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OVERVIEW AND SYNTHESIS OF MAIN FINDINGS
(ICT DIFFUSION AND APPLICATIONS)

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1.   Introduction

The Department of Trade and Industry commissioned a study of the use and diffusion of Information and Communications Technologies (ICT) in eight industrial sectors in South Africa. The sectors were drawn from three broad categories—so-called traditional sectors, service sectors, and new economy sectors, as follows:

Traditional	Service	New Economy
Platinum Mining	Cultural Tourism	Biotechnology
Automotive Manufacturing	Health Information Flows	Multimedia
Clothing Manufacturing		
Deciduous Fruit Farming		

The intention was to examine likely trajectories for the absorption of ICTs in these sectors and suggest how government and the domestic private sector might adjust their policies and strategies to maximise the benefits of ICT to South Africa.

The study builds on existing research work and comprises two phases—desk research into international trends in the selected sectors (Phase I) and empirical research on each of the sectors in South Africa (Phase II).

The Phase II study was based on a survey of the perceptions of nearly 400 people across the eight sectors concerned, who responded to questions categorised as follows:

- Background Information
- ICT Usage
- ICT Spending Patterns
- Sources of ICT Information and Training
- ICT Adoption: Drivers and Barriers
- Diffusion of ICT

In addition, each respondent was asked a set of questions which were particular to that sector.

This report provides a brief overview of the local findings, links the local and international findings and summarises the main recommendations as to possible future interventions to foster diffusion of ICT. It also contains the extended summaries for each of the sector reports[1].

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[1] The overview in this report is perforce very brief. It is intended to place the specific studies within an overall context rather than do real justice to well over 500 pages of professional study and research by the South African sector leaders, coordinators and the international consultant. The detailed results are now available and readers wishing to study them are encouraged to obtain the full reports at *www.tips.org.za/research/dtipsp*

2.   Important Issues Common to All Sectors

Each Sector had specific recommendations for that Sector, the ICT Industry and the Government, which were aimed at enhancing the diffusion of ICT through that sector. There is a common thread running through most recommendations that can be used to distil several main areas of concern.[2]

- **Cost, Availability and Reliability of Telecommunications Infrastructure**

  This factor was cited by all sectors, across the full range of company sizes, as the single most important impediment to ICT Diffusion within each sector. It is seen as a major cause of competitive disadvantage in a globalising world. Organisations that operate in a rural environment (such as those in the Deciduous Fruit and Mining Industries) are particularly vociferous about the difficulties they encounter, as are those where rapid communication is a competitive imperative (e.g. Biotechnology). In the Deciduous Fruit Sector, for example, 23 out of a total of 25 responses cited communications infrastructure, slow telephone lines or a variation thereof, as a technology gap.

- **Training**

  o   Every sector expressed the need for increased government involvement in either subsidising training, promoting training more explicitly, or motivating the Sector Education and Training Authorities (SETAs) to provide more ICT training.

  o   There were also suggestions for multidisciplinary training (e.g. between biotechnology and ICT disciplines).

  o   Incentives in various forms were suggested, highlighting that either existing incentive schemes were seen as inadequate/ineffective or had not been publicised enough.

  o   Each sector felt that more could be done in the sector through Industry Associations or other business groupings to provide better and more relevant ICT training. Courses could be devised that are targeted at the realities of a sector rather than generic training which is often seen to be expensive and over-emphasised (e.g. in the Clothing Sector, ICT training on topics such as CAD/CAM could be made a part of a practical training curriculum).

  o   There should be active dissemination of ICT Training among empowerment groups or new entrants through mechanisms such as the collaboration with ICT companies, literacy training, or development of expert systems. This was noted particularly by the platinum mining and deciduous fruit sectors.

- **Awareness Raising**

  o   Various respondents commented on the need for greater public awareness of both the benefits of ICT and the integral links of ICT with innovating sectors such as Biotechnology or Multimedia. Suggested actions ranged from 'road-shows' to the publication of 'success-stories'. Respondents felt that the task of raising awareness of the

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[2] Many of these issues were also identified by the South African Information Technology Industry Strategy (SAITIS) project, with specified courses of action as proposed in the ICT Sector Development Framework document of November 2000 (*www.saitis.org.za*)

potential benefits of ICT rested with all three major role-players i.e. the sectors themselves, the government and the ICT sector.

- ## Information Flows and Common Standards

  The need was often expressed to integrate information flows across different players within the value-chain and indeed between the public and private networks relevant to particular sectors. This led to the call for common data and transaction standards within the value-chain, emphasised most strongly by the Automotive and Health Sectors. Such initiatives are clearly of great importance to support effective exploitation of business-to-business and business-to-government e-commerce.

- ## Introduce More Rigorous ICT Quality-Control Standards into the Industry

  In particular, ways should be found of providing appropriate services to SMMEs who often find themselves in the parlous position of not having the skills or money to select and install suitable systems and very often get advice from suppliers that is not necessarily in the interests of the company. ICT Industry Associations can take the lead here by promoting professionalism within the Industry and by providing forums where small businesses in particular can engage in dialogue with suppliers.

- ## Collaboration between the ICT Sector and other Sectors

  Many respondents felt that if the ICT Industry and their Sector were able to form links at the Sector level, the spin-offs could be considerable. Examples include joint conferences, business ventures, and strategic partnerships.

- ## Reduce 'Cost of ownership' of ICT Solutions

  The opportunity exists to develop product and financing innovations that are more suitable to the needs of South African companies, which are being forced to settle for 'developed country' solutions even where such solutions are inappropriate. The problems are multi-faceted and need to be tackled by cross-disciplinary teams.

- ## Incentive schemes

  There were various comments regarding tax breaks, write-offs, import offsets and publicity regarding existing schemes. A number of comments indicated that existing schemes were too cumbersome to respond to—clearly action can be taken to improve this area on a number of fronts. Other countries have similar problems. In Canada, for example, one region complains about existing schemes being too cumbersome while another region uses the same scheme exclusively without apparent difficulty.[3] This requires further investigation in the South African context.

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[3] G Sibthorpe, personal communication

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3. Key Actions to Increase the Diffusion of ICTs

In addition to the above common themes in all sectors, there were sector-specific proposals emanating out of the study that the Sector Coordinators believe have particular merit. The recommendations that follow are based on the outcomes of the Phase II study, but also draw on the overall experience of the research team.

This section presents discussions in the following two areas:
i)   Key actions that can be taken by the DTI /Government; and
ii)   Specific projects emanating out of the individual sector recommendations

3.1 Key Actions to be considered by the Department of Trade and Industry / Government

- *Expedite the Liberalisation of the Telecommunications Industry*

  The requirement for a competitive telecommunications environment is a *sine qua non* in the modern economy. There is little doubt that the present restricted competitive environment is damaging the ability of certain sectors to compete. Although pricing parity against the major developed countries on an industry-by-industry basis may be hard to achieve, there are a number of innovative technologies that could rapidly be brought into play to improve service levels in particular circumstances. Innovation is currently being stifled through regulation.

- *Co-ordinate the provision of ICT training across all SETAs*

  There is a general consensus that the SETAs are not making enough effort to provide / promote ICT training. The holding of a national workshop where both the SETAs and Industry are represented could initiate changes in this environment.

- *Ensure that Current Incentive Schemes are Meeting the Needs of Industry*

  There appear to be several explanations for the perception that there are no incentive schemes in place:

  i)   Suitable schemes are not available;
  ii)   Suitable schemes are available but are not being widely used because they are inappropriate or difficult to access; and
  iii)   Suitable schemes are available but the potential users are not aware of them due to insufficient marketing actions.

  Whatever the reason, an analysis of the incentive schemes themselves and the reasons for industry perceptions that they are not adequate should be undertaken.

- *Establish a Programme to Facilitate the Growth of e-Commerce into African Countries*

  The growth of e-commerce into Africa is hampered by a lack of training, standards, infrastructure, and a common understanding of the potential benefits of this technology. For suitable progress to be made, a considerable investment needs to be made now so that the environment becomes progressively more attractive and facilitates economic growth on a national and regional level.

3.2   Key Actions to be considered by Industry

This section concentrates on the sector-specific initiatives that appear to have particular merit.

- *Develop Common Standards in Automotive Industry B2B e-Commerce*

  The Automotive Industry needs to implement a system of common B2B standards to enable Original Equipment Manufacturers (OEMs) to communicate with their suppliers at Tier Levels 1 and 2. Initiatives are already under way in this regard but need to be more fully supported and strengthened.

- *Create Biotechnology/ICT Industry Partnerships*

  These partnerships could develop new opportunities such as visualisation systems for molecular modelling and perhaps also be instrumental in alleviating bandwidth issues. The partnerships between these two sectors could result in new market growth opportunities for both sectors.[4]

- *Use ICT to drive Higher Value-Add Production in the Clothing Industry*

  South Africa faces fierce competition in the Clothing Industry from low-cost producers. The use of ICT is an important ingredient in moving up the value-chain in order to expand international markets.

- *Develop Regional Portals in the Cultural Tourism Sector*

  In order to compete effectively internationally it is important to consolidate marketing initiatives, particularly where individual budgets are limited and unlikely to have a major impact. Multimedia technologies are particularly appropriate in catering for cultural heritage and development products and services.

- *Use ICT to Improve the Efficiency of the Supply-Chain in the Deciduous Fruit Sector*

  Since this industry deals in perishable goods, the effects of inadequate or incorrect data and information can be profound. In particular, a project to disseminate and promote the use of ICT in the emerging farmer community, if coupled with the necessary training and support, could have very beneficial effects to grow this part of the sector.

- *Improve the Flow of Information in the South African Health Sector*

  Information flow in the Health Sector is perceived as being inadequate in two areas:

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[4] It is relevant that both sectors have been identified as priority areas by the Department of Arts, Culture, Science and Technology in its Technology Road Mapping initiative.

i) Inadequate, incomplete and inaccurate flow of information within the Public Health structures, particularly as it pertains to District Managers in the Department of Health; and

ii) 'Silos' of information are seen to exist within the public sector, the private sector and the academic and research community.

The necessary interfaces to ensure optimal exchange of information need to be put in place.

- *Develop Specialist Skills for the Multimedia Sector*

  Training for this sector is perceived to be ad hoc and generally inadequate. The training that is available outside of multimedia firms does not cater for the specialist requirements of the sector.

- *Assist Empowerment Partners in the Platinum Mining Sector with ICT Training*

  The major platinum mining companies will be expanding their activities strongly in the Limpopo Province. The number of empowerment and joint venture partners will be growing, and their contribution and impact can be enhanced through ICT training.

4.   Results of Phase I (International) Study

The findings of the Phase I Study on International Trends provide a useful background to the responses emanating from Phase II. A brief summary of the Phase I findings is included here and readers are encouraged to go to the full report for more detail.

4.1   International Trends – Basic Technologies

Wireless Networks and Satellite Technology have evolved to the point where wireless access is generally available. Use of wireless is made attractive by the emergence of standards (e.g. Bluetooth and WAP), inexpensive standards-based devices, and a wide array of digital programmable devices, many of them portable.

Monitoring & Sensing Technology is proliferating. Monitoring and sensing devices are prevalent in a wide range of applications. For example, they are used extensively in Automobiles, where they continuously monitor component performance. They are appearing in personal medical devices, consumer packaging (including clothing labels) and as part of smart-highway infrastructure. The list of uses expands daily. Coupled with wireless networks, this technology is a key foundation of burgeoning telematics, telemedicine and similar network based solutions.

Geo-spatial Technology (including remote-sensing) is being used in a wide range of applications from sub-surface mineral analysis to land-use monitoring to vehicle location tracking. Improvements in sensor technology, especially in the spatial, spectral, radiometric and temporal resolution, have enabled a proliferation of feasible applications. Geo-spatial technology provides the mapping support required for navigation systems that form a key part of the rapidly evolving telematics market.

e-Commerce (B2B & B2C) is defined as sales or purchases over the Internet, with or without online payment, excluding private networks. Dramatically increased computing power, the rapid growth of broadband networks, and out of the box software solutions are the key drivers behind the rapid growth of e-commerce across all sectors of the economy.

Robotics. With more powerful processors and smarter lower cost sensors, robot systems are becoming more intelligent. They have long been used in manufacturing applications and new uses are starting to emerge in entertainment, social, and environmental fields among others.

CAD/CAM software, and particularly 3D modelling has long been integral to industrial manufacturing businesses. With the increased availability of affordable, off-the-shelf software and improved 3D modelling capabilities, CAD/CAM use is growing in a variety of industries including, apparel and textiles, mining exploration and production, and building estimation and construction scheduling.

4.2   International Trends - Applications

eCustomer Relationship Management (eCRM) is the applications software that allows enterprises to deepen their relationships with customers through more effective sales management and customer service. It is based on a variety of technologies, including inbound e-mail management, outbound e-mail marketing campaign management, call centres, chat groups, voice over IP (VOIP), knowledge-base searching, customer self service, and interactive selling software. ECRM is becoming a cornerstone of eBusiness implementations.

Enterprise Resource Planning (ERP) refers to an integrated suite of business applications that typically includes a variety of financial and human resource management products.   At this time, most ERP vendors are actively pursuing e-business integration strategies that include web-enabling ERP business functions, linking e-business servers to ERP business functions, and integrating ERP business functions with their business partners. Convergence between ERP and Supply Chain Management (SCM) applications is also underway.

Multimedia technologies combine sound, video, text, and graphics into a set of systems, products, and services that are essentially interactive in nature. Multimedia standards, storage and interface technologies, tools and applications are evolving at a frenetic pace. Thus, the content side of the information revolution is now in a position to take advantage of the rapid growth of broadband networks that are making a wide range of new business applications possible. Such applications are starting to emerge in all of the targeted sectors.

Knowledge Management is a business concept that includes concerted, coordinated and deliberate efforts to maximize an organization's performance through creating, capturing, sharing and leveraging knowledge from internal and external sources. Extensible Markup Language (XML) is a metadata language widely used as the basis for knowledge management in a variety of business applications. A growing set of XML-based languages is being developed to meet the particular needs of specific business sectors (e.g. Automotive financial reporting).

5. Overview of Research Findings from Sector Studies

The eight sector studies used a generic questionnaire to obtain information in a number of categories, as described in Section 1: Introduction. In addition, every sector asked a number of sector-specific questions which were designed to obtain information on those aspects of ICT usage that the individual sector researchers believed were not covered or which required further elaboration.

The analysis that follows in this Section examines the data obtained from the generic part of the study from two perspectives:

i)   Overall averages obtained from the combined data aggregated across all eight sectors; and

ii)   Inter-sectoral variations.

5.1 Background Information on Phase II

The eight sector researchers collectively interviewed 396 people drawn from several parts of their respective industry value chains, and companies varying widely in size and geographic location. The samples were not intended to be representative, but to enable the collection of perceptions and opinions of a broad cross-section of industry leaders.

The first section of the questionnaire gathered background information. Table 1 shows the percent of companies of different sizes interviewed.

Table 1. Company Sizes by Sector

Sector	Large (>250 employees)	Medium (100-249 employees)	Small (10-99 employees)	Micro (<10 employees)
Automotive Manufacturing	65.2	28.3	6.5	0.0
Biotechnology	37.2	9.3	23.3	30.2
Clothing Manufacturing	56.0	22.0	20.0	2.0
Deciduous Fruit	31.0	23.8	23.8	21.4
Health Information Flows	41.5	22.0	29.3	7.3
Multimedia	0.0	0.0	36.1	63.9
Platinum Group Mining	67.6	14.7	14.7	2.9
Cultural Tourism	24.4	9.8	29.3	36.6

While this spread does not necessarily reflect the range of company sizes in the population for each sector, it is noteworthy that more than eighty percent of the Automotive Manufacturing and Platinum Mining companies represented in this sample are medium to large, while the Biotech, Cultural Tourism and especially Multimedia sectors comprise mainly to almost exclusively small to micro enterprises. This is a possible reflection of the fact that these sectors are still in the early stages of developing into mature sectors.

