

THE FUTURE OF THE WESTERN CAPE AGRICULTURAL SECTOR IN THE CONTEXT OF THE 4TH INDUSTRIAL REVOLUTION

Annexure D: Research methodology description

Table of Contents

1.	Introduction	3
2.	Research design: qualitative research	3
3.	Research process	4
4.	Information sources	4
5.	Information analysis	7
6.	Triangulation of qualitative research information	9
7.	Limitations associated with the research	10

1. Introduction

A research design serves as a framework for collecting and analysing data and the choice of research design reflects the priority given by the researcher to a range of dimensions of the research process¹. In this case, the following aspects are relevant:

- Understanding behaviour and the meaning of that behaviour in its specific social context, and having a temporal appreciation of social phenomena and their interconnections;
- Expressing connections between variables; and
- Generalising to larger groups of individuals than those forming part of the investigation.

A research design is also a plan or blueprint of how research is conducted, and the type of study required to provide acceptable answers to the research problem or question².

This study is not in the domain of developing new theory, but is more about creating an understanding of the future in order to construct a strategic outlook. Whereas theory construction would imply findings that can be confirmed and generalised within certain boundaries, the intent of this specific research was focused more on the construction of possibilities that could be argued on the ground of current trends and perspectives of the future. The knowledge and insights of a range of key experts in the field under focus, as well as authoritative secondary data are typical sources of data for such research.

In this research therefore, we relied primarily on tapping the views from a purposively selected group of experts by means of interviews, in other words, qualitative data. A structured interview guide was used, but questions were designed to elicit open-ended responses, and further freedom was allowed to experts to add additional information they deemed relevant and important. The term purposeful sampling (or selection) is used mostly in exploratory research where the intention is, within reason, to access the best-known data sources given the purpose and subject matter of the study.

The expert interview is, in certain circles, an accepted research methodology, although often viewed with scepticism by paradigmatic purists³, which mostly have an interest in explaining or understanding existing phenomena. A more extended expert data collection method is the Delphi technique, which is a systematic process starting by building a set of findings based on the initial set of data and then have subsequent rounds of refining the findings re-reviewed by the same experts. This is however a timeous process which was not considered for this research. In this research, we used two forms of interview processes: interviews with individual experts, and focus group interviews where a broader set of knowledgeable people could provide their inputs. Whereas one-on-one interviews are best for individual views and reasoning, focus groups are better for group reasoning and stimulation of further ideas, thus adding a supplementary angle.

Based on the above background, a qualitative research approach was deemed appropriate for this study.

2. Research design: Qualitative research

The research approach choice was further influenced by the purpose and required outcomes of the study.

*"The purpose of this **diagnostic, impact and design** evaluation is to investigate the trends underpinning the fundamental change [associated with the 4th Industrial Revolution] expected to disrupt economic, social and politic systems at various levels of society, evaluate the impact of the change and to provide a scientific foundation for a response plan to ameliorate the negative and maximise the positive impacts"* ⁴(Inception report, September

Annexure D: Research methodology description

2017: 5). This needs to be done within the context of the agricultural sector, and specifically that of the Western Cape.

The **five (5) key questions** to be answered by this diagnostic, impact and design evaluation are:

1. *Describe the variables influencing multi-faceted change in the global agricultural environment.*
2. *What new technologies and trends will most likely have an impact (positive and adverse) on the Western Cape agricultural and agri processing sector?*
3. *Describe and rank the economic, social and political impacts of the identified trends.*
4. *What should be done (actions) by the Sector to minimise negative impacts and maximise positive opportunities?*
5. *Who (government, farmers, agribusinesses, etc.) should take responsibility for which future actions, and how specifically?*

In the light of the above purpose of the research and the key questions, it is clear that the social context for the research is the potential impact of the 4th Industrial Revolution on Agriculture, specifically in the Western Cape.

Qualitative research is described as ideal for exploring the meaning and understanding of concepts as well as identifying the pervasiveness of phenomena and patterns of association⁵. Qualitative research is suitable when a researcher, through an iterative approach of induction and deduction, wants to understand concepts, especially those emerging over time, based on information about context and voices of participants. In *deductive* qualitative research the application of current information directs the way in which observations and findings are made, while an *inductive* study reverses this connection to start with observations and findings from which constructs emerges through iterative weaving back and forth between data and theory⁶.

