
Evaluation Report

Mobile Telecommunications Pilot

**For DTIR
(Department of Training
and Industrial Relations)**

Prepared by:

Jeff Parker
JP Consulting (Aust) Pty Ltd

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Details	Signature	Date
Mr B. Carlon (Chair - Project Steering Committee) Executive Director Training & Employment Queensland DTIR		
Ms M. Timson Director, Information Technology Branch DTIR		
Mr J. Parker Director JP Consulting (Aust) Pty Ltd		

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JP Consulting (Aust) Pty Ltd, can be contacted through Mr Jeff Parker on

telephone:	(07) 3262 4545 (office)
	0411 110299 (mobile)
facsimile:	(07) 3256 0088
e-mail:	ParkerJ@ozemail.com.au
www:	http://www.ozemail.com.au/~parkerj

Correspondence should be addressed to:

JP Consulting (Aust) Pty Ltd
PO Box 512
Albion QLD 4010

Glossary

DEET	Department of Employment, Education and Training (federal), now called DEETYA.
DEVETIR	Department of Employment, Vocational Education, Training and Industrial Relations (now called DTIR)
DSS	Department of Social Security (federal)
DTIR	Department of Training and Industrial Relations (was DEVETIR)
e-mail	Electronic Mail
FBT	Fringe Benefits Tax
GSM	Global System Mobile (an international standard for digital mobile cellular telecommunications)
IIB	Information Industries Board
ITB	Information Technology Branch (of DTIR)
IT&T	Information Technology and Telecommunications
LAN	Local Area Network (typically a wire-based in-office network for computers and printers)
LMR	Labour Market Reform (a Business Division of DTIR, and a strategy)
PC	Personal Computer
PSTN	Public Switched Telephone Network (the telephone network in general use by the Australian population)
Q-TEL	Queensland Telecommunications
TEQ	Training and Employment Queensland (a division of DTIR)
TMR	Trunked Mobile Radio
X.25	A standard for packet-based telecommunications

1. Executive Summary

1.1 Introduction

DTIR, with support from Q-TEL and the IIB, conducted a pilot project to evaluate the business benefits possible with the implementation of mobile telecommunications technology.

The pilot was part of an overall government program called the Mobile Telecommunications Services Applications Panel, administered by Q-TEL.

This report documents the evaluation of the pilot, and includes a number of recommendations that will enable DTIR to invest in the technology to achieve its business goals. The pilot demonstrates the technology does support DTIR's goals.

This is not simply a report on the pilot. It takes the learnings from the pilot experience and other relevant information, and provides an analysis that can help DTIR plan for the implementation and operation of the technology. It was important to DTIR that the pilot provide value, in terms of evaluation, to the whole department.

A number of models, viz. costs, benefits, cost of ownership and sensitivity analysis, are included to help DTIR Business Units evaluate the potential benefits.

Pilot Profile

The pilot clearly demonstrated that mobile telecommunications technology can provide significant benefits to the business of DTIR.

Nine participants in three sites across the state were involved in the pilot which ran during the last half of 1995. These participants were equipped with technology that permitted them to conduct and complete the majority of their client services in the field and on-the-spot with their clients.