The companies chosen operate in South Africa, Africa and internationally as shown in the pie chart below.
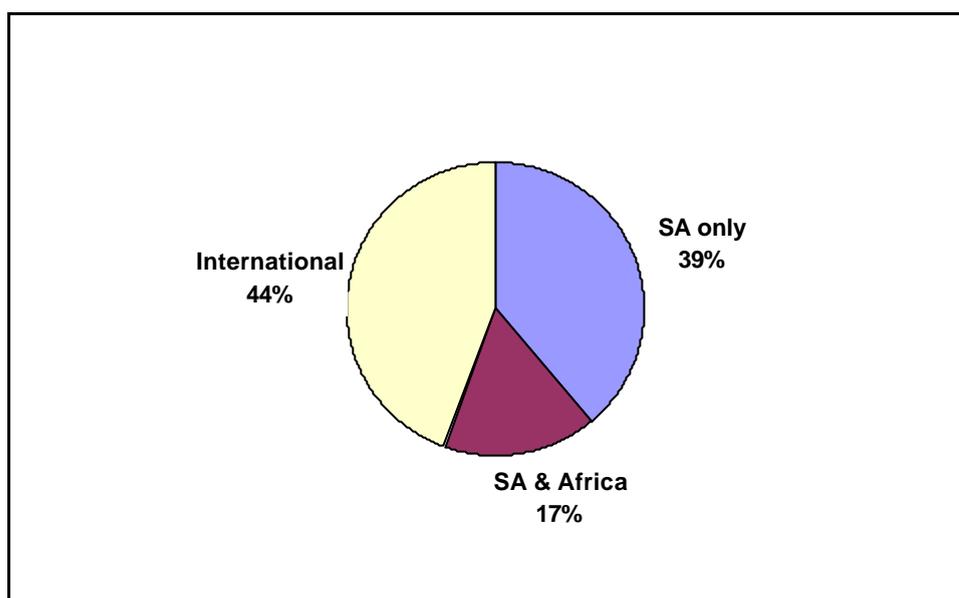
Figure 1. Company Sphere of Operations

Table 2 shows the breakdown of 307 of the 396 interviewees who reported their involvement with ICT.

Table 2: Involvement of Interviewees with ICT

1 (None or very limited involvement with ICT)	2	3	4	5 (Extensive involvement with ICT)
15	20	65	86	121

Most of the respondents thus claim average to extensive involvement with ICT, lending credibility to the responses in the rest of the questionnaire.

5.2   ICT Usage

The second section of the questionnaire polled the usage of basic hardware and communications technologies as well as a range of ICT applications.

5.2.1   Basic Hardware and Communication Technologies

As can be seen in Figure 2 below, all sectors reported high **Usage of PCs**, with the Multimedia sector stating almost "full utilisation" of PCs. Health, Deciduous Fruit and Biotech also reported very high usage. Servers are heavily used in the 'large company' sectors (Auto, Platinum Mining, Health) and also in sectors heavily dependent on communication for their existence (Multimedia, Biotechnology). The usage of CAD/CAM technologies is generally low, however, except for some usage in Platinum Mining, Automotive and Clothing. There is also little evidence of the use of so-called "emerging technologies" except in the case of Deciduous Fruit (probably geo-spatial technologies) and Automotive (sensing devices, robotics, vehicle tracking devices). These results should be treated with caution since the survey did not thoroughly explore the range of emerging technologies, such as those listed in the International Trends section.
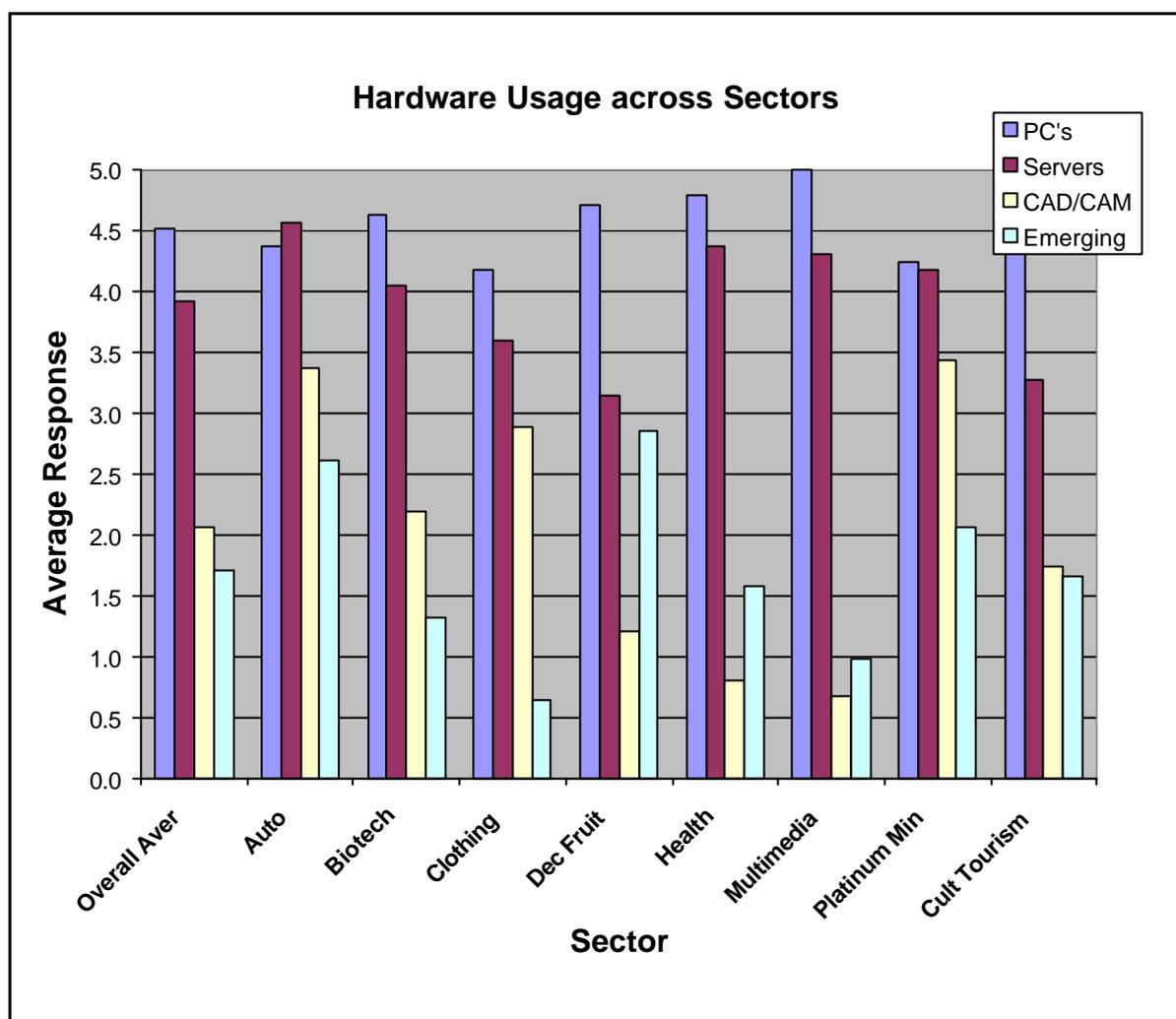
1 = No use at all, 5 = Fully utilised

Figure 2: ICT Usage – Basic Hardware

With regard to **Communications Infrastructure**, all sectors report significant use of Local Area Networks, especially Multimedia, Automotive and Health. Automotive and Health also report significant usage of Wide Area Networks/Virtual Private Networks. There is widespread Internet connectivity for all sectors, with more use of leased lines than dialup. There is clearly a relationship between leased lines and company size, but even in sectors where there are a significant number of smaller companies (e.g. Cultural Tourism) the use of leased lines is high. There are various possible explanations for this—in the Tourism Industry, for example, travel agents are extensive users of large centralised booking systems; however more detailed research would be required to validate this explanation.

It is noteworthy that there is almost no evidence of use of wireless data connectivity (VSAT, microwave, mobile, etc.), which is a set of communications technologies of growing importance especially in rural areas and areas where fixed line connections are unreliable (e.g. as reported by Deciduous Fruit). It would be instructive in a follow up study to explore the reasons for this, which might relate to existing legislation and/or lack of awareness of the possibilities.

5.2.2 Applications

The usage of ICT Applications was polled under twenty captions divided into three major categories: Information Acquisition and Communications, Streamlining Business Processes, and Transforming Business Processes.

Information Acquisition and Communications

The dramatic diffusion of **e-mail** for communications purposes emerges clearly with very high usage figures in all sectors. Most sectors also report extensive use of the **public Internet** (presumably for information acquisition in addition to e-mail). On the other hand **Intranets and Extranets** are not in much use except for Health and Biotech. It is noticeable that the Automotive sector makes quite low use of the public Internet, perhaps because the larger firms in that sector rely on their own private networks. There is minimal use of **teleconferencing** except for Automotive and Health, and **videoconferencing** is minimal across all sectors. This suggests missed opportunities to exploit telecomm facilities for efficient and effective communications between and within companies. As noted in the Key Recommendations, concerns about telecomm costs and lack of bandwidth have emerged strongly from this study and may explain this result.
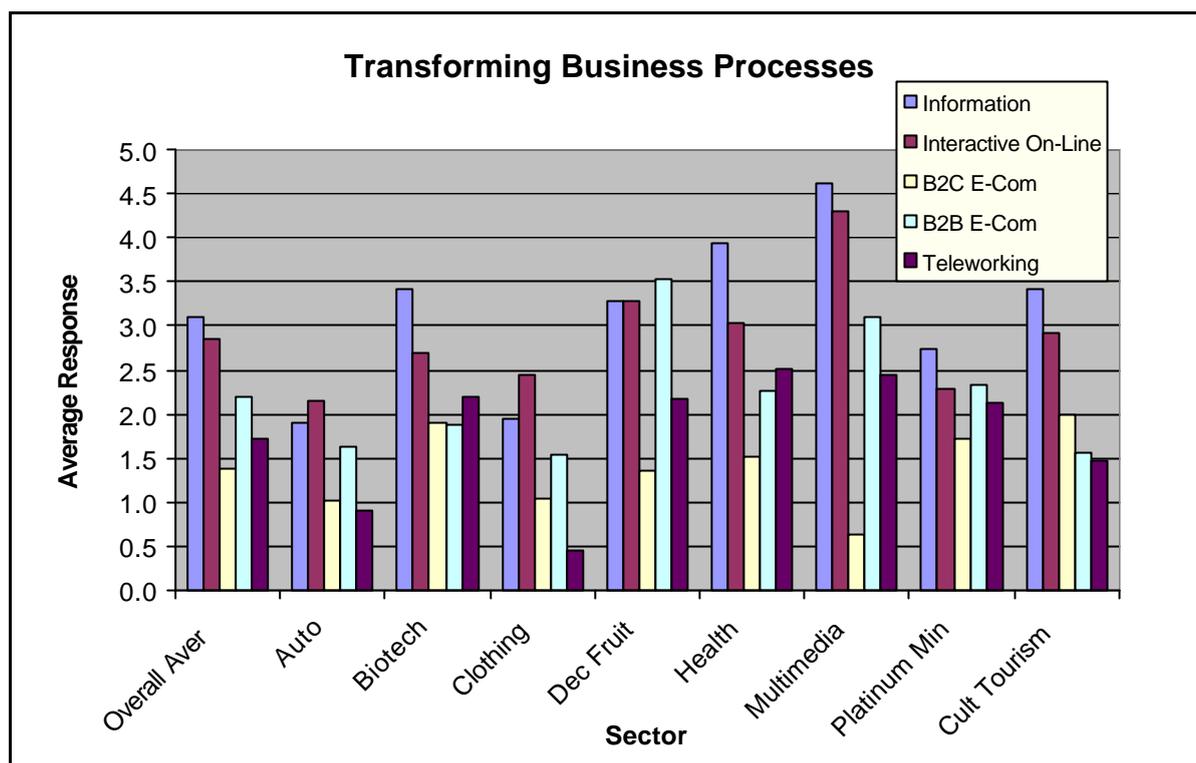
Streamlining Business Processes

The extent to which sectors are exploiting ICT to streamline their business processes was examined in several application areas. Almost all sectors reported high usage of ICT for Business Support (finance and accounting, payroll etc.), which is not surprising since this is the area where ICT has been in use the longest. The Automotive sector reports medium to high usage of ICT for Purchasing, Manufacturing Process Control, Inventory Management, Distribution and Systems Integration. Deciduous Fruit states high usage in Strategy, Customer Service, R&D, Manufacturing Process Control, Distribution and Systems Integration. This suggests that the sectors in question have progressed quite far in the application of ICT in their organisations. *In all other sectors the usage of ICT for these other categories of business process streamlining was very low.*

Transforming Business Processes

This section examined the more sophisticated applications of ICT, essentially enabled by the Internet, the World Wide Web and e-Commerce. With the exception of the Biotech and Multimedia sectors, which report high usage of CD-ROMs and Websites for acquisition and provision of information and some use of interactive on-line services, *there is almost no stated use of ICT for any of the categories here*, including CD-ROMS, Websites, business-to-consumer e-commerce, business-to-business e-commerce and teleworking.

In a way this finding is not surprising, since it is likely that the firms ready to consider radical changes to their business processes will already have adopted the better-known opportunities afforded by ICT to streamline their existing processes. The previous section suggests that, apart from Automotive and Deciduous Fruit, very few firms in this sample have even reached that point.

1 = No use at all, 5 = Fully utilised

Figure 3: ICT Usage – Transforming Business Processes

If the profiles reported by the interviewees and companies in this study are representative of their industries as a whole, these findings are very important. They suggest *disappointingly slow diffusion of ICT into major industrial sectors in South Africa.* But of course they also suggest many opportunities for South African organisations and sectors to use ICT for greater efficiency, effectiveness, innovation, customer service, etc. Many of the respondents made specific comments as regards future focus and readers are referred to the respective summary reports for the detail.

5.3 ICT Spend

Respondents were asked to assess the ICT spending patterns of their firms relative to their sectors in South Africa. Generally the sample of firms in this study considers they are on a par with their sector in general in South Africa. In relation to their sector globally, in all cases except Deciduous Fruit, *the local sectors consider they are behind their equivalent sectors internationally.* This is especially so for Clothing and also for Multimedia and Biotech. Given the opportunities for the Clothing sector occasioned by the Africa Growth and Opportunity Act (AGOA) and the potential for new economy sectors such as Biotech and Multimedia, there is little doubt that ICT is already a vital competitive element in the global context. This is therefore an important finding and needs to be confirmed for representativeness in these sectors.

5.4 ICT Information Sources and Training

This section polled respondents as to sources of ICT-related information and training. For most sectors, suppliers of their hardware and software are the primary sources of ICT

information. The primary source for the Multimedia and Tourism sectors is the Internet, and Biotech relies on internal experts. Significantly absent as sources of information are government, Trade and Industry organisations and Chambers of Commerce.

As regards training, it is again the ICT suppliers, supplemented by in-house training and internal experts that are most used. Multimedia makes strong use of the Internet. There is little use of Universities and Technikons, and Trade and Industry organisations and Chambers of Commerce as well as government training initiatives are not mentioned.

There is thus a surprising lack of industry and government input into provision of ICT-related information and training. This is a concern since suppliers of hardware, software and telecomm facilities are primarily interested in selling their products. As sources of information and training, they are likely to be biased towards technical rather than business solutions.

5.5 Drivers and Barriers to ICT Adoption

This question examined nineteen factors that might hinder or encourage organisational decisions to invest in ICT. The factors were grouped by External Economic Factors, Supply Chain Factors and Internal Factors.

External Economic Factors

General economic conditions are seen as neutral to negative influences to investment in ICT by all sectors except Automotive. The latter may be an exception because of its vibrant export market.

All other external factors—*the sectors' culture and attitude towards ICT, expected increased competition, increased global opportunities and increased influence of multinationals*—are either neutral or positive influences for all sectors. For all factors this is especially so for Deciduous Fruit. Multimedia highlights Culture and Attitude as a positive driver, and Automotive notes the influence of multinationals.

Supply Chain Factors

To a greater or lesser extent all sectors see the supply chain factors as drivers for ICT investment. These include: *need for increased organisational efficiency, improved communications and reduced paperwork, and responding to customer, supplier and government needs and national/international regulatory/environmental standards.* The strongest drivers appear to be meeting customer requirements and the need for better communications.