Literature reviews and in-depth interviews are techniques associated with a qualitative research approach. In-depth interviews are a qualitative research technique that is particularly useful for exploration purposes, such as developing propositions on a particular subject and is deemed suitable as research technique for relatively-unexplored subjects^{7 8} - as is the case with this research study. The use of literature is important to complement the results of an exploratory study⁹.

3. Research process

The five (5) phases of the project with a description of key content and outputs is shown in Table 1 below.

4. Information sources

The literature study part of this project is based on secondary research sources representing data that other researchers have collected or data that other organisations have collected "in the course of their business". The use of such data render cost and time-related advantages, but in this project secondary was complemented with primary data sources as describes later. The identification, evaluation and interpretation all available research relevant to the specified research questions was critical. Secondary data sources considered in this study include literature, social media, and materials available from professional bodies and knowledge communities. A directed review of agri-technology literature is supplemented with related 4th Industrial Revolution literature sourced from electronic databases, including Science Direct, EBSCOhost, Emerald, ProQuest and Wiley InterScience journals and databases.

Annexure D: Research methodology description

Books, journal publications, conference papers, web-based information were considered. Part 2 and 3 of this report reflect the finding of the literature review.

Table 1: Research process phases

Phase 0	Phase 1	Phase 2	Phase 3	Phase 4
Inception report	Literature review	Personal interviews	Focus groups	Integration
Scope of work based on terms of reference reflecting interpretation, approach and required deliverables	4IR - Description - Drivers and Mega trends - Impact on global agriculture - Implications on WC agri-sector Existing and emerging agri-technologies	Technology and futures experts Agri-scientists Agri-practitioners Agri-development experts	Dialogues with stakeholders: - Emerging commercial farmers - Agri businesses and large commercial farmers - Agri-science community -Agri industry associations	Interpretation of information Key findings Recommendations
Outputs: Approval by Steerco	Outputs: Four (4) position papers on 4IR 26 AgTech overviews Integrated AgTech report	Outputs: Transcribed interviews Synthesised thematic view based on five (5) key questions of study	Outputs: Transcribed focus group views Synthesised thematic view based on five (5) key questions of study	Outputs: Final project report Annexures Presentation to Steerco E-publication

Speculative and intuitive contributions found in popular management literature, blogs and conversation forums may not have been subjected to the rigour of scientific research protocols and were only considered as research input when scholarly sources were not readily accessible or unavailable. Popular literature and social media used by agri-tech practitioners, agri-experts and commentators were also considered to supplement scholarly perspectives. The multi-disciplinary nature of this study necessitates the inclusion of scholarly perspectives from several disciplines¹⁰.

In order to answer the five (5) key questions outlined in the terms of reference, the first major deliverable of the project was to develop a comprehensive literature review. The aim of this literature review was to describe the 4IR phenomenon, its implications for agriculture both globally and in the Western Cape, and to review the existing and emerging technologies that will influence the agricultural sector in the future (5-7 year view). The literature review pursued existing and emerging trends (and anticipated disruptors) that may impact the Western Cape agricultural ecosystem in the context of global, national and local spheres. The literature was structured according the following broad topics, the details of which may be found in the specific outputs:

- Introduction and Background to the 4th Industrial Revolution
- Key Drivers of Change in the 4th Industrial Revolution
- Future Technologies and their Relevance to the Agricultural Sector

Annexure D: Research methodology description

A detailed literature review was conducted for each technology, according to a template, which was designed to define each technology in the following ways: definition and description; applications with cases studies where possible; a view on the status of each technology and future developments; a view on the inter-dependencies and enabling conditions / infrastructure required to make the technology work in an agricultural context/societal context; the benefits and risks of each technology; and a view on the economic, social, political and ecological developments and impacts.

