Cotton Futures Forum

Hosted by the
Cotton Research and
Development Corporation

Introduction

In December 2013, the Cotton Research and Development Corporation (CRDC) hosted a 'Futures Forum' to bring together a broad range of people to consider the future of the Australian cotton industry and the type of research and development (R&D) investments that will make the industry profitable, sustainable and competitive into the future.

This report presents an outline and summary of the event and the results from the two days of discussion.

THE COTTON FUTURES FORUM

Fielding new ideas to secure our tomorrow.

Australian Government
Cotton Research and Development Corporation

Background to the Futures Forum

The Australian cotton industry is internationally recognised as innovative, dynamic and hugely successful. This has in part been attributable to the willingness of the industry to invest in world-class research and rapidly adopt this emerging science and technologies.

The environment in which the industry operates at the farm, industry and international scale is rapidly changing however. Increased volatility in production, prices and climate along with rising input costs, general shortages of skilled staff, cotton's declining share of the global fibre market, greater consumer awareness and rapidly emerging technologies all suggest the future for the industry is going to be increasing complex, uncertain and volatile. The challenge for the industry is to continue adapting to these changes and remain profitable, sustainable and competitive in the future.

The Cotton Research and Development Corporation (CRDC) invests in research, development and extension (RD&E) on behalf of the Australian cotton industry and a key aspect of the 2013-2018 Strategic Plan is to invest in areas that ambitiously seek to transform the industry to be profitable, sustainable and competitive in 20 years time and beyond. This is an ambitious goal given that the future is unpredictable and the challenge for CRDC is how and where to focus these investments.

In an interesting Forbes.com article on the 'Top 20 R&D Spenders' (2012) it was argued that "*The companies most known for innovation don't keep spending money year after year on their old business. Instead of digging deeper into what they already know, they invest laterally. They spend money putting the pieces together in new, unique ways. They try to find new solutions to old problems, using new – even fringe – technologies. They try to develop disruptive solutions that actually change the marketplace, rather than trying to make something that already exists better, faster or cheaper.*" Source:http://www.forbes.com/sites/adamhartung/2012/11/05/top-20-rd-spenders-not-good-investments/

In this vein CRDC's three themes (Profitable Futures, Sustainable Futures and Competitive Futures) provide a clear framework through which CRDC can invest in long term innovations to address its goal. However, the scope of research in which CRDC could invest in order to position the industry to be profitable, sustainable and competitive in the future is currently very broad.

To narrow this focus a Futures Forum was held in Brisbane on 9 and 10 December 2013 which helped focus and identify the areas of priority and possibility for the industry.

Futures Forum Overview

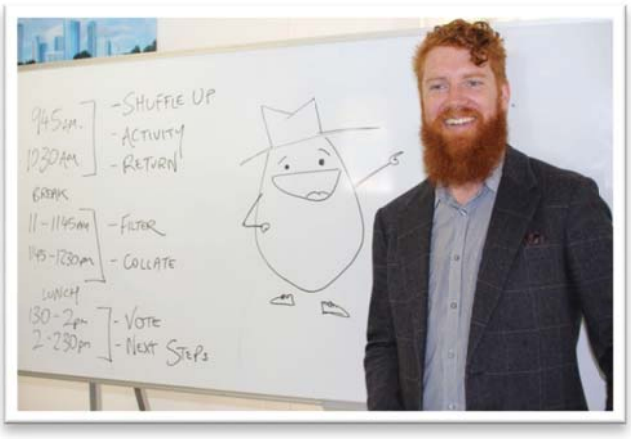
The Futures Forum brought together a diverse range of delegates who were a mix of cotton and non-cotton researchers, growers, industry personnel, government representatives, research providers and CRDC staff and Board.

Forum delegates were invited on the basis of their experience and understanding of the industry as well as the external insights they could offer the event.

The forum was held over two days and facilitated by Dr Jason Fox, a motivation strategy and design expert. It was designed to focus and identify the areas of priority and possibility for the industry and its purpose was to harness the delegate's knowledge and experience to:

- Challenge the assumptions currently made about the way in which Australian cotton is used and produced
- Identify ways in which we could imagine cotton being produced and used in the future
- Identifying the areas along the Australian cotton production chain where CRDC can focus its investments.

An outline of the full programme can be found in Appendix 1.



Provoking ideas

Three keynote speakers addressed the forum to stimulate and challenge the delegates thinking. The first speaker, Darren Hill, a Behavioural Scientist spoke about change and the effects change can have on the way people feel. He used a change matrix as a way to demonstrate places where individuals and organisations need to make change.

Darren then introduced the concept of the 'Edge effect'. This is a concept derived from ecology where there is often the greatest diversity at points where different ecosystems meet. The 'Edge effect' provides a framework to look at change, the uncertainty that comes with it, and ultimately how species, individuals and organisations can succeed. Darren spoke about this concept using explore, adapt and specialise responses as a way to think about the change in the cotton industry.

Explore - in a changing environment it is critical to explore the edges where worlds meet. Learn by doing, don't die by ignoring. Increasing your understanding of opposing forces is the starting point for success.

Adapt - Successful people shape and evolve their offering through the process of adaptation. If the world is in constant evolution, then it makes perfect sense your business should be also. If nothing changes, then nothing will change.

Specialise - Generalists do not survive the edge effect, but specialists actually thrive. Honing your niche means a turbulent, competitive market is the breeding ground for success.

"The world as we have created it is a process of our thinking. It cannot be changed without changing our thinking."

Albert Einstein

"If you want something new, you have to stop doing something old"

Peter F Drucker

Continued

The second speaker was Professor David Lamb from the University of New England. David has a research background in physics and his research interests include applied optics and precision agriculture.

