, of residues, of flavour contamination and a whole host of other problems. You name it - you can think of some technical issue which pertains to the meat industry and which could be a technical barrier if New Zealand does not secure sound scientific advice on the issue.

The point is that New Zealand has a reputation for clean products and yet in the year 2020 people everywhere will be able to analyse the composition of products, including contaminants, to a much lower level than is dreamed possible today. Already scientifically you can measure the presence of single molecules and you might have seen in a recent newspaper, the demonstration of a sensor that could pick up the change in level of sugar in Darling Harbour when a scientist dropped a sugar lump in it. The levels of contamination involved are so low that most people will have difficulty comprehending. The question then is at what level do contaminants become a problem for human consumption. That argument is one that has gone on for years but it will continue. It is becoming largely a political question but it is a question where the answer only lies in scientific reasoning and no amount of wishing that such analytical developments would not occur can stop these developments.

It is for that reason that most of the major industries, including the meat industry, must develop a common view of the problem areas and support a common scientific and technological effort in order to build sophisticated analytical capability and a deep understanding of the various issues.

**Transporting and Packaging the Product**

Having surmounted the problem of getting a product into a new niche market place to meet a consumer whose demands are understood - what about the product itself? What about the technologies which are going to make a difference in getting products from New Zealand into those markets. Two things spring immediately to mind. One is simply, how is a product going to be transported - chilled, frozen or ambient. What will be the technologies involved, in the transportation process, the control and management of those products in the distribution chain. There will be significant technological advances driven in particular by environmental concerns. Environmentally friendlier refrigeration systems will be common and certainly lower cost ones . In addition, the packaging materials themselves will be technically sophisticated. The vastly

superior understanding of the physical material properties of packaging will be such that packaging will be very sophisticated. Compared today they will be unbelievable. Already there is the emergence of smarter packaging. By smart packaging is meant packaging which reg the composition of gases surrounding the product, through a wide range of temperatures and other physical conditions. This packaging also act as a mechanical protective barrier to make sure that they get delivered in good physical shape.

That might also mean that heretical practices might, by 2020, be the norm. Thus if a product may be made in which the atmosphe controlled very carefully, is it conceivable to control what happens to specific bacteria which may also be present. Even if all surface bac could be eliminated - would you want to? Are there bacteria which could be deliberately introduced for some particular reason? Thos questions which are highly speculative, but remember that ideas often leap from one product area to another. This has recently been seen in area where, investigations into bacteria taken from organisms several million years old have already identified potential sources of antibiotics. Who knows what the world will look like at the bacterial level in 2020.

In terms of bacteria, I for one do not believe that genetically modified bacteria using DNA manipulation techniques will have an exte future. Such bacteria will certainly provide products with characteristics which are beneficial. However the world of science and importantly, social awareness and traditional taboos, will severely control the exploitation of that type of technology. As the populati general becomes more technically literate so the awareness of the potential risks inherent in such technologies will increase. Gone are the when a nuclear fission technology was seen as the white knight of our energy problems. What has at last been learnt, is that there is alw plus and a minus in these major technologies and society is only now beginning to recognise that being technically ignorant is a signi social problem. By 2020 this technological awareness will have been achieved across a wide section of society. Therefore the exploitati such technologies will go forward at a slow, considered pace.

In summary, packaging materials, like the products that they will contain, will be niche products in their own right. Packaging will also had to cease being a commodity business if it is to survive. It will be the production of tailored, clever plastics and other materials which respond to an individual product need which will dominate the world of food products in 2020.

**Processing**

Moving back down the chain towards processing - what is likely to be seen there? It is here that we will see the biggest physical change way we do business in the meat industry. By 2020, the processing for new niche products will have seen a major shift from the single chain based structure. Individual identification of animals and even individual cuts, will drive processing methods for niche products smaller more flexible chains. A consequence of such a trend will be that the high capital cost involved in the industry and which has recognised so painfully over the last few years, will continue to be an issue. Processing costs are a significant part of the overall price o product and smarter processing will be needed to contain the growth of the costs. It is also one of the social and environmental problem and if both the skilled workers' health and the environmental health of New Zealand are to be improved, the problems associated wit traditional killing chain must be successfully addressed. It is in that area where by 2020, the use of automation supporting a skilled m operation, will be the norm, reducing accidents and minimising the contact between the human being and the product. The result will b improvement in overall hygiene that will improve, both the cost structure, the capital structure and the health of skilled people.

The technologies are already beginning to emerge. In the area of automation and robotics cleverer robots than companies are currently usi will be common and already this industry has started down that track. Robots and automation will be applied widely in which people/machine interface will be much more important than it is at the moment. Instead of just pushing a button and watching a robotic arm an operation, robots will assist people by amplifying muscle power to do what is today, highly dangerous operations e.g., lifting heavy go Those types of technologies will be daily in place. This in turn will give process staff, as well as technical staff a different dimension to jobs. This will provide everyone the opportunity to think about what they are doing and why or how they can help cut costs, maintain pro improvement etc. This contribution to the processing operation will come from every level in an organisation so that employees will be using both hands and heads.

Around the world a vast amount of science is being carried out on what is called material science. Gone will be the days when mate basically came out of an iron foundry or an aluminium smelter. Even today highly sophisticated ceramics or metal alloys are available in w materials are constructed from a molecular level upwards. The product characteristics which are required, will be available to equip designers. They will define the functions and environment of a new machine and manufacturers will have a range of new sophisticated mat to chose from. This will result in a new technology capability in suppliers and benefit processors through lower cost/higher performance.