As a common data collection method that allows for recording and transcribing content¹¹, one-to-one interviews were conducted in which the researchers were the interviewers and each identified expert in Table 2, the interviewees. Respondents' views were used as primary research input into the developing perspectives on the five (5) research questions of this study. As part of the primary information gathering process for this research, experts, practitioners and key stakeholders were either interviewed or participated in focus group dialogues. A structured interview questionnaire was developed to solicit perspectives on aspects related to the five (5) key questions to be answered by this research (See Annexure F). This questionnaire was used for personal interviews and adapted for the focus group dialogues.

Primary research sources included experts in agri-technology innovation and application from both the public and business sectors, as well as societal representatives. Respondents were identified by the research team and declared. The criteria used to select individual respondents were based on one or a combination of the following expert areas: future technologies, agricultural development, application of new technologies in agriculture, agri-science and agri-practitioners. The sampling can therefore be understood to be purposeful and stratified¹². Twenty five (25) interviews were conducted as reflected in Table 2 below.

In line with the ethical research guidelines of Stellenbosch University, expert interviews were done on the basis of individual consent prior to the interview, and each interviewee was given an undertaking that their views would not be presented in a way which would link their inputs to their organisations or themselves personally. Accordingly, they are not referenced directly.

The primary data for this project was further expanded through focus group dialogues with stakeholder categories as reflected in the project scope. Dialogues were conducted with the following stakeholders: Agri businesses and large commercial farmers (Kaap agri, Overberg Agri, and Inteligrow); Agri industry associations (Vinpro, Winetech, Hortgro, Deciduous Fruit Producers Trust, and Olive SA), and Emerging farmers (the latter were interviews). The Agri-science community is covered under our expert interviews. The purpose of these dialogues was to test the themes emerging from the initial individual interviews and to obtain views on the future of the Western Cape agricultural sector in the context of emerging technologies and the 4IR change drivers.

Table 2: Expert interviews with project respondents

Respondent	Category
1. Prof Richard Sikora	International Agriculture Development.
2. Kosie Loubser	Commercial Farmer
3. Jose de Kock	Commercial Farmer
4. Liam Viljoen	Commercial Farmer
5. Werner Schrenck	Commercial Farmer
6. Benjamin Rosman	Technology and Futures
7. Brad Smith	Technology and Futures
8. Gerald Neves	Technology and Futures
9. Steve Pinto	Technology and Futures
10. Stuart van der Veen	Technology and Futures
11. Berno Greyling	Technology and Agriculture Development
12. Dr. Willem Botes	Technology and Agriculture Development
13. Dr Jasper Rees	Technology Expert - Bioinformatics
14. Dr Rick De Rose	Development Expert - Economic
15. Dr Willem de Clercq	Water
16. Anton Kunneke	Technology Expert - Forestry
17. H Pjesky	Agriculture Development Expert and Smallholder Farmer
18. Gerhard Backeberg	Water
19. Dr Reinhard Hiller	Technology Expert - Genomics
20. Theo Pistorius	Technology and Futures
21. Prof Gunnar Sigge	Food Sciences Technologies
22. Prof Nick Kotze	Agronomy
23. Prof J van Rooyen	Agricultural Economics
24. Andries van der Poll	Smallholder Farmer
25. Keamogetse Mokomele	Agribusiness

5. Information analysis

The literature review was synthesised into the following outputs:

- Four (4) position papers on 4IR) which was further refined into a single position paper on 4IR and the Western Cape Agricultural sector.
- 26 AgTech overviews which was then integrated into an AgTech report. Finally, a summarised AgTech report based on a description, current and future use in agriculture and synergies with related technologies.

The processing of qualitative research data obtained from the sources used in this study adopted a pragmatic approach based on early and consistent coding during content analysis, as advocated by Bryman and Bell¹³. They argue that early coding assists the researcher to understand the available data, while also alleviating feelings of being swamped by data, which may happen when analysis of data is deferred to the end of the data collection period.

Analysis of the primary data from the respondents' interviews and focus groups commenced after the recorded interviews and dialogues were transcribed and subjected to the content analysis of the questions posed. The coding of the qualitative data from primary sources were largely based on the codes associated with the five (5) key question that should be answered in this research. The base coding structure is reflected in Table 3 below.