David spoke the audience about the University of New England's SMART Farm project which is a 7000 acre commercial farm currently being transformed into a SMART Farm (sustainable, manageable and accessible rural technologies). It will be a national demonstration site showcasing the latest on-site technologies aimed at improving productivity, environmental sustainability, safety, workflow and social/business support networks on Australian farms.

David also spoke about the emergence of a new generation of people called Generation C (Connect). Unlike previous generations (baby boomers, Gen X etc.), people who belong to Generation C are not based on their birth dates but rather how connected they are via the new technologies. He argued that the commodity of the future is data.

The third speaker, Dr Peter Riddles has broad experience in governance and strategy across the life science industries having worked with various companies and universities on commercialisation and new venture creation, and with governments on policy and program development concerning economic development.

Peter defined innovation as something that was both new and useful. If it is not either of these things then it cannot be considered innovative. He also spoke about innovation being an active process and argued that while necessity is the mother of invention, innovation is driven by necessity. He asked the audience to consider 'What is the necessity in cotton?' and also to consider 'What happens when innovation stops?'

Exploring, adapting and specialising.

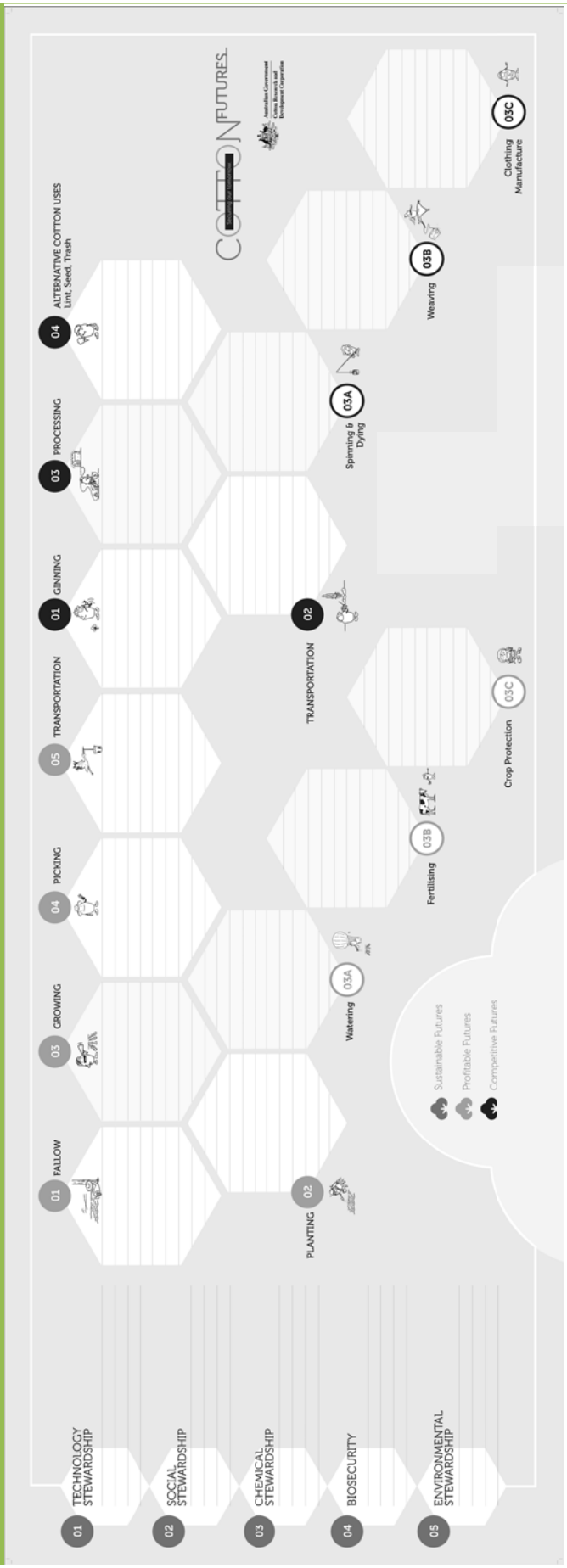
The concept of explore, adapt and specialise introduced by Darren Hill was then used as a way of framing the engagement with delegates through the remainder of the forum. During the 'explore' phase, delegates were encouraged to examine the assumptions currently made about all aspects of cotton production and use through a functions maps (see explanation on following page).

In the 'adapt' phase, these challenges were then 'flipped' or 'crushed' as delegates began looking at alternative possibilities and questioning the validity of these assumptions.

Delegates were also encouraged to think about how others might approach the challenge of transforming industry profitability, sustainability and competitiveness using the following key questions:

- What would Oprah Winfrey do?
- What would Steve Jobs do?
- What would Montgomery Burns (Simpsons tv programme) do?

Finally, in the 'specialise' phase of the forum, delegates began identifying and refining key priority areas. These individual priority areas were then drawn together and the group voted on those areas considered to be of highest priority overall. The results are presented on page six of this



A Functions Approach

In preparation for the Futures Forum and to provide some context for the discussions, a function map was developed.

The function map represents the different elements of current cotton production and processing at the moment and outlines the 'function' of that part of the process. For example, the purpose of ginning is to remove the lint from the seed.

When all the production and processing elements are considered in light of their function, it opens up different possibilities as to how for example lint might be removed from a seed.

The functions map was developed to align with the three Futures Themes in CRDC's 2013-18 Strategic Plan. They are:

1. Profitable Futures (farm scale)
2. Sustainable Futures (industry scale)
3. Competitive Futures (national and international scales)

The key elements of the functions map are presented here (left side of page) and show the main steps and process in the cotton production chain. An additional function (market access) was added to the map during the Forum.

This map became the key tool through which delegates individually and collectively recorded their thoughts. The functions map was also used to collect and vote on the overall priority areas for investment.

The priority areas established by the delegates are presented overleaf and full summaries of the small group discussions for each function are presented in Appendix 2.

Prioritised areas of Focus

After extensive thought and discussion, the delegates at the Futures Forum considered the following areas to be of highest priority for investment across CRDC's three Futures Themes.

