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THE DEPARTMENT
OF TRADE AND INDUSTRY
SOUTH AFRICA

DEPARTMENT OF TRADE AND INDUSTRY
POLICY SUPPORT PROGRAMME

IMPLICATIONS OF THE INFORMATION REVOLUTION FOR ECONOMIC DEVELOPMENT IN SOUTH AFRICA PROJECT CODE: A.1.009

D15
FINAL SECTORAL REPORT –DECIDUOUS FRUIT SECTOR (ICT DIFFUSION AND APPLICATIONS)

JUNE 2002

Submitted by

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Acknowledgements

The study team would like to acknowledge the support of the European Union in providing the funds for this study and the Department of Trade and Industry (DTI) for initiating the project.

In particular, we would like to acknowledge Alan Hirsch, Chief Director, DTI Information Technology Cluster Team Leader, Pearl Thandrayan of the DTI and Wolfe Braude and his team from the Programme Management Unit of the DTI Policy Support Programme, without whose vision and commitment this study would never have been realised.

During the field work the study team interacted with many people across a range of industries. Their input and comments form the basis of this report, and the willingness of so many individuals to devote considerable time to answering the questionnaire is much appreciated.

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Executive Summary

Background and Motivation to Information and Communication Technology (ICT) Diffusion Project

This report represents part of the second Phase of an eight-sector study, commissioned by the Department of Trade and Industry and funded by the European Union, to examine:

i) The likely trajectories for the absorption of ICTs in a range of economic sectors; and

ii) How to adjust the policies and strategies of the government and the domestic private sector to maximise the benefits to South Africa from the insights flowing out of i).

The project builds on existing research work but has at its heart the analysis of a number of 'vertical markets' for ICT, first through a worldwide scan (Phase I) and then through sectoral research in each of the chosen eight sectors.

The sectors selected were drawn from three broad categories – traditional sectors, service sectors, and new economy sectors, as follows:

Traditional:
Platinum Mining
Automotive Manufacturing
Clothing Manufacturing
Deciduous Fruit Farming

Service:
Cultural Tourism
Healthcare Information Flows

New Economy:
Biotechnology
Multimedia

The objectives of the research work were to:

- Generate accurate, objective findings regarding patterns for absorption of ICTs in a range of SA economic sectors, in order to guide South African participants in vertical markets for ICT;
- Provide recommendations for impacting public and private sector policies;
- Guide the government in directing some of its existing and future intervention strategies, including research and development programmes and industrial development facilities, whether through the science vote or departmental programmes; and to

- Give government more guidance regarding the commitment of funds for human resource development.

1.1 Project Research Methodology

The overall approach adopted by the lead consultants was to use Sectoral Experts for the interviewing and primary research, with three ICT coordinators (responsible for up to three sectors each) ensuring consistency across the sectors. An International Consultant was employed to provide an external perspective to the research.

The research methodology for Phase I of this project (The International Scan) involved:

- Defining each of the eight industry sectors;
- Identifying the main players in the value chain; and then
- Performing secondary research on each of the sectors to obtain current data about the diffusion of ICTs into those sectors; and
- Identifying leading-edge applications, as far as possible.

Phase II (Diffusion of ICT in South Africa) involved the use of these sector and value chain definitions to identify the major role players and to set up interviews, based on a structured questionnaire, with selected stakeholders across the value chain.

The questionnaire consisted of both a generic section (i.e. used by all sectors) and a sector-specific section (i.e. aimed only at those interviewees within the sector). Most of the questions relied on the *perception* of the interviewee. A rating scale was typically used, but a number of 'open-ended' questions were included to allow interviewees to express opinions in a less structured way.

The questionnaire was subdivided into six generic sections and one sector-specific section:

1. Background Information (Name, Address, Organisation Size, etc.)
2. ICT Usage (of Technology and Applications)
3. ICT Spending Patterns
4. Sources of ICT Information and Training
5. ICT Adoption: Drivers and Barriers
6. Diffusion of ICT into Organisation/Sector
7. A sector-specific section dealing with issues of importance to the particular sector.

Between 40 and 55 interviews were conducted per sector; these should not necessarily be construed as being representative of the sector, as the selection of interviewees was often dependent on personal contact from the sector researcher. Also, the responses from those interviewed undoubtedly contained an emotional bias (for example, the desire not to seem technologically backward), which would have influenced the responses. Hopefully, these biases have been minimised through the averaging process.

1.2 Analysis of the Results

The results from the questionnaires were captured on an Excel spreadsheet and a basic analysis performed centrally. This information was then fed back to the individual sector researchers for further analysis and comment. The generic portion of the questionnaire captured up to 117 separate items of information per respondent (either a rating, a comment or basic data), so that a typical sector analysis involved 5000+ items. These responses were subdivided into various categories (e.g. Large, Medium, Small organisations) as applicable and further iterations performed.

Most of the results were shown graphically for ease of comprehension, although only basic statistical analysis was performed due to the nature of the data.

1.3 Summary Report on the Deciduous Fruit Sector

This report was informed by results obtained from a survey of the Deciduous Fruit Industry, both here and internationally (Phase I of this project). Fifty-four people were interviewed across the value chain.

The full report describes the Deciduous Fruit Industry in South Africa, noting its importance as a job creator and as an export industry, and defined to include:

- Table grapes
- Stonefruit (peaches, nectarines, apricots and plums)
- Pomefruit (apples and pears).

Although the dried fruit and canned fruit are included, the emphasis will to a great extent be on fresh fruit since fresh fruit supply chain management is much more complex and information technology plays a more important role.

Approximately 65 000 hectares of deciduous fruits are produced in South Africa. The replacement value of the industry is estimated to be R8.1 billion. Gross export earnings are approximately R5 billion of which R2.5 billion are producer payments. Fresh deciduous fruit volumes are approximately 80 million units (550 000 tons). The industry creates approximately 170 000 job opportunities (85 000 permanent and 85 000 seasonal), supporting 365 000 dependants.

South Africa's deciduous fruit exports are produced by approximately 3 350 producers. The industry operates in a free market environment with no government subsidisation.

Of all the agricultural industries in South Africa the economic multiplier (forward and backward linkages) of the horticultural industry is the largest. These include linkages to input supply industries and service providers as well as forward linkages to wholesalers, retailers, hawkers and many other

role-players in the supply chain. Many rural communities are dependent on the industry for their livelihood.

The economy of the Cape Metropolitan region (larger Cape Town) is to a large extent dependent on the industry. Most of the deciduous fruit exports are from Cape Town harbour. A large proportion of the capital investment in the harbour facilities is exclusively for fruit exports.

This project had the objective of eliciting opinion from a broad range of stakeholders concerned with different aspects of the Deciduous Fruit Industry.

The interviewees who participated in this study came from the following categories:

- Producers (the largest group);
- Exporters;
- Pack Houses / Cold Storage;
- Producer Organisations;
- Research Organisations; and
- Transport Companies.

The Summary findings from the survey questionnaire are as follows:

ICT USAGE

Basic Technologies

Primary producers make the least use of ICT in terms of both hardware and applications. This is largely due to the relatively poor infrastructure in the producing regions, but also a function of organisation size; for example, the use of LANs / WANs and leased lines can be expected to be greater in larger organisations.

Applications

Both e-mail and the Internet are extensively used across all groups. The use of intra-and extranets is surprisingly high across all groups with the exception of the producers and the transport groups. E-mail serves an important communication role throughout the industry and is extensively used by all the groups, except for the transport companies who make less use of it. The reason is that transport contracts need to be signed by both the parties and therefore they make use of faxes. Teleconferencing does not play a significant role, except for the exporters and "others" group who make use of it to a lesser extent. The use of videoconferencing is an exception and is only occasionally used by the exporters because of high costs.

Strategy and planning activities combined with business support activities are the two applications where ICTs are used most commonly. Due to the long and complicated supply chain in the deciduous fruit industry, especially for export, this is logical. National and international regulatory /

environmental standards make strategy and planning activities of paramount importance for the industry as a whole to comply with health regulations and to stay globally competitive.
The second most important applications were identified as customer service and business process / systems integration. The industry needs to actively strive towards good relationships with its customers, especially the international supermarket chains that determine the future of the industry and must defend its customer base in a very competitive marketing environment. To achieve this objective it is essential for the different parts of the South African supply chain to collaborate and in some cases integrate some of their services.

ICT SPENDING PATTERNS

The producers believe that relative to the global norm they spend less on ICT while relative to the South African norm somewhat higher. The ICT budget is growing at an average rate. Exporters believe that globally and in South Africa their ICT expenditure is more than the norm. Their budget is growing more quickly.

SOURCES OF ICT INFORMATION AND TRAINING

Exporters, packhouses and producer organisations are the main suppliers of information. The research organisations also disseminate information to the industry. The producers supply primary information mainly to producer organisations and their exporters. This information, although limited, is of paramount importance. Although there is a trend towards online services, transport companies tend to rely on faxes. The producers and the transport companies rank the lowest with interactive on-line services.

Producers mainly make use of their ICT suppliers and specialised private sector trainers as sources of ICT information. Due to their remoteness a group of producers will often make use of the same source. Consultants and service providers are also sometimes used. Exporters almost exclusively make use of ICT suppliers and consultants / service providers, as dopack houses. The latter also use experts within the company. The larger pack houses usually have a specific IT section.

Both producers and exporters use ICT suppliers, specialised private sector trainers, and in-house training programmes for training. Service providers are sometimes used when training forms part of a new software package deal.

Pack houses normally use the above, supplementing with experts within the company, consultants / service providers as well as the Internet.

ICT ADOPTION: DRIVERS AND BARRIERS

There are very few factors in any of the three categories that are perceived to be negative or a barrier. An external barrier that is quoted by most groups is 'Economic Conditions', although interestingly enough exporters are the most positive towards this factor.

On average there are no significant barriers in the supply chain, but an internal barrier that is noted by most groups is the cost of ICT equipment and services.

Most other factors are seen as significant to very significant 'Drivers' of ICT Adoption' e.g. the attitude of management and personnel scores highly across all groups, although less so among producers.

DIFFUSION OF ICT

- All groups rate themselves as late adopters of ICT in all categories relative to the global economy. There is thus clear consensus that South Africa is behind in the competitive stakes as far as ICT adoption is concerned.

- Producers overall tend to lag behind the other groups with respect to the diffusion of ICT in all categories, namely product/service, market innovation, administration, relationship and resource management.

- Transporters perceive their sector in SA and the world as slow to adopt ICT but rate their own organisations as early adopters in all categories except product/service.

- Exporters rate their own organisations as leading the field in administration, relationship and resource management.

- 'Others' rate themselves as early adopters in all categories but particularly so in product/service and market innovation.

- Packhouses see themselves both locally and globally as laggards, especially in relationship and resource management.

CONCLUSIONS

- The development and maintenance of export markets is increasingly dependent on the ability to meet the business requirements of the major chain store groups that are rapidly consolidating their position through strategic alliances and partnerships in order to better manage global sourcing of food products. In order to compete in this trading environment it is essential that suppliers adopt similar strategies to those of the major players in the market. ICT is essential in realising such a strategy.

- There is a need to communicate with consumers. What do consumers want? Choice, value for money, continuity of supply, a guarantee that what they put in their mouths is safe to eat, assurances that the fruit has been produced with a social conscience. Above all they want consistent quality and not just on the outside. Once again, the use of ICT can assist in keeping track of the desires of consumers.

- The deregulation of the industry in 1997 stimulated diffusion since it sparked an immediate need by all the sub sectors for global and local information, and increased communication needs within the global marketing environment. Overnight, farmers and other role players did not only have to compete with each other but also with farmers in other countries and with foreign governments who heavily subsidise their industries directly or indirectly. This also coincided with an annual decrease in funding for the commercial agricultural sector in South Africa. At present South African agriculture is one of the lowest subsidised agricultural sectors in the world.

During the 2001 pome (apple and pear) fruit season the Deciduous Fruit Producers Trust (DFPT) estimated that financial losses in the apple industry alone were in excess of R150 million. This was attributed to inefficient communication between local marketers. This can be attributed to:

- Inefficient flow of information between especially primary producers and other sub sectors in the supply chain;

- The cost of inefficient logistics. In the deciduous fruit industry cold chain management is of paramount importance. In many cases fruits are rejected for the export market (with huge financial losses) due to a lack of knowledge (mainly because of bad communication).

- It is generally accepted by the industry that the South African deciduous fruit sector has built up a backlog compared to its major competitors in the introduction of new cultivars. It appears as if the problem can be traced back to the lack of timely information on such new cultivars and the inefficient use of ICT.

ICT can make a major contribution to minimising the financial impacts of these problems.

What Impact will the ICT Industry have on this sector in the future?

E-commerce related technology will become increasingly important.. The catalyst will be increased speed at which transactions are finalised and the need for product information.