Annexure D: Research methodology description

Table 3: Base coding structure

Overarching research questions and related questions as reflected in interview questionnaire
<p><i>Key Research Question 1:</i> Describe the variables influencing multi-faceted change in the global agricultural environment.</p> <ol style="list-style-type: none"> 1. The most important megatrends that will reshape the global agricultural environment over the next five years. 2. The three most important industry specific change accelerators that will drive innovation in the global agricultural sector. 3. The important emerging technologies and innovations that will transform global agricultural practices the most in the next five years. 4. Today's biggest opportunities and challenges for the global agricultural sector. 5. Which countries in the world are leading agricultural innovation and the use of new technologies?
<p><i>Key Research Question 2:</i> What new technologies and trends will most likely have an impact (positive and adverse) on the Western Cape agricultural and agri processing sector?</p> <ol style="list-style-type: none"> 6. Considering innovation and new technologies in the WC agricultural sector is it necessary to consider adoption differently for smallholder and commercial farmers. 7. The important emerging technologies that will transform agricultural practices in the WC agriculture and agri-processing sector most in the next five years. 8. The necessary enablers and support systems required to facilitate the adoption of innovation and new technologies in the WC agriculture sector.
<p><i>Key Research Question 3:</i> Describe and rank the economic, social and political impacts of the identified trends.</p> <ol style="list-style-type: none"> 10. The major socio-economic, ecological, technology and policy challenges that need to be addressed to ensure the long-term sustainability of the WC agricultural and agri processing sector.
<p><i>Key Research Question 4:</i> What should be done by the Sector to minimise negative impacts and maximise positive opportunities.</p> <ol style="list-style-type: none"> 9. What are the most logical, affordable and effective direct interventions to ensure sustainable farming in the WC in the medium to long term? How these interventions would be best supported. 11. Considering the WC agricultural sector value chain, what are the important innovations required to ensure the growth and sustainability of the sector. 12. The overall policy changes required to enable the WC agricultural sector to reap the opportunities associated with the 4IR, and to minimise the negative effects and unintended consequences.
<p><i>Key Research Question 5:</i> Who (government, farmers, agribusinesses, etc.) should take responsibility for which future actions.</p> <ol style="list-style-type: none"> 13. Concluding comments.

For each of the five overarching questions, support questions (1-13) were used to emerge views about the primary questions. The responses on each of the 13 questions above (Table 3) were analysed for themes, frequency and interconnectedness. This thematic analysis approach is based on the guidelines by qualitative research experts^{14 15 16} Bryman's four-phased qualitative analysis¹⁷, as summarised in Table 4, was used as a guideline for linking chunks of data or text as representative of the same phenomenon. Babbie and Mouton¹⁸ indicate that content analysis includes both "... conceptual analysis and relational analysis" with conceptual analysis previously also known as "thematic analysis". Content analysis requires the coding and categorising of the data. A 'category' is described as a group of concepts with similar meaning or connotations and categories must be mutually exclusive and exhaustive¹⁹.

Table 4: Bryman's four-phased qualitative analysis

Stages		Activity
1	Read	Read the text and make notes at the end. Look for what the text is all about. Identify major themes. Look for unusual issues or events. Group cases into types of categories that may reflect the research question.
2	Read again	Mark the text (underline, circle or highlight). Add marginal notes or annotations. Labels for codes. Highlight key words. Note any analytical ideas suggested.
3	Code the text	Systematically mark the text. Indicate what chunks of text are about and index them as themes. Review the codes. Eliminate repetition and similar codes (combine). Think of groupings. You may have many codes at early stage that can be reduced later.
4	Relate general theoretical ideas to the text.	Coding is only part of the analysis. You must add your interpretation. Identify significance. Review interconnectedness between codes. Relate codes to research question and research literature.

6. Triangulation of qualitative research information

Triangulation means examining the research issue or phenomenon from more than one perspective to answer the research question(s)²⁰. Triangulation also entails using more than one method or source of data in the study of social phenomena²¹. The use of “between methods” triangulation is proposed by Quinlan to provide a more valid view of that phenomenon by using interviews, observations and focus groups. In this study, triangulation was done between expert interviews, stakeholder focus groups, steerco inputs and targeted literature reviews as reflected in Figure 1.