1. Profitable Futures Theme

This theme looks to initiate RD&E efforts that deliver innovations in cotton production and builds the long term profitability of cotton farmers. Key areas in order of priority were:

a. Reducing input costs through new technologies e.g. Nitrogen fixing cotton, insect invisible cotton, stress tolerance, self defoliating, pupae busting alternatives
b. Integrating big data and emerging technologies for improved profitability e.g. Decision support, sensors, data analysis.
c. Transforming ginning and picking. e.g. combined activities, using robots, self ginning cotton
d. Maximising the whole cotton system. e.g. the whole plant, fallow periods, use of machinery, incorporate two shorter crops.
e. Reducing human error in the farming process

2. Sustainable Futures

This theme looks to identify and consider solution for both those challenges and opportunities that will impact on the future sustainability of the Australian cotton industry. Key areas in order of priority were:

a) The sustainability of our whole supply chain
b) Responding to rising energy costs
c) A proactive, transparent and visible industry. One brand across the industry.
d) Maintaining an engaged and supportive community. e.g. labour costs, social fabric, development of capability, social license.
e) Preparing for a combination of physical drought and imposed water constraints.

3. Competitive Futures

This theme aims to transform the way in which customers demand Australian cotton products and innovations that continue to make Australian cotton competitive. Key areas in order of priority were:

a) Identifying markets and creating products. e.g. mosquito repellent clothes, functional garments, non-lint products including seed oil, food, pharmaceuticals, energy, consider lint as a raw material.
b) Creating a market niche and brand for Australian cotton
c) Transforming the supply chain logistics. e.g. improved traceability, improving efficiency, maintaining control through to the consumer, awareness of what we deliver and how it is delivered.
d) Understanding why people choose and use a cotton product verses an alternative. Closing the loop for research, production and development.
e) Transforming the product manufacture process. e.g. textiles, 3D printing, working with others to deliver new and useful things

A full outline of those assumptions and ideas generated by the delegates is presented in Appendix 2.

Next Steps…

The Futures Forum was able to explore all potential possibilities of where CRDC might look to focus its R&D investments across the three Futures Theme areas.

A broad range of priority areas were established and gave some clear guidance to CRDC as to where potential investments may now lie. Much more work though is required before CRDC is ready to formally invest in projects.

The steps CRDC will be taking to continue developing a research portfolio in these theme areas is as follows:

1. Distribute the complete write up of the futures forum report to forum delegates (and those that were unable to attend) for their feedback and reflections on the event and the ideas generated (this report).

2. Capture delegates post forum ideas and refine the priority areas based on delegate feedback (online survey).

3. Following delegate feedback, draft a briefing paper on the priority areas outlining the focus and key outcomes CRDC will be driving toward in these theme areas.

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Appendix 1. Futures Forum Programme

Monday 9th December

8.30-9am – Participants arrive and have coffee

9-10.30am – Purpose, context and framework

This session covered:

- Introduction to the day, housekeeping and getting people comfortable.
- Official opening from CRDC linking the workshop to the bigger strategy
- Outline of agenda and objectives of the event
- Key Note Speaker - Darren Hill. The address covered the concepts of explore, adapt and specialise as the basis for the forum and following sessions. Darren spoke about cognitive biases that we bring to these types of events in preparation for getting the delegates to use Edward de Bono's 'green hat thinking' during the forum. This is essentially creative thinking and the generation of ideas and possibilities.
- Interactive Q&A session, plus activity framing for morning tea break

<u>Speaker Bio</u>
Darren Hill is a Behavioural Scientist and Darren's study of people has seen him emerge as one of Australia's most authoritative voices on the topic of behavioural dynamics within business.

Darren is currently Executive Director for Pragmatic Thinking, a behaviour and motivation strategy company, having a client list of well known businesses and brands such as Schweppes, Suncorp, The Australian Federal Government, Serco, Sydney Water, PepsiCo and LJ Hooker to name a few.

A contracted author with international publishing powerhouse Wiley, Darren is co-author of the bestselling title *Dealing with the Tough Stuff – how to achieve results from key conversations,* has written several other books, and is currently writing two other works to be published in the coming 24 months.

10.30-11am – Morning tea

Programme Continued

11-12.30pm – Cotton Futures insight!
This session covered

- EXPLORE session framing from Jason, who then introduces first speaker
- First speaker — Professor David Lamb (UNE) - The Connected Farm
    - Q&A with group,
- Second speaker – Dr Peter Riddles - Commercialising Innovation!
    - Q&A with group,

Speakers Bio
Professor David Lamb is the Convenor of Physics and Electronics, Project Leader CRC for Spatial Information and of the Leader Precision Agriculture Research Group at the University of New England.

David's research interests include applied optics and precision agriculture. His applied optics work covers the development and application of optical sensors, including optical fibre sensors for environmental, chemical, physical and biophysical sensing. David currently also leads the University of New England's SMART Farm project.

Dr Peter Riddles has broad experience in governance and strategy across the life science industries having worked with various companies and universities on commercialisation and new venture creation, and with governments on policy and program development concerning economic development.

He is presently the Chairman of the Wound CRC, Chairman of the Griffith Enterprise Advisory Board, Chairman of Life Sciences Queensland, a Member of the Alberta Research and Innovation Authority, and a Member of the Innovation Australia Board (including Chair of its Innovation Grants Committee).

He advises a number of private firms seeking to commercialise life science products and in the past has worked for both commercial and government clients in Europe, Asia and New Zealand while maintaining a large network in the global innovation system. He is a Fellow of the Australian Institute for Company Directors, and has been awarded an Honorary Life Membership of AusBiotech (2004) and the Life Sciences Industry Excellence Award (2010).