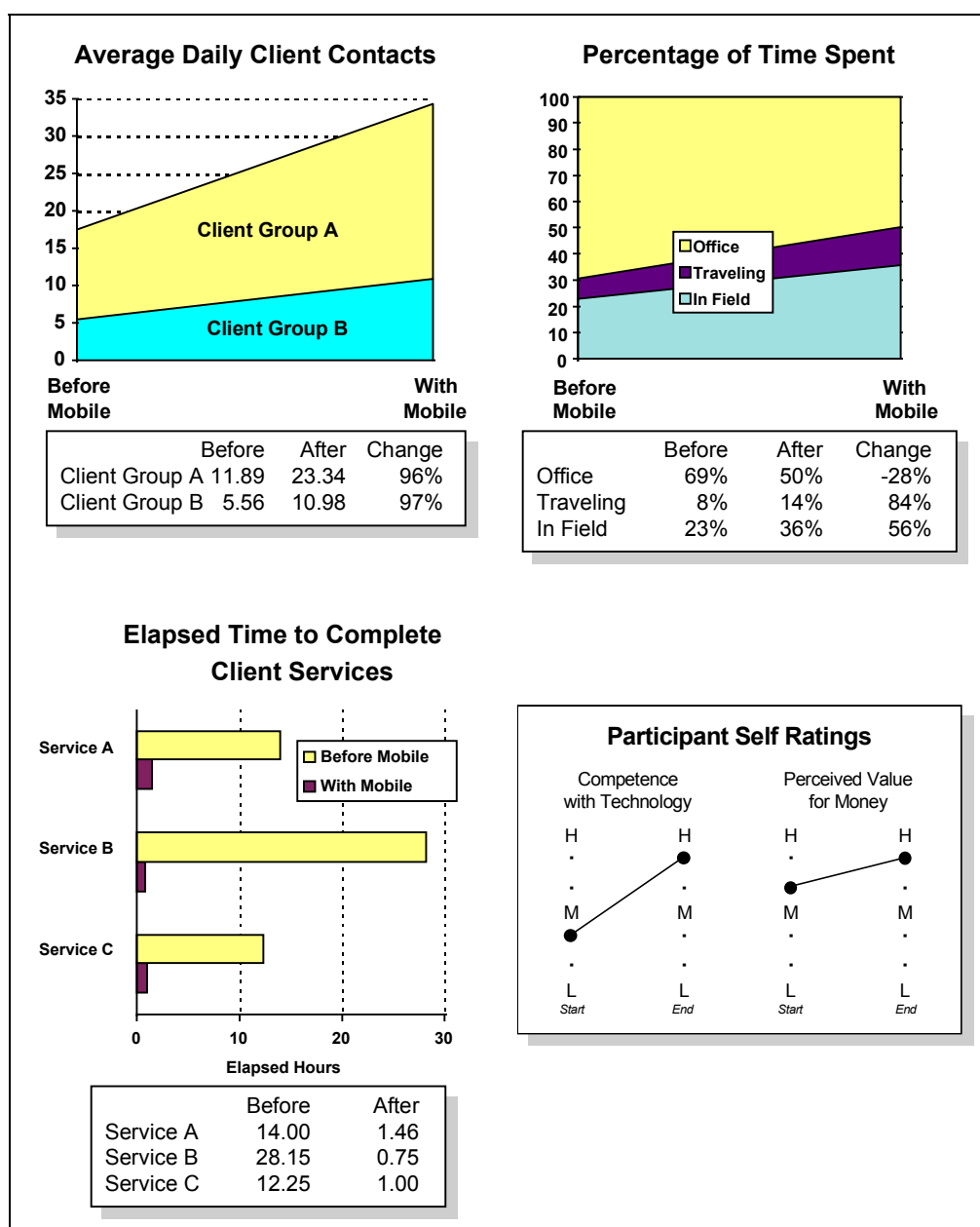
The pilot trialed and proved the concept of the "mobile office".

A number of significant technology-related problems were encountered during the pilot that were eventually overcome. The pilot largely delivered the specified functionality and was able to remain within budget.

1.2 Evaluation Summary

A number of key business measures for the participants were identified as relevant to the use of the mobile technology. Benchmark values for these measures were established before the pilot commenced. Values for these measures and others were collected during the pilot, to provide for a before and after-mobile comparison.

The following is a summary of the evaluation data.



These values are averaged across all participants and types of technologies trialed. The data illustrates overall trends and benefits achieved during the pilot.

The evaluation data presented on the previous page indicates that the mobile telecommunications technology enabled the field workers to achieve:

- greater client contact and more working time in the field; and
- a significant reduction in elapsed time to provide client services.

The data is corroborated by feedback from the participants and their clients, and demonstrates that the technology does support DTIR's business goals.

Benefits

The above information identifies an important area of business benefits. There are a number of others that should also be considered.

- Cost savings are possible. E.g. disposal of unnecessary equipment, reduction in FBT for car parking, and even reduced office accommodation.
- Productivity gains can be achieved. The amount depends on the specific field worker situation, however gains of between 10-25% can be expected.

As a specific benefit value cannot be determined that is relevant for all mobile opportunities in DTIR, the report provides a number of gross annual benefit scenarios that are used in the evaluation and for sensitivity analysis.

Costs

The pilot provided DTIR with a good understanding of the communications needs of field workers. While the pilot provided LAN (in the office) and wireless data communications (in the field), it was realised that other communications requirements also need to be considered.