- At the farm level, traceability signifies more information on production activities. This will spark a growth in information systems, such as GIS related systems. Traceability Management Information Systems must increase in sophistication and accuracy. Retailers will demand this information from the supply chain.

- Global competition will encourage the development of integrated databases and management information systems which will combine crop estimates, product intakes, stock, shipment, sales and price information to calculate break-even points for everyone in the supply chain.

- The accuracy of crop estimate systems must be of paramount importance to plan infrastructure and to develop longer-term marketing strategies to become or to remain internationally competitive.

- The development of ICTs to provide information to consumers is already important but the importance will escalate with more sophisticated and more informed customers.

- As increasingly sophisticated ICT systems are required, staff will need to be trained.. The survey results reveal that in many cases the technology is available but staff do not use the full capacity of systems due to a lack of knowledge.

- During 2001 statutory levies were imposed on the deciduous fruit sector to fund research and information requirements. However, the National Department of Agriculture required that the industry supply them with a quarterly report on trends in the industry. Without proper information flows it is not possible to generate the required information. In future this demand will become a requirement for continued statutory levies for the industry.

What can the Deciduous Fruit Sector do to exploit ICT?

The sector can provide the different role-players with information on available technologies and how they can be used to improve the efficiency of the supply chain. The DFPT should play an important role in this regard by raising awareness of the cost to the industry of inadequate information and communication systems and the possible solutions that different ICTs can provide. Sub-sectors can also play a role by communicating their information and communication requirements to the other sub-sectors and engaging in collaborative efforts to find ICT solutions to their problems.

- Facilitating the development of technical expert systems to be made available through the relevant ICTs.

- Facilitating and informing sub-sectors of the potential role that they can play in development projects.

- Most of the farmers come from a disadvantaged background and schooling, and have had little or no contact with ICTs. Literacy training is a prerequisite for the use of many ICTs. In this regard the sector can play a role in at least making people aware of existing literacy projects.

- The sector can play a role in the development of information systems, which are specifically targeted at emerging farmer groups.

- In some cases infrastructure has been created but inadequate education and backup programmes diminish the potential benefit.

- A private sector land reform initiative is currently gaining popularity, and in some cases is being implemented with success. It is an equity scheme where emerging farmers are placed in partnership with commercial farmers, allowing them to benefit from available expertise and knowledge and gain indirect access to electronic information.

What can the ICT Industry do for the Deciduous Fruit Sector?

The ICT industry could play an important role by developing training programmes for relatively ICT illiterate communities and for emerging farmer groups.

- To be globally competitive will become increasingly difficult in the future and even more so for emerging farmers. They need to be informed of national and international regulations, especially concerning food safety, if they are to consider exporting their products. If emerging farmers have access to ICTs and the knowledge to use them they can obtain crucial information needed for making strategic decisions concerning suitability of areas for certain crops. They could also obtain up to date information on:
    - Local and export marketing opportunities;
    - Technical and financial aspects; and
    - Up-to-date information on the latest cultivars, future trends in consumption, area specific climatic conditions, etc.

What can Government do?

The role of any responsible government is to create a business environment where businesses can flourish to the benefit of all the inhabitants of that country. In South Africa the government accepts the role of the deciduous fruit sector as the growth engine to the economies of many of the provinces. However, in many cases the infrastructure does not exist or is too expensive for communities to create without assistance. This applies especially in remote areas and to previously disadvantaged rural communities where government could play an active role in ensuring that the infrastructure exists for people to make use of ICT. Government could collaborate with private sector institutions / companies to create these infrastructures.

- Government and the private sector could also collaborate to provide training in the use of ICTs. Land reform is often characterised by a group of emerging farmers receiving a land allocation (or land right). It is impossible to educate all these farmers. Rather the focus should be to educate one or more delegates from each group. With the help of local extension officers these delegates can act as examples and educators for their fellow farmers.

- Government could provide the emerging farmer groups with an extension service that could play a much-needed facilitating role between private sector, government and the affected communities.

- The agricultural sector receives few subsidies in South Africa. To enhance economic growth, there is a valid case for government to either finance infrastructure development or subsidise it generously in areas where infrastructure inhibits the use of technologies. For example: telephone lines, cell phone technologies and Internet access points or telecentres. The returns on this investment could reveal a positive cost-benefit ratio due to the strong forward linkages of agriculture and specifically the deciduous fruit sector with other economic sectors.

1. Overview

The results of the agricultural survey indicate the existence of substantial differences within various subsectors of the supply chain. The supply chain is long and information and communications technologies (ICT) should play an important role. The industry is a high value export base and operates in a highly global competitive environment. In this environment information technology will play an increasingly important role especially with regard to traceability (EUREPGAP) and marketing co-ordination (volumes, destinations and quality exported). Although most role-players in the industry already use information technology to some extent there is still large scope for improvement. Any improvement in international competitiveness will play an important role in enhancing economic growth on a regional, provincial and national level through the positive economic multi-player effect of the industry.

2. Methodology

A survey was conducted with a structured questionnaire. The purpose of this section is to discuss the survey process.

2.1 Nature of Questionnaire (Sector Specific Components)

The generic questionnaire that was compiled for use in all the sector studies was accepted as sufficient for the purpose of this study.

2.2 Questionnaire Administration

In order to capture the differences in the use of ICT between different role-players in the supply chain a code was used during the process to link a particular questionnaire with a group of users within the supply chain. The data was captured by the person who conducted the interviews to ensure accurate interpretation of open-ended questions.

2.3 Interviewee's Selection and Role in the Sector

The interviewees were selected in such a way as to cover the most important role-players in the supply chain. Table 1 represents the number of questionnaires that were completed by the different role-players as well as the number of persons interviewed. The "others" group consists of role-players in the supply chain where only one interview was done and the results will not be representative of a particular role-player. Although the research team realises that "others" is a broad spectrum of role-players, it was decided that for the purpose of this study there was no other option. In future studies it will be necessary to split the "others" group.

Table 1: Interviewee selection

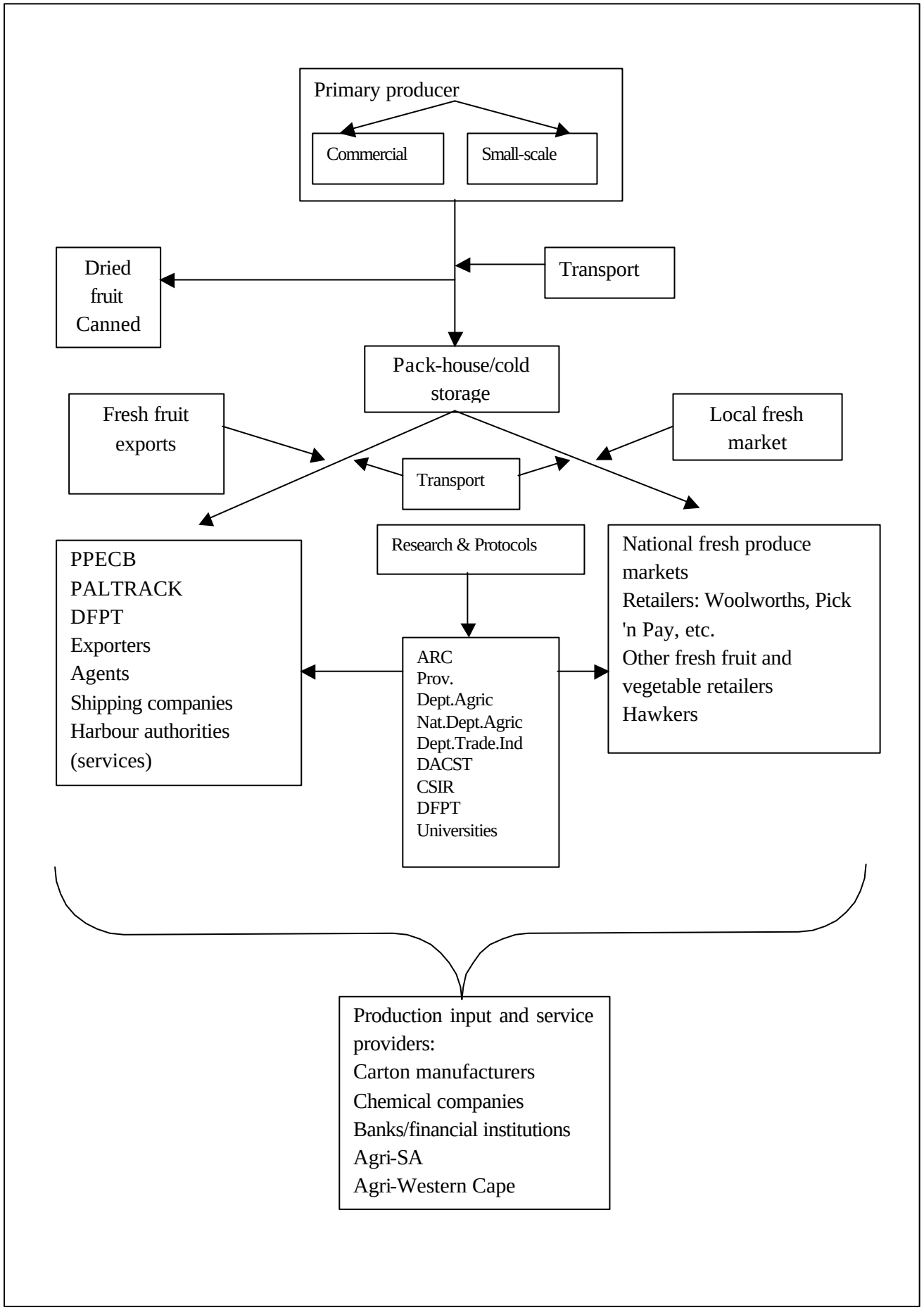
Interviewee section	Questionnaires	Interviewees
Producers	13	20
Exporters	3	3
Others	8	8
Pack-houses / cold storage	7	9
Producer organisations	7	7
Research organisations	3	3
Transport companies	2	4
Total	43	54

Note: Others include packing material suppliers, Perishable Products Export Control Board, retailers, processors, Department of Agriculture and Paltrack.

It is clear from Table 1 that the largest group is producers. The reason for this is the fact that deciduous fruit production regions are scattered over a wide area. In some cases these areas are very remote (Orange River and the Langkloof) which may have an impact on the use of ICT. It was therefore necessary to attempt to capture these differences. Also, the survey provided for commercial as well as emerging (small-scale) farmers. Before surveying the emerging farmers the authors knew that there were very few, possibly none, of the questions in the questionnaire that they would be able to answer. The approach was one of establishing their difficulties and needs. The interview thus took on more of a discussion format. ***Figure 1a*** below represents the supply chain.

2.4 Interview Process

All the questionnaires were completed through a personal interview. In some cases group interviews were conducted where the group was relatively homogeneous e.g. farmers with the same farm structure, in the same area. While making appointments with the interviewees they were briefed on the purpose of the study and the time required to complete the questionnaire.


Primary producer
Commercial
Small-scale
Dried fruit Canned
Transport
Pack-house/cold storage
Fresh fruit exports
Local fresh market
Transport
Research & Protocols
PPECB
PALTRACK
DFPT
Exporters
Agents
Shipping companies
Harbour authorities (services)
ARC
Prov. Dept.Agric
Nat.Dept.Agric
Dept.Trade.Ind
DACST
CSIR
DFPT
Universities
National fresh produce markets
Retailers: Woolworths, Pick 'n Pay, etc.
Other fresh fruit and vegetable retailers
Hawkers
Production input and service providers:
Carton manufacturers
Chemical companies
Banks/financial institutions
Agri-SA
Agri-Western Cape

3. Results

The results are discussed in terms of the nature of the sector and the characteristics of ICT Use including basic technologies, applications, ICT spending patterns, sources of ICT information and training, ICT adoption and finally diffusion of ICT.

3.1 Nature of Sector: boundaries and subsector map; large company/small company picture; international relationships

The sectors consist of many different subsectors. However, in most cases the boundaries are relatively clear. The questionnaire included a supply chain map where interviewees were asked to indicate in which part of the supply chain they operate. ***Figure 1*** represents the contribution of the various subsectors to the total survey.