12.30-1.30pm — Lunch

Programme Continued

1.30-3pm – Challenging Assumptions – ***Explore***

This session covered:

- Introducing the Function Map and workbooks
- Examining each of the elements of the function map, introducing each concept and then allowing 2 minutes for each individual to jot down key assumptions.
- A group chat through a shared discussion of assumptions generated for each element of the function map and collation of key points onto one document.

3-3.30pm – Afternoon tea

3.30-5pm – Assumption flipping/crushing - ***Adapt***
This session covered:

- Here the group began to look at alternative possibilities, questioning fixed assumptions for each element of the functions map.
- Profitable futures focus
- Sustainable futures focus
- Competitive futures focus

Programme Continued

Tuesday 10th December

9-10.30am – Review and reflecting on previous day - *Adapt*
This session covered:

- A reflection and review of day one, relinking efforts back to the overarching purpose.
- Group chat reflecting on day one, and adding in any 'overnight' thoughts.
- A creative thinking activity to encourage possibility thinking. Key questions were
    - What would Oprah Winfrey do?
    - What would Steve Jobs do?
    - What would Montgomery Burns from the Simpsons television programme do?

10.30-11am – Morning tea

11am-12.30pm — Refining key priority areas - *Specialise*
This session covered:

- Beginning the process of identifying and refining key priority areas. Groups had time to discuss and collate their thoughts.
- As a whole group, we'll walk through the function map, drawing the collective insights from each group and scribing them onto the oversized functions map.
- CRDC input where the concept of "implementation and impact" was considered to get people thinking about which areas will provide the biggest "bang for buck" over the three areas of focus.
- Groups were then invited to discuss possible futures with this added consideration.

12.30-1.30pm — Lunch

1.30-2.30pm – Prioritising and next steps – *Specialise*
This session covered:

- The concept of dot voting (each participant had 6 "dots" they could invest into any element of the function map they consider most worthy).
- The votes are counted, and the top 5 priority areas are shared.
- CRDC shared an overview of how CRDC's efforts contribute to this process, linking things back to the overarching strategy and providing opportunities for continued involvement from delegates.
- Final wrap up

Appendix 1. Consolidated Group Feedback

Profitable Futures

01. Fallow

Purpose:

- Store and exchange water and inputs,
- Wait for temperatures to rise, avoiding frost
- Break pest and disease cycles

Assumptions:

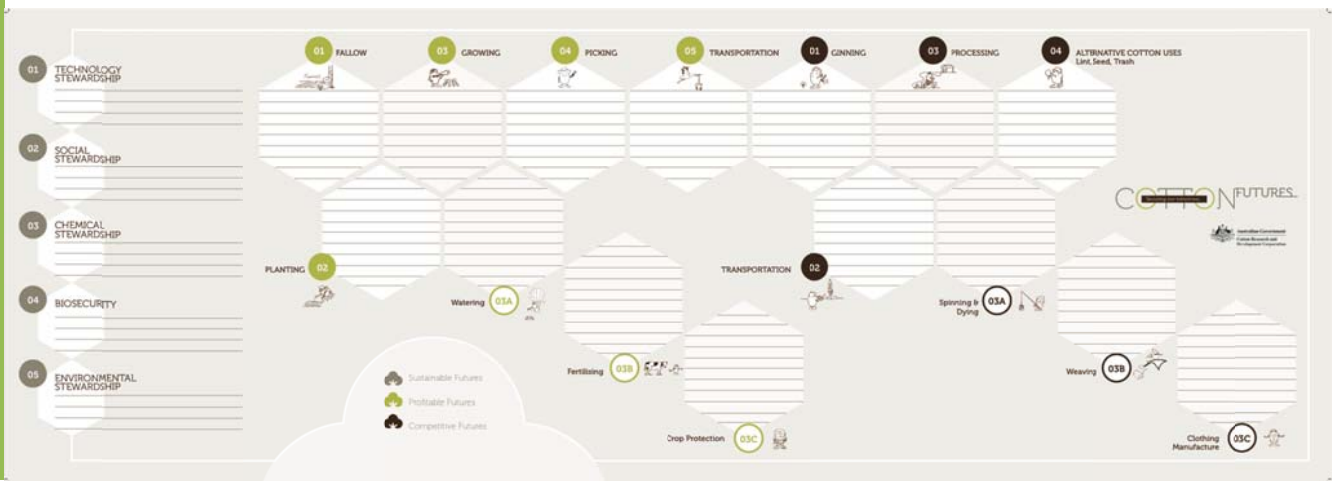
- Tilling is needed to pupae bust
- A necessary step of the growing cycle and is a positive function and should be part of the rotation.
- Used for insect and disease management
- Soil management is optimised.

Key Questions:

- Can you crop continuously?
- Do you have to till to bust pupae?
- What if there is a parallel productive use that could be used during the fallow cycle?
- What would we do differently if we had more water? Grow different crops?
- What is the true value and true cost of the fallow?
- Could we use trash as ground cover to maintain moisture?
- Should fallow be a passive activity? ie can the benefits of fallow be realised another way?
- Can we replace with a cover cropping system?

Ideas for the future:

- Cotton is a perennial crop
- Relay cropping between plantings
- The benefits of fallow are achieved through productive means
- Potential for industry to grow cotton all year round
- Maximise value of 'bank' through better capture and efficiency of nutrients and water
- Reduce need for fallow in future
- We could explore alternative systems / mediums for growing ie non soil.



02. Planting

Purpose:

- Establish an even cotton plant stand

Assumptions:

- Cotton is an annual crop
- The environmental conditions are suitable for plant emergence (temperature and soil moisture)
- Timing of when planting occurs is critical for crop establishment
- There is a limited planting window

Key Questions:

- What if you only had to plant the crop one? ie it is a perennial crop
- Does cotton have to be an annual?
- Why is cotton grown in rows? Do you have to plant in straight rows?
- Do we need a planting window? Alternative options?
- Should we interplant with another crop? Could there be more than two crops at one time?
- Could there be two or more varieties at one time?
- Does the seed need to be delinted?
- Crop ratooning, is it an option?
- Do we have to plant as a seed? ie plant as a seedling
- Why do we plant when we do?