A technology configuration model, with appropriate costs, is provided that supports all the communications needs of DTIR's field workers. This includes:

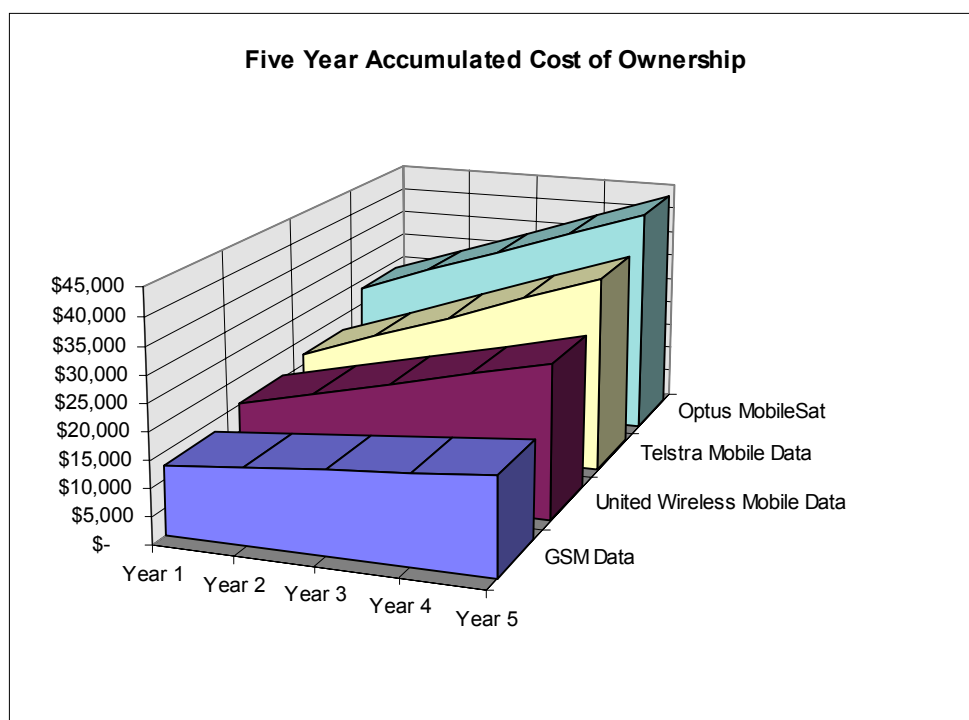
- Data communications, with LAN, wireless and wireline access; and
- Mobile voice communications

This will equip the field worker with sufficient capability to communicate effectively in any situation, e.g. in the office, on the road, at home, at a motel and other offices.

In order to provide a useful cost base for analysis, a typical usage model was developed. This is based on the experience of the pilot and includes expected variations with the above expansion of capability. The model excludes the cost of mobile voice calls.

The costing model includes a base configuration, to which the choice of wireless options can be added. The costing model also includes the cost of establishing the necessary shared network infrastructure, and allocates a share of these costs on a per-user basis.

The base configuration is costed at \$9,765, and \$76 per annum to use. The wireless options add costs ranging from \$1,200 and \$1,162 per annum, to \$8,900 and \$4,957 per annum. The following diagram illustrates a five year cost of ownership using the typical usage model, comparing the trialed wireless technologies.



Cost / Benefit Analysis

The gross annual benefit scenarios, when combined with the above cost information indicates that the GSM Data wireless technology option is a viable investment when the gross annual benefits is at a minimum of approximately 12%. At this level, the pay-back would be approximately 20 months.

This should be viewed as the minimum acceptable scenario. The evaluation data suggests that a much higher level of benefits would be achieved. These need to be evaluated on a case-by-case basis.

1.3 Summary of Recommendations

The recommendations in this report aim to provide DTIR with maximum possible leverage of its business goals, through the implementation and operation of mobile telecommunications technologies. In summary, they address these areas:

- The identification and development of business cases for further mobile projects, and the technology planning required to maximise benefits and minimise costs.
- Build on the completed pilot with the deployment of appropriate mobile technology for the pilot participants to gain immediate business benefits.
- Providing benefits to the broader government environment through DTIR's experience with its pilot.

2. Introduction

2.1 Background

The IIB (Information Industries Board), in conjunction with Q-TEL (Queensland Telecommunications), established a program to encourage government agencies to consider the business benefits available with the implementation of applications using mobile telecommunications technology.

The program sought to provide opportunities for improvements to the delivery of government services and to provide the Queensland IT&T industry with the opportunity to develop expertise, products, etc. in this new area of technology.

This government-wide program is called the Mobile Telecommunications Services Application Panel.

DTIR sought to be involved in this process and was successful in gaining approval for the development of a Business Case and the subsequent implementation of a Mobile Telecommunications Pilot. The IIB provided assistance to DTIR in the form of a funding subsidy for both of these activities.

This document is the Evaluation Report for DTIR's Mobile Telecommunications Pilot.