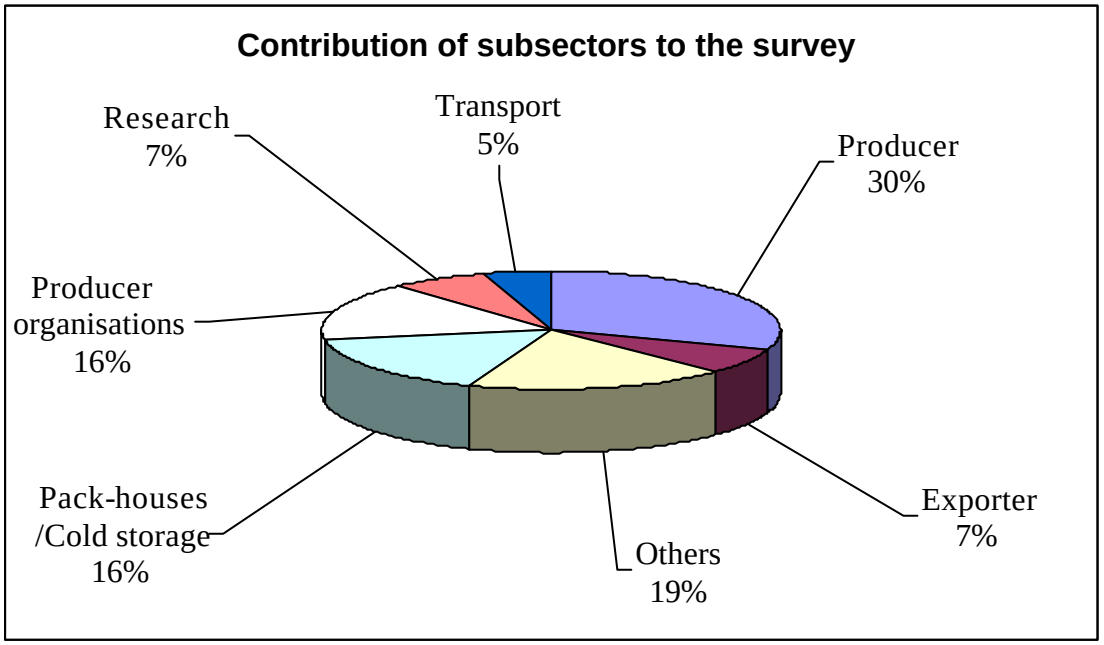


Figure 1: Contribution of Subsectors

In many cases the pack-houses are also the marketers in the local fresh produce market. However, the export sector is a specialised marketing business and most of the farmers use exports agents to export their crops.

Figure 2 represents the international relationships of the interviewees. For the purpose of the study an international relationship was that between a company or institution and international clients with whom it deals directly. In the case where farmers use export agents to export their crops they were not regarded as international role-players even though they produce products for the export market.

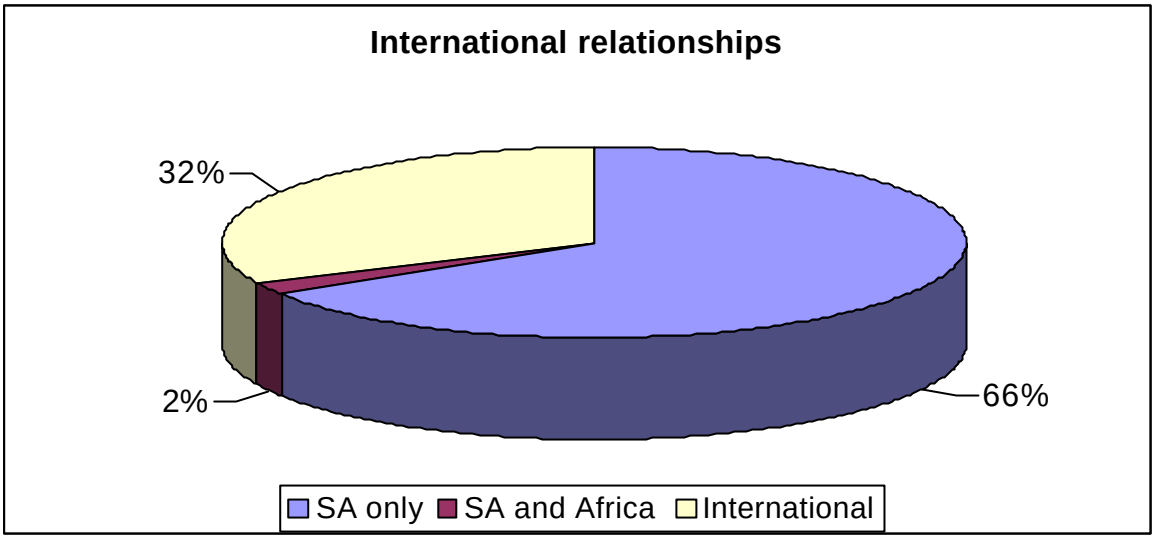


Figure 2: International relationship of interviewees

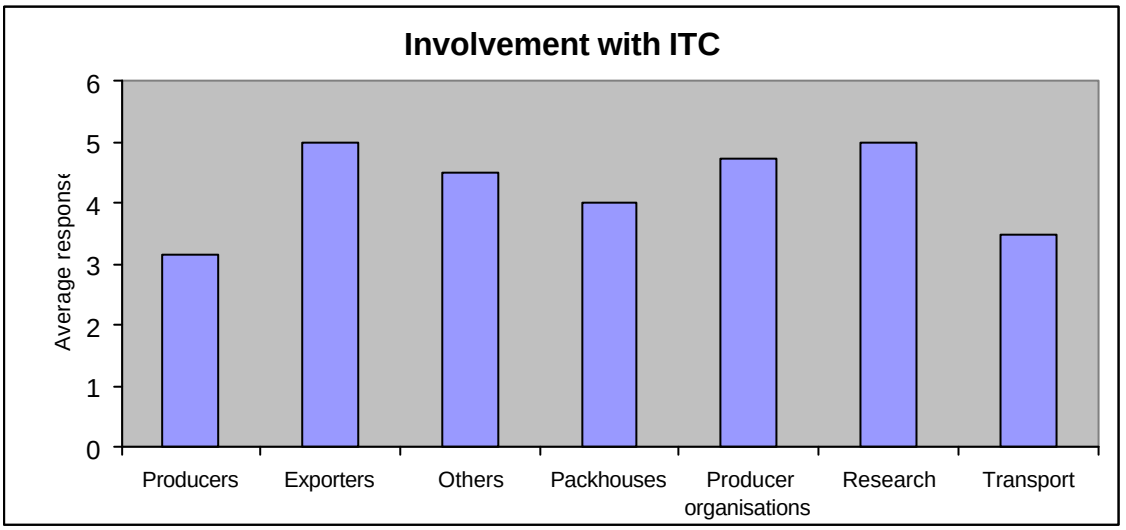


Figure 3: Interviewee's involvement with ICT

The average response was measured on a scale of 1 to 5, with 1 being none or very limited and 5 extensive involvement. ***Figure 3*** clearly shows that exporters and research organisations are most involved with ICTs. Next are producer organisations, "others", pack-houses and transport companies. The producers are the least involved in ICT use. The relatively low level of ICT use on the primary producer level can be attributed to infrastructure problems that exist in many of the production regions as well as the fact that the group includes small-scale emerging farmers with very little or no use of ICTs.

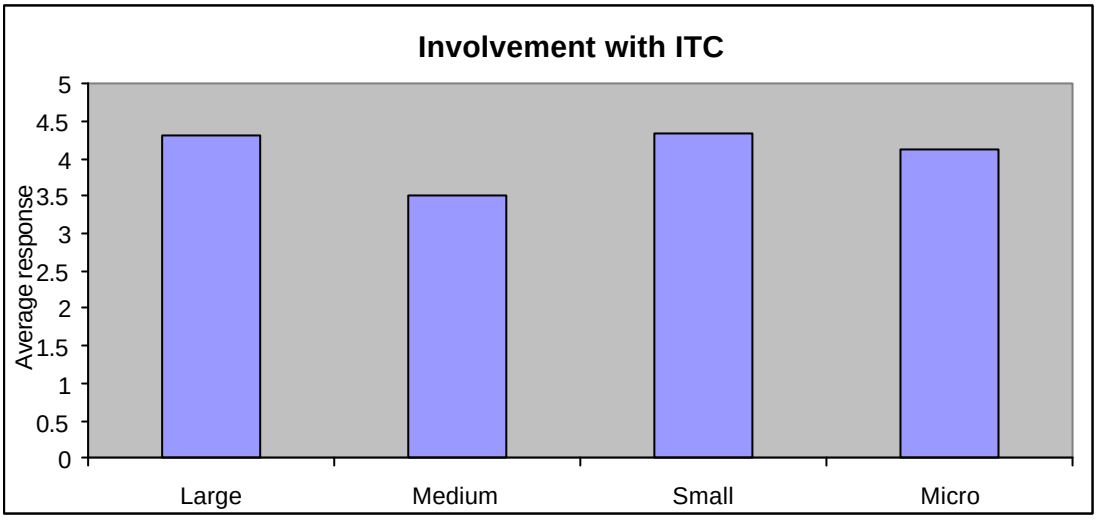


Figure 4: Interviewee's involvement with ICT

There seems to be no correlation between the size of an organisation and its involvement in ICT use.

3.2 Characteristics of ICT Use

The characteristics of ICT use are discussed in terms of the basic technologies, applications, spending patterns, sources of information and training, drivers and barriers and finally the extent of diffusion.

3.2.1 Basic Technologies

Figure 5 represents the basic technologies used by subsectors. The average response was measured on a scale of 0 to 5, with 5 being full utilisation and 1 no use at all. If the interviewee did not know or the usage was not needed it was assigned a 0 on the scale. The stacked format of the graphs also shows which group makes the most use of ICT hardware. The extent of ICT hardware use in the subsectors is approximately the same with regard to the utilisation of PCs, except for producers who use it to a lesser extent. As can be expected the producers make little use of servers/mainframes. They usually only have a few PCs, in some cases local networks or as single stand-alone units. On the other hand the exporters, pack-houses, producer organisations, research organisations, transport companies and "others" extensively use servers.

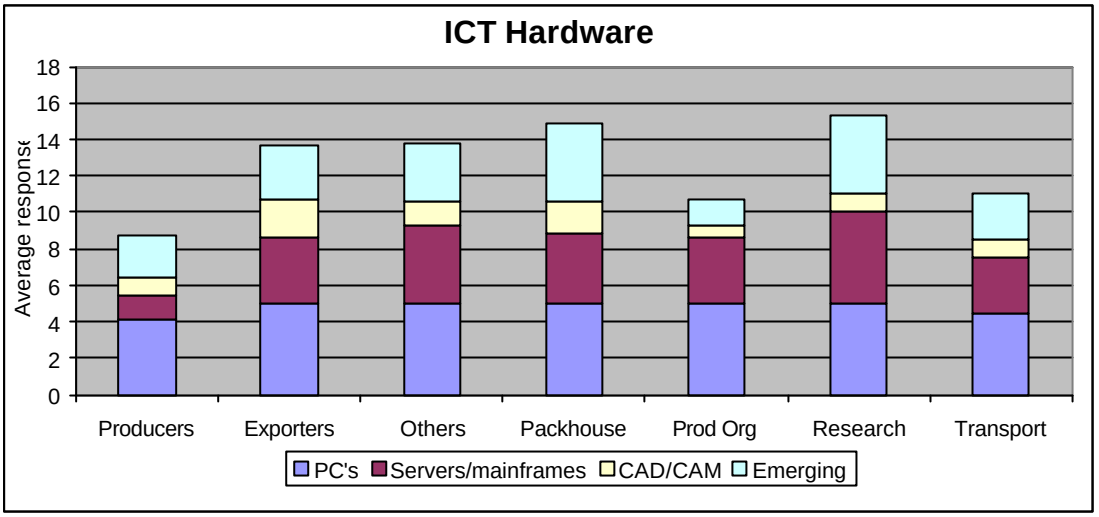


Figure 5: ICT Hardware usage

CAD/CAM technologies have very little or no use at producer level. These technologies may sometimes be used for computerised irrigation systems, field weather stations and the packing of fruit. Exporters make use of CAD/CAM technologies within each company's specific way of handling, packing and tracing of fruit. Pallet scanners are extensively used in the traceability of fruit and this is becoming a very important requirement for the export of fruit. The larger export companies also use custom designed computer software to fulfil the needs of each specific department of the company. Pack-houses make extensive use of CAM technologies in their pack-lines. CAD technologies are also used in the technical grading of fruit. Producer organisations, research organisations and transport companies make the least use of CAD/CAM technologies. CAD technologies are used in the design of specific software programs for each organisation's particular needs. The "others" group also make use of CAD/CAM technologies, but to a lesser extent than the exporters or the pack-houses.

Emerging technologies on a primary producer level consist mainly of cell phone, irrigation and other farm planning technologies. Exporters and packers are increasingly making use of emerging technologies regarding quality control and food health issues. The most important of the emerging technologies in the research subsector is biotechnology.

Figure 6 represents the communication infrastructure of subsectors. As stated earlier producers mainly use single unit PCs or LANs. In exceptional cases, usually large farming companies, they will make use of WANs.