Internal Factors

Management and staff attitudes are generally a positive influence, especially for Deciduous Fruit and Multimedia. The *level of ICT skills in the workplace* is a driver for Multimedia and Deciduous Fruit, but bordering on a barrier for Clothing and Cultural Tourism. *The availability of ICT professional skills* is a neutral to negative factor except for Deciduous Fruit, which sees it as a driver. *The need for increased computing to do business* is a driver for all sectors. Finally, Figure 4 clearly shows that *the perceived cost of ICT* across all industries is a significant barrier to investment. There are probably a num-

ber of reasons for this, from the high relative cost of goods and services compared with overseas competitors to the difficulty of estimating ROI on ICT capital expenditure.
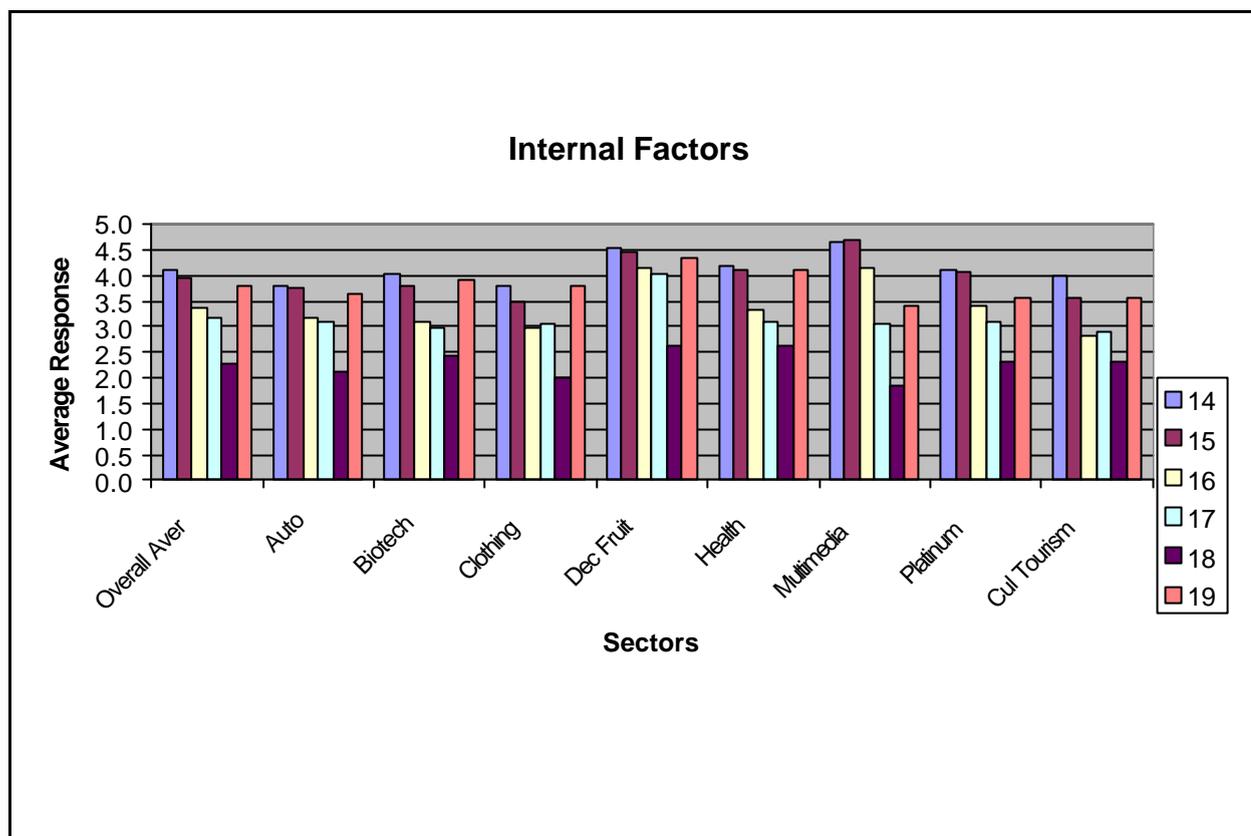
Figure 4: ICT Adoption: Drivers and Barriers – Internal Factors

Where   14 = Attitude of Senior Management towards ICT

15 = General Attitude of personnel towards ICT

16 = Level of ICT Skills in the workplace

17 = Availability of ICT professional skills

18 = Perceived cost of ICTs

19 = Need for increased computing to do business (R&D and other functions)

5.6   Diffusion of ICT

This final section of the interview guide applied Everett Rogers' well-known model of diffusion of innovations to ICT in South African organisations. The questions called on interviewees to assess the extent of adoption of ICT in their own organisations, in their sectors relative to the SA economy as a whole, and for their sector in South Africa in relation to their sector globally. Further, the interviewees were asked to consider ICT diffusion in five areas: Product/Service Innovation, Market Innovation, Administrative Process Management, Relationship Management and Resource Management. In terms of the Diffusion Model, in each case, entities could be assessed as being Innovators, Early Adopters, Early or Late Majority, or Laggards.

Table 3 summarises the results for the eight sectors across the five categories of application. Brief notes follow on the separate sectors.

Table 3. Summary and Comparison of Diffusion Of ICT in Eight Industry Sectors

	Product/ Service Innovation	Market Innovation	Administrative Process Management	Relationship Management	Resource Management
Automotive	Early Majority	Late Majority	Early Majority	Early Majority	Late Majority
Biotech	Early Majority	Early Majority	Early Majority	Late Majority	Early Majority
Clothing	Early Majority	Early Majority	Early Majority	Late Majority	Late Majority
Deciduous Fruit	Early Majority	Early Majority	Early Majority	Late Majority	Early Majority
Health	Early Adopters	Early Majority	Early Majority	Early Majority	Early Majority
Multimedia	Early Adopters	Early Adopters	Early Adopters	Early Majority	Early Adopters
Platinum Mining	Early Majority	Early Majority	Early Majority	Late Majority	Late Majority
Cultural Tourism	Early Majority	Early Majority	Early Majority	Late Majority	Late Majority

Innovators, **Early Adopters**, **Early Majority**, **Late Majority**, **Laggards**

Automotive: Regard themselves as in the Early Majority with respect to ICT in Administrative Processes, Product/Service Innovation using ICT, and use of LANS/WANS and the Internet for Supplier and Customer Relationship Management; but Late Majority in the use of ICT and the Internet for Market Innovation (e.g., B2C and B2B ecommerce) and Resource Management (e.g., distance learning)

Biotech: Also rate themselves as Early Majority in Administrative Processes, Product/Service Innovation, Market Innovation and Resource Management. Late majority for Relationship Management.

Clothing: Similar to Biotech, but see themselves as Late Majority as regards Resource Management using ICT and the Internet.

Deciduous Fruit: Similar to Biotech, but close to being Early Adopters as regards Administrative Process Management.

Health: Shows a somewhat different pattern; the only sector outside of Multimedia that regards themselves as an early adopter (in Product/Service Innovation) in one of the categories. They are in the Early Majority in every other category.

Multimedia: Consider themselves to be Early Adopters in every category apart from Relationship Management.

Platinum Mining: Follows the pattern of the Clothing Sector.

Cultural Tourism: Follows the pattern of Clothing and Platinum Mining, but their average response in Product/Service Innovation and Market Innovation positions them just outside the Early Adopters.

These results need to be treated with caution, since there is often averaging across quite different types of organisation and elements in the sector value chain which may blur important similarities and differences. The real value of such an analysis is at the individual organisational level. Nonetheless, the results reinforce the earlier conclusions that generally speaking *the eight sectors are most innovative in the management of administrative processes and least so in the use of ICT for supply chain management, and market innovation and resource management using the Internet.*

It should also be noted that this section proved to be the most challenging aspect of the questionnaire. In many cases—understandably—the interviewees were not confident in their perceptions of ICT diffusion in their sectors globally, and preferred to omit assessments for that aspect. For similar reasons, assessments of specific sectors relative to the SA economy as a whole proved difficult. There is nonetheless a good deal of data to be analysed in this section and readers are referred to the individual sector reports for specifics.

6.   Sector Summaries

The summaries that follow are based on the full Sector Reports, which examined the perceptions of important role players in each sector by means of the structured questionnaire. The Sector Reports are available for distribution electronically.[5]

6.1   Automotive Manufacturing Industry

The automotive sector in South Africa is typically described in terms of three sub-sectors: OEMs (Original Equipment Manufacturers, in this case the car assemblers), T1 (tier 1 suppliers, supplying to the OEMs), and T2 (tier 2 suppliers, supplying to the T1 suppliers). This study followed that classification and conducted interviews with fifty-two senior personnel in twenty-nine companies spread across the three sub-sectors. The interviewees responded to the items in the generic questionnaire as well as to a set of specific questions, several of which derive from previous research on the sector.

The summary findings from the generic questionnaire and the interviews include:

ICT Usage
Basic Hardware and Communication Technologies

The sector shows wide use of servers, mainframes and PCs. Emerging technologies are moderately used, except for T2s who make little use of them. T1s make greater use of CAD/CAM than the others. This is not surprising, but the low uptake by T2s may indicate an opportunity.

LANs are fully utilised. However, OEMs make only moderate use of dialup connectivity and wireless networks, while the T1s and T2s make little use of them. Leased lines and Wide Area Networks (WANs) / Virtual Private Networks (VPNs) are fully utilised by OEMs and moderately by T1s, but WANs / VPNs are little used by T2s.

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[5] The sector reports may be downloaded from *www.tips.org.za/research/dtipsp*

ICT Applications

E-mail has clearly established itself in all three tiers. Intranets and teleconferencing are also widely adopted by the OEMs but only modestly by the others. The Internet and CD-ROMs are modestly used by all. Only OEMs use videoconferencing—one must ask with whom the OEMs are engaging as it is clearly not their upstream suppliers.

ICT is well entrenched in support of business activities such as accounting, payroll, etc. Stock control is another popular application area. Distribution planning is an application for OEMs and less so for the others. Business systems integration is reportedly high for T1s and less so for the other two tiers. Manufacturing process control is moderately used by all. The balance of applications are weakly supported, with T1s being particularly slow in taking up ICT in the areas of marketing, customer services, and distribution planning and control (the latter impacting their relationship with the OEMs).

Surprisingly there is little evidence of 'Transforming Business Processes' via key new approaches such as business-to-business e-commerce and teleworking. The OEMs in particular express the need to work on B2B applications, customer relationship management, and streamlining business processes, particularly with respect to suppliers (the reasoning behind the latter being to cut costs). T1s are strongly concerned about B2B, with both the OEMs and the T2s. Getting shop floor information for better control is also a concern.

T2s have a wider variety of concerns with less focus. CAD able to 'talk' with customers is one. Having better integrated data systems is another. Cost reduction seems the main concern.

OEMs are most concerned that multiple standards do not emerge for B2B and create havoc with suppliers. Vulnerability of Telkom and VPN links are a concern and T1s are also concerned that a 'Tower of Babel' may develop in B2B. T2s express less concern about B2B and more about the capabilities of people as limiting ICT use.

The 'cost of bandwidth' is also a concern. The OEMs want more accelerated Internet access (bandwidth) at a lower cost. In general, the cost of ICTs is a concern, as is the perceived poor appreciation of and skills to support ICT in the supplier base.

ICT Spending Patterns

Participants felt their sector underspends relative to global standards; but this is less strongly emphasised by the T1s.

Sources of ICT Information and Training

As regards general sources of information, the priorities for sourcing are: Suppliers of software and hardware, Consultants and service providers, In-house experts, and via the Internet. Industry associations (NAAMSA and NAACAM), Chambers of Commerce, and Government training initiatives are not a source. Use of higher educational institutions (HEIs) is low, particularly for T2s.

With regard to training, the following table shows the most used sources. Again, a strong industry as opposed to academic focus is evident. As to the sufficiency of training for professionals, OEMs and T1s felt this was sufficient. T2s had a more mixed feelings,

many saying it was not sufficient or not cost-effective. The use of ICTs in providing training is in its infancy; CBT is mentioned mostly by the OEMs, who also mention limited use of e-learning and the Internet as a source of training. This pattern is weaker for T1s and weaker still at T2s.

Table 4.   Most Used Sources for ICT Training

	OEM	T1	T2
Most used source	Suppliers of software & hardware	Private sector trainers	Suppliers of software and hardware
Second source	In-house experts	Consultants	Private sector trainers
Third source	Consultants	In-house training	Consultants
Fourth source	In-house training	Universities and Technikons	In-house experts

There is very little awareness of any government initiatives supporting ICTs in the auto industry. However, scattered among the OEMs, T1s and T2s are a very few mentions of the AIDC activities.

ICT Adoption: Drivers and Barriers

In their responses to drivers and obstacles regarding ICT usage, fourteen of the nineteen items in the questionnaire were identified as drivers towards adoption; clearly investment in ICTs is going to grow! In general the OEMs, T1s and T2s move in sympathy with each other; the one exception is that T2s are much more sensitive to economic conditions as an inhibitor. The main drivers were:

- Need to improve communications;
- Need to respond to customer requirements;
- Need for increased organisational efficiency;
- Increased global business opportunities;
- Increased influence from multinational firms; and
- Need to reduce paperwork.

The pressure from expected competition in the medium term rather than the short term drives adoption.

It must be noted that attitudes of both senior managers and more junior personnel are seen as positive drivers supporting ICT adoption.

Regarding security of data and information, this is stated as of 'extreme' concern by OEMs, 'very' concerned by T1s and 'quite' concerned by T2s

Regarding the confidentiality of personal data, a pattern similar to that stated in the previous paragraph emerges: the OEMs and T1s appear much more pro-active in protecting this data than the T2s.

Diffusion of ICT into Organisation/Sector

The automotive sector is seen as an early adopter of ICT globally and ahead at T1 level in South Africa. T1 respondents are particularly negative in viewing the innovativeness of their own companies, and see the sector in SA as lagging somewhat. Application of ICTs to administrative process management by the OEMs is seen to lag a little across the board (globally, locally, and their own companies). On the matter of managing relations with customers, suppliers, etc., the OEMs see, across the board, a tendency to early adoption. Regarding obtaining expertise at a distance (via the Internet), the OEMs again have an across the board view, of late majority.

When asked 'what types of projects/incentives/schemes should be initiated immediately to stimulate the use of ICTs in the auto sector and industry as a whole?', the following rough consensus emerged across the sub-sectors:

- The need for common standards for OEMs to communicate (B2B) with their suppliers. Industry to lead (a very strong message);
- Cost and speed of communication "pipe" must be dramatically improved. Or worded differently, reduce telecommunication costs and improve infrastructure (bandwidth). Government to lead;
- Training at all levels to create an understanding of the 'what, why and how' of ICT. Government initiative at school level;
- Cost of software and ICT skilled people; what of subsidies or tax benefits in this area? (This also covers the OEMs concern for SME incentives for ICT investment);
- Sector-Specific Questions

There was a specific set of questions unique to the automotive sector. They were designed to identify the main application successes of the past and where plans lie for the future.

Out of twenty three application areas listed, the three sub-sectors were quite unanimous on the first four: JIT materials management, production-inventory control, production scheduling, and integrating information systems within the business unit. But then differences emerged, with the 'engineering' needs of the T1s and T2s showing up in high use of CAD and CAM. Nothing speaks more loudly than the 100% of OEMs working on integrating the supply chain with only 60-70% of the suppliers doing so—this is a key need identified in this study. The rankings for this item are shown in the table below, with low numbers indicating greater importance. T1s and T2s give 4th priority to integration within their own companies with much lower rankings for integration across the supply chain. By contrast the OEMs rank integration with distributors and suppliers 3rd and 5th respectively.

Table 5. Rankings for Integrating Information Systems in the Supply Chain

Place in Supply Chain	Integrating information systems		
	With distributors	With suppliers	Within the business unit
OEMs	3	5	9
T1s	12	8	4
T2s	16	13	4

In summary, the overriding concern of participants in the automotive supply chain is one of communication. In particular it is the B2B communication via ICTs. It is feared that the absence of an agreed common communications system and standard could lead to a 'Tower of Babel' situation. In this scenario, systems are hardly compatible and suppliers have to make a number of expensive investments to allow them to communicate with their multiple downstream customers.