2.2 Mobile Telecommunications for DTIR

The Business Case for DTIR's Mobile Telecommunications Pilot indicated that there are several hundred officers in the department whose work activities might benefit from the application of mobile telecommunications technology. These activities, which are conducted across the whole of the state, include inspection, case management, audit, surveillance, and client liaison.

As the lead government agency for labour market reform, DTIR has a responsibility to understand the impacts that technological developments may have on the work-

place. Research undertaken and the experience of this pilot, indicates that mobile telecommunications has the potential to provide opportunities for significant improvements to client service and worker efficiency. As an enabling technology, it can also support work-place reform strategies.

The mobile telecommunications industry is expected to grow at extraordinary rates over the next 3-10 years. There is no doubt that it will be an established and valuable part of the future technology scene, and as such, will require integration with the technology plans of all forward-looking organisations.

DTIR is now amongst the few organisations that have trialed the technology. Through this experience it has an appreciation of the issues involved, from the business and technology angles, and also of the potential costs and benefits.

DTIR can, and now should, include mobile telecommunications in its work-place and technology plans with a high level of confidence.

2.2.1 Work Place Challenges

An important challenge that faces DTIR is the implication of this type of technology for the work-place. When applied effectively, mobile telecommunications can provide the potential for major improvements to business processes and work practices. This can provide benefits in areas including client service, productivity and cost savings.

With mobile telecommunications, people aren't limited to sitting at a desk in an office to use a PC that is connected to the corporate network. As long as care is taken in the choice of technologies and in the system design, the field officer can access their business systems from anywhere that there is coverage of the chosen telecommunications service.

This can effectively unhook many workers from their desks, and enable them to undertake much of their work in other places. These places may include client premises, motel rooms, home, in a car, and other offices - basically anywhere. The DTIR pilot revealed that this can provide dramatic improvements to client service and also to administrative processes.

It is not suggested that an entirely mobile work force is desirable. There are reasons why it is necessary for workers to have a place they can call their "office". These include practical work related matters as well as the social dimension. What this technology enables is an option. An option for field workers to take the computerised systems with them when they leave the office to deal with clients.

The design of office accommodation naturally needs to be considered in the scenario where field workers operate in a mobile manner. The DTIR pilot revealed that there is the opportunity to share office facilities, which can provide consequential cost savings, but that care must be taken to address all of the issues involved, and not simply the technology related ones.

This is an area where the field workers themselves should have substantial input to process and facility redesign.

2.2.2 Technology Challenges

There are currently a number of technology choices for mobile telecommunications, and indications are that the options will continue to expand in the future. Each technology type has relative strengths and weaknesses, and particular types of applications for which it is more suitable than others.

Examples of such applications are: electronic mail, database query, client/server applications, telemetry, and examples of relevant business processes are: dispatch, field sales, service/repair, case management, etc.

Like many large organisations, DTIR has more than one type of field officer and therefore has a requirement to support different mobile applications.

A challenge faced by DTIR and other organisations planning the implementation of mobile telecommunications services is the establishment of an effective infrastructure that ensures flexibility and choice, and also provides appropriate controls and cost efficiencies. An approach that provides a sound technology infrastructure, built to an architecture that permits choice to suit different applications, ie. to the business requirements, is recommended.

A factor that needs to be included for consideration is performance. Wireless communications are still relatively slow and people should not expect, at least for the next few years, that performance will be anywhere near that available via land-based wireline services. This means that people should not expect that all of the functionality that is available in the office can be available in the field.

However, the DTIR pilot and other trials indicate that current performance can be acceptable with the application of appropriate technology, software design and work practices.

The effective equipping of the mobile field worker so they can perform necessary business functions while they are “on-the-road” is a subject that needs to be explored. There is already an acceptance that a mobile telephone for voice communications is a necessity. The challenge with equipping the mobile field worker is to not burden them with a vast array of technology that becomes unwieldy and interferes with their activities. Opportunities to integrate or at least minimise the equipment required should be sought.

2.3 Benefits of the Pilot

The pilot has provided DTIR with experience and information to address these types of challenges, and to plan with confidence the implementation of mobile technologies.

This report documents the findings of the pilot and recommends actions to be undertaken that will enable DTIR to achieve the business benefits possible through the implementation of this technology.

3. Evaluation

3.1 Pilot Profile

Pilot Profile

- Users and sites
 - Milton (4)
 - Townsville (2)
 - Cairns (3)
- Technologies
 - 5 wireless services from 3 suppliers
 - Systems Integrator
- Functionality
 - “Mobile Office”
 - Office Services (eg. word processing, e-mail, portable printing)
 - Business Services (eg. software application)
 - One PC for the Office and the Field

An ambitious project - compared with the other Q-TEL/IIB pilots

DTIR realised that the technology has implications for the whole of the department and determined that the pilot was to provide feedback that would be useful to all of its divisions.