The trustworthiness features of the results from the study was also enhanced through data-integration workshops by the core research team where arguments and assumptions were challenged and synthesised conclusions evaluated for robustness. The core team also reviewed each other's work to ensure alignment and consistency.

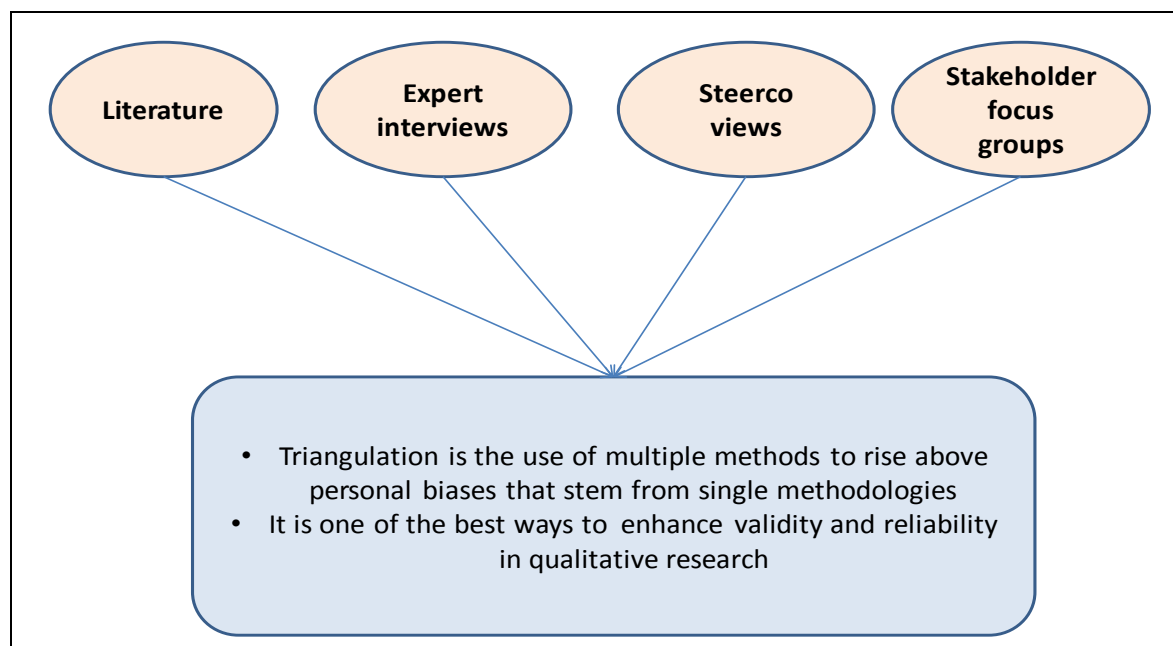


Figure 1: Triangulation of research sources to inform findings²²

7. Limitations associated with the research

A key departure point for the project was to be open, transparent and accessible for key stakeholders of the Western Cape agricultural system to participate in the project. Participation was however slightly limited due to the time-cycle of the project.

This project started six months later than originally planned for and ran during the December/January summer break period. The affect was that not all stakeholders were available during this time. Furthermore, the period of January to March represents the key harvesting time for producers, thereby further limiting participation.

With hind-sight, this project would have produced another level of contributions if it was run over a longer period (e.g. 9-12 months). There was just not enough time to search for deeper insights into the data or to extrapolate the trends more.

It is very difficult to evaluate innovation at a sector level, given that the Western Cape agricultural sector is very diverse by nature. Innovations needs to be evaluated and driven at a crop and livestock commodity level. Even conducting technology analysis on industry value chain level seems to produce sub-optimal results. The results from this report should be viewed as a high level first-cut review which should be followed by more specific deep dive studies on crop and livestock level.

This study focused mostly on primary agriculture and did not adequately include the full value chain. For example the evaluation of agriculture processing from a technology and 4IR perspective. This is mainly due to time constraints.