Another cause for concern arising from an analysis of the data is that the further up-stream companies have different ICT priorities from those downstream. The OEMs are concerned about supply chain integration while Tier 2 companies are concerned about internal integration of information systems. This is also symptomatic of the less advanced status of T2s (and T1s to a lesser extent) versus OEMs. Cost of ICTs and the cost and availability of skilled ICT people is also a greater concern to upstream companies than the OEMs.

Respondents are almost universally critical of the cost and availability of what they refer to as 'bandwidth.' It is at Telkom's door that they wish to lay the blame. Many would like to see more competition in the supply of the telecommunications infrastructure.

An appeal is also made to make ICT training more broadly available 'to create an understanding of the what, why and how' of ICT. In the view of the auto sector this should start at school level. Furthermore, tax and other incentives should be available to encourage companies to invest in the development of people with ICT skills.

Export opportunities of locally developed software exist. But it is felt that some DTI support may be needed to exploit these opportunities.

International Trends in Automotive Manufacturing

Nature of Applications. Automotive manufacturing applications cover the full spectrum of ICT enablement. Key technologies being deployed in the Automotive manufacturing industry include robotics (for assembly line automation), e-commerce (for integration of supplier and distributor operations), ERP (for managing a just-in-time production process where the inventory resides on trucks on the highway), as well as wireless and geo-spatial (for automobiles that are increasingly connected to the Internet).

Extent of Diffusion. The automotive manufacturing industry has been an intensive user of ICT in all aspects of its operations for many years. Computers are now embedded in many automobile components and are essential to their operation. In fact, we are generally thought to have entered the Information Age in 1991 – the year that the $ value of computers in automobiles exceeded that of steel.

Implications for the Future. Computers are now appearing in the dashboards of cars and a rapidly increasing range of services are being provided through the use of wireless networks and geo-spatial systems.

6.2 Biotechnology

There is as yet no defined biotechnology 'sector' in South Africa and the development of the sector is still immature. Most of the activities are focused at the R&D level, and the application of biotechnologies within certain defined sectors. Estimated R&D spend has increased from R 100 million to R 200 million since 1997, but there are no estimated figures available for the South African biotechnology market – this is an area where further research is needed.

Biotechnology is heavily dependent on intensive use of ICTs. As biotechnology evolves, the volume of biological information is growing rapidly. The ability to collect, manage, manipulate and apply this resource depends increasingly on ICT capacity. Large multinational ICT companies such as IBM are increasingly seeing their own future in becoming bio-industries. This trend is not as yet reflected in South Africa and there is little interest from the ICT industry in exploring such potential opportunities. The development of a National Biotechnology Strategy in 2001 will go some way towards supporting increased R&D activity in this area, and future research will hopefully see an increased number of companies building on this intellectual capital.

More than 150 questionnaires were sent out by fax or e-mail - 47 organisations were interviewed across the value chain. The following specific sectors were targeted: food and agriculture (including beverage); pharmaceutical and medical (including veterinary); industrial (including chemical, mineral and environmental). The interviewees who participated in this study came from the following categories:

- Companies;
- Suppliers;
- Sectoral Associations;
- Research Organisations;
- Academia;
- Government Departments; and
- Investors and key international linkages.

There was a lack of interest from companies in the industrial as well as the medical and pharmaceutical sectors, in participating in the survey. Academic institutions responded well and there was a good sample spread across organisation size - 34% large, 13% medium, 19% small, and 34% micro-sized. Data was analysed in most cases according to organisation size, since this reflected the most revealing trends in ICT uptake and use.

ICT Usage

Basic Hardware and Communications Technologies

The biotechnology sector shows a very high usage of personal computers and hardware such as servers (on average one personal computer to two employees based on the survey results). CAD/CAM is primarily used by large organisations. Emerging technologies such as robotics and sensing devices are not well used across the sector, possibly because some of these technologies are not relevant to the industry yet.

Local Area Networks (LANS) show high levels of usage by all categories of organisations, whereas the use of Wide Areas Networks (WANs) is, not surprisingly, more prominent in medium to large organisations.

Dial-up connections are used predominantly by micro-organisations, but also used to a lesser extent by the larger organisations, mainly by staff requiring Internet access from their homes. Generally teleworking was not widely used across the sector, irrespective of size.

All companies indicate very high levels of e-mail, Internet and Intranet / Extranet usage, as well as CD-ROMs. This is indicative of a sector that relies on strong national and international networks, with high levels of interactions and an emphasis on collaborative research ventures. ICT forms the backbone for these virtual networks as demonstrated by the fact that 85% of the organisations interviewed have a Website.

It is significant that the use of tele- and video-conferencing was low across all companies, but understandably so in the micro-sized organisations. Comments from survey respondents indicate that this is an area that could be exploited more fully for communications and building relationships with customers.

A number of barriers were identified by respondents, the most prominent being the inadequate provision of bandwidth by Telkom, and the high associated costs. Telecommunications speeds are also too slow for the nature of the work required in the biotechnology sector.

ICT Applications

All respondents showed high levels of ICT use in most of the business process components. There were significantly higher levels of use in the business support area e.g. finance, accounting, payroll, etc. Of significance are the relatively lower levels of usage in marketing. Several respondents raised this as a concern, although reasons given were that existing and potential customers were not using ICTs extensively and therefore were not 'ICT-ready'.

There was low usage of e-commerce applications, both B2C and B2B. Several respondents noted the need for better Web-based marketing and provision of services to national and international customers.

There was fairly extensive use of online services, and the provision of information showed high levels of ICT usage across the whole sector.

ICTs were extensively used in data collection, management and manipulation, and to a lesser extent in diagnostics, imaging, sequencing, and detection systems. There was relatively lower usage in areas such as molecular modelling and identity preservation systems.[6]

An area of concern is the weak and inadequate support provided by ICT service providers. Many do not understand the needs of this ICT-intensive sector and cannot provide the necessary expertise on specialised support systems.

The lack of affordable ICT applications and systems, as well as the high cost of computing power that meets the needs of the sector, were also mentioned.

ICT Spending

Large organisations perceive their spending on ICT hardware and software to be more than the norm for the global sector, whereas small and micro-sized organisations saw their spend as below the global norm. Within all organisations, the ICT spend is on the norm or above, with indications that ICT budgets are growing. This would be expected, as the biotechnology sector cannot operate without ICT systems and applications.

Sources of ICT Information and Training

The common sources of ICT information were experts within an organisation, and the Internet. Trade associations, Chambers of Commerce and government initiatives were hardly used. This is an area that requires more emphasis as these organisations could play a role in stimulating ICT diffusion and business development.

Sources for training followed the same trends as those for sourcing ICT information. Most respondents source their ICT training from experts within their organisations, in-house training programmes and the Internet. ICT suppliers were also rated high as a source of training.

Drivers and Barriers to ICT Adoption

The most important factor influencing the sector is the general economic climate. The strongest driver is expected to increased competition in the short-to-medium term, and new opportunities for business development through ICT.

On the whole, the culture and attitude of the sector towards ICT is regarded as having a positive influence.

The strongest positive influences in the adoption of ICT are the need to: improve communication, respond to customer requirements, respond to national or international regulatory or environmental standards, increase organisational efficiency, and minimise paperwork. Internal driving factors are the need for increased computing to do business,

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[6] Molecular modelling and identity preservation systems (as used in the identification of GM and non-GM products for example) are a definite need for research purposes in South Africa – if the sample had included more researchers the rating would in all likelihood have been higher. These technologies are not as yet widely used in the industry, and may explain the low rating in this survey.

and the attitude of senior management and staff towards ICT (which, as indicated elsewhere, is already positive).

A major negative influence is the lack of available ICT skills, as well as the costs of ICT, particularly in small and micro-organisations.

ICT Functions Within Organisations

A number of existing models emerged: in the large organisations there were generally between 5-30 ICT support staff, with some multinationals providing an ICT unit at the global level with local support units at the national level. One respondent created a separate IT company wholly owned by the mother company. In the case of small and micro-organisations, all ICT functions are outsourced. Some organisations have created help desks that are either in-house or outsourced.

Reporting lines also showed some variations: IT managers report to either the Finance Director, Office Manager, Business Excellence Manager, Chief Information Officer, IT Steering Committee or to the CEO with a place on the board; The Divisional Information Officer reports to the Marketing and Innovation manager; or The IT Management function resides in the Directorate of IT.

Security

Most organisations have firewalls, back-up systems, protective filtering software, and surveillance systems, as well as policies for personnel conduct relating to the use of ICT.

Various confidentiality systems were in place, particularly with regard to client information, but security regarding employee information was not as good.

Diffusion of ICT into the Sector

In general, this sector is characterised by being an early adopter or early majority of ICT for the development of new products, services or niche markets. This also applied to the use of e-mail and the Internet, although large organisations were the slowest adopters of this application.

The use of ICT to market services and products was seen as lagging behind on the national level, whereas the global biotechnology sector is seen as an early adopter in this area.

There is likely to be an increase in the adoption of ICT for R&D, particularly due to the implementation of the National Biotechnology Strategy. How this approach will impact on new commercial applications will depend on how well the industry and R&D organisations are prepared to collaborate.

The emerging South African biotechnology sector acknowledges that it will not be competitive globally if the development and application of ICT does not keep pace with that occurring globally.

International Trends

Nature of Applications. Biotechnology is an emerging industrial sector that, as its name implies, is highly dependent on ICT for its existence. A focus of ICT use in the biotechnology sector is strategic management (particularly as it relates to the management and dissemination of vast quantities of genetic information). Key technologies being deployed in the biotechnology sector include knowledge management (particularly XML for managing large databases) and e-commerce & CRM (for marketing and supply chain management).

Extent of Diffusion. The sector uses ICT extensively in the development of new products that often have an integral ICT component and which may one day redefine our concepts of ICT.

Implications for the Future. Strong linkages will need to be forged between the biotechnology sector and the ICT sector at all levels in order to develop a strong and vibrant biotechnology sector.

6.3   Clothing

A working definition of the Clothing Industry is:

Activities relating to the transformation of knitted or woven fabrics into garments.

The South African clothing industry is located mainly in three provinces: the Western Cape, Kwazulu Natal and Gauteng. The distribution of clothing companies is fairly even between these three provinces, accounting for over 90% of South Africa's clothing production capacity. There is a noticeable trend in the industry towards de-localisation. In other words, there is significant movement away from the main centres towards outlying areas, largely in search of a competitively priced and more flexible supply of labour.

This observation is true mostly at the lower end of the market, i.e. among producers of commodity type clothing, who are most vulnerable to imported products. A further trend that has characterised the clothing industry is the large-scale establishment of, and outsourcing to Cut-Make-and-Trim (CMT) clothing manufacturers.

In many of these cases, the original firm continues to specialise in the design and marketing of the garment, while the production side is completed by CMT contractors. This trend is particularly prevalent in the Western Cape and Kwazulu-Natal.

The Clothing Sector in South Africa has emerged from an era of being heavily protected to one of open competition. This has substantially changed the dynamics of the industry, with significantly increased foreign competition in the domestic market.

However, the clothing industry has also been provided with many new opportunities, especially in the export market.

South Africa is party to various international and regional trade agreements, some of which are having a direct impact on the domestic clothing sector. These include the Free Trade Agreements (FTA) with the EU, and more recently, the trade arrangement stemming from the US Africa Growth and Opportunity Act (AGOA). The AGOA provides

qualifying Sub-Saharan countries, including South Africa, with duty free access to the US market - including articles of clothing. This preferential market access granted to the South African clothing industry is considered by many to be the most important opportunity ever presented to it, notwithstanding the fact that the Agreement has some stringent conditions attached to it. Since the Act's implementation, exports of clothing articles to the US have increased significantly, and are bound to continue to do so if South African manufacturers meet the challenge of high and consistent quality of output and price competitiveness demanded by the export market.

This study gathered primary data from 50 manufacturing enterprises distributed across those three provinces. Interviewees were asked to respond to questions from a generic cross-sectoral component and a shorter sector-specific component.

ICT Usage

Basic Hardware and Communication Technologies

The South African clothing-manufacturing sector is, on the whole, a medium-intensive user of ICTs. It is characterised by significant variations in the adoption of ICTs, ranging from very low use (mainly basic technologies to run office applications and e-mail) to intensive use (completely integrated systems, high end CAD facilities etc.). There is a general realisation, though, that ICTs will play an increasingly important role, even in a relatively labour-intensive sector such as the clothing industry.

The clothing sector is a relatively intensive user of PCs, servers and local area networks (LANs), and has readily taken to the Internet. Owing to the nature of clothing manufacturing, which is labour intensive and makes heavy use of sewing machines and related technology, the use of these technologies is mostly limited to the administrative functions of organisations. The exception, of course, is a technology such as CAD, which is integrated into the manufacturing process.

Although the use of PCs is relatively high, the uptake of basic technologies is far greater among the large companies, rather than the small and medium-sized enterprises. Because the domestic clothing industry is highly competitive and constantly under threat from low-priced imports, financial constraints are frequently a barrier to investment in ICTs.
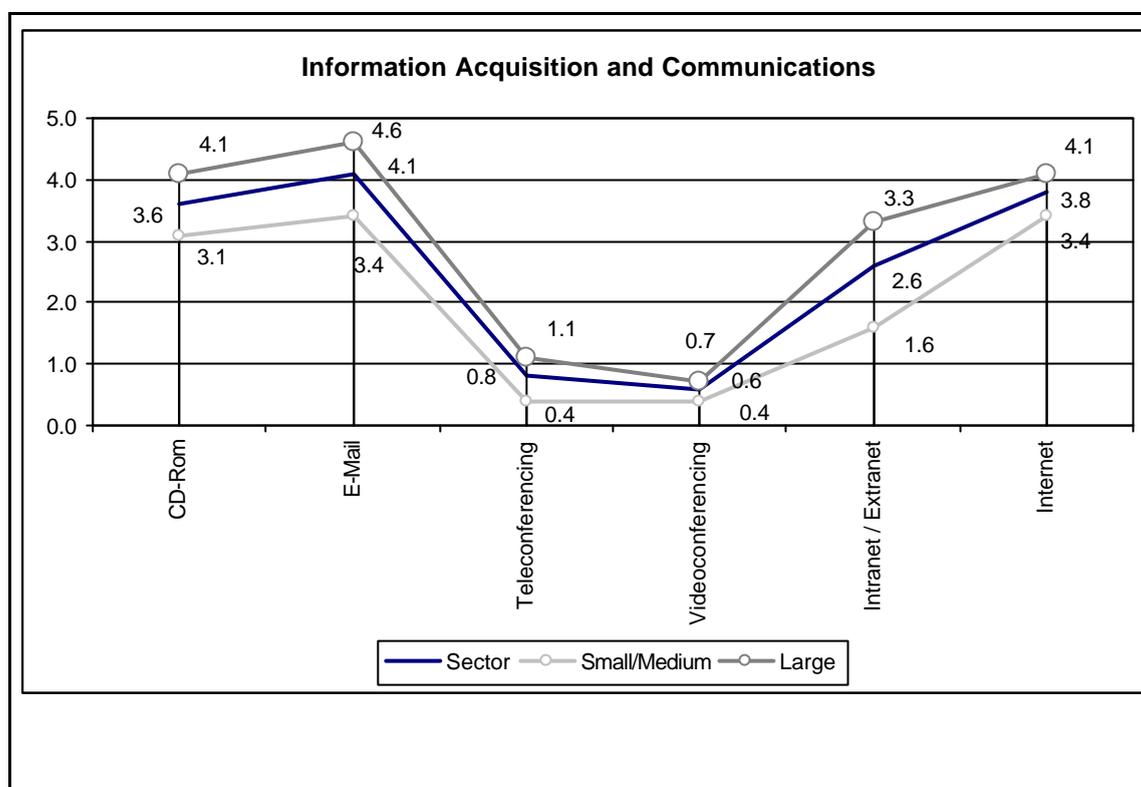
ICT Applications

This section focused on ICT-related sources of information, and the usage of ICTs for a wide range of applications and processes.