The DTIR Mobile Telecommunications Pilot differed from the other early pilots conducted as part of the Q-TEL/ IIB program, in that it included:

- sites outside the Brisbane metropolitan area;
- a range of mobile telecommunications technologies, instead of just one; and
- testing of the “mobile office” functionality, and not a vertical niche application.

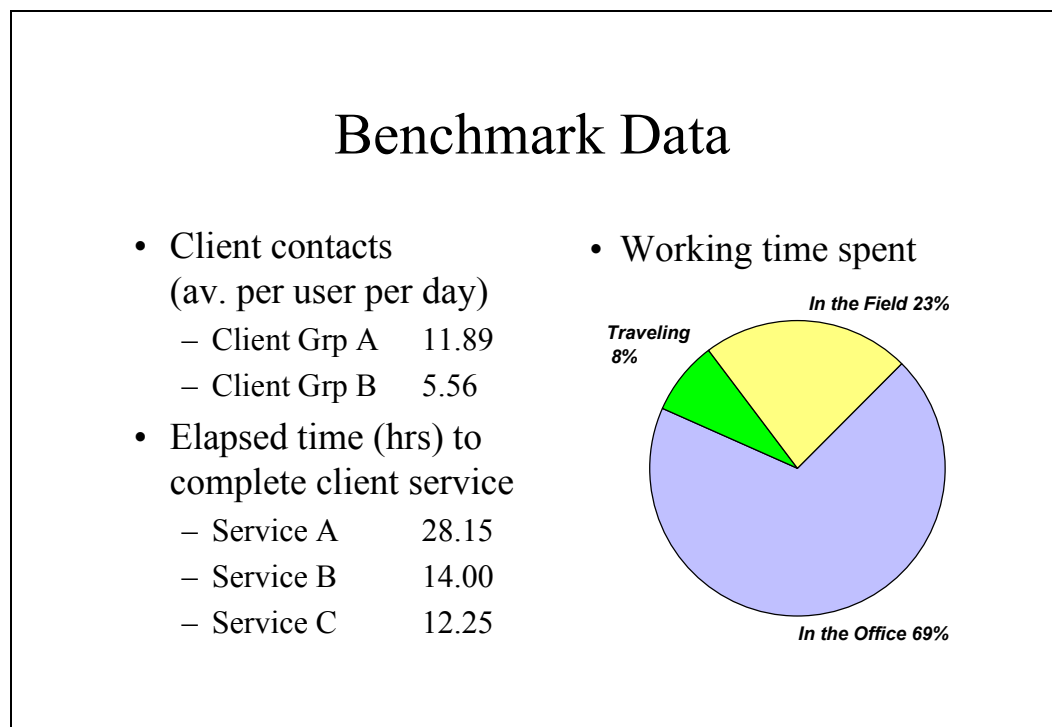
As is expected with any project involving the innovative use of leading-edge technology, this pilot had its fair share of technology-related problems. With persistence and effective management, these were eventually overcome.

The pilot completed having achieved operation of the required functionality, and also remained within budget.

3.2 Evaluation Process

In order to assess the impact of the use of the technology, a set of measures was developed for which before and after values could be compared. The measures, as requested by the Project Steering Committee, were few and easily measurable.

Before the pilot commenced, a process was undertaken to determine non-mobile benchmark values for these measures. These would then be used to provide a comparison with the mobile environment.



The benchmark data, as shown above, was averaged across all participants at all sites. The intention was to identify and evaluate overall trends and benefits of the use of the technology, and not to concentrate on areas of high or low performance.