The role of consumerism and consumer activism in technology development and adoption is not to be underestimated and more resources should have been allocated for a more in-depth view.

Despite the above limitations, the results and findings of this study still represent a realistic and pragmatic view at a specific point in time on the topic.

Annexure D: Research methodology description

-
- ¹Bryman, A. & Bell, E. 2011. *Business research methods*. 3rd edition. New York, USA: Oxford University Press:40.
- ² Mouton, J. 2003. How to succeed in your Master's and Doctoral Studies: A South African Guide and Resource Book. Pretoria, RSA: Van Schaik: 49-53,107.
- ³ Trinczek, R. 2009. How to Interview Managers? Methodical and Methodological Aspects of Expert Interviews as a Qualitative Method in Empirical Social Research. In Bogner, A., Littig, B. & Mentz, W. Interviewing Experts; Palgrave Macmillan: 203-216
- ⁴ Western Cape Government Department of Agriculture. 2017. *Project inception document, The future of the Western Cape Agricultural sector in the context of the 4th Industrial Revolution*, Version V2.0, 19 September.
- ⁵ Meissner, H.I. 2010. *Best practices for mixed methods research in the health sciences*. Bethesda, MD, USA: National Institutes of Health, Office of Behavioural and Social Sciences Research.
- ⁶ Bryman, A. & Bell, E. 2011. *Business research methods*. 3rd edition. New York, USA: Oxford University Press: 13.
- ⁷ De Jong, J.P.J. & Den Hartog, D.N. 2007. How leaders influence employees' innovative behaviour. *European Journal of Innovation Management*, **10**(1), 46.
- ⁸ Meissner, H.I. 2010. *Best practices for mixed methods research in the health sciences*. Bethesda, MD, USA: National Institutes of Health, Office of Behavioural and Social Sciences Research:5.
- ⁹ De Jong, J.P.J. & Den Hartog, D.N. 2007. How leaders influence employees' innovative behaviour. *European Journal of Innovation Management*, **10**(1), 46.
- ¹⁰ Council for Scientific and Industrial Research in South Africa (CSIR). 2010. *Science Leadership Programme*. Pretoria, RSA: Council for Scientific and Industrial Research in South Africa.
- ¹¹ Quinlan, C. 2011. *Business research methods*. Hampshire, UK: South-Western/Cengage Learning: 221.
- ¹² Babbie, E. & Mouton, J. 2001. *The practice of social research*. Cape Town, RSA: Oxford University Press.
Babbie, E. & Mouton, J. 2008. *The practice of social research*. Cape Town, RSA: Oxford University Press.
Babbie, E. 2010. *The practice of social research*. 12th edition. Belmont, CA, USA: Wadsworth.
- ¹³ Bryman, A. & Bell, E. 2011. *Business research methods*. 3rd edition. New York, USA: Oxford University Press: 585.
- ¹⁴ Bryman, A. 2015. *Alan Bryman's 4 stages of qualitative analysis*. [Online] Available: <https://youtu.be/7X7VuQxPfpk> Accessed: 1 August 2015.
- ¹⁵ Bryman, A. & Bell, E. 2011. *Business research methods*. 3rd edition. New York, USA: Oxford University Press: 289.
- ¹⁶ Babbie, E. & Mouton, J. 2008. *The practice of social research*. Cape Town, RSA: Oxford University Press:492

¹⁷ Bryman, A. & Bell, E. 2011. *Business research methods*. 3rd edition. New York, USA: Oxford University Press: 289.

¹⁸ Babbie, E. & Mouton. J. 2008. *The practice of social research*. Cape Town, RSA: Oxford University Press:492

¹⁹ Stemler, S. 2001. An overview of content analysis. [Online] Available: <http://pareonline.net/getvn.asp?v=7&n=17> Accessed: 2 December 2014: 4

²⁰ Quinlan, C. 2011. *Business research methods*. Hampshire, UK: South-Western/Cengage Learning: 42.

²¹ Bryman, A. & Bell, E. 2011. *Business research methods*. 3rd edition. New York, USA: Oxford University Press: 397.

²² Adapted from Babbie & Mouton, 2008; Bryman & Bell, 2011; Quinlan, 2011