Ideas for the future:

- Intercropping with other crops
- Use of polymers to modify the soil environment
- Planting window where temperature is not limiting
- Host plant is resistance to seedling pest and disease
- Fungal beneficials used at planting
- A high vigour seed eg lower growth temperature, reducing season to increase yield
- Develop varieties with more flexible seasonal options (including perennials / 3 yr)
- Review planting technologies and cultural systems
- Spray seeds not plant in rows
- Increase genetic diversity and adaption to climatic variations
- Modification of environment ie under plastic

03. Growing

Purpose:

- Produce cotton lint and seed
- Key drivers are light, temperature (not too hot, nor cold), adequate water and nitrogen, and CO_2

Assumptions:

- Yield is king
- Day degrees are critical to plant growth and yield
- High quality and high yield is the aim

Key Questions:

- What if cotton varieties could be grown in more temperate climates or high rises or glass houses?
- What if cotton seed is more valuable than lint?
- What is our impending 'Kodak moment'?
- Can the plant tell us how it feels? Eg monitoring sensors for plant requirements
- Can we develop a perennial management system for cotton?
- Is a longer growing season better?
- How large is the GxM interaction?
- Do we need people to actually grow the crop? Technology taking over these roles.

Ideas for the future:

- Edible cotton
- Ultra early cotton, growth regulation
- Harvest the whole crop then process
- Transform our information system
- Fit for purpose and integrated with processors eg increased yield and lower quality may be better
- Crop not just valued for lint, seed and oil used for higher value
- Plant stress signals / indicators developed
- Automated intelligence technology, automated farming systems.
- Make cotton plant produce its own nitrogen
- Monitor real time growth
- Seedless cotton
- Less climatically influenced
- Exploring new areas and plant tolerance ie frost and stress
- Improved energy efficiency (plus other inputs)
- Modifying environment (soils, hydroponics, glasshouses)
- Multiple crop cycles within a year, 100 day crop

03a Watering

Purpose:

- Plant Physiology - Keep plant cool, hold plant up, enable photosynthesis and assimilate production and distribution.
- Water extraction - Water is extracted from groundwater aquifers and the river system for use on the crop
- Crop Watering - Water is applied to the cotton crop

Assumptions:

- Plant Physiology - Cotton needs a certain amount of water for growth
- Water extraction - Water needs to be pumped from groundwater systems, Water is largely stored off farm and above ground (rivers, dams, storages)
- Watering - Current irrigation practices are the most efficient and economical way of delivering water to the crop (water, energy, labour).
- Water is a scarce resource and WUE gains are on-farm

Key Questions:

- Can we add things to the water before applying it to the plants
- The maximum agronomic output is economically optimum, is this the case?
- Will the cost of water go down?
- Can we regulate plant transpiration?
- What will be the effects of climate change on cotton systems in terms of rain?
- What is the maximum potential WUE level?

Ideas for the future:

- Off farm infrastructure efficiency gains (irrigation sourcing)
- Water holding technologies in and on soils eg gels and biofilm polymers
- Automated systems and integrated systems
- Multi-port field monitoring
- Limited water systems
- Alternate water systems
- Range of cotton varieties tailored to the system
- Genetics x management x environment (GxMxE)
- Technologies with real time monitoring and plant stress
- Reduce labour needs
- Plant indicators for water stress
- Automation on full farm with peak optimisation and more efficient
- Cotton changes colour when water is required
- Moving cotton regions closer to coastal regions and aquifers to stabilise water
- Plants designed to use less water
- Self watering, moisture collecting system (humidity harvesting), capturing humidity
- Drought tolerance or not requiring water
- Redesign of farm layouts for irrigations
- Drought, salinity and sodicity tolerant varieties
- Affordable different application methods delivering only what the plant needs
- Doubling water efficiency and communicating
- Plant a mixture and thin with herbicide if dry season unfolds.

03b Fertilising

Purpose:

- Plant Physiology -Nitrogen is critical for photosynthesis rate, other nutrients provide different functions.
- Fertiliser application - Fertiliser is delivered to the crop.

Assumptions:

- The crop needs to have fertiliser applied
- The current methods of fertiliser application are the most effective and cost efficient
- Most of the nutrients are sources off-farm
- Fertiliser is a limited resource
- Nitrogen is lost the most

Key Questions:

- When will we really need to worry about phosphorus?
- Can fertilisers be applied at anytime?
- Can the plant be made self reliant for nitrogen, phosphorus and potassium?
- High input equals highest return but is this the best return?
- Are fertiliser inputs the continued path?
- Can we develop a biological solution?
- Are synthetic / mined fertilisers required for profitable yields?
- Have we reached peak fertiliser?
- Is fertiliser good for soil health?
- Can we adapt to a new / different product

Ideas for the future:

- Pelletised and slow release fertiliser
- Different fertiliser sources ie sewerage, recycled human waste
- Timed release
- Real time field testing
- Plants that produce their own nutrients without a need for fertiliser, nitrogen fixing
- Crop sensors to fine tune the application process
- On farm production of fertiliser
- Efficient application to top up
- Identify genetic production ie cactus
- New technologies to improve losses and uptake efficiency
- Use of nutrient by plant ie foliar vs soil application
- Improved biological cycling
- On-the-go plant sensing and response.
- Under-sowing with a nitrogen fixing plant
- Phosphorus extraction from soil by plant
- Grow at lower critical nutrient levels
- Fertigate what is needed through improved irrigation systems.