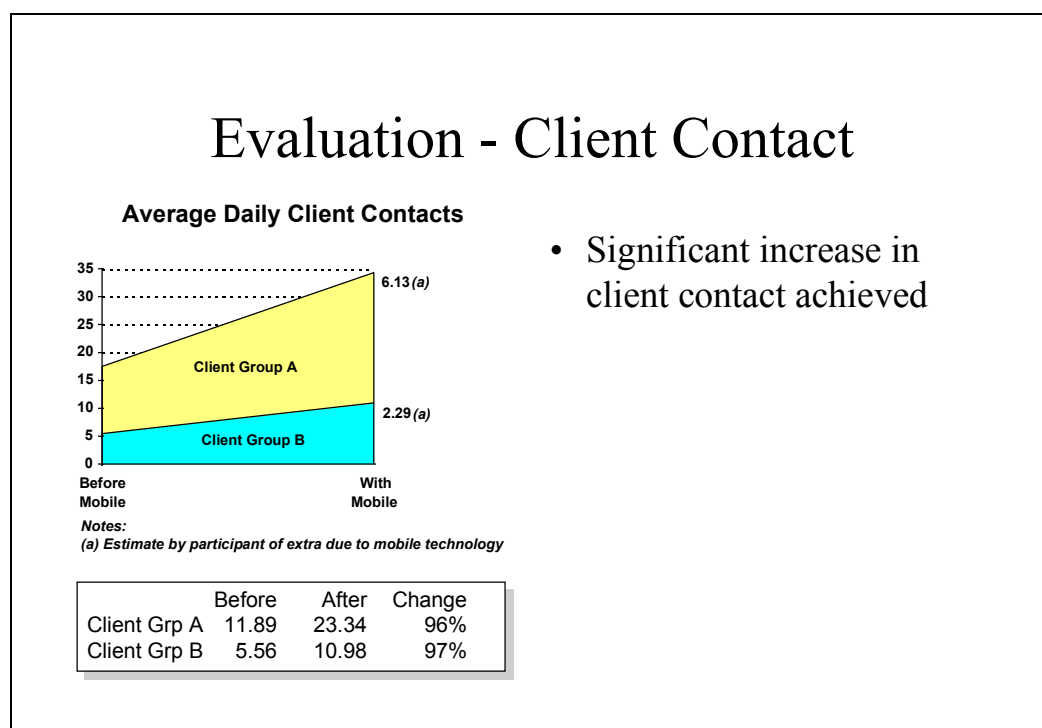
Values for these benchmark measures, plus some others, were collected during the pilot. The other measures included self-ratings by the participants of their level of competence with the technology, their rating of the “value for money” of the technology to their work, and also feedback provided to them from their clients. The participants were also asked to provide general feedback.

In addition to the regularly collected data, interviews were held with each participant at the end of the pilot to gather input on work-place aspects and the pilot in general.

3.3 Evaluation Results

3.3.1 Client Contact

The following diagram indicates that the level of contact with clients increased significantly over the period of the pilot.

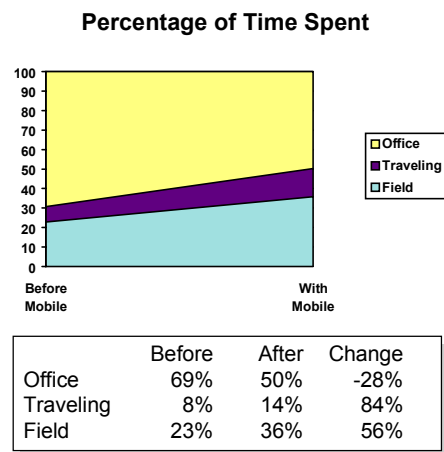


When this measure is reviewed in conjunction with the others that follow, it can be seen that the participants were able to spend more of their working time in contact with their clients. This is a key goal of participants, and of many field workers.

3.3.2 Working Time Spent

The pilot demonstrated that mobile telecommunications technology can significantly increase the time that field workers spend in the field with their clients.

Evaluation - Working Time Spent



- Significant increase in working time in field
 - probably caused increase in travel time
- Able to complete many tasks away from the office
- More face-to-face time with clients