Accounting, stock control and basic payroll functions are the minimum standard among most clothing manufacturers, including small enterprises. CAD is not (yet) the standard across the entire sector, although many companies have readily embraced Automated design and are continuously improving its functionality. The significant costs involved in investing in CAD capabilities, including hardware and relatively expensive software applications (as well as the skills required to properly utilise CAD), are a major problem for most smaller enterprises.

Most frequently used sources of information, from the perspective of ICTs, were CD-ROMs, e-mail and the Internet. These applications are widely used and dispersed within the clothing industry, and the majority of enterprises (both small and large) feel comfort-

able with using them. E-mail and the Internet were frequently stated as being an extremely useful business and communication tool.

Information Acquisition and Communications

Figure 5. Information Acquisition and Communications

Advanced applications such as teleconferencing and videoconferencing were hardly used at all due to the high cost of these tools (both hardware and bandwidth), although some scope exists for using these tools in future. This relates largely to the fact that the South African clothing sector is a major importer of foreign-produced fabrics and yarns, and can enhance business dealings and supply chain arrangements by using these tools. The average ratings for these applications are illustrated in Figure 5 above.

Although a small number of large companies have achieved extensive business process integration through ERP applications, the majority of respondents consider these applications too elaborate for their needs, and / or too expensive.

The use of websites in general is disappointing among South African clothing manufacturers, with only a small number of exceptions. This is an area where the sector definitely lags behind other industries, and substantial improvements are possible with a relatively small financial outlay.

The use of B2C and B2B e-commerce, while not uncommon in the clothing manufacturing industry, is utilised mainly by large companies.

B2C e-commerce is utilised to a relatively low degree (across the sector), which probably relates to the existing supply chain configurations whereby clothing manufacturers mostly deal only with the retail sector. Most of the companies that used B2B extensively were very large manufacturers producing either exclusively for one major retailer chain,

or for a small number of national retail chains. In many cases, the use of B2B is driven by the retail sector, which sees it as a pre-condition of doing business efficiently.

ICT Spending Patterns

Companies in the clothing manufacturing industry are unanimous in their opinion that the South African clothing industry as a whole spends significantly less on ICTs than is the perceived norm internationally. However, with regard to perceptions relating to the company's expenditure relative to the norm *in South Africa,* SMEs felt that their total expenditure on ICTs lagged behind the sector average, while large companies (as is expected) perceived their expenditure to be fairly significantly *above* the norm.

This outcome indicates that:

- Large companies are committed to increasing ICT-related expenditure, and appear to be moving towards more 'knowledge intensive' manufacturing;

- SMEs, who typically do not have access to the same financial resources as large companies, appear not to be able to invest significantly in ICT-related matters;

- There may (rightly or wrongly) be a perception among many SMEs that they can "get away with" not prioritising ICTs in their organisation; and

- Economic conditions and a weaker exchange rate (which frequently push up the cost of ICTs) reveal that among the smaller manufacturers, demand for ICTs is particularly sensitive to price increases etc.

Sources of ICT Information and Training

Information and training needs are to a large extent fulfilled by the same sources, namely ICT suppliers, in-house training programs, experts within the company and consultants / service providers. Furthermore, the Internet is a medium that is used very frequently to obtain ICT-related information.

An observation that stands out is the fact that ICT vendors (i.e. suppliers of hardware and software) are most frequently used to fulfill the clothing sector's ICT information and training needs. This is not surprising: ICT vendors are likely to be the first "port" of call when companies consider investing in ICTs.

Universities and Technikons were used infrequently as a source of ICT information and training, as few of these institutions offer formal clothing / textile technology training (with an emphasis on ICTs).

Respondents were not aware of any Government ICT-related training schemes, although a few thought "it might be available under the Sector Education and Training Authority" (SETA)" for the clothing and textile industries. Significant scope therefore exists for these institutions to play a more meaningful role in facilitating (or directly providing) the diffusion of ICT-related information and training.

ICT Adoption: Drivers and Barriers

External economic factors provided the industry with both drivers and barriers to ICT adoption. Companies across the sector felt that general economic conditions (within the industry) were not conducive to the adoption of ICTs, although larger companies were a little less negative than SMEs.

Some external economic factors were seen as significant drivers, such as: expected increased competition, both in the short and medium term, and the increased presence of global business opportunities. The latter is seen as a driver by large companies, the majority of whom are presently exporters.

Supply chain factors are seen as having a positive influence on ICT adoption, facilitating response to customer requirements and improved communications. Customers (meaning the clothing retail sector) are seen as having a driving influence on large manufacturers, frequently steering them to B2B e-commerce arrangements with a view to improving their own efficiencies and supply chain.

Internal factors: Among large companies, respondents felt that senior management was a critical driving force in their organisation's adoption of ICT, more so than any of the other internal factors. Small and medium-sized companies did not, on the whole, display this result, and their response was more muted. In a number of cases, senior management was even seen to be a strong barrier to ICT adoption, although this detail is lost in the overall average. The perceived cost of ICTs is seen as a significant barrier, although as stated earlier, demand for ICTs by large companies is clearly less price-elastic than for the small and medium-sized entities.

Diffusion of ICT

Respondents from small and medium-sized companies feel their companies are lagging behind the sector average in terms of the use of ICTs for product / service innovation, market innovation, administrative process management, relationship and resource management. They rate their companies as the "late majority" in terms of adopting ICTs. The sample of large companies, on average, see themselves as early adopters of ICTs.

Status Within International Context

The economic context in which clothing manufacturers operate in South Africa determines the extent of ICT diffusion. The South African clothing sector appears to lag behind its European and US counterparts with regard to the application of ICTs within its organisational and manufacturing functions. The sector has been undergoing significant changes since the large-scale opening (through the downscaling and removal of restrictive trade tariffs and quotas) of the South African market. This has led to increased domestic competition, especially at the lower end of the market (commodity-type output, such as T-shirts etc.). Many domestic companies have been unable to adapt effectively to this influx; some retreating into their "shell", while others adapting and evolving.

The international context is of particular importance to the South African clothing industry, since (export) opportunities abroad play a critical role in ensuring the long-term survival. The overseas market for lower-end clothing made by South African manufacturers is limited, due to South Africa's relatively high local input and labour costs, especially vis-à-vis competing countries such as China.

A market does exist for higher value-added fashion apparel, both locally and overseas. To be competitive in this market requires innovation and movement up along the value chain. The clothing industry globally is largely buyer-driven, and more and more of the value-adding occurs in the (innovative) design, logistics and branding functions. The up-

take and use of ICTs will play an important role in achieving greater competitiveness, through organisational management, design, lead times, production efficiency and knowledge facilitation.

Expected Trends in Applications And Diffusion

The adoption of ICTs is likely to increase across the sector, although the trend towards greater knowledge and technology intensity will also claim its victims. Some firms will continue to operate at the lower end of the market, where the focus is predominantly on factors such as price competitiveness and economies of scale.

The concentrated nature of the domestic clothing retail sector, and its market power, will continue to be an important driver of ICT adoption. As a whole, the clothing sector should benefit from the DTI's Integrated Industrial Strategy, and its support for greater knowledge intensive manufacturing and innovation. Recent trade opportunities brought about by the SA/EU Trade Protocol and AGOA, are providing South African manufacturers with vastly improved access to the EU and US markets. These opportunities are likely to be important drivers to ICT diffusion if communication and bandwidth costs, especially relating to the transfer of data (e.g. electronic sending of designs), become more in line with those of South Africa's competitors.

International Trends in Clothing Manufacture

Nature of Applications. Clothing manufacturing industry applications have largely focused on use of ICT for cost reduction and quality improvements, and in the area of strategic management. Key technologies being deployed in the clothing manufacturing industry include B2B e-commerce (for supply chain management), ERP (for inventory management) and CAD/CAM (for product design).

Extent of Diffusion. The investment in ICT for the clothing industry has been relatively modest compared to other manufacturing sectors due to the high dependence on contracted SMEs. Increasingly, independent clothing manufacturer SMEs are establishing a web presence and are deploying B2C solutions.

Implications for the Future. An increasingly competitive world market, and rapidly changing fashions, will necessitate increased investment in ICT, particularly in support of SMEs

6.4   Cultural Tourism

This report was informed by results obtained from a survey of the various industries that make up the cultural tourism sector, both in South Africa and internationally (Phase I of this project).

This project had the objective of eliciting opinion from a broad range of stakeholders concerned with different aspects of the Industry. Contact was made with 116 institutions and 40 questionnaires and/or interviews were completed. The interviewees who participated in this study came from the following categories:

- Government and conservation agencies;

- SA Tourism;
- Cultural heritage and conservation agencies, such as Ezemvelo KZN Wildlife, the South African National Parks (SANP);
- Peace Parks Foundation (public-private partnership);
- City/local tourism authorities such as Cape Town and Grahamstown;
- Provincial tourism authorities, such as Mpumalanga, and KwaZulu Natal;
  - o Tourism Boards e.g. Cape province;
  - o Museums e.g. the African Window;
  - o Libraries and Collections;
- Research and Development Organisations
  - o Council for Scientific and Industrial Research (CSIR), which is working on software development for the digitisation of cultureware;
- Private sector
  - o Cultural industries which produce books, magazines, newspapers, music, records, film and videos, multimedia products and other new industries that are being created;
  - o Stagers of cultural events (National Arts Festival);
  - o Cultural tourism operators, such as the Federated Hotel Association of South Africa (Fedhasa) and Comair, the partner of the no-frills Kulula.com
  - o Cultural tourism portals e.g. Open Africa, the African Dream, and WildNet Africa;
  - o Publicity associations; information and marketing agencies;
  - o Cultural villages e.g. Shangana and Shakaland;
  - o Travel agents;
- Communities involved in cultural tourism activities such
  - o Cultural villages and Craft centres;
  - o Guided cultural community-based initiatives, etc.;
- Cultural Tourism and ICT Experts.

About two-thirds of the survey respondents were in the small and micro category, with 36,6% in the micro enterprises category with fewer than ten employees[7]. The survey respondents in the small category came to nearly 30%. Large institutions comprised 24% of the sample and medium institutions made up the remaining 10 %. Small, and micro enterprises (SMMEs) are typically part of the vibrant tourism economy that are usually characterised by entrepreneurs that start and sustain dynamic businesses, which provide much-needed jobs. Of these companies 66% operated only in South Africa, 24% have operations in SA and Africa, while about 32% have international links.

The following results emerged from the survey:

ICT Usage

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[7] Few SMMEs are proficient in technology, this is especially notable from those who did not want to participate in the survey and the large number (193) of local crafters exhibiting their wares in the craft market and the industry training workshops) at the 2002 Tourism Indaba.

Basic Hardware and Communication Technologies

Cultural tourism is a communications-intensive industry with high-levels of e-mail and Internet use in the established part of the sector. E-mail is fully used by the respondents and the Internet is likewise an important source of information acquisition and communications. Teleconferencing and videoconferencing hardly feature, and was identified as an area that could be used more frequently. This is in line with the trend to use videoconferencing and teleconferencing in active travel management.

The data indicates that most of the respondents have PCs that are nearly fully utilised. Local Area Networks (LANS) are widely used. CAD/CAM technologies are not a prominent feature of the ICT hardware. In terms of the communications infrastructure, leased lines were slightly more used than dialup Internet connectivity. Wireless networks are hardly used.

The situation in the emerging sector lags behind, but is improving with specific initiatives targeted around community initiatives, particularly in the Western Cape. ICT plays a crucial role in stimulating development by modernising delivery systems. As the survey results indicate, the challenge in South Africa is to catalyse the rural economy to leapfrog development.

The lack of bandwidth (Telkom) is a major concern, because it inhibits the optimal functioning of Websites and the uploading and downloading of graphics and images. Respondents also felt that the leased line charges and the high Telkom rates are deterrents to higher levels of use. Easy access to satellite technology was suggested.

ICT Applications

In the area of relationship management, the survey outcome supports the notion that personal contact and the human interface are more important than electronic systems in building customer relationships. There are however a number of respondents who commented that more investment is needed in the more effective use of CRM (customer relationship management systems) and communications to satisfy customers.

The responses regarding transformational business processes confirm that except for providing information via Websites and CD-ROMs, other B2C and B2B activities do not readily feature yet.

The survey also revealed that South African musicians and other artists are benefiting from e-commerce to access B2C world markets, cutting out layers of middlemen and improving the creator's bargaining power.

A number of ICT applications were identified as areas that needed the most emphasis:

- Knowledge management, reinforcing the importance of ideas and research and the protection of intellectual property;
- E-commerce (B2B, P2P, B2C), R&D; multimedia, virtual reality, augmented reality, culturally adaptive software;
- Marketing using the Internet, and packaging culture in such a way that it can be consumed and generate economic value, e.g. digital cultural exhibitions, Websites, electronic marketplaces and services; harnessing the power of mobile technology;
- The use of GPS to provide next generation applications;
- Business process/system integration and streamlining business processes, by integration between strategic and technical capabilities;

- Diffusion of connectivity across the broadest possible front, communications infrastructure and satellite technology;

- Multimedia could be applied for marketing more creatively;

- The development of integrated tourism information systems, as current efforts are diluted; and the

- Ability to track visitors to Websites, to capture their preferences and market to them regularly.

ICT Spending

Most of the respondents indicated that their ICT expenditure was less than the norm (more than 35%) or about the norm of the industry globally (about 32%). Eighteen % indicated that they were spending much less than the norm. A few did indicate that they were spending more than the norm globally. The weak Rand and the fact that ICT budgets were generally the first to be cut in a lean economic climate were given as contributing factors.

Sources of ICT Information and Training

The Internet is the source that is most used to access ICT-related information, followed by consultants, newspapers and ICT vendors. As the chamber of industry does not play a prominent role in tourism this was the least-used source. Government is seldom used as a source of information.

A similar pattern emerges for sources of ICT-related training. In-house training is the preferred source, followed by e-training on the Internet, and the application of consultant's services. Experts within the institution are also a preferred source to provide training. The Chamber of Business and the government are the least used for training. It would appear that higher education institutions are also not a popular training resource.

Drivers and Barriers to ICT Adoption

The low levels of use and understanding of ICTs by clients was considered problematic and an inhibitor to growing the use of ICTs in cultural tourism.

The potential for global business opportunities is seen as a strong driver. This was reinforced by the general upbeat mood among cultural tourism industry players, following a strengthening of foreign tourist arrivals particularly from Germany during February and March 2002.

By far the most respondents indicated that a strong driver was the need to be responsive to customer requirements. In a similar vein, almost all the cultural tourism operators were of the opinion that they continuously needed to improve communications. Many of the survey respondents confirmed the necessity to listen to customers' needs. Other supply chain factors did not feature prominently as either barriers or drivers.

The attitude of senior management is more favourable towards ICT than that of the average staff member. The level of ICT skills in the workplace is neither a barrier nor a driver. The same argument applies to the availability of ICT professional skills, where respondents were generally not concerned about the availability of IT skills.

Security

Some survey respondents emphasised the ethical dimension of ICT diffusion along the lines of corporate governance, including consumer protection, security of transactions, privacy of records, intellectual property and the treatment of digital signatures. These issues are relevant to the recommendations on good corporate governance contained in the King II Report and need concerted attention by both the industry and the government.

Closely related to this is the building of trust relationships. This can be important to be accepted as a global player in the market. Small entrepreneurs are particularly vulnerable and face the challenge of building virtual trust to be able to trade effectively in a global market.

Diffusion of ICT into the Sector

Cultural tourism role players see themselves as highly innovative and as early adopters, and even world leaders, in the areas of product and service as well as market innovation. A strong presence of innovation is also discernible in the field of resource management.

High access costs are a serious deterrent to wider diffusion. Telecommunication monopolies are one contributing factor to the high costs, but low telecommunications network density in rural areas can also prevent connection to the Internet via a local phone call, that have rising cost implications. The leased line charges and the high Telkom rates are deterrents to wider ICT diffusion.

Another challenge is to lower the hurdles of ICT access. Location is relevant for ICT diffusion to outlying areas where they cannot operate, for example, a 56K modem. One option to overcome this hurdle is Internet cafes that would make telecommunications more accessible to remote areas, providing access to communities in remote areas.