03c Crop Protection

Purpose:

- Protect the plant from pests (insects, weeds, diseases, virus etc)

Assumptions:

- Chemicals are applied to the crop to protect it from insect damage
- Chemicals are applied to the crop to manage weed growth
- Pest, weed and disease populations remain the same.
- The highest factor in plant growth and yield is impacted by pest and disease
- GM will remain the key component
- Resistance remains a threat

Key Questions:

- Is insect resistance more important than other issues?
- Technology will solve the problems?
- Will GM be the mainstay?
- Can we increase beneficial populations without chemicals? ie make beneficials do more work
- Are there other methods of control? ie drones, force fields
- Do we have to have chemistry? (eliminates resistance issue)

Ideas for the future:

- Grow cotton in areas where pest and diseases are not tolerant
- Perfect a super plant with terminator technology
- Organic cotton
- Harvest the insects
- Plants that are invisible to insects
- Host plants resistance optimised (produce its own toxins)
- Treat pest / diseases specifically
- Evolve good IPM without chemical intervention
- More competition
- Real time monitoring
- Robotics for weed monitoring and spraying or mechanical chipping
- Robotic sensing, targeted response
- Beneficial biological control
- Precision cultivation
- Pest resistant allelopathic to weeds

04. Picking

Purpose:

- Lint is removed from the plant

Assumptions:

- Plant needs to be defoliated to remove leaves in preparation for picking
- The picker can only remove the lint from the plant, the seed remains attached to the lint
- Mechanical picking is required

Key Questions:

- Can we modify the morphology of the plant for picking?
- What if we don't have to open the cotton boll before picking?
- Can we develop self shedding fibre?
- Why worry about leaf material?
- Do we need to defoliate / chemically prepare the crop?
- Do we need people to pick the cotton?
- Is spindle harvesting the best?

Ideas for the future:

- Self defoliating cotton: terminator gene
- On-board ginning
- Real time fibre quality feedback
- Small, quicker, mobile pickers or even bigger 'transformer' pickers
- Pre-cleaning in the picker
- Drying seed cotton in the picker
- Focus on another value-add options for cotton to be harvested
- Plants that don't need defoliating
- Plants that naturally drop leaves at set time
- Semi processing of cotton in the field
- Automatic genetic trigger for defoliation
- Suction system for picking
- Picking without defoliation
- Separate seed and lint in the field.
- Leafless varieties
- Using leaves for other purposes
- Harvest and gin in one operation
- Non-mechanical separation of seed and lint
- Alternative to plastic wrap or alternative uses for wrap
- Self ripening and defoliating
- Fibre resistant when harvested at higher moisture content or picker has some drying capacity

05. Transportation

Purpose:

- Transport lint from the farm to the processing plants

Assumptions:

- Only the growing and picking of the lint can occur on the farm
- Lint in bale form is a necessary step

Key Questions:

- Why are the modules round? (not an effective use of space)
- Can you process on farm?

Ideas for the future:

- Robotic mobile ginning on farm
- Harvest and transport the hard cotton boll as the crop like wheat
- Shape – not rounds but slabs
- Blank canvas on the back of trucks and a missed opportunity to promote cotton 'socks and jocks for the world'.
- On farm ginning
- Automatic module gathering systems
- More efficient transport systems
- Transport needs for other uses – lint, bark
- Autotag: traceability from farm to spinning mill
- Field process then direct to port
- Light / fast rail as an option?
- Improved traceability
- Higher payloads to gin with round bales
- Mobile gin which moves to the farm

Sustainable Futures

01 Technology Stewardship

Purpose:

- Protect the current GM technology from any failures

Assumptions:

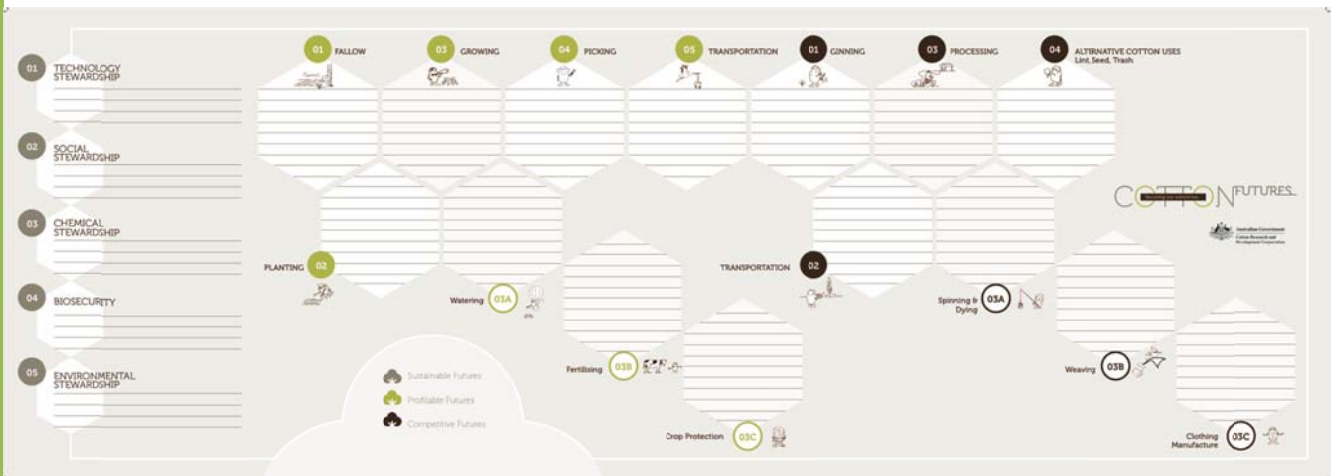
- The current GM technology will continue to function
- GM cotton will continue to be the main cotton crop grown in the future.
- A commonly accepted technology that industry has access to
- Technology benefits will exceed its cost and the benefits are beyond the grower and include environment and community.
- Resistance management dependent on the use of a range of technologies

Key Questions:

- What if community rejects the technology that cotton relies on?
- What if we make hay while the sun shines, take the upfront value and ignore the stewardship step?
- A life without transgenics?