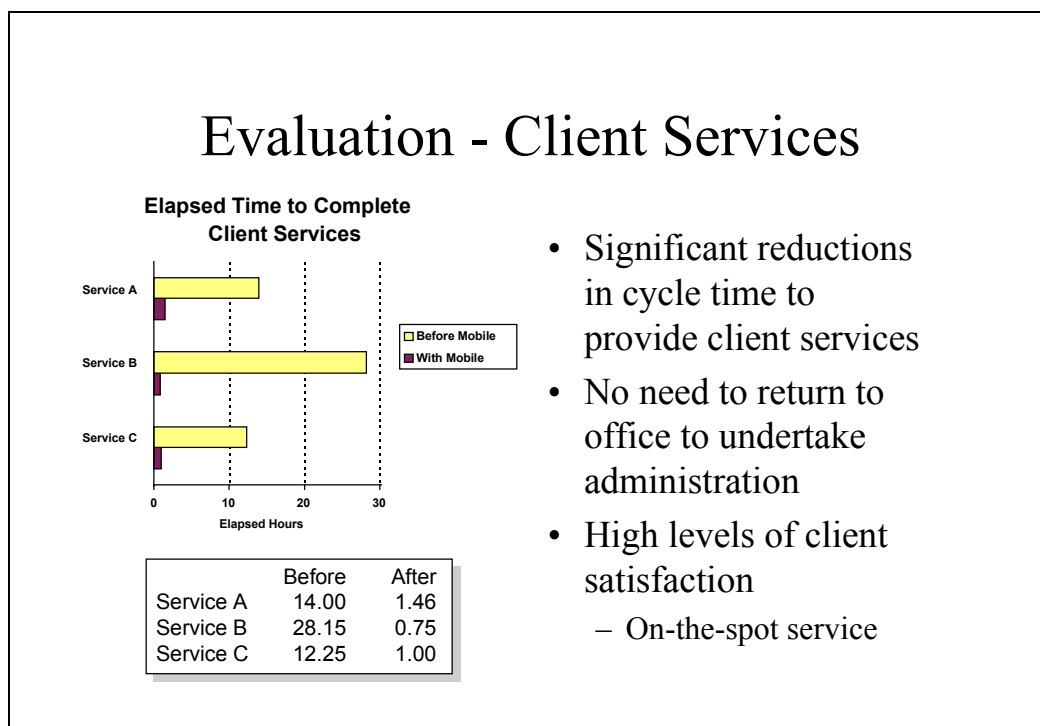
This measure indicates that the mobile telecommunications technology enabled the participants to spend 56% more time in the field than previously - from 23% of their working time to 36%. Importantly, they were also able to spend 28% less time in the office.

The increase in travelling time is probably due to the participants spending more time in the field with their clients, and should not be viewed as problematic. A factor that does need to be realised though, is that increased travelling time may cause some costs to increase, such as fuel and maintenance of vehicles.

Feedback from the participants and their clients, indicates that the ability to spend more time in the field had a beneficial effect on client service.

3.3.3 Client Services

In addition to the previous measures, the participants were asked to provide elapsed timings to complete a sample of their most common client services. As before, these are also compared with the benchmark measures taken before the pilot.



The elapsed time to complete client services was dramatically reduced with the use of the technology, as shown above. This data is for elapsed time and does not denote a reduction in effort time.

While it is not reflected in the presentation of the data, feedback from the participants suggests that the ability to complete client service transactions on-the-spot did in fact result in less effort applied, as the double-handling of data is avoided. That is, when the data is entered on-the-spot, there is no need to use hand-written sheets which then need to be entered into the system at a later time.

The significant reductions in cycle-time for the client services listed above can be reasonably expected in any situation where the current mode of operation involves a business process that requires the field worker to return to the office to perform an element of, or to complete a client service transaction.

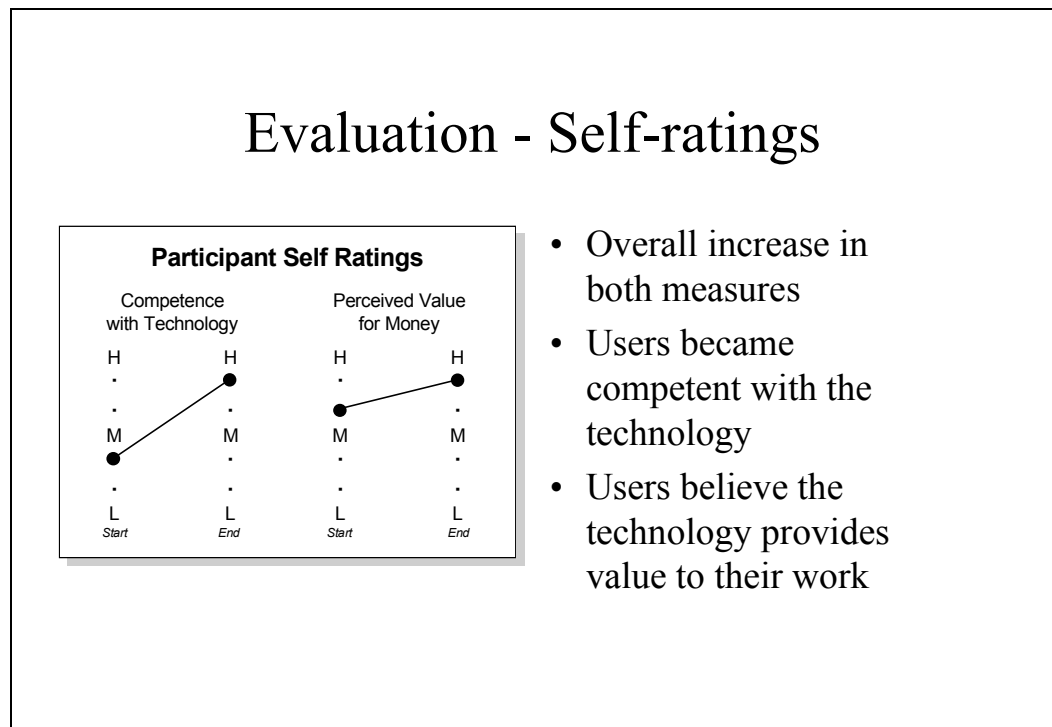
The pilot also revealed that the ability to print while in the field is a major advantage. This included reports from the business application and also office applications like word processors, electronic mail, etc.