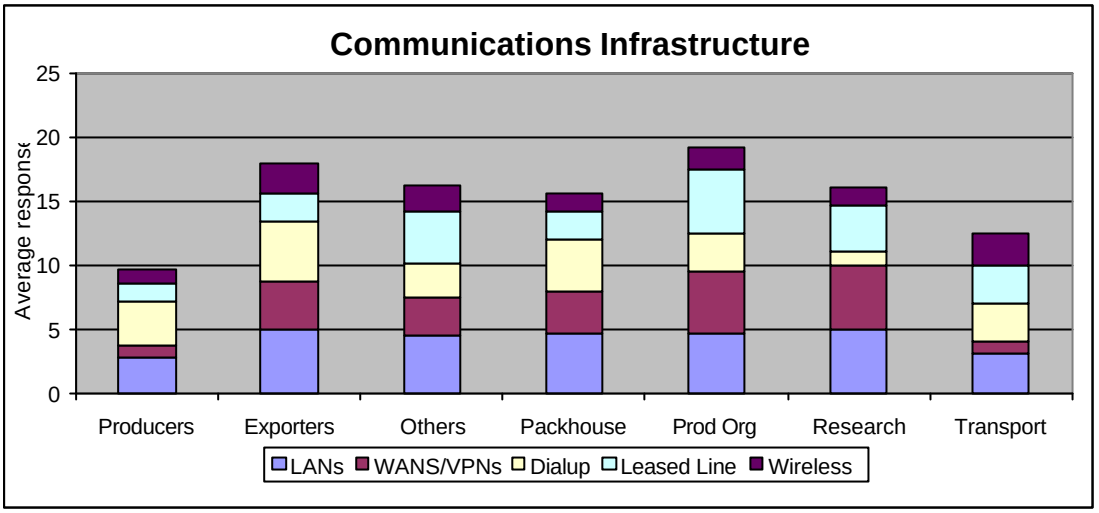


Figure 6: Communications infrastructure usage

Exporters use LANs within the company for transfer and gathering of information and WANs to connect to their suppliers and for distribution of information. Pack-houses make use of LANs in the control process for the packing and tracing of fruit. They also use WANs for the dissemination of information to interested parties, like the exporters and local marketers who continuously need to be updated on the status of their fruit. Producer- and research organisations are centres of information gathering and dissemination and administrative processes. Therefore they utilise LANs and WANs extensively. Transport companies make little use of WANs, but they do use LANs. The reason for this is that they still make use of faxes extensively. The "others" group make use of LANs and WANs but it depends on the specific organisations' function as to the extent to which they use them.

The "others" group, producer- and research organisations mainly use leased lines for Internet connection. They do however also use dial-up connections. The producers, exporters, pack-houses and transport companies on the other hand make more use of dial-up connections than leased lines. However, much will depend on the size of the organisation.

Wireless networks for the transmission of data are not commonly used. Only the export and transport companies and "others" group use them. Cell phones play a vital role in the organisational processes throughout the supply chain of the fruit industry, but not yet in the transmission of data as such.

3.2.2 Applications

Figure 7 represents the application of ICT for information acquisition and communication. CD-ROM sources are least used by the producers, transport companies, pack-houses and producer organisations. They do not really serve a purpose for these organisations and are only used occasionally. The exporters and "others" group make limited use of these sources. The research organisations make the most use of CD-ROM sources for information acquisition.

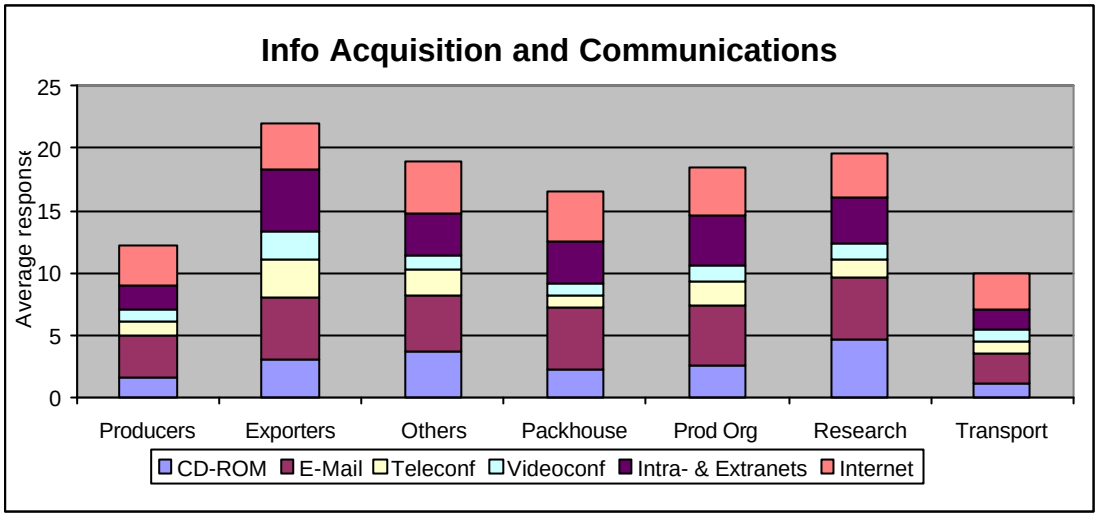


Figure 7: Information acquisition and communications usage

E-mail serves as an important communication tool throughout the industry and is extensively used by all the groups, except for the transport companies. The reason for this is that transport contracts need to be signed by both parties and therefore they use faxes. Teleconferencing does not play a significant role, except for the exporters and "others" group who use it to a small extent. The use of videoconferencing is an exception and is only occasionally used by the exporters. The reason is the cost involved.

Almost all the groups, apart from producers and transport companies, utilise intranet and extranets. The Internet is widely used by all except for producers and transport companies.

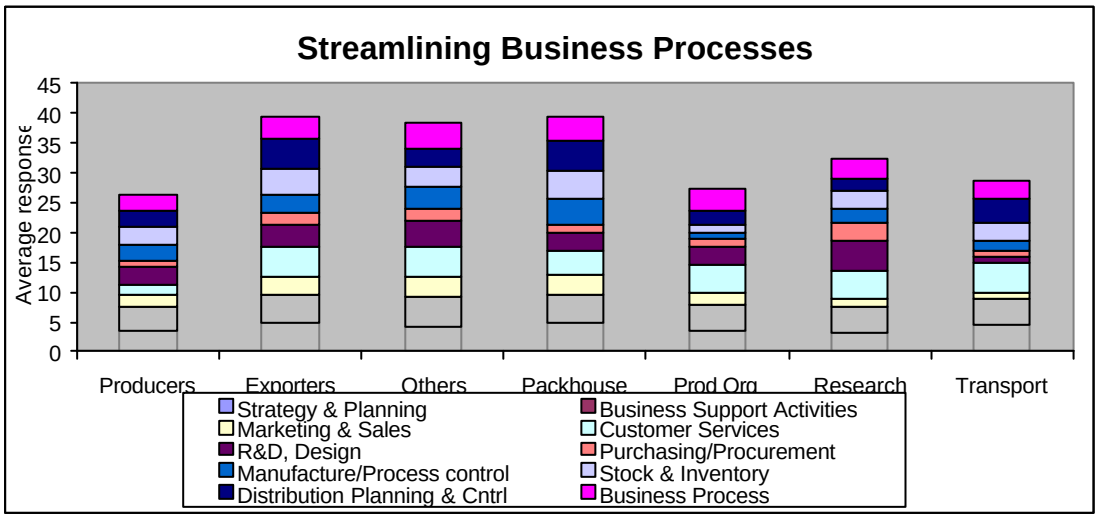


Figure 8: Streamlining business processes usage

In the streamlining business processes applications section, strategy and planning activities combined with business support activities are the two applications where ICTs are used most commonly. Due to the long and complicated supply chain in the deciduous fruit industry, especially for export, it is logical that these two applications are singled out as the most important use.

Especially with national and international regulatory/environmental standards the strategy and planning activities are of paramount importance for the industry as a whole to comply with health regulations and to stay globally competitive.

The second most important applications were identified as customer service and business process/systems integration. It is very important for the industry to actively strive towards good relationships with its customers, especially the overseas supermarket chains that determine the future of the industry. To defend their customer base in a very competitive marketing environment, it is essential for the different parts of the South African supply chain to collaborate and in some cases integrate some of the services.

On the more technical side research, development, design and production usage was also identified as being important. Stock and inventory control/warehouse management together with distribution planning control are also areas where ICTs are commonly used. The use of ICT for this purpose depends on the organisation's role in the supply chain. For example, distribution planning and control plays an important role in determining the success of export companies.

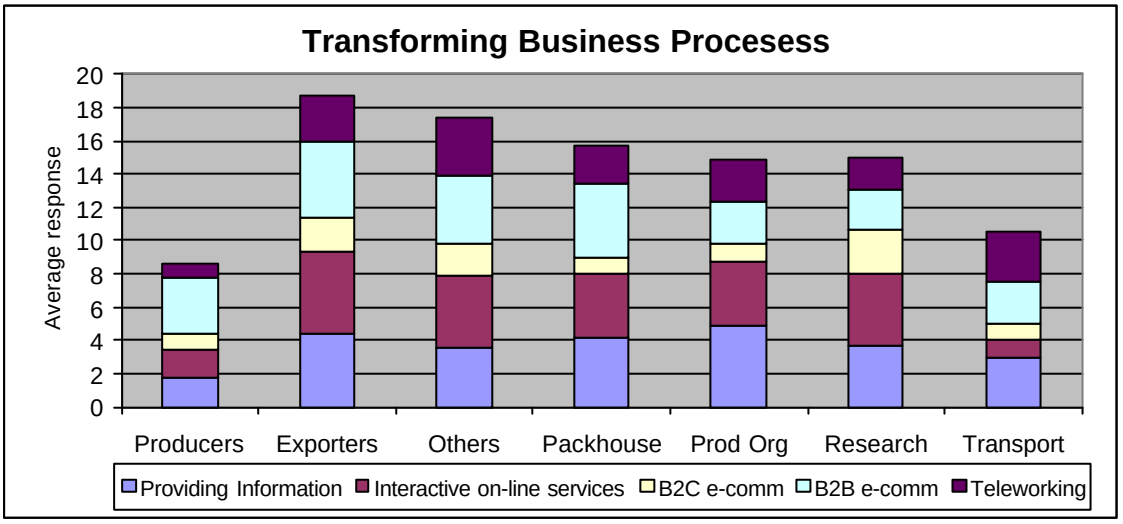


Figure 9: Transforming business processes usage

Exporters, pack-houses and producer organisations are the main suppliers of information. The research organisations' functions also include the dissemination of information to the industry. They, and the "others" group are on the same relative level for providing information.

The producers only supply primary information and mainly to producer organisations and their exporters. The information that they supply is of paramount importance, but is limited. The transport companies use ICTs to a lesser extent to supply information. The producers and the transport companies rank the lowest with interactive on-line services. Again the transport companies mostly rely on faxes for communication although there is a trend towards on-line services.

The exporters, "others", pack-houses, producer organisations and research organisations all provide a substantial amount of interactive on-line services. This consists of answering queries and staying in

contact with the relevant parties. Business to consumer e-commerce is not very popular yet. Only researchers, exporters and "others" make limited use of it.

Business to business e-commerce, on the other hand, is used throughout the supply chain, mainly Internet banking and financial services. All the groups except the producers make occasional and limited use of teleworking.

3.2.3 ICT Spending Patterns

Figure 10 represents the spending patterns on ITC for the different subsectors. The producers' perception of their ICT spending pattern is that relative to the global norm they spend less and relative to the South African norm a bit higher. Their budget for ITC is also growing about average.

The exporters believe that relative to the global norm and in South Africa their ICT expenditure is more than, to much higher than the norm. Their budget for ITC is also growing more, to much more quickly. Results for the pack-houses and producer organisations reveal the same, indicating that relative to the norm globally, their ICT expenditure is less, and relative to South Africa, it is more. Their budget for ITC is also growing about average to more than the norm.

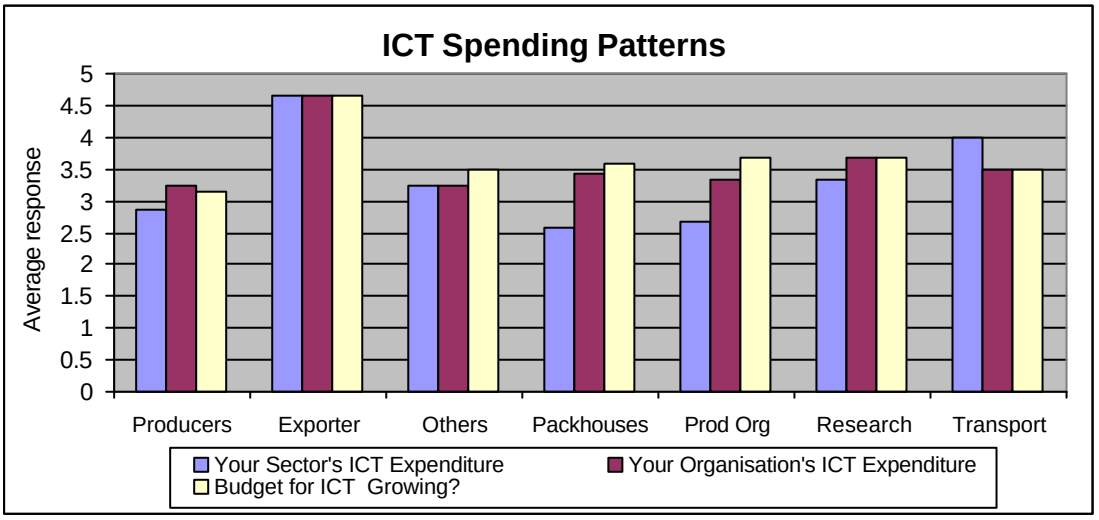


Figure 10: ICT Spending patterns

The research organisations believe that relative to the norm globally their ICT expenditure is about the norm, and relative to the norm in South Africa it is a bit higher than the norm. Their budget for ITC is growing about average to more quickly.