International Trends in (Cultural) Tourism

Nature of Applications. Cultural tourism forms a part of the broader tourism sector and the ICT applications are very similar. They have largely focused on quality improvement and strategic management of the tourism resource with increasing investment in new products and services that are only possible through the use of ICT. Key technologies being deployed in the tourism industry include multimedia (for promoting tourism capabilities) and B2B and B2C e-commerce (for tourism marketing and reservations).

Extent of Diffusion. The tourism industry generally has been a limited user of ICT in the past, with the primary focus being on tourism marketing and reservations applications. This is largely due to tourism in general, and cultural tourism in particular, involving large numbers of SMEs who have traditionally been unable to afford substantial ICT investments.

Implications for the Future. Substantial attention will need to be placed on increasing use of ICT by SMEs in order to ensure that they remain competitive. Increasingly in the future, use of ICT will become an integral part of the tourism experience.

6.5 Deciduous Fruit

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 Hardware and Communication 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.

ICT 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.

It is interesting to note that the Deciduous Fruit Industry is very progressive in the use of sophisticated applications such as B2B e-Commerce, particularly by Exporters, Pack houses and 'Others' as shown below. The use of Interactive on-line services (e.g. taking orders by e-mail) is also extensively used by all members of the value-chain with the exception of the 'Transport' category.
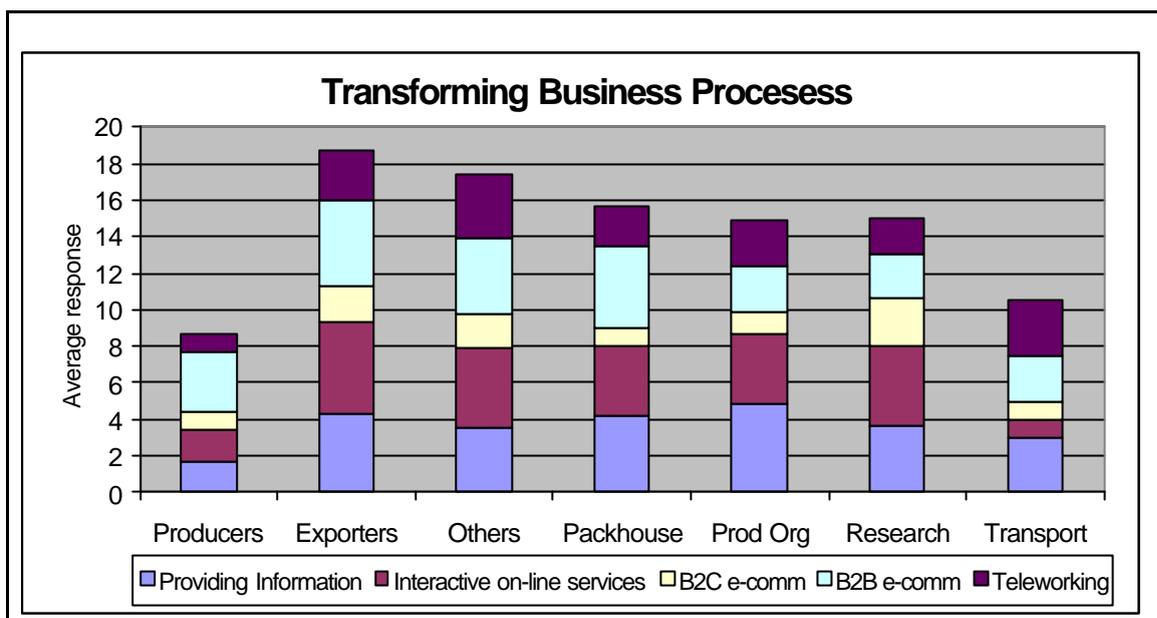
Figure 6. ICT Usage: Transforming Business Processes

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, pack houses 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 do pack 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.

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

International Trends in Agriculture (Deciduous Fruit)

Nature of Applications. Agriculture applications have largely focused on strategic management of the agricultural resource with substantial investment in cost reduction and quality improvement. Key technologies being deployed in the agriculture industry include geo-spatial (for assessing and managing cultivation), ERP (for managing the agricultural operations) and e-commerce (for marketing of agricultural products).

Extent of Diffusion. The agriculture industry generally has been a broad user of ICT over many years in such areas as managing cultivations, managing agricultural operations as well as improving the agricultural knowledge base, and its diffusion. However, ICT has traditionally been affordable predominantly to large agricultural organizations in a sector that includes large numbers of SMEs.

Implications for the Future. Substantial attention will need to be placed on increasing use of ICT by SMEs in order to ensure that they remain competitive. The linkage with biotechnology will also be important in the future as increased dependence is placed on crop varieties, pesticides, etc. developed by this sector. The linkage with biotechnology can be enabled by increased use of ICT.

6.6   Health Information Flows

ICT has the potential to significantly and irrevocably change the delivery of health care services and patient care, and the management of the health care system around the world. Technologies and applications are changing at ever increasing speeds and so are the dynamics of the business surrounding the implementation of e-health technologies and applications. The Internet in particular presents a valuable opportunity to disseminate quality information to the right people across national boundaries, facilitating access to powerful collaborative tools.

In response to this, large numbers of national and international agencies, research organisations, NGOs, etc. continue to carry out studies and develop systems and procedures to exploit the power of ICT in health.

Specifically the developing world suffers from a tremendous burden of disease, in particular Africa, sub-Saharan Africa, and closer, southern Africa. The Economic Commission for Africa (ECA) published a Common Position for Africa's Digital Inclusion in 2001.[8] This document highlighted the fact that ICT can play a substantial role in mitigating some of Africa's problems in the health sector. It can do this by improving access to health services in rural areas, underpinning public education campaigns to promote healthy behaviour, transferring diagnostic information to specialised centres, strengthening the basis for decision making, promoting information exchange among researchers and students, and enhancing the effectiveness of health institutions.

In South Africa various health ICT initiatives are in place—ranging from highly sophisticated systems to rudimentary ones, from basic computerised systems to support patient records for research projects to highly sophisticated computerised diagnostic equipment. In many instances, however, there is a lack of logical integration or interfacing of relevant systems. The level of ICT diffusion also varies considerably between the public and private sector healthcare services, and with variations within these sectors. Given that the sector has demonstrated a growing demand for ICT and that the efficiency and effectiveness of the health sector has a potentially huge impact on productivity, there is a need to understand the diffusion of ICT within the sector. For this study, *the emphasis has been placed on the role of ICTs in ensuring information flows to support decision making, at facility or practice level, and at district, provincial and national levels, and between these levels, in both the public and private healthcare sectors.*

Research data has been gathered from interviews based on a detailed questionnaire with fifty-two senior representatives of organisations in the public and private health care system in South Africa. Responding to the generic component of the questionnaire, the interviewees noted:

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[8] Economic Commission for Africa. Common Position for Africa's Digital Inclusion: Recommendations of the Meeting on Africa's Contribution to the G8 DOT Force and the UN ECOSOC Panel on Digital Divide, 10-12 May 2001, Addis Ababa, Ethiopia.

ICT Usage

Basic Hardware and Communication Technologies

The health sector in general is geared for the ordinary use of PCs as workstations. They are networked in LANs and WANs and linked to file servers in most of the private sector institutions surveyed, and in some public sector organisations. There are, however, many geographically dispersed clinics and private practices that are not linked to any network. Where physical telecommunication infrastructure is the root cause of such insular cases, the potential of wireless solutions should not be ignored.

ICT Applications

E-mail is widely used, but due to high bandwidth and equipment costs, video over the Internet or Intranets is not generally a viable option at this stage.

ICT is most commonly used for business support activities (e.g., finance/accounting, data storage and retrieval, personnel management and payroll activities, training), followed by customer service (e.g.: database records of customers, telephone call centres, customer relationship management) and strategy and planning activities (e.g., organisational and strategic planning, knowledge management).

The use of 'emerging technologies' is generally relatively low; however this is not the case in environments providing specialised health services or for instance doing meta-analysis of health information.

E-business services are widely used in some components of the private healthcare sub-sector in South Africa, and constitute a potential growth area in both the public and private healthcare sub-sectors.

ICT Spending Patterns

The health sector in South Africa, on average, spends less than the norm of the global health expenditure on ICT; the organisations represented in the survey spend slightly more than the norm of the South African health sector's expenditure on ICT and their ICT budgets are growing slightly more than other budget areas. This is consistent with the nature of the organisations represented in the sample, which could generally be regarded as being more extensive users of ICT than the norm for this sector.

Sources of ICT Information and Training

The sources most used for ICT-related training are: ICT suppliers; in-house training programmes; and experts within the company. Comments related to training were more positive than expected, and although gaps were identified, the use of computer-based training seemed fairly widespread. Although there are obviously deficiencies and issues, the overall impression was that this was not a major item on the agenda. The researchers are concerned that some interviewees may have underestimated training needs and consider this as an area that still needs particular attention.

On the question whether the interviewees are aware of any government initiatives supporting the use of ICTs in their industry, the following (general) response is worth noting: *"Yes, an extensive roll out of health information systems is being implemented by*

provincial Departments of Health, although limited funding is restricting this and in some instances results in outdated technology solutions (e.g. DOS-based systems)."

ICT Adoption: Drivers and Barriers

External economic conditions: 'increased global business opportunities' is viewed as the strongest driver, with 'general economic conditions in the South African health sector' as a negative influence. For the public healthcare sub-sector, 'increased global business opportunities' was interpreted as referring to increased opportunities for accessing technology solutions.

Supply chain factors: no negative barriers reported. The following were considered as having a positive influence: need for increased organisational efficiency; need to respond to customer requirements; need to improve communications; and, need to reduce paperwork.

Internal factors: Apart from 'perceived cost of ICTs' there were no negative barriers, while the following were considered as having a positive influence: 'attitudes of Senior Management towards ICT';' general attitude of personnel towards ICT'; and, the 'need for increased computing to do business (R&D and other functions).

Diffusion of ICT into Organisation/Sector

In terms of almost all aspects, including product/service innovation, market innovation, administrative process management, relationship management and resource management, the organisations surveyed can be considered to be 'early adopters' of ICT. The health sector in South Africa compared with other sectors is viewed as falling in the category 'early majority', and the same holds true for the South African health sector in terms of the health sector globally.

The report contains a variety of schemes suggested to stimulate ICT use. Apart from bandwidth/transmission issues, there is a need for better integration of health information flows and the establishment of an 'independent' centralised health data warehouse, which can feed data for research purposes, specialised analyses and building commercially-viable information products. There is also a great need to use common standards.

Sector-Specific Questions

The survey questions specific to the health sector included an assessment of the extent to which the following conditions obtain:

- Sufficient IT infrastructure and telecommunication links are in place to conduct business optimally;
- Common standards are used (including the implementation of data dictionaries);
- Security is addressed;
- e-Health systems are in place (knowledge networks, portals, call centres, telemedicine);
- e-Business is used (claim eligibility checking, electronic claims processing and billing;
- New technology is introduced and linked to sophisticated databases and warehouses (use of smart cards);

- Systems are in place to adhere to new legislation and to protect sensitive data (patient confidentiality);

- Computerised district health information systems are used;

- Computerised laboratory information systems are in place;

- Burden of disease systems are in place (supporting the information flow on the burden of disease e.g. on infectious diseases, such as HIV/AIDS, TB and malaria); and

- The organisation is catering for data and knowledge flows in the greater health sector.

In general none of the abovementioned elements of health ICT is implemented or operating at a high level of utilisation. The narrative comments received closely correlate with the low scores recorded.

With reference to the integrated model of information flows as depicted in the diagram in section 2.1 of the full report, and reproduced below, it can be stated that many of the organisations in their own right do contribute to the data and information flow of the larger health sector. Some systems are quite advanced—with integration of components—such as in the case of the information systems implemented at some academic hospitals. There is also an emergence of e-Health gateways/portals serving various audiences in the greater health sector and in some instances specifically providing for communities of practice to stimulate innovation and enable improved decision-making. However, there are several 'broken lines' in the model in terms of (electronic) information flows. This is due to several factors, such as a lack of computerisation at some levels (e.g. in many parts of the Eastern Cape Province), the fact that ICTs have been implemented in vertical environments as 'stand-alone' solutions that have not been designed to feed information beyond the operational environment, lack of Internet access, and a lack of holistic planning or financial constraints to implement more integrated systems.

These flows obviously differ between those organisations operating in the public sub-sector and those operating in the private sub-sector, and one finds that the two sub-sectors, in most cases, are actually operating in somewhat independent environments. Flows in the private sub-sector are mostly driven by a business model to expedite the processing of financial transactions—refer the information flows from healthcare service providers via switching networks to administrators and funders. The intermediaries in such a chain have started to build their own warehouses, mostly to protect data but also to analyse data with a view to selling information to third parties, although they are not (necessarily) the owners of the data. In general the information flows in the private sub-sector are fairly advanced, but there is the (common) phenomenon of parallel flows—not interlinking to allow a holistic view.
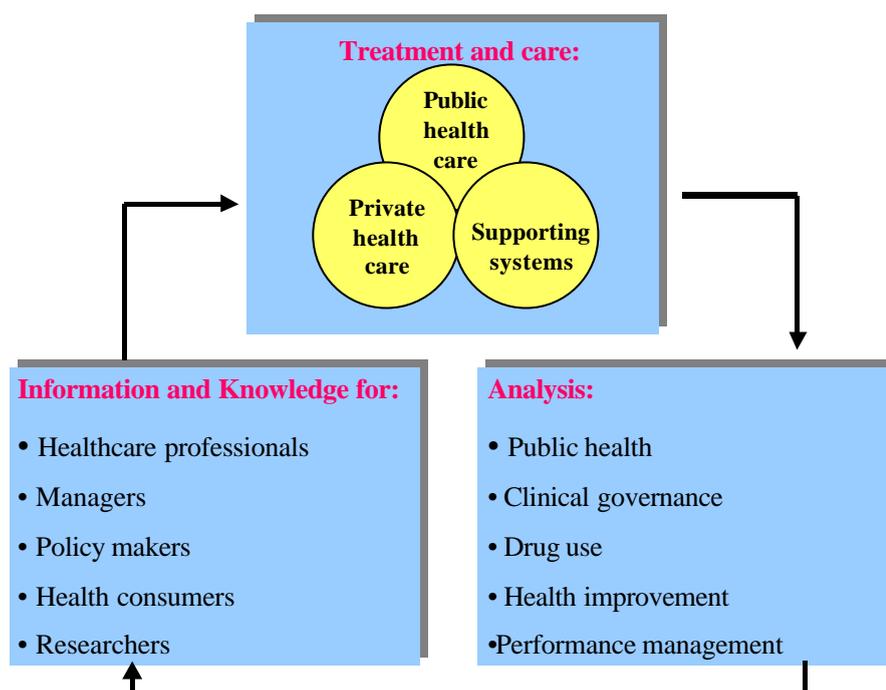
Figure 7. Information Flows in the Health Sector

Systems implemented at small organisations/entities may be as advanced in terms of functionality as those of larger organisations. The systems being implemented at health district level are well designed and are providing a good basis for an interfaced hierarchical health information system, such as being envisaged by the National Health Information System for South Africa (NHISSA). Minimum data sets for districts, and for public and private hospitals, are currently being collated at district, provincial and national level, on a monthly basis. The review of the national disease notification system is currently out to tender, and should result in greatly improved availability of information. However, flows within the public sub-sector are far from optimal, which would make it very difficult for instance at this stage to build a common comprehensive data warehouse which can be interrogated for management information purposes and insight into the burden of disease.

The researchers view the level of codification of knowledge and the availability of such codified knowledge as important for a country such as South Africa where transfer of knowledge to build capacity should be an important goal. The study therefore included a broad Knowledge Management assessment of the organisations surveyed. It concludes that the private healthcare sub-sector is the most sophisticated as regards knowledge management. The level of "unarticulated codified" knowledge, however, is the highest in the public healthcare sub-sector. The higher this value, the more inefficient the organisation concerned will be in terms of knowledge transfer. It therefore indicates an insular approach to information and knowledge dissemination in this sub-sector. The level of "unarticulated uncodified" tacit knowledge is also the highest for the public healthcare sub-sector. These findings correlate with the general situation of uncoordinated ICT systems in the public healthcare sub-sector.