The three measures (ie. levels of client contact, time spent percentage, and the elapsed time to complete client services) when combined, indicate that significant improvement is possible with the use of mobile telecommunications technology.

3.3.4 Participant Self-Ratings

In addition to the previous measures, the participants were asked to provide a rating on a seven-point scale of their own subjective view of two other aspects.

They were asked to rate their own level of competence with the technology, and their perception of the value-for-money of the technology to their work.



As can be seen in the above diagram, these measures also indicated improvements over the period of the pilot.

The competence measure indicates that the technology was not difficult for the users to master. The experience of the pilot was that there was some difficulty in the early stages. This can be largely attributed to having a number of first-time computer users involved as participants, as well as the expected early learning curve.

Difficult aspects such as the cabling, connecting and power management (eg. recharging of batteries) were overcome as the participants became familiar with the equipment and established a regime of use that was compatible with their work styles.

3.3.5 Pilot Feedback

Two types of additional feedback was requested from the participants. These were:

- comments from their clients to the use of the technology and how it impacted client service
- any general comments

The participants were encouraged to tell their clients that they were participating in a pilot project that involved mobile telecommunications technology and to ask for feedback about their services as a consequence of using the technology.

The following table provides a sample of client and general feedback.

Client Feedback
<ul style="list-style-type: none"> • <i>"Clients and other workers impressed by speed and availability of services."</i> • <i>"Amazin!"</i> • <i>"Clients become frustrated when system is slow to react."</i> • <i>"Inquisitive."</i> • <i>"Client who received letter on the spot was very pleased; action could be done immediately."</i> • <i>"Great; good; fantastic; whow; can I try it; what is the idea of it?"</i> • <i>"Clients impressed with quickness of getting print-outs."</i>
General Comments
<ul style="list-style-type: none"> • <i>"System working well. Desperately need facility to send documents and e-mail."</i> • <i>"Had problems logging on and picking up transmission."</i> • <i>"If I had a reliable mobile system the advantages would be more apparent."</i> • <i>"Happy when all systems go - but frustrated when problem areas occur."</i> • <i>"Country area clients, both employers and unemployed people are amazed at this system - because all can be done on the spot."</i> • <i>"I am unable to use the mobile service in Malanda, Herberton, Mt Garnet and Ravenshoe - reason being no Telecom service available."</i> • <i>"Clients have commented on the ease with which documents have been prepared 'on the spot'. There is no waiting, no delays, and the client contributes to the preparation. Clients are impressed with the mobile service which provides 'out in the field' service."</i> • <i>"The overall product will be an excellent work tool for Field Staff to be mobile now and in the future."</i>

The above feedback supports the measures reported earlier, and also indicates the frustration experienced by the participants when the technology wasn't operational for some reason or other.

In some cases this was due to service coverage limitations, e.g. in the outlying areas of the Atherton Tablelands and other regional centres. As there is a significant investment currently being made by telecommunications carriers in the deployment of GSM cellular technology, it is expected that these problems will reduce over time.

In other cases, there were problems with the software applications provided to the users, and the back-end servers, etc. that support the business functions of the participants.

In many cases, the participants found it difficult to discriminate these problems from those caused by the mobile technology. This led to instances where the problems were incorrectly attributed to the mobile telecommunications technology.

However, the overall feedback indicates a very positive response to the use of the technology. It's a case of *"its great when it works, and a pain when it doesn't"*. This should be viewed positively. It would be quite different if the system wasn't valued when it did work.

This adds extra weight to the challenge to the technology providers to improve their products and services. This includes the IT&T industry as well as DTIR's own information technology services groups.

3.4 Evaluation Analysis

The previous section indicates that mobile telecommunications technology has the potential to significantly improve work practices and the delivery of client services.

The above figures have been averaged across all pilot participants at all sites, and includes all of the technologies trialed. This was done in order to evaluate overall trends