Ideas for the future:

- Our own transgenics
- Need to capture new technologies
- Intelligent smart automated technology developed to capture information and manage resources
- BMP for use of new technology
- Intelligent design using RNAi
- Allelopathic cotton suppresses weeds
- Non-GM plant that still works on heliothis
- Industry would insist and own GM technology
- Increased diversity of traits
- Increased automation
- More off the shelf technology requiring less demonstration with easier user validation



02 Chemical Stewardship

Purpose:

- Protect the efficacy of current insecticides, pesticides and herbicides.

Assumptions:

- The current chemistries will continue to be used in the future
- Chemistry will be main form of pest, weed and disease control in the future.
- The agrochemical sector will continue to develop new products.
- IPM biological products manage resistance need

Key Questions:

- Will we need chemicals in 20 years time? genetics, biopesticides?

Ideas for the future:

- More organic alternatives
- New herbicides needed
- Targeted input systems
- Nanotechnology formulations
- HPR – new natural genes, herbicide resistance
- Biological products natural defence systems
- Plant design actually repelling insect species
- Chemical free cotton farms
- Increased biological control
- Rotation of chemical groups
- Precision applications to improve efficiencies
- Chemicals for weeds and pest to become the last line of defence not the first.

03 Biosecurity

Purpose:

- Protect the Australia crop from exotic incursions

Assumptions:

- Exotic incursions pose a risk to the cotton crop
- Is that the threat is on shore ie that the issues are within Australia already

Key Questions:

- What if the threat is offshore and will be imported into Australia? Ie the challenge for the industry is wide not just within cotton.
- Can genetic solutions be developed before the problem arises?
- Will the current voluntary scheme still be appropriate in 20 years time?

Ideas for the future:

- Helping other nations to help us,
- Early warning / monitoring systems
- Assessment of key pests
- Conduct international collaboration of key threats
- New tools to target future threats
- New variety development
- Exchange of germplasm
- AQIS sniffer technology for DNA plants (electronic or biochemical)
- Global initiatives – screening overseas
- Early detection
- Crowd source photos of insects from growers and consultants to 1300 COTSECURE

04 Environmental Stewardship

Purpose:

- Maintain the current condition of natural resources (soil, water, biodiversity)

Assumptions:

- Access to scarce natural resources will be more competitive
- The variability of climate will remain
- Government policies will continue to change in an unpredictable way.
- Government and community dictate / set the standards that we must achieve (external expectation)
- It is assumed that meeting environmental standards will have the cost covered

Key Questions:

- What if we mapped our threats and opportunities and managed our programs to address them (ie internally we drive the agenda and set the expectations)?
- When is enough enough?

Ideas for the future:

- BMP and education remain critical
- Environmental value required by consumers
- Accredited systems in place to secure market access
- Options for organic cotton – new tools
- Resistance to environmental weeds overcome
- Climate change and adapting
- Natural resources – managing soils similar to water management plans
- Premium product – a value added product, better branding / image for implementing programs.
- Industry sustains commitment to all matters related to BMP – environment, social licence, technology, biosecurity.

05 Social Stewardship

Purpose:

- Cotton can be grown in Australia
- Labour resources responsive to community

Assumptions:

- The community will continue to support the cotton industry operating in its regions
- People will buy cotton products

Key Questions:

- What does it really mean?
- Will everyone currently involved still be involved?
- How do we make a casual workforce in individual businesses permanent employees of the industry?

Ideas for the future:

- Labour skills modified to meet technology needs, how best to use technology
- Use of social media networks / systems to promote cotton story
- Social licensing
- Traceability for garments – tracing back to the farmer (iphone app)
- Better community / marketing program
- Promoting as a food source
- 2025 many specialised cotton industries
- Business and workforce mentoring for growers

06 Market Access

Purpose:

- Promote and deliver Australian cotton to the world

Assumptions:

- Environmental needs are just as critical as fibre quality

Key Questions:

- Can we deliver easy care cotton?
- What's Plan B if there is a change is our biggest consumer country?
- Do we create a cotton reserve?
- What trends / needs / demands will be there in the future?
- New markets
- How to make people connected and care about cotton?

Ideas for the future:

- Brand Australia – traceability and QA smart systems
- Sustainability indicators for market access
- Premium fabric benchmarks
- Fibre quality modified to meet premium products
- Bacteria with cotton with 3D printer creating clothes
- Explore opportunities to manufacture domestically
- New market opportunities ie construction verses clothing, expectations of consumers
- 2025 tagline: Australian cotton – functional, renewable, desirable

Competitive Futures

01 Ginning

Purpose:

- Lint is removed from the seed.
- Cotton is cleaned and trash removed
- Cotton is packed and ready for transport

Assumptions:

- Mechanical removal of the lint is necessary
- The ginning facility has to be located in a central regional point.
- The trash has limited value.
- Trash is an inevitable part of the lint removal process

Key Questions:

- Why not roller gin everything?
- Is the lint the most valuable part of the plant?
- Can we gin on route to market?
- Can we non-mechanically remove the seed from the lint?

Ideas for the future:

- Remove this step and process raw cotton via 3D printer.
- Extract fibre directly from boll
- Gins providing other services eg gins as energy providers
- Preserve the fibre completely
- Use of non-ginning space, time and resources
- Transformer ginning
- Mobile ginning, take the system to the farm
- Prior knowledge of fibre quality would improve ginning outcomes
- Value add to ginning process, gin for quality, variety type and custom ginning
- Gin becomes hub for other processing (trash, seed, bio-products, biofuels)
- Chemical treatments for ginning
- Data management for custom ginning
- Self defoliating seed
- Seed is shaken off the lint
- Testing for honeydew automatically therefore treating on the spot
- Cotton classed at the gin
- Ginning for quality and textile products
- Trash for biofuels, animal food
- Non-mechanical separation, chemical or physical rather than mechanical separation
- Energy used from by-products
- Separation of batches more easily to recover particular seed types

02 Transportation

Purpose:

- Transport lint from cotton growing regions to export destinations

Assumptions:

- Australian cotton is exported
- Transport infrastructure is adequate and available
- No processing occurs during transportation

Key Questions:

- Why transport overseas at all?
- Why not just export seed cotton?
- Can we gin on-route to market?
- Are bales the right form to be of transporting cotton?
- Can we spin locally to minimise double handling in transport?