The transport companies indicated that relative to the norm globally their ICT expenditure is more and in South Africa a bit higher than the norm. Their budget for ITC is also growing about average to more quickly.

The "Others" group indicated that relative to the norm globally their ICT expenditure is about the norm and relative to South Africa it is about the norm. Their budget for ITC is growing about average to more quickly.

3.2.4 Sources of ICT Information and Training

Figure 11 represents the sources that subsectors use for ICT information and training. The legend in ***Figure 1*** (1-12) represents the following sources of information:

1 = ICT suppliers e.g. vendors of software/hardware
2= Specialised private sector trainers
3= In-house training programmes
4= Newspapers, magazines, journals
5= Experts within the company (incl. Parent company)
6= Consultants/service providers
7= Trade and business associations
8= Chambers of Commerce
10= Internet
11= Universities/Technikons
12= Other

The producers mainly make use of their ICT suppliers and specialised private sector trainers as their sources of ICT information. Due to their remoteness a group of producers will often make use of the same source. Consultants/service providers are also sometimes used.

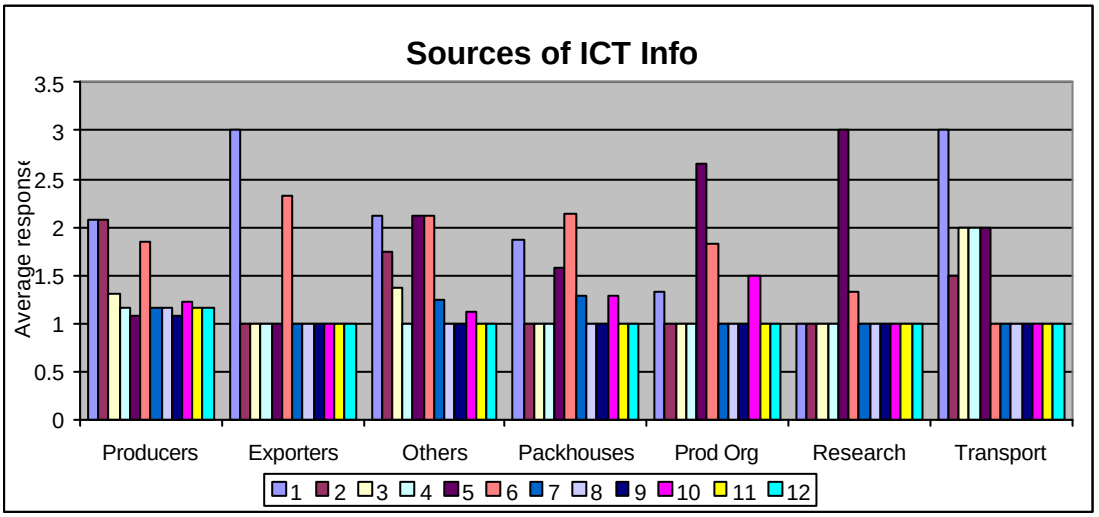


Figure 11: ICT-related information

Exporters almost exclusively make use of ICT suppliers and consultants/service providers. Pack-houses make use of ICT suppliers, consultants/service providers and also experts within the company. The larger pack-houses usually have a specific IT section.

Producer organisations depend on experts within the company for their information. The experts within the company make use of ITC suppliers, consultants/service providers and the Internet when they need further information.

Research organisations almost always make use of experts within the company and consultants/ service providers. In most cases, they also have a specific IT section within the company.

The transport companies mainly make use of ICT suppliers but also use specialised private sector trainers, in-house training programmes, the media and experts within the company for their information needs.

Due to the diversity of the "others" section it is not surprising that they make use of a wide range of sources for their information, as can be seen in ***Figure 12.*** The same legend applies as was discussed for ***Figure 11.***

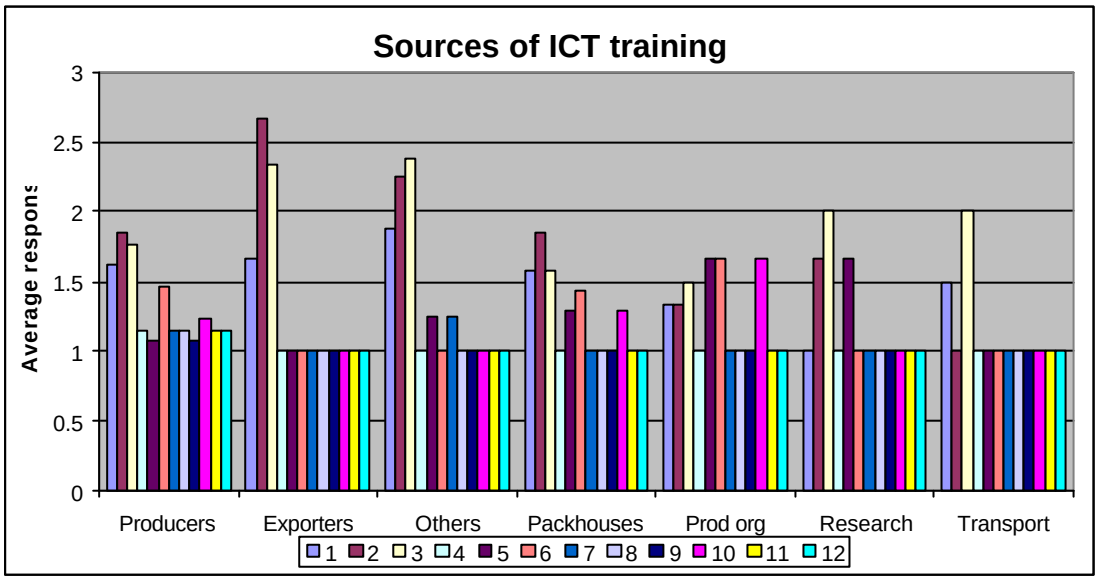


Figure 12: ICT-related training

Producers mainly use ICT suppliers, specialised private sector trainers, and in-house training programmes for training. Their service providers are sometimes used when training is part of the package when they purchase new software.

Exporters make use of ICT suppliers, specialised private sector trainers and in-house training programmes for education.

Pack-houses normally use ICT suppliers, specialised private sector trainers, in-house training programmes, experts within the company, consultants/ service providers as well as the Internet for their training purposes.

Producer organisations also make use of ICT suppliers, specialised private sector trainers, in-house training programmes, experts within the company and consultants/ service providers. Compared to

the other sectors they make the most use of the Internet. This can be explained by the fact that as part of their information function they extensively use the Internet.

The research sector mainly use specialised private sector trainers, in-house training programmes and experts within the company as their sources of training. The transport companies mainly make use of their IT suppliers and in-house programmes for training.

The "others" group shows the same tendency as the rest with the use of ICT suppliers, specialised private sector trainers and in-house training programmes as their main sources of training.

3.2.5 ICT Adoption: Drivers and Barriers

Figure 13 represents the external barriers and driving forces in the use of ITC by different subsectors. There is a resemblance between the producers and pack-houses. The economic conditions in their sector have a relative negative influence on accelerated investments while expected increased competition in the short and medium term is a positive driver for accelerated investments. They also have a positive culture and attitude towards ICT.

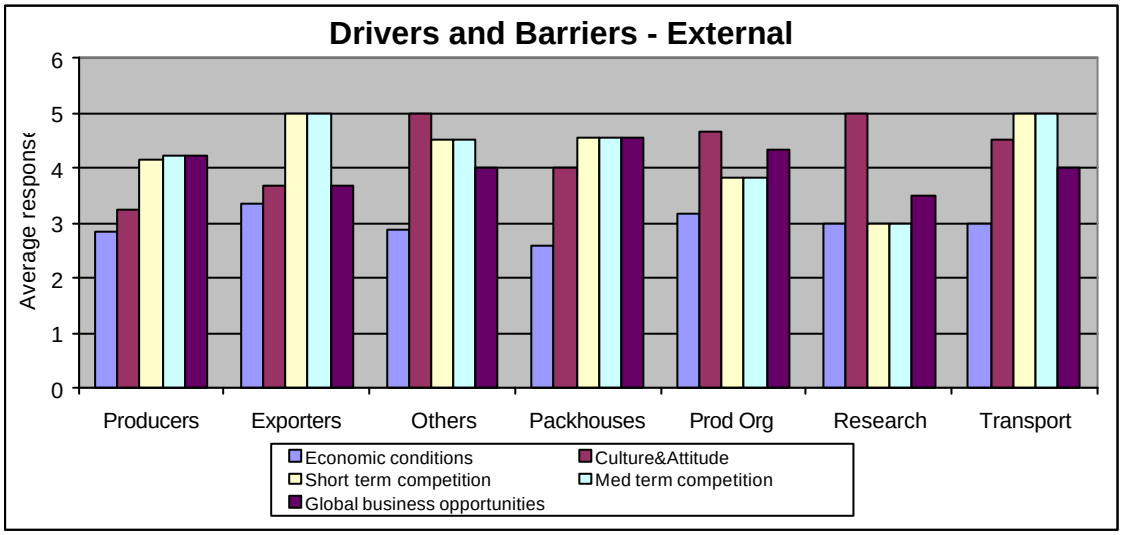


Figure 13: External economic factors

The exporters and transport companies have a similar tendency. However, economic conditions have no particular influence. Expected increased competition in the short and medium term is a strong positive driver for accelerated investment. They also have a positive culture and attitude towards ICT.

The producer- and research organisations are similar. Their economic conditions have no particular influence. Both of them have a positive culture and attitude towards ICT. Expected increases in competition in the short and medium term are a positive driver with the producer organisations and have no particular influence with the research organisations. Increased global opportunities have a positive influence on both.

The only barrier to adoption with the "others" group is the general economic conditions. Their culture and attitude, expected increased competition in the long and medium term as well as increased global business opportunities are all positive drivers for accelerated investments.

Figure 14 represents the drivers and barriers within the supply chain.

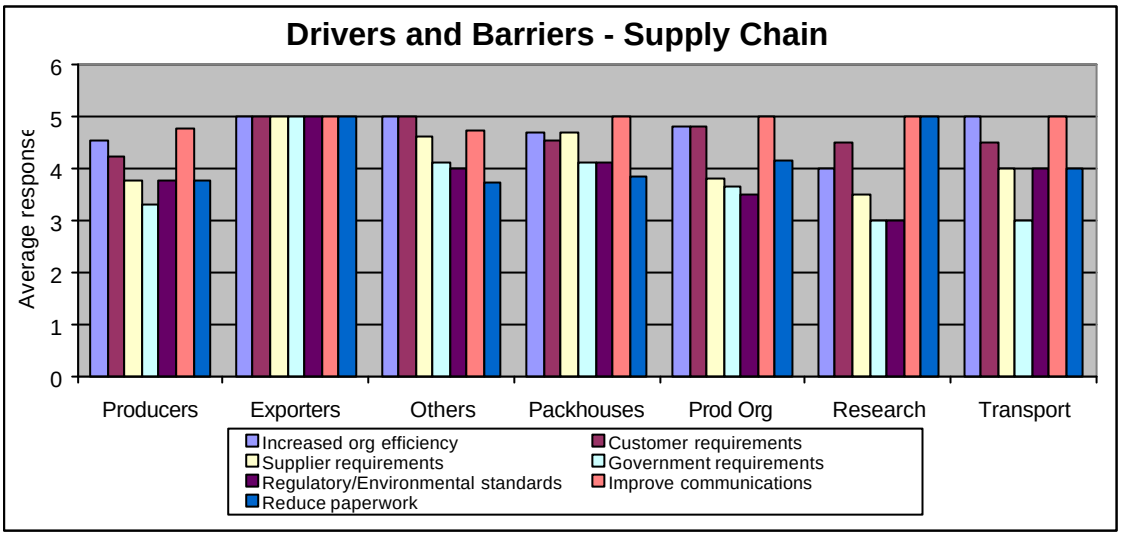


Figure 14: Supply chain factors

The need for increased organisational efficiency to:

- Respond to customer requirements;
- Respond to supplier requirements;
- Respond to national or international regulatory/ environmental standards;
- Improve communications; and
- Reduce paperwork,

are all positive drivers for accelerated investment, only the need to respond to government requirements is considered inapplicable. ***Figure 15*** represents the internal drivers and barriers. All the groups have the same tendencies, except for the producers.