In fact one of the hardest known substances, a boron compound, was actually predicted before it had ever been made. A scientist then out and made it and then proved that the hardness was the same as a prediction. In superconductors the molecular layers of atoms complex structure are what gives the superconducting material its unique characteristics. Such an approach to new materials applies al other ceramics and to half-way houses, ceramic metallic compounds. Thus by 2020 materials will be designed to have certain phy characteristics and characteristics which enable them to operate in defined environments. In another example, silicon carbide has been ar for the last 20-30 years. Silicon carbide has some unique properties but it is only now that it can be made into thin films. These films are hard, and are very difficult to make but it has some highly useful properties, particularly for the semi-conductor business. Equally some u metal alloys are now being made for the aerospace industry. Carbon fibre which was originally made for exotic uses, rapidly came dow price as the characteristics were appreciated and is now used in quantity in a variety of different industries. The same trend will be seen result of the effort currently underway in material sciences where a major international effort is occurring at the moment. So machines wi very different to those of today - running longer without failure or service and with lower energy consumption.

**Integration with The Farms**

The meat industry will also be more integrated. It must not forget that the value to the farmer, to the processor, to the consumer - is in the utilisation of the whole animal.

This leads to the inevitable interlinking of organisations through networks, alliances etc. In this area, clairvoyants have trouble picking what the next 5-10 years will bring, let alone the next 25.

So how will processors and farmers and therefore on farm research help the industry in the year 2020? In many ways this is a paradox. Farming at the beginning of this century could be best described as primarily a family way of life rather than a simple profit business. In many countries today it has become driven by economics and become more of a business than a family way of life. As products in 2020 come to serve niche' markets, individual products and animals become individuals once again. By 2020 animals will be identified as arriving at a processor and a consumer from a particular farm, even a particular part of a farm. This will mean that the role and capability of the individual farmer to produce a particular type of animal, will once again be of major importance as a whole new behavioural pattern will emerge in the way that farm management is conducted. By the year 2020 a lot more information will be on hand about the inter-relationship between the characteristics of an animal as needed by the processor / consumer and the interaction with the weather and the wider environment, farm management and geography of the farm. The meat industry will be able to do what can already be done scientifically in dairy cattle. That is, type individual animals for particular genetic characteristics which are related to the product required. In this case, by genetic characteristics I mean an animal with particular types of a specific protein for example which may effect the overall product quality. To answer questions of flavour or tenderness, by 2020 a greater understanding will be available of the actual physical composition of meat and what that may mean for processors and consumers alike. Therefore for example, smaller, more specialised flocks of sheep could be the norm. This will create a different set of management issues, ones of maintaining and exploiting characteristics based on genetics and the local environment. Thus through sophisticated selection of animals, farmers will be ensuring that animals have certain physical characteristics which aid the processor, provide disease resistance, tenderness improvements, etc. The issue therefore will not just be a question of the heaviest animal, or the smallest animal or the middle weight animal, but what are the characteristics required for efficient processing and consumer acceptance in niche markets. What's more, by understanding the genetic characteristics and the response to the environment, farmers will be able to respond directly and more quickly to the market signals, through the processors, in terms which provide much greater flexibility. What that actually means is that a farmer's risk, and processor's risk, be more integrated as a total business yet leaving the individual farmer and processor to manage their type of business to best advantage.

In effect the meat industry will be a virtual industry with each partner maximising value for a common goal.

It goes without saying of course that if the environment and the farm environment is important and the husbandry of animals is important then so too is the pasture production and utilisation.

**Conclusion**

Overall what will be happening by 2020 and the way that science can assist the industry, will be not just an extension of what is happening today. It will be significantly effected by what is happening in the world of material science. It will have everything to do with electronic communications, automation and robotics, with animal identification, with laser scanners of pelts to identify from which farm an animal originated. Farmers will have access to and an understanding of the role of genetics in providing appropriate animals. We may even see which cut of meat has come from which animal from which farm. Scientists and technologists will also be very active in advising Government and indeed perhaps even dominating Government discussions in trade negotiations to ensure open access to markets. A further consequence will be the rising importance of social and business awareness of the significance of science and technology.

In short science and technology will enable products, animals to be farmed and farms to be viable and to enable the companies to produce meat products, which are required for and fit into many different niche markets around the world. Science will be able to identify what characteristics are required right back through the production/marketing chain.

All of this is possible in the scenario of the future and at the same time this may not be possible.

It will not be possible for the New Zealand meat industry, unless the industry recognise the trend to a much greater involvement in science and technology. In short the industry collectively must own a concept of such a future and take the responsibility to move to achieve it now. Everyone needs to own the idea of being one industry serving a multitude of globally located niche' markets. As a result of this complexity, which is inevitably going to grow as the industry seeks to maintain its place in the global meat industry. The industry will need to support encourage and fund research in a number of these key areas if New Zealand is to continue to be recognised as one of the world's major sheep meat providers. We recognise that New Zealand is only a small country, and by ensuring a primary focus for our industry and resources, the science and technology advances which are taking place right now, let alone in 20 years from now, will open up all sorts of opportunities and possibilities.

The meat industries strength in the future, will depend on how well the need and use of science and technology is understood and how they are applied at every step in the chain from consumer to farm. Gone will be the preoccupation with how a farmer or a producer gets paid. The industry will be one vertically integrated virtual operation. There will be many discreet entities but without this new way of integrating among all of us, we will not maintain a viable industry into the future. So I predict in 2020 that there will be fewer countries in the international meat business. For the countries whose meat industry does not have a strong science underpinning they will be in the hobby farming business, they will not be in a real profitable business of national importance. That is the challenge that the New Zealand meat industry faces.

Finally, it will be interesting to look in 2020 and see how much of this look into the future will have come to pass.