Ideas for the future:

- Do some cotton processing during this stage
- Off shore ginning
- Value add to products before transporting
- Traceability for selected transport
- Data management from gin (quality)
- Another alternative to export
- Centrally class and warehouse cotton near to market
- Efficiently process and transfer perhaps without ginning
- Embed genetic marker in lint for on-farm traceability
- Air freighting
- Better use of rail with improved infrastructure
- New technology that attracts processing back on-shore
- New dedicated cotton port

03 Processing

Purpose:

- Transform the lint into a product

Assumptions:

- Cotton is used for clothing

Key Questions:

- Could cotton be used for 3D printing, building materials, super foods?
- Cotton as a substrate material? Further market differentiation
- What can be learnt from man made fibres? What is their vision for 10-15 years?
- What are the relative returns on all cotton products (lint, seed, trash)?
- Is lint the most valuable form to be processed?
- Are there other ways to process lint?

Ideas for the future:

- Better feedback systems (real time) to the grower
- Fibres for new technology
- Fibres based on fabric needs
- Processing bio-products in Australia
- Use in 3D printers
- Carbon fibre
- Spray on clothes
- Extrude cotton fibre to get away from spinning
- Technology breakthroughs in processing
- Costs of production and functionality / new composites
- Technology allows for localised processing
- New business models with relationships between grower, processor, miller and consumer (price discovery, product differentiation)
- Make cotton more like a synthetic
- Value add to customers (spinners etc) through technology service by selling more than cellulose.

03a Spinning and Dyeing

Purpose:

- Lint is spun into yarn
- The lint is coloured

Assumptions:

- Australian cotton meets spinning and dying specifications.
- Cotton needs to be spun and dyed.
- You can only grow / deliver white cotton off-farm
- A garment has to be dyed and only remains one colour
- We need to improve fibre quality for spinning needs

Key Questions:

- Can you grow and dye cotton on-farm?
- Is spinning the highest value use for Australian cotton?
- Can we breed for better / improved dye uptake?

Ideas for the future:

- Garments are electrode activated to change its colour chameleon style (invisible cloaks)
- Denim-coloured cotton
- Multi-coloured cotton
- Chemicals (bioenzymes) to change properties of fibres
- Biofibres – fibres with function
- Dye lint at the gin
- Natural coloured cotton or gm breeding lines with colour
- Fibre blends
- Self assembling fibres fibre characteristics – breathable and stronger
- Personalised clothes dyed at point of sale
- Embedded consumer demands into product
- Biological incorporation of colours
- Make more environmentally and sustainable
- Dyes that don't wash out or fade

03b Weaving

Purpose:

- Convert yarn into a fabric

Assumptions:

- Cotton fabrics need to be weaved
- Cotton continues to remain competitive with synthetics
- Cotton has to be mechanically woven
- There will be demand for sustainable fibres
- Competition with man made fibres will increase

Key Questions:

- Is spun fabric the highest value?
- Can we make a fabric without weaving?
- Do we know what weavers want?

Ideas for the future:

- Fibre created by 3D printers
- Self cleaning collars
- All Australian sports people in cotton
- Positioning cotton as an essential product
- Technical textiles / industrial uses
- Fibre composites for fibre and waste products
- Functional fabrics – bio reactive response to environmental change
- Combining with other blends
- Combing with new products
- Some products may not need to be woven ie layered and glued
- Make cotton a raw material for fabric printing – garments made to size on demand
- Australian cotton should own the market

03c Clothing Manufacture

Purpose:

- To convert woven cloth into a garment.

Assumptions:

- Cotton fabrics need to be sewn together to construct clothing.
- People will continue to want to wear cotton.
- It is a labour intensive process
- Cotton types are grown for specific fabrics

Key Questions:

- What is the price point for customers to care about their source of clothes?
- Is high end clothing the best market?
- How do we connect the plant breeder and the market?
- Can we shorten / reduce the supply chain?
- Cotton as clothes, alternatively what else can we do?

Ideas for the future:

- Robotics and adhesive processes instead
- Self destructing fibres / fabrics (increase demand)
- Other markets for cotton need to be developed
- Varieties with function personalisation
- Mix cotton with other functional properties
- Printable manufacture at home
- Increased product / fibre differentiation for specific uses
- Product tracking from consumer back to farm
- DIY design and print
- Make cotton fibre suitable for deconstruction overnight and reassemble into a different garment, you will never be a 'dress repeater' !!!

04 Alternative Cotton Uses

Purpose:

- Uses of cotton other than for its lint and fabric production

Assumptions:

- The highest value part of the cotton plant is the lint
- Other by-products (seed, trash) are of lesser value and a waste product.
- Lint is the main crop

Key Questions:

- What if we could produce a super high omega 3 oleic, low gossypolic super food?
- Could seed be a human super food?
- Should we reconstitute lint?

Ideas for the future:

- Pelletised trash for feed
- Cotton leaves for other uses, ie stock feeds
- Harvest leaves and separate composite materials for manufacture.
- Reclassify trash (not an industrial waste)
- Value add to all elements of the plant
- Cotton seed use as a food source
- Cotton trash use as biofuels / biofilms
- Create an added oil content in the seed, omega 3
- Cogenerate electricity
- Utilise cotton stalks
- Explore different business models
- Bio composites
- Marketing strategies for seed meal for animal feed