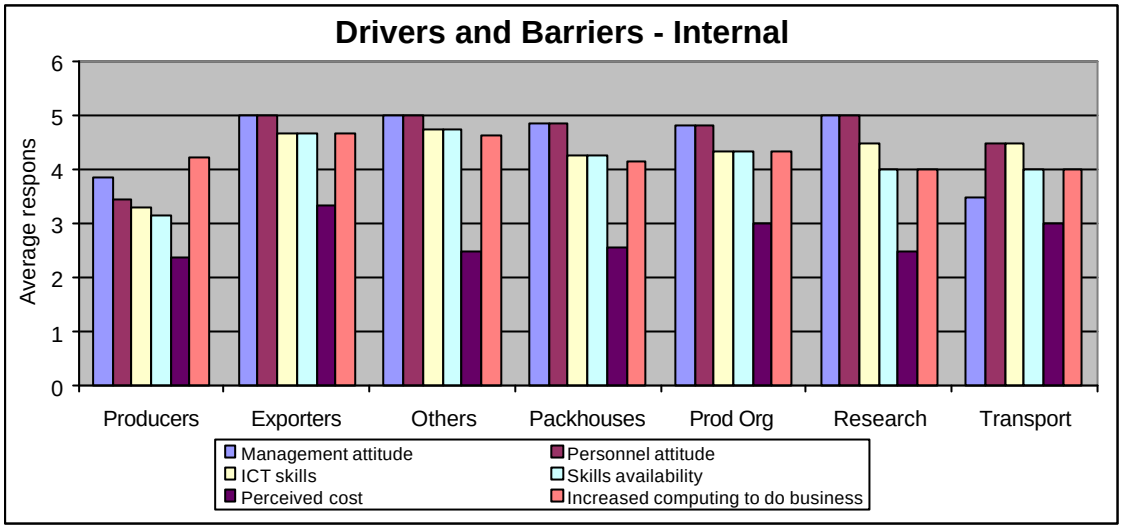


Figure 15: Internal factors

The attitude of senior management and general attitude of personnel towards ICT on the producer level is positive, although it is not as positive as for the other groups. Their level of ICT skills in the workplace and availability of professional skills are slightly positive. The perceived cost of ICT is a relative negative barrier and the need for increased computing to do business is a driver for accelerated investments.

The respective tendency of the exporters, "others", pack-houses, producer organisations and research organisations show the same tendency. The attitudes of senior management and general attitude of personnel towards ICT, the level of ICT skills in the workplace, the availability of ICT skills and the need for increased computing to do business are all positive to strong drivers for accelerated investment. Perceived cost of ICTs has no particular or a negative influence on all the groups.

3.2.6 Diffusion of ICT

Figure 16 indicates the perception of subsectors with regard to the diffusion of ICT in products and services. The producers and transport companies perceive that they are among the early majority when ICTs are used to develop new products/services or exploit new market niches. They rate their sector in the SA economy between the early and late majority and their sector in the global economy among the late majority.

The exporters rate themselves among the early adopters/early majority when using ICTs to develop market innovations, new products/services or to exploit new market niches. They rate their sector in the SA economy in the same category. In the global economy they believe that they are among the early majority. The "others" and the producer organisations rate themselves among the early adopters when using ICTs to develop new products/ services or to exploit new market niches. They rate their sector in the SA economy and in the global economy in the same category. The pack-houses rate themselves among the early adopters to early majority within their sector, the SA economy and in the global economy.

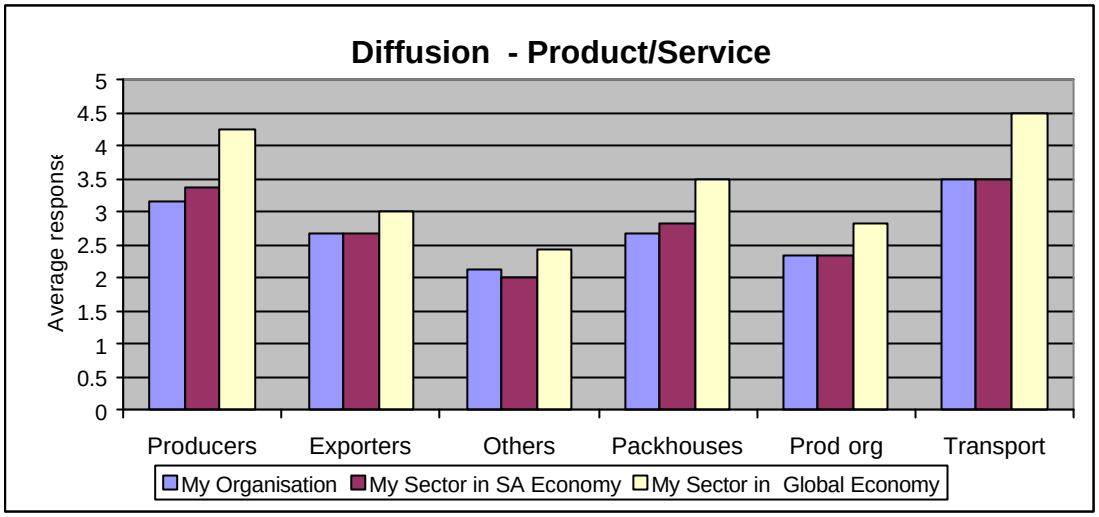


Figure 16: Product/service innovation diffusion of ICT

The producers and transport companies rate themselves to be among the early majority when ICTs are used to develop new products/ services or exploit new market niches. They rate their sector in the SA economy between the early and late majority and their sector in the global economy among the late majority.

Figure 17 represents the diffusion of ICT for market innovation. The exporters rate themselves among the early adopters/early majority when using ICTs to develop new market new products/services or to exploit new market niches. They rate their sector in the SA economy in the same category. In the global economy they believe that they are among the early majority. The "others" and the producer organisations rate themselves among the early adopters when using ICTs to develop new products/services or to exploit new market niches. They rate their sector in the SA economy and in the global economy in the same category. The pack-houses rate themselves among the early adopters to early majority as well as their sector in the SA economy and their sector in the global economy as early majority.

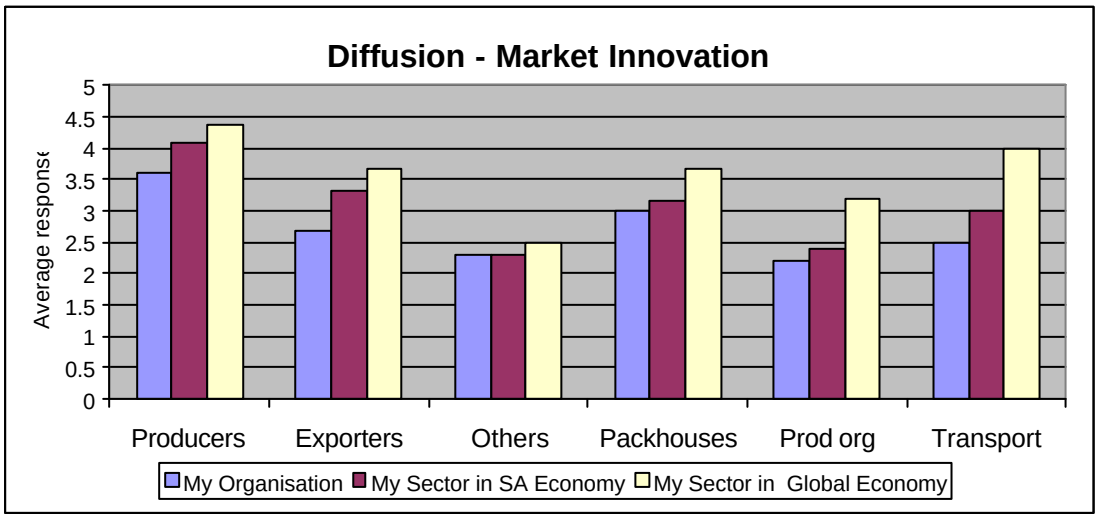


Figure 17: Market innovation diffusion of ICT

The producers rate themselves as the early to late majority when applying ICT and especially the Internet to create new channels for marketing and distributing products and services. Their sector in the SA and global economy is seen as being in the late majority category.

The exporters and transport companies have the same tendency. Both of them rate themselves among the early adopters. Both of them also rate their sectors in the SA economy among the early majority. The exporters rate their sector in the global economy among the early to late majority while the transport companies are in the late majority.

The "others" rate themselves, their sector in the SA and global economy as among the early adopters. The pack-houses rate themselves and their sector in the SA economy as among the early majority and their sector in the global economy in the early to late majority.

Figure 18 represents the diffusion of ICT in the admin process. The producer organisations rate themselves and their sector in the SA economy as among the early adopters and their sector in the global economy in the early majority.

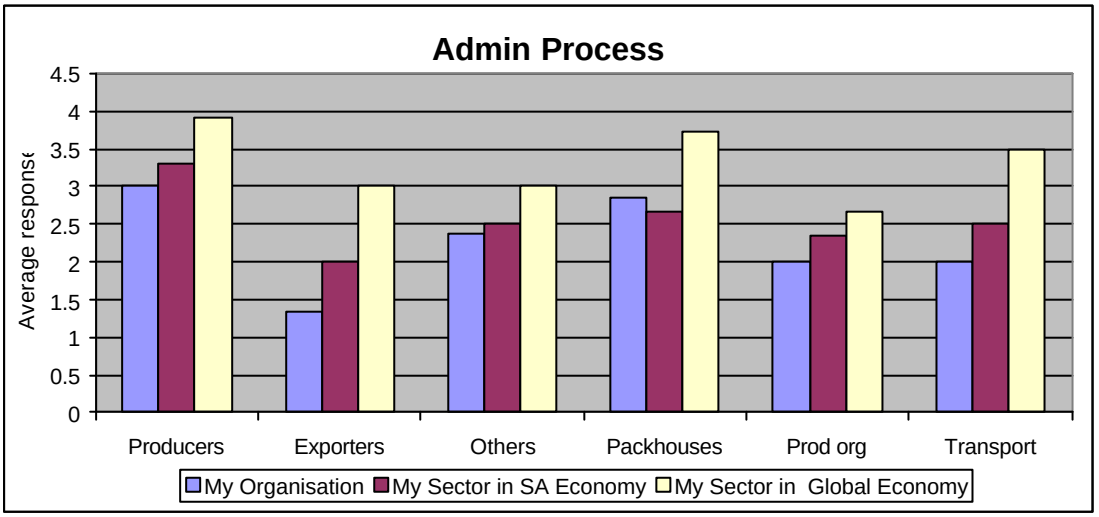


Figure 18: Administrative process management diffusion of ICT

The producers, exporters, "others", producer organisations and transport companies all have the same tendency. All of them rate their organisations higher up than their sector in the SA economy, which they rate higher up than their sector in the global economy.

The producers believe that they are among the early majority when using intranets and the Internet to improve communications, especially via e-mail and web access. They rate their sector in the SA economy as in the early majority category and their sector in the global economy in the late majority. The exporters are in the innovator category. This can be expected when considering the amount of communication that has to take place between the exporters, producers, shipping companies, transport companies and the overseas buyers. They rate their sector in the SA economy as early adopters and in the global economy as in the early majority.

The "others" group, pack-houses, producer organisations and transport companies all rate themselves as early adopters. All of them also rate their sector in the SA economy as early adopters. In the global economy context the "others", pack-houses and transport companies believe that their sector is among the early majority. The producer organisations rate their sector as being in the early adopter category.

Figure 19 represents the diffusion of ICT to improve relationships. Again the same resemblance in the tendency is encountered with all the groups when using extranets, the internet and virtual private networks (VPNs) to create closer links with other stakeholders (customers, suppliers, interested parties), especially for EDI-based ordering and invoicing and "just-in-time" production.

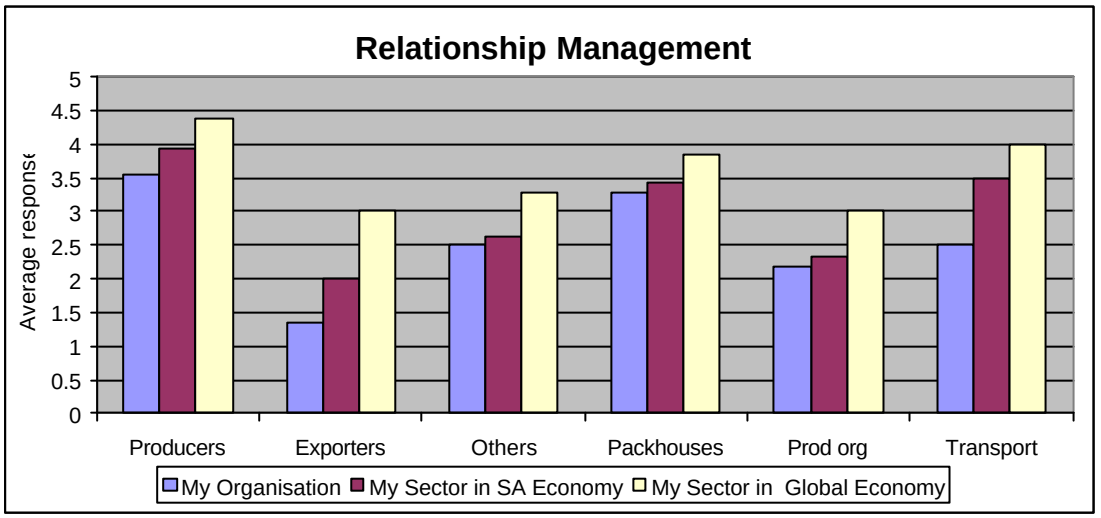


Figure 19: Relationship management diffusion of ICT

Overall the producers rate the lowest in this section. They rate themselves and their sector in the SA economy in the early to late majority category. Their sector in the global economy is rated as being among the late majority.

As in the administrative process management section the exporters rate themselves as innovators, their sector in the SA economy as early adopters and in the global economy as in the early majority.

The "others", producer organisations and transport companies all think that they are among the early adopters within the sector and the SA economy. The transport companies rate their sector in the SA economy as among the early majority. The "others" and producer organisations rate their sector in the global economy as among the early majority and the transport companies among the late majority. The pack houses rate themselves, their sector in the SA economy and their sector in the global economy in the early to late majority category.

Figure 20 represents the diffusion of ICT for resource management. When using the Internet to provide or obtain expertise at a distance, like remote consultation, distance learning and education

the producers and pack-houses rate themselves and their sector in the SA economy among the early majority. Their sector in the global economy is rated to be in the late majority.]

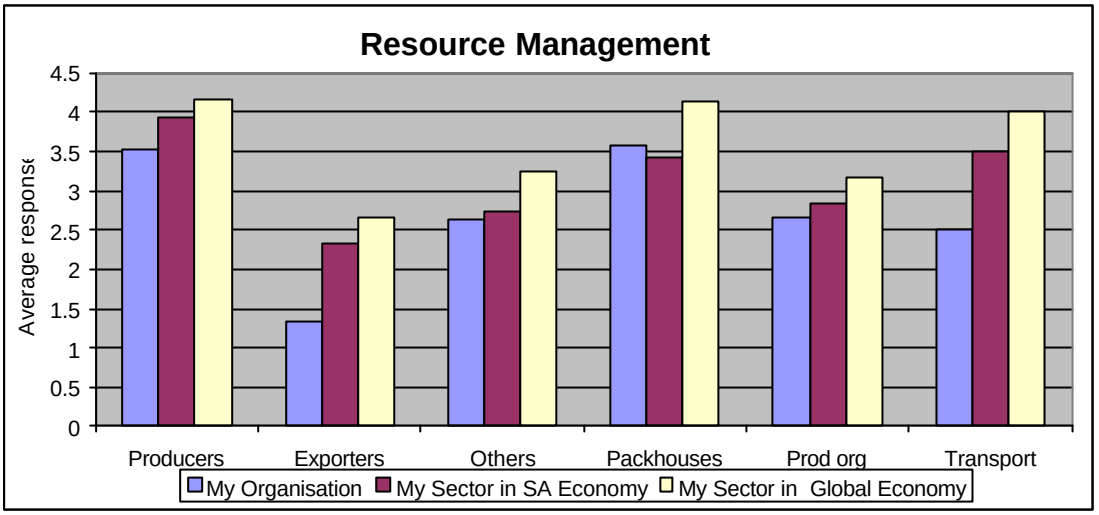


Figure 20: Resource management diffusion of ICT

The "others" and producer organisations believe that they and their sector in the SA economy are among the early adopters to late majority. Both of these subsectors perceive themselves in the global economy to be in the early majority category. The exporters rate themselves among the innovators and their sector in the SA and global economy among the early adopters to early majority. The transport companies rate themselves among the early adopters, their sector in the SA economy among the early majority and their sector in the global economy in the late majority.

4. Analysis and Interpretation

The reader must be aware that the sample size of interviewees is not statistically representative for the different subsectors. However, even with this shortcoming it is possible to arrive at some conclusions, which will be important for future research.

4.1 Nature of ICT Applications

Although the use of ICT is not *per se* a guarantee for success, powerful applications can make a substantial contribution towards increased competitiveness. The development and maintenance of export markets is increasingly dependent on an ability to meet the business requirements of the major chain store groups that are rapidly consolidating their position through strategic alliances and partnerships in order to improve global sourcing of food products. In order to compete in this trading environment it is essential that suppliers adopt similar strategies to those of the major players in the market. There is significant opportunity for the development of commercial alliances and partnerships in the global food industry that will improve competitive position and performance. The development of alliances with key international trading competitors will open up commercial

opportunities for businesses that rely on strategic cold chain management to supply export markets. The mission of such initiatives should be:

To give deciduous fruit suppliers the ability to guarantee complete satisfaction to customers by:

- Ensuring absolute product integrity
- Developing, in association with customers, world class business performance
- Building and maintaining structures and services that meet customer and alliance partner expectations.

Information technology will play an important role in accomplishing this mission. The relatively low cost of ICT overwhelms the potential revenue benefits. These benefits also include the long-term sustainable production of deciduous fruit and ultimately the survival of the industry. The study clearly indicates that there is a correlation between the nature of ICT use and the business environment. The motto of SA Table Grapes is "Grapes from South Africa, always sweet, always fresh". This motto is typical of the main objective of cold chain management. The study points out that in the main the use of ICTs is targeted at reaching this objective (for example, in the use of emerging technologies such as CAM and CAD).

Major changes are coming to the deciduous fruit industry as the growers feel the impact of retail consolidation. There is an oversupply of deciduous fruit everywhere, not just in South Africa. World production continues to put up a product that doesn't excite the customer. If there were a consumer delight index of deciduous fruit, it probably would have declined in the last decade. The only way to get more money for the farm is to find ways to add value to the product. For farmers and exporters that haven't already prepared for change it may be too late to survive.

There is a need to communicate with consumers. What do they want: choice, value for money, continuity of supply, a guarantee that what they put in their mouths is safe to eat and assurances that the fruit has been produced with a social conscience? Above all they want consistent quality and not just on the outside. Also, everyone knows that fresh produce is good for them. But fruit just doesn't have the same appeal, not to mention the same marketing budgets, as snack foods and other sectors. For too long, eating quality has been sacrificed for external appearance. The industry must realise that they must give the consumer what he wants and now is the time to redress the imbalance. This can only be achieved by maximising communication between all the role-players in the supply chain. There is a need to identify what consumers want in different market segments through effective communication. Once consumer needs are identified, they must be effectively communicated to the different subsectors within the deciduous fruit supply chain. However, consumer needs change rapidly. Within such a marketing environment the effective use of ICT has become indispensable to give consumers what they want and thereby maximise profits. Traceability has become a buzzword in the deciduous fruit industry. Because of the perishable nature of the product, information needs to be transmitted fast, thus timely information is essential to ensure effective management in the supply/cold chain. This can only be achieved through state-of-the-art ICT.

The study clearly points out that many ICT drivers are related to consumer/client communication. The correlation is strong and the authors are of the opinion that it will grow even stronger in future

since the scope for product diversification in the deciduous fruit sector is fairly limited. To be successful, it will be essential for the South African fruit industry to convince consumers through highly efficient and sophisticated ICTs that the South African product is better than that of the competitors. This is indeed a challenge and can only be accomplished with the strong involvement and partnership of the ICT sector.

4.2 Extent of ICT Diffusion

The use of ICT in the deciduous fruit sector does not have a long history. It has gained momentum during the last four to five years. The deregulation of the industry in 1997 stimulated diffusion since it sparked an immediate need by all the subsectors for global and local information and increased communication needs within the global marketing environment. Overnight, farmers and other role-players did not only have to compete amongst each other but also with farmers in other countries and with foreign governments who heavily subsidise their industries directly or indirectly. This also coincided with an annual decrease in funding for the commercial agricultural sector in South Africa. At present South African agriculture is one of the lowest subsidised agricultural sectors in the world. Government in the event of natural or other disasters previously protected farmers but within this new environment they must take all the risk. Given the information above, this section is intended to show the reader through examples how these changes affected the diffusion of ICT.

During the 2001 pome fruit season the DFPT estimated that financial losses in the apple industry alone, due to inefficient communication between local marketers, on the local market was in excess of R150 million. This is by far not the only loss in the South African deciduous fruit industry due to a lack of marketing co-ordination. Although it is difficult to calculate the foregone profits due to this lack of communication these losses are real and substantial. During this study it has become evident that many of these problems are related to the lack of effective use of ICT. In many regions a simple technology such as Internet and cell phone technology either does not exist because of a lack of infrastructure or is highly inefficient in terms of frequent interruption of services. It is obvious that this must cost the industry a substantial amount of money for the following reasons:

Inefficient flow of information between especially primary producers and other sub sectors in the supply chain. Producers do not get timely information on state-of-the-art technology, information on their competitors, what consumers want, price information, crop estimates, fruit intakes at packing-houses and shipment volumes to market destinations, phytosanitary requirements of import countries and also good agricultural practices (GAP) requirements such as EUREPGAP. Worse still, many farmers don't even realise that the lack of timely information and communication is a substantial cost to the individual farmer as well as the industry.

The cost of inefficient logistics. In the deciduous fruit industry cold chain management is of paramount importance. In many cases fruit are rejected for the export market (with huge financial losses) due to a lack of knowledge (mainly because of poor communication).

The cost of lack of timely information on new cultivars can also be traced back to the inefficient use of ICT. It is generally accepted by the industry that the South African deciduous fruit sector has built up a backlog compared to its major competitors in the introduction of new cultivars. This can mainly be attributed to a lack of direct communication with our consumers in the export markets. The financial crisis on many deciduous fruit farms can be traced to the fact that they still farm with old cultivars. To rectify this problem will take years due to the long-term nature of deciduous fruit farming. Biotechnology will play an important role in decreasing the time needed to produce new cultivars commercially.

The latest tendency for service providers is that almost all new services are to some extent ICT related. In the deciduous fruit sector this includes:

On a farm level, this means the introduction of Geographical Information Systems (GIS), weather reports through satellite technology, precision farming, internet farm planning through expert systems (i.e. direct access to specialised farm planning technology through the internet), irrigation scheduling, evaporative cooling, monitoring of fruit fly by communicating through the SMS medium, information transfer between farmers and producer organisations, traceability information and technical assistance services and local and export market information services.

Transport services increasingly make use of SMS and other cell phone services and satellite tracking services.

There is an increasing tendency for market co-ordination to depend on the efficient use of ICT technology by pack-houses, cold storage depots, fruit pallet tracking services, the Perishable Products Export Control Board (PPECB), and feedback to exporters and ultimately producers. It is of paramount importance that independent information with high integrity is produced by service providers to accomplish an efficient co-ordinated marketing effort. The table grape industry is an excellent example of how this can be achieved. After deregulation the industry was in chaos due to uncoordinated marketing strategies. Many producers suffered huge financial setbacks. They reacted by organising their regional producer organisations into article 21 companies to generate funds to be invested in information services and marketing. One of the first actions was to accredit exporters according to certain criteria to force "fly-by-night" exporters with no integrity out of business. This resulted in a code of conduct for exporters. Secondly they increased the accuracy of their crop estimates through a collaborative effort to gather information and to process it centrally. They contracted a pallet tracking company, which uses bar codes to keep track of most pallets of table grapes being packed in the different regions and to compile this information in a central database. This information and the fruit inspection information of the PPECB are then compared to establish the intake volumes, stocks, shipment destinations, expected time of arrival at destinations and actual arrivals at each of the market destinations. Also, the Fresh Produce Exporters' Forum established an interactive Internet database to collect price information from exporters on a weekly basis to provide price information to the industry. The DFPT appointed a data analyst to compile a weekly report to be discussed on a two weekly basis with all the relevant role-players. This new service proved to play a significant role in the marketing successes of the 2001/2002 season. Without the effective use of ICT such as the Internet, WAN, SMS, cell phones, barcode and satellite technology this effort

would not have been possible. The expectation is that the pome and stone fruit sectors will soon implement a similar service.