It is the researchers' view that the flow of knowledge in the South African health sector is not optimal, particularly in the public sector. Insufficient telecommunication and

Internet connectivity is an important aspect highlighted by this survey. It is clear that bandwidth is a major factor to be taken into account for future ICT planning initiatives. Many respondents highlighted this as a major inhibiting factor.

International Trends in Health Information Flows

Nature of Applications. Health information applications have largely focused on strategic management of the overall health care budget during a time of exploding health care costs. Key technologies being deployed in health information include geo-spatial (for monitoring health care trends on a geographic basis), multi-media (for communicating health care information) and e-commerce (for supply chain management, particularly with pharmaceutical suppliers).

Extent of Diffusion. Health information has been an important component of ICT usage in health delivery over many years. The US is currently spending ~8% of its health care budget on health information networks. Health information is increasingly available on the Internet to consumers who often challenge the knowledge of medical practitioners and are increasingly taking a more active role in their own health care. Such information networks are starting to shift the emphasis from cure to prevention by promoting healthier lifestyles.

Implications for the Future. Many of the smart community developments around the world are placing a high priority on health information. For example, pilot initiatives in this area are monitoring, collecting and transmitting health information from patients recovering from illnesses in their own homes. Such applications will have far reaching implications on health care delivery in the future.
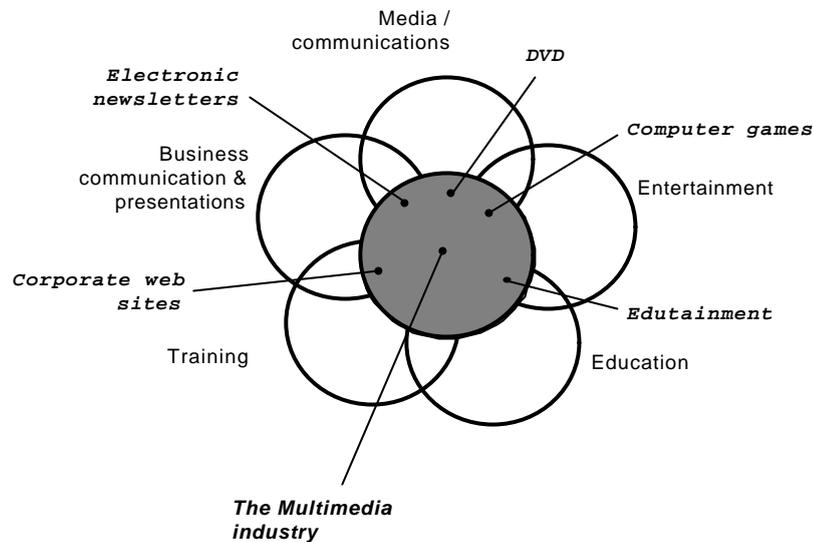
6.7 Multimedia

This report is a research component of a study commissioned by the Department of Trade and Industry, which set out to assess the application and diffusion of Information and Communications Technology (ICT) in eight economic sectors. One of these is the multimedia industry. The research was conducted during the first half of 2002.

A well-accepted definition of 'multimedia products' is:

> *Multimedia products enable the consumer to experience simultaneously at least three of: sound, text, video and graphics, often in an interactive manner.*

As shown in the diagram below, consumers of multimedia products include the media & publishing (print and electronic), entertainment (including games), education (including training and business presentations) and business customers for web sites and presentations.

Graphic Representation of the Multimedia Industry

Multimedia products are generally developed using tools to capture or create visual images (both film and graphic, generally in digital form), text and sound and manipulate them together. These tools are created by the suppliers to the industry; this distinction further narrows the definition of the multimedia industry to **the developers of multimedia content for customers.**

The activities likely to be carried out in the multimedia industry include:

- Design and definition of multimedia products;
- Generation of content for multimedia products;
- Integration of content of various kinds (sound, text, video, graphics) into multimedia products; and
- Reproduction, marketing, sale and distribution of these products.

The skills needed by participants in the sector include:
- Animation and 3-D modelling;
- Film and video production;
- Graphic design;
- Scriptwriting, translation and copywriting;
- Sound composition and recording;
- Interactive presentation design and development; and
- Electronic product design and development.

South African multimedia content developers are evolving into a recognisable, albeit nascent industry. A particular opportunity for this industry is to capitalise on both the

digital nature of the product and the cost advantage of South African skills over the developed world, to become a 'design and development factory' of multimedia products for the international market.

The research study identified 57 companies in South Africa that actually or potentially fit the broad definition of 'multimedia company'. Senior personnel in thirty companies were eventually interviewed. Most companies interviewed (63%) were 'micro' in size—less than ten employees. In this industry, twenty people constitute a 'large' company. Only three had twenty staff or more and none had more than twenty-five. Twenty-three of the thirty companies interviewed (77%) had or have overseas clients. Some also have international operations in the form of a physical presence—often a sales or client relations office - which feeds work back to South Africa for production.

Only five interviewed companies met a more rigorous definition of a multimedia company, with full integration between strategic, creative and a broad range of technical capabilities. Those five were all larger companies (for the industry), providing strategic, creative, technology and even reproduction services in-house, and all have international clients.

Regarding technology use by multimedia companies, it is important to appreciate that multimedia companies only exist because certain types of digital technology allow them to exist at all. ICT use is inherent in the nature of the services that they provide, products that they offer, and tools that they use to do so. Thus respondents did not see certain technologies as 'needing emphasis'—they are understood and used as tools to do a job of work. What was very frequently mentioned instead was the need for skills development. This is also universally seen as a major inhibitor of the achievement of business goals in this sector, together with access to viable markets. Appropriate expert skills are in short supply, and competent and experienced developers of multimedia products are in demand, even in a static — or for some, shrinking — market.

If multimedia companies are typical, then it would seem that companies who use specific digital technologies for their core production process are also highly likely to use ICT business tools in support of their administrative processes and promotional activities.

The 'technologies and application areas needed for growth of the business' are seen to be not the development of new technologies, but rather the penetration of existing technologies into the workplace and the populace at large so that more people will be in a position to utilise multimedia products. The limits on this are taken to be the sophistication and education of the general population, and their very limited ability to afford the necessary technology platforms—for example, home PCs—as well as the (by developed world standards) exorbitant cost of bandwidth and connectivity.

The size and rate of growth of the market for multimedia products in South Africa is thus limited by the rate of diffusion of computers as multimedia viewing platforms throughout homes and businesses. While computers are now ubiquitous in most more sophisticated businesses, the number of people with access to computers and other multimedia-capable computing platforms either at work or at home is still a small proportion of society. This has two consequences:

First, most multimedia products developed in South Africa are for the purposes of business-to-business communication. These mainly take the form of company web sites, pro-

promotional and sales presentations and tools. When the Internet is not the medium of distribution these take the physical form of CD ROMs.

Second, the focus of South African multimedia companies wishing to expand their client base is on international, developed world markets—primarily in America and Europe.

The multimedia companies interviewed are confident that they can compete in these markets on the basis of product quality (including innovative use of multimedia development tools to create new kinds of product), price and delivery time.

Computer games – which are a form of multimedia product - have a very small market in South Africa. South African multimedia companies do have some experience of producing games for promotional purposes, which could be basis for the expansion of this area. One company was identified specifically focused on multimedia products for the gaming (gambling) industry whilst another supports back-office functions for a number of international gaming sites. Several of the more sophisticated multimedia firms have a market focus on the television and film industries, producing multimedia branding and special effects 'products.'

Overall responses to the questionnaire may be summarised as follows:

ICT Usage

Basic Hardware and Communication Technologies

PCs (or Apple 'Macintosh' equivalents – generally for graphic design purposes) together with file servers networked locally are fully utilised. Most interviewees view the Internet as a wide area network, which again is fully utilised – no instance of the use of a virtual private network was identified. Most use leased line Internet connectivity. Emerging technologies (as defined in the questionnaire) have no use, though other newer technologies such as digital 3-D rendering and digital video editing are frequently found. Wireless networks – even for local internal use – have not yet been adopted (this is still a novel technology and with legal limitations on use). The delivery of multimedia content over wireless cellular networks is limited by network bandwidth and the low penetration of WAP[9] handsets, though SMS[10] use for promotional purposes is growing.

ICT Applications

E-mail is the prime source of information acquisition – workers in multimedia companies have their computer in front of them at the centre of the desk, not to one side. Most 'live on e-mail'. A few use teleconferencing occasionally (sometimes using web-cam technology), but most see this and videoconferencing as unnecessary and expensive. The Internet is used for communication, information gathering, business promotion, providing customer support and for transaction processing.

ICT is used for stream-lining relevant business processes – shared files are generally stored on central servers for knowledge management purposes, and accounting functions

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[9] Wireless Application Protocol, a technology standard for the delivery of digital content to cellular telephones.
[10] Short Message Service, a format for the delivery of 160 character alphanumeric text messages to cellular telephones.

are performed with appropriate PC based packages. Most rely on digital communications to promote their businesses – though never exclusively (face-to-face contact with clients is still important!)

Customer records are stored digitally, and some aspects of project management and related process control are performed via the network – though the paper 'project job file' has not yet been superseded.

As stated previously, there are no uses for manufacture process control, inventory management or distribution management systems within this environment.

Multimedia products are themselves responsible (in part) for transforming business processes, and so – as one would expect – they are fully utilised where appropriate. The provision of information on-line or via websites, as well as quoting process, answering queries and taking orders by e-mail is fully utilised. Business-to-business transactions are mostly – and when ever possible – concluded on-line. Teleworking is common – though not extensively used (partially due to the high cost of bandwidth into homes or other remote work locations – people come to a place of work because that's where the connectivity is!)

When further probed, respondents generally did not see certain technologies as 'needing emphasis' – they are understood and used as tools to do a job of work. What was very frequently mentioned instead was the need for skills development. This is also universally seen as a major inhibitor of the achievement of business goals, together with access to viable markets. Appropriate expert skills are in short supply, and competent and experienced developers of multimedia products are in demand – even in a static (or – for some – shrinking) market.

The 'technologies and application areas needed for growth of the business' are seen to be not the development of new technologies, but rather the penetration of existing technologies into the workplace and the populace at large so that more people will be in a position to utilise multimedia products. The limits on this are taken to be the sophistication and education of the general population, and the very limited ability to afford the necessary technology platforms – for example, home PCs – as well as the exorbitant cost of bandwidth and connectivity (by developed world standards).

Since this situation locally is unlikely to change any time soon, the local market is not expected to deliver significant growth for the foreseeable future.

ICT Spending

ICT related costs are the major expense of multimedia companies. These costs break out as follows:

- Hardware costs, including maintenance and support;
- Multimedia and tools and other applications;
- Network and connectivity costs; and
- Skills acquisition and retention.

The first two costs are basically priced in US Dollars, and thus are relatively high for South African companies when compared to their developed world competitors. Connectivity costs—especially the cost of bandwidth—are generally higher in South Africa than in the countries of competing multimedia companies. This negatively affects the local

cost structure, as well as the costs associated with servicing overseas clients. Skills are in high demand and command a premium relative to other similar ICT skills, but are still less costly than those of competing developed world companies. Other costs of doing business (rent, utilities etc) are lower than those of competing developed world companies.

On average, the South African multimedia sector's ICT expenditure is reckoned to be slightly less than the norm for the industry globally. This reflects the reality in South Africa that both the hardware and software tools are imported, and the industry's customers do not demand products that require the latest tools. The consensus is that IT expenditure is not keeping up with other demands.

Sources of ICT Information and Training

For information about ICT developments respondents primarily use the Internet, followed by in-company 'experts', equipment and software vendors, and newspapers magazines and journals.

The main source of training is Internet sources followed by company 'experts' and suppliers. In house and private training schools, together with magazine publications, were ranked next.

ICT Adoption: Drivers and Barriers

External Economic Factors. The strongest positive economic driver is the multimedia industry's general culture and overall attitude towards ICT; for many these are more than 'just tools'. ICTs are a means of creative expression as well as source of income and profit. (However, this should not be taken to mean that ICT spending is undertaken recklessly, especially in the current poor economic environment; larger companies especially expect a measurable return on their investment on the technologies they employ.) The expectation of increasing global business opportunities is also a positive factor, as well as the need to stay competitive. On the negative side, current economic conditions and short-term competition are a current disincentive to investment in the further adoption of ICT.

Supply Chain Factors. These are marginally positive, with responding to customer expectations and the continual push by suppliers to adopt new tools (or new versions of tools) the main drivers. The ubiquitous business needs to improve communications and reduce paperwork were also cited.

Internal Factors. Internal factors are overwhelmingly positive, with the exception of perceived ICT cost and the critical shortage of skills to use the available technologies.

Diffusion of ICT into Organisation/Sector

From a technology perspective, respondents are innovative, with most considering themselves to be more innovative than their competitors in the multimedia sector in South Africa, but marginally less so than their competitors globally. However, respondents do generally perceive their local industry to be better at product/service innovation than its competitors globally.

The multimedia industry in South Africa is an innovative adopter of ICT tools that are relevant to its needs—though this attitude towards technology permeates even the adoption of ICT tools that are non-core, resulting in adoption—for example—of relationship management and administrative process tools ahead of most other industry sectors. Provided that the industry can remain viable and access international markets, then the advanced diffusion of ICT is likely to remain or even advance further towards perceived international norms.

Prospects for the Future

The multimedia industry is different from other industries in the DTI study of ICT diffusion since it is actually a part of the ICT industry itself. Aspects such as 'what can this sector do to better exploit ICT?' are not directly relevant. As the sector grows it exploits ICT in ways appropriate to the needs of its marketplace. A response to 'What can the ICT industry do for this sector?' on the other hand would include addressing its need for skills, and the high cost of hardware, imported software tools and costs of bandwidth. Multimedia products could be used to showcase not only the South African multimedia industry, but also its IT industry and the country as a whole. Given this high potential, there are several aspects that government and the industry as a whole might address. Critical for sector growth will be the identification of factors required to increase international visibility and penetration, so multimedia products need to be recognised as viable exports, sector and the ICT sector at all levels in order to develop a strong and vibrant multimedia sector.

International Trends in Multimedia

Nature of Applications. Multimedia is an emerging industrial sector that is highly dependent on ICT for its existence. The ICT sector provides the infrastructure and technology underpinnings that the multimedia sector need for its products and services. A key use of ICT in the multimedia sector is strategic management (particularly as it relates to the management and dissemination of vast quantities of multimedia information). Key technologies being deployed in the multimedia sector include knowledge management (particularly for managing large multimedia databases) and B2C e-commerce & Customer Relationship Management (for marketing and supply chain management).

Extent of Diffusion. The sector uses ICT extensively in the development of new products that typically have an integral ICT component. Many multimedia companies had their origins as content providers in the ICT sector.

Implications for the Future. Strong linkages will need to be maintained between the multimedia sector and the ICT sector at all levels in order to develop a strong and vibrant multimedia sector.

6.8   Platinum Mining

Platinum Group Metals (PGMs) comprise the metals platinum, palladium, rhodium, iridium and osmium. These metals usually occur together in the same ore. So interlinked are they that the terms 'platinum mining' and 'PGM mining' are used interchangeably. Their properties include high density, strength, high melting points and catalytic properties. These properties make them suitable for jewellery and many industrial uses, notably as catalysts in autocatalytic converters.

South Africa is the world's top producer of PGMs, accounting for 46% of total world supply. It also has 56% of the world's identified resources, showing the potential for sustained future production and continued world dominance. Export sales reached nearly R25 billion in 2000, compared to R5 billion in 1990, and are set to increase further. With the decline of the ageing gold mining sector, the role of platinum mining in South Africa's economy is becoming more and more significant.

Between 1980 and 2000, global platinum consumption increased by an average of 5,7% per annum. The fastest growing use was for jewellery, which increased by an average 14% per annum in the same period. During 1999, global supplies fell 6.3%, due largely to decreased Russian output, while at the same time global demand rose by 7%. In 2000 Russia increased output, and global supplies grew marginally. Demand for palladium decreased, which lowered global PGM demand slightly. However, by the end of 2000, supply was still outweighed by demand (supply was 88% of demand). This supply shortfall is predicted to continue in the near future, ensuring that prices remain high.