The transformation of business processes will determine the global competitiveness of the industry in future. It is generally accepted that the sustainability of future business growth will be in e-commerce. Although Business to Consumers e-commerce still plays a relatively insignificant role in the deciduous fruit industry it is expected that it will increase rapidly in future. It has been estimated that in the USA approximately 3 percent of fruit trade is though e-commerce. However it is expected that growth will be rapid and will gain momentum as the percentage increases. Business to business e-commerce is gaining momentum globally and in the South African fruit industry. The most popular use is Internet banking. However, in many remote production regions where Internet services do not exist or where they are inefficient, e-commerce cannot be employed.

The effective use of ICT is a powerful tool to break down organisational boundaries. Effective communication increased the awareness of organisations in the deciduous fruit industry that they cannot operate in a vacuum with strict boundaries. After deregulation in 1997 there was a tendency to "scatter". However, through an increased awareness of a need to collaborate (ICT played an important role in this process) a natural process of consolidation and a common mission to be globally competitive gained momentum. Collaboration between the deciduous fruit organisations, the Citrus Growers' Association, and the Subtropical Fruit Growers' organisations is on the increase. A visible product of this is the SA Fruit Journal that will be published soon. This journal will replace the individual journals. Partnerships with organisations are also on the increase. The DFPT have strong partnerships with various research organisations as well as service providers. A notable one is the partnership with the Centre for International Agricultural Marketing and Development (CIAMD). The CIAMD-DFPT partnership evolved from a need to generate independent market and strategic industry information. The CIAMD is linked to the University of the Free State Department of Agricultural Economics. The CIAMD Paarl office is situated in the premises of the DFPT, which is more than a 1000 km away from the CIAMD head office in Bloemfontein. Through its link with the head office, the DFPT does not only have access to the professional services of the staff at the CIAMD Paarl office but also to the whole CIAMD team in the rest of the country. As recently as 1994, this would not have been possible due to a lack of appropriate ICT technology. The diffusion of ICT in the deciduous fruit sector can and will play an increasing role to gain momentum in similar efforts.

4.3 Status within International Context

In an international context, the Southern Hemisphere countries are actively involved in creating a united front in the marketing environment. An organisation, SHAFFE, provides a forum where Southern Hemisphere exporters and producer organisations exchange information on crop estimates, shipment volumes etc. Recently the World Apple and Pear Organisation (WAPO) was established with similar objectives. These efforts would be impossible without the use of appropriate ICT technology because of the time value attached to information.

4.4 Expected Trends in aApplications

It is expected that the following ICTs will play an important role in the deciduous fruit sector:

- E-commerce related technology will play an increased role in the deciduous fruit sector in future. The increased speed at which transactions will be expected to be finalised as well as the need for product information will be the catalyst.

- On a farm level, traceability signifies more information on production activities. This will spark a growth in information systems, such as GIS related systems. Traceability management information systems will increase in sophistication and accuracy. Increased pressure on the supply chain by retailers will ensure the supply of this information.

- Global competition will enhance the development of integrated databases and management information systems which will combine crop estimates, product intakes, stock, shipment, sales and price information to calculate breakeven points for everyone in the supply chain.
- The accuracy of crop estimate systems will become of paramount importance to plan infrastructure and to develop longer-term marketing strategies to become or to stay internationally competitive.

- The development of communication technology to provide information to consumers is already important but the importance will escalate because of a more developed and more informed customer. More sophisticated customers tend to demand more information.

- The need for the use of increasingly sophisticated ICT systems in the deciduous fruit industry will increase. The survey results reveal that in many cases the technology is available but staff do not use the full capacity of systems due to a lack of knowledge.

- During 2001 statutory levies were introduced by the deciduous fruit sector to fund research and information requirements. However, the National Department of Agriculture required that the industry supply them with a quarterly report on trends in the industry. Without proper information flow it is not possible to generate the required information. In future this demand will become a requirement for continued statutory levies on the industry.

- The rapid diffusion of ICT to increase organisational efficiency has already been mentioned previously in this report (table grape example).

5. Conclusions and Recommendations

The study identified the present status of ICT diffusion, shortcomings and future needs for ICT in the deciduous fruit industry. The following can be concluded from the survey results and the experiences of the authors:

The most advanced use of ICT is by the exporters, research organisations and producer organisations. The relatively low level of ICT use by primary producers is related to infrastructure problems and a lack of knowledge in the use of some of these technologies.
There appears to be no correlation between the level of ICT use and the size of organisations.

PCs are the most important hardware used by primary producers. Servers are widely used by all the subsectors with the exception of the primary producers. It is interesting to note that in most of the subsectors, emerging technologies play an important role. This is closely correlated to transforming businesses to be globally competitive.

Primary producers mainly use dial-up networking and to a lesser extent LANS and WANS. It is clear that wireless application is still in its infancy but it is expected that this will increase in future because of the rapid development in satellite technology. The most common communication technologies are LANS and WANS, except in the transport and primary producer subsectors. Also of interest is that with the exception of research organisations the whole industry to a large extent still depends on dial-up technology.

The combined use of e-mail and the Internet for information acquisition and communications is most popular in all the subsectors. Intra- and extranets follow this. As expected, due to the requirement for efficient communication with overseas customers, the exporters are the main users of teleconferencing and video conferencing devices.

Primary producers main applications of ICT are in strategy and planning and for business support activities. Although this trend is the same for the other sectors, ICT use in customer service and distribution planning and control is also significant in these sectors.

The most important role of ICT in the transformation of business processes is in provision of information and interactive on-line services. The study also clearly points out that e-commerce applications are more developed in the field of business to business than for business to customers. The most common e-commerce application is Internet banking.

It is concluded that the exporter's perceived ICT spending pattern is on par with the sector's pattern and grows more quickly than for the other subsectors. This is not surprising since they are in the frontline of marketing the product and communicating with the final consumer. All the other sectors are about average or slightly higher than average in both present ICT expenditure and growth on ICT expenditure.

Producers mainly use ICT suppliers and specialised private sector trainers as sources of ICT information. There is a close correlation between the size of organisations and their source of ICT information. Large organisations normally employ ICT experts to provide managers and staff with ICT information. These experts mainly use ICT suppliers, consultants, service providers and the Internet as sources of information.

The same tendency appears in sources of ICT training. Larger companies have their own capacities for in-house training. However, in the deciduous fruit sector this is not common and most of the subsectors use specialised private sector trainers or ICT suppliers as sources for ICT training.

Economic conditions are not an important barrier in the use of ICT. Short and medium term competition, the attitude of management and personnel as well as global competition seem to be strong external driving forces in the use of ICT.

The study points out that there are very few barriers for ICT implementation in the supply chain. The needs in this regard are all important driving forces for the introduction of exciting new developments in ICTs.

The most important internal barrier in the use of ICT is perceived cost. However, these results contradict what the interviewees indicated under external economic factors. Her they say that economic conditions are not really a barrier. It seems that there are more barriers for primary producers than other subsectors of the supply chain. This is not surprising since most of these farmers are less informed on the use of ICT than other subsectors.

The study clearly indicates that primary producers and transporters are in the late majority in the extent of ICT diffusion in product/service innovation. This result is consistent in that it relates to the general lack of knowledge on the primary level. There is also a tendency for exporters and producer organisations to be early adopters or in the early majority. The same tendency applies to almost all the other categories of ICT applications. In general most of the subsectors perceived their sectors to be in the late majority in a global context. This can probably be explained by the fact that the South African industry was highly regulated until 1997 and most of the subsectors were not exposed to a highly competitive international environment.

What can the Sector do to better exploit ICT?

The research team is of the opinion that the sector can improve the use of ICT by providing the different role-players with information on available technologies and how they can be used to improve the efficiency of the supply chain. The DFPT should play an important role in this regard by raising awareness of the cost to the industry with regard to inadequate information and communication systems and the possible solutions that different ICTs can provide. Subsectors can also play a role by communicating their information and communication requirements to the other subsectors and in collaborative efforts to find ICT solutions to these problems.

The sector can play an important facilitating role in disseminating the use of ICT in the emerging farmer sector. Although this sector does not produce a significant volume of deciduous fruit at present the volume will increase in future. The authors are of the opinion that ICT can play a significant role in increasing the efficiency and sustainability of emerging farmer development projects. The education and empowerment of emerging farmers is not an objective that can be reached in the short-term in this sector. The main reason for this is the long-term character of

production where most deciduous fruits take 5 years to reach full production. Currently there is no short-term solution for them to catch up and reach the level of the commercial farmers. However, empowering emerging farmers with the knowledge to use appropriate ICTs in the sector has the potential to reduce this period. The deciduous fruit industry (including all sub-sectors) can enhance the diffusion of ICT by:

- Facilitating the development of technical expert systems to be made available through the relevant ICTs.

- Facilitating and informing subsectors on the potential role that they can play in development projects.

- Most of these farmers come from a disadvantaged background and schooling and have had little or no contact with ICTs. Literacy training is a prerequisite for the use of many ICTs. In this regard the sector should play a role in at least making people aware of existing literacy projects.

- Another problem is that many of the current information and communication systems were developed for commercial farmers and do not cater for the specific needs of emerging farmers. The sector can play a role in the development of information systems, which are specifically targeted at emerging farmer groups. Although the national and some of the provincial Departments of Agriculture have taken some initiatives, the authors are not aware of any information system in an electronic format, which can be accessed from remote computers.

- In some cases infrastructure has been created but there is inadequate education and backup programmes to support the initial infrastructure. Although the sector can only play a facilitating role, the authors believe that training and information needs can be identified and this information taken up in existing transformation programmes such as those of the DFPT that were mentioned in the phase 1 study.

A private sector land reform initiative that is currently gaining popularity and in some cases being implemented with success concerns equity schemes where emerging farmers are in a partnership with commercial farmers. In this way emerging farmers can make use of the available expertise and knowledge of the commercial farmer and will therefore have indirect access to electronic information. However, the diffusion of ICTs in this indirect way is not sustainable and more will have to be done to increase the direct use of ICTs by emerging farmers as they gradually become more independent. Finally, such projects will benefit whole communities through education and upliftment.

What can the ICT Industry do for this Sector?

The most efficient way to involve the ICT industry is to provide all subsectors in the supply chain with adequate information and training services. An increase in awareness and knowledge of current and future ICTs will stimulate the diffusion of ICT in these sectors. Also, there is a lack of understanding of ICT language. The survey clearly points out that many people do not understand

the terminology. The ICT sector can play an important role in the development of a "layman's" language that can be understood by relatively unsophisticated users. It was mentioned earlier in this report that current information systems are not appropriate for emerging farmers. The same is true for training programmes in the use of ICTs. The ICT sector can play an important role in enhancing the diffusion of ICTs to previously disadvantaged rural communities and specifically to emerging farmer groups by developing training programs for relatively ICT illiterate communities.

To be globally competitive will become increasingly more difficult in the future and for emerging farmers to enter the global market even more. They need to be informed of national and international regulations, especially concerning food safety, before they even think of exporting their products. They cannot produce fruit with no idea of where the fruit will be marketed. The only way for them to reach the high value markets is through the use of ICTs. But reaching the global market is a long-term goal. If emerging farmers have access to ICTs and the knowledge to use them they can obtain crucial information needed for making strategic decisions concerning suitability of areas for certain crops.

They can also obtain up-to-date information on:

- Local and export marketing opportunities.
- Technical and financial aspects.
- Up-to-date information on the latest cultivars, future trends in consumption, area specific climatic conditions, etc.

The ICT sector could play an important role in developing expert systems for remote regions.

What can Government do?

The role of any responsible government is to create a business environment where businesses can flourish for the benefit of all the inhabitants of that country. In South Africa the government accepts the role of the deciduous fruit sector as a growth engine for the economies of many of the provinces. However, in many cases the infrastructure does not exist or is too expensive for communities to create on their own. It is especially in remote areas and in previously disadvantaged rural communities where government can play an active role in ensuring that the infrastructure exists for people to make use of ICTs.

Government can collaborate with private sector institutions/companies to create these infrastructures. These partnerships can also provide training in the use of ICTs. In many cases land reform is characterised by a group of emerging farmers receiving a land allocation (or land right). It is impossible to educate all these farmers in the use of ICTs. The focus should be on educating one or more delegates from each group. With the help of local extension officers these delegates can then act as examples and educators for their fellow farmers. It is up to government to provide the emerging farmer groups with an extension service to facilitate relations between the private sector, government and the affected communities.

It was pointed out earlier that the agricultural sector receives minimum subsidies in South Africa. To enhance economic growth, the researchers are of the opinion that a good case can be made for government to either finance infrastructure development or to subsidise it generously in areas where infrastructure inhibits the use of many existing technologies. These include, for example, telephone lines, cell phone technologies as well as the provision of central Internet access points. The returns on such investments should reveal a positive cost-benefit ratio due to strong forward linkages between agriculture, and specifically the deciduous fruit sector, and other economic sectors.