Demand for platinum, palladium and rhodium for auto-catalyst manufacture continues to increase. New uses for platinum, such as fuel cells, are being developed and demand from these uses is expected to come on stream in the near future. It is forecast that by the year 2020 platinum demand will have grown by a further 50% of today's figures.

In South Africa, platinum mining is spread around the Bushveld Complex. There are three main limbs of the Bushveld Complex where platinum mining is taking place, represented geographically as:

Western limb:	Thabazimbi to Rustenburg to Pretoria
Eastern limb:	Lydenburg to Steelpoort to Zebediela
Northern extension:	Potgietersrus to west of Pretoria.

Platinum mining is an important component of the economies of three provinces: North West, Mpumalanga and Northern Province, with the North West province being predominant. The synergy between the Bafokeng tribe and the platinum mining sector has seen a significant proportion of the revenue flowing directly into the surrounding communities. The resultant expansion in communications, health, education and social amenities infrastructure is a sterling example of what could be achieved in the platinum mining sector.

The industry operates on a free market basis, with no government subsidy. The sector employs 96 000 people on the mines. There are four major traditional mining companies, Angloplats, Impala, Lonplats and Northam. All these players have either embarked on, or are planning, major expansion projects to meet the predicted growth in demand. More recent entrants in the sector include Aquarius Platinum (Kroondal and Marikana) and Southern Era (Messina Platinum).

Joint ventures and participation by empowerment groups are becoming increasingly important in the sector. African Rainbow Minerals has gone into a R1.35 billion joint venture with Angloplats at Maandagshoek on the eastern limb of the Bushveld Complex. In 2000, Mvelaphanda Platinum bought a 22.5% stake in Northam. During 2001, Lonmin and Angloplats agreed to develop the Pandora mine. Also Anglovaal and Implats announced plans to develop Dwars Rivier on the Eastern limb, most likely with an empowerment partner.

South Africa's PGM mining sector is therefore well geared for growth and is set to maintain its global dominance. The sustained growth of the PGM mining sector will produce extraordinary leverage in enhancing economic growth in the regional communities, and the provincial and national economies. This will occur through the knock-on effect that always follows developments in any mining sector.

This report that follows was informed by results obtained from a survey of the Platinum Mining Industry both here and overseas (Phase I of this project). Based on a questionnaire designed to obtain general (generic) information about ICT Use plus that specific to the Platinum Sector, over 60 people were interviewed across the Value-Chain.

There is a dramatic spectrum of size when reviewing the organisations in the sector, from producers in the sector, each with many thousands of employees, to several medium sized mining companies relatively new to the area. These companies are involved in the production value chain from mineral rights to sale of refined metal. They are supported by large to medium size suppliers, contractors and service providers. Other stakeholders with a lesser presence in terms of the Platinum Mining Sector include mining systems suppliers, industry and regulatory bodies and research institutions.

The group that is growing significantly in numbers but does not have any strength as yet in the mining business is that comprising regional and local authorities, as well as the local interested and affected parties throughout the three provinces where platinum mining rights are located.

The Summary findings from the survey questionnaire are as follows:

ICT Usage

Basic Hardware and Communication Technologies

Personal Computers, Servers, CAD/CAM, and Local Area Networks are well used with the expected variation across size of firm, and with a lower response as far as the use of emerging technologies and mobile phones/pagers is concerned.

Emerging technologies, such as geospatial technology and robotics, are not yet well utilised in the sector. At the time of the survey, most of South Africa's platinum mines are underground operations. Sensing devices and geospatial technologies are used to some extent in surface mining but underground application is still under development.

Another emerging technology which is not well utilised in mining is robotics, despite the fact that it has long been recognised that the hazardous environment of underground mining would be a suitable place to use such technology. However, the technology has not yet been developed to the point where it is a commercially attractive option.

Wireless data transmission is not widely used because of the slow speed of transmission, and the patchy network coverage in remote mining areas. It is envisaged that with new network technology, transmission speeds will improve and the use of wireless networks for data transfer will increase.

ICT Applications

ICTs for information acquisition and communications are well utilised, except for teleconferencing and videoconferencing. E-mail is well utilised across the sector except for some of the new entrants. Teleconferencing and videoconferencing are generally not used on the mines. Their use is mainly in the corporate offices of the large mining com-

panies that have international links. Such links may be international offices, directors, shareholders, or contractors.

ICTs for streamlining business operations are all reasonably well used except distribution and marketing. Mines dispose of their mineral products in terms of long-term contracts. There is thus little or no place for marketing and distribution effort via ICT channels. The use of ICT for business support activities (finance, accounting etc) is high, as is to be expected in modern companies. The use of ICT in certain applications such as marketing and sales, stock and inventory control is average to low, and probably indicates some opportunity 'gaps'.

ICTs for transforming business processes are not widely utilised to date. The major companies provide information on Websites, which are generally not interactive.

Business to business e-commerce is limited to transactions at the corporate offices of large companies. Mines and their major plant and equipment suppliers currently obtain their equipment and consumable materials by means of procurement contracts set up on a tender basis at mine or corporate level from time to time. These are medium term in nature and usually renewable annually or by formula. There is thus not the same scope for business-to-business e-commerce as for consumers outside the sector who wish to scan and obtain a large number and scope of materials at irregular intervals.

There is the current move to set up large contract purchasing on a business-to-business basis via the announced international Quadrem procurement system that will operate as a service to participating mines on a worldwide scale. This has been set up by the 14 largest mining companies in the world as a standard procurement portal. This is likely to grow rapidly in the near future and will step up the demand for ICT use on mining operations. Comments from respondents show the importance of this area of ICT application by highlighting 'streamlining and transforming business processes' as areas needing emphasis. Projections show that this area will receive greater priority in the next two years.

ICT Spending Patterns

The growth of the ICT budget within the various organisations is believed to approximate the organisation norm. For the large mining organisations this is a reflection of the prevalence of central guidance and control. In the very small organisations there is only one budget to cover this expenditure. Expenditure on ICT within the Platinum Sector is felt to be less than the global norm.

## Sources of ICT Information and Training

ICT Information is obtained primarily from ICT suppliers, experts within company and consultancies or service providers. Trade and Business Associations, Chambers of Commerce and the Government initiatives are hardly used. The pattern for ICT Training is similar, but here in-house training is extensively used.

ICT Drivers and Barriers

External Factors.   External factors in general have no particular influence. The South African platinum sector commands a dominant position, and is not driven by competition or global opportunities.

Supply Chain Factors.   Supply chain factors all have positive influence, except for government, which has no particular influence. The mining sector is efficiency driven. Mineral producers have no direct control over commodity prices, so the only control they have on profit margins is increased efficiency. It therefore follows that the need for organisational efficiency is a driver for ICT adoption. First class communications and reduced paperwork help to enhance that efficiency and are also positive drivers.

Internal Factors.   The internal drivers of ICT are the positive attitudes of both management and personnel, without which any attempts at adoption would fail.
The perceived cost of ICT is the only factor that is a barrier to ICT adoption, as shown in Figure 6 below. This is backed up by various comments to the effect that the cost of ICTs, especially the telecommunications component, is too high.
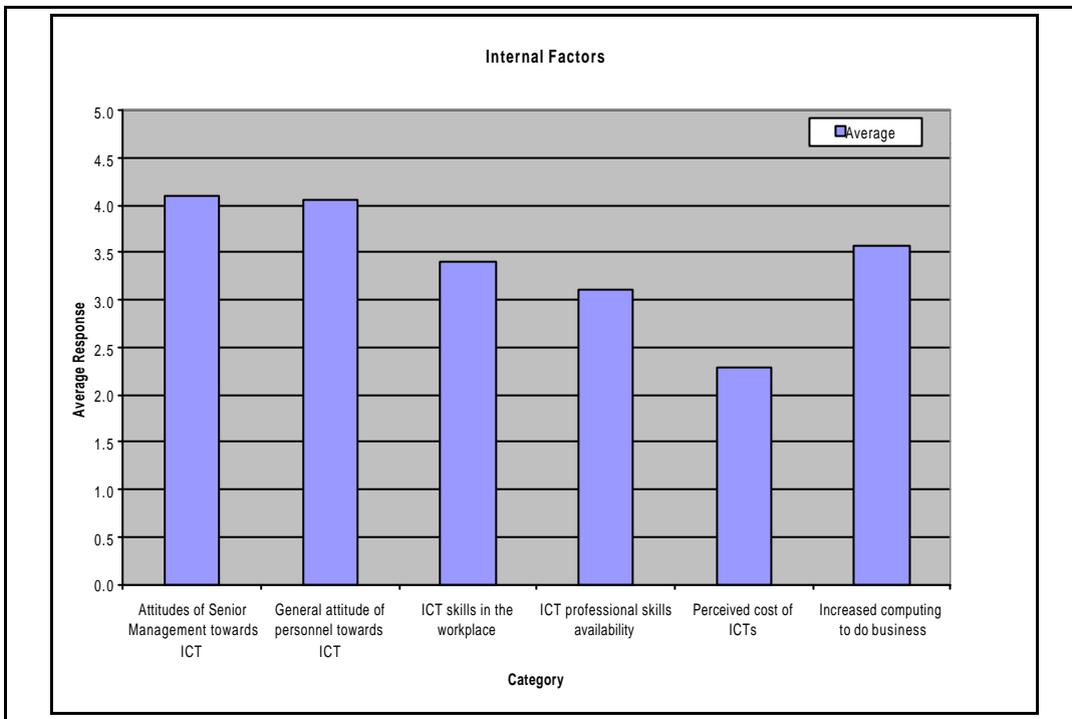
Figure 9. ICT Adoption: Drivers and Barriers – Internal Factors

Extent of ICT Diffusion

Respondents in the Platinum Mining Sector feel that they are slightly behind the rest of the Mining Sector in South Africa in their adoption (diffusion) of ICT, although Mining globally is seen to be in the early majority.

Sector-Specific Questions

The **sector-specific** part of the questionnaire examined both present realities and future trends within *categories of respondents* e.g. mines, process and metallurgical plants, equipment suppliers. While in some cases the number of respondents per category miti-

gates against placing too heavy an emphasis on these results, a number of interesting trends were identified.

Usage of ICT was forecast to grow in practically all areas of the business, across categories, over the next two years. This probably matches the position with the other major mining sectors. The mining sector with its traditional large company involvement has been amongst the early majority of ICT users when compared with other sectors.

Information warehousing is seen as increasing in use in future. This probably reflects a trend towards greater integration of systems across the value chain, as was also highlighted in the international scan. This is also indicated by a sharp increase in the use of ERP systems such as SAP in future. However, it seems clear that not all players are putting in the same effort or even have the same understanding of the issues involved.

In recent times there has been increasing political pressure to prevent known mineral rights from lying undeveloped. Further, it is becoming a requirement to have empowerment partners involved in the exploitation of these mineral rights. The pattern of Joint Venture projects up until now has been of two types. The first is where two of the traditional major companies have collaborated to optimise the exploitation of adjacent mineral rights (e.g. the Pandora 50:50 project between Anglo Platinum and Lonmin Platinum). The second has been between one of the large companies (who hold most of the mineral rights) and a development with an empowerment partner in the form of a Black-controlled mining investment company e.g. the Anglo Platinum and African Rainbow Minerals project at Maandagshoek. There is now, however, a growing group of aspirant mining entrepreneurs, who are aware that mineral rights are being made available by the major companies and wish to be included as empowerment partners in Joint Venture projects. There were a number of these people *(new entrants)* included in the survey.

Future Joint Venture partners show little usage of ICT, although usage is forecast to increase over the next two years. There is clearly a need for an extensive education and support programme, which includes ICT.

There is general consensus that services provided by Telkom need improvement. Concerns were expressed over the cost of telephone services, the speed of data transfer and the unreliability of connection. The problem seems to be most acute in the more remote mining areas, *where all aspects of communication except the fixed line network were ranked as being inadequate both now and into the future.*

The *processing and metallurgical plants* as well as the *contractors* were concerned particularly about videoconferencing and satellite communications, since both groups are reliant on international communications.

Suppliers as a group were particularly unhappy about the adequacy of their overall communications infrastructure, rating it the lowest of all groups going into the future.

The question on which projects should get the priority of diffusion, in terms of their importance to the speedy implementation of development projects planned, elicited some interesting responses. The mines, for example, rated no basic technology or sector-specific application above a '3' on average, indicating that they see no particular ICT as requiring high priority for development. Mining Companies, Process Plants, Suppliers and ICT Suppliers rated E-Commerce as a high priority.

Mine systems suppliers place low priority on all sector applications except Mine Planning and Design, their area of specialisation.

The mines in particular seem to suffer from a shortage of trained people, with their ratings being at the 'insufficient' or below level in every category. The mining companies are relatively satisfied, presumably largely because they operate out of the major centres and have the resources to buy skills; most other groupings show shortages or acute shortages in selected areas.

There are some interesting anomalies. For example, the availability of skills in the 'Mine Planning and Design' area is rated as '3' or below in every group except the ICT Suppliers (of mine planning and design software) – who have presumably cornered the market. Mining companies will therefore require the management skills for the technology uptake.

International Trends in the (Platinum) Mining Industry

Nature of Applications. The mining industry generally has been very focused on use of ICT for cost reduction although some applications address areas of quality improvements (e.g. in the scheduling and maintenance of equipment) and in the area of strategic management (e.g. mine planning and inventory management). Key technologies being deployed in the mining industry include wireless (for truck/shovel management) and geospatial, including sub-surface mapping and remoter sensing (for mine planning and management).

Extent of Diffusion. The investment in ICT for the mining industry has been growing exponentially over the last two decades. However, the Platinum mining industry remains highly labour intensive compared to the sector as a whole.

Implications for the Future. Continued emphasis on use of ICT for cost reduction is likely to result in increased competitiveness but at a cost of reduced overall employment in the sector.

7. Conclusions

This project is the most comprehensive of its kind undertaken in South Africa, and indeed there have been few attempts internationally to examine ICT Diffusion on a sectoral basis. It should be borne in mind that, although the sectoral surveys measured the perceptions of role players in each sector and do not include much quantitative data, the results were reinforced by background material obtained from a scan of international trends in that sector or industry. In addition, interpretation of the results has in every case been performed by professionals with extensive experience in each sector.

The individual sector reports provide a succinct overview of the ICT activity in each sector, together with a list of recommendations for government, the sector in question, and the ICT Industry. In many cases these recommendations stem from similar issues, and the project team has endeavoured to summarise the main themes in the early part of this report. These common themes or cross-cutting issues can be—indeed should be—addressed by government as a matter of urgency as they are seen to be major impediments to the effective operation of industry.

The most pressing concern, expressed frequently and across all sectors, is the urgent need for a better and cheaper telecommunications infrastructure. Although it could be argued that South Africa is competitive with many other developing countries, the sectors in question are without exception looking at international best practices. It is in this arena

that they believe that they are placed at a disadvantage when competing against for instance American or European companies.

In some sectors this issue is most pressing in rural areas, as in the Deciduous Fruit Industry and in Platinum Mining; here it would probably be necessary to do further analysis to establish how best to provide their communication requirements.

ICT Training is a concern for most of the sectors. In general it is felt that the SETAs are not providing the needed emphasis here, and further dialogue is called for in order to understand how best to move forward.

Although there are a number of incentive schemes available that do or could support ICT projects, these are widely seen as being ineffective. The reasons for this are not immediately apparent from this study, and further analysis is required.

It is clear that tremendous advantages will accrue to South African firms if regional markets prosper; few common structures exist, however, that will allow the efficient servicing of such markets using modern techniques such as B2B e-commerce. Programmes need to be put in place to introduce these structures as soon as possible, since they require both political and economic actions.

Each sector also identified key projects that could be instigated either solely through industry initiatives or in conjunction with the ICT industry. Some of these initiatives are described in Section 3 of this report, while others can be found in the full sector reports.

It is clear that opportunities exist to realise significant productivity gains across most sectors, and that many of those opportunities require clear and focused initiatives from government or through private/public partnerships. Many of the respondents in this survey expressed concern that the major recommendations would not result in significant action. That is the challenge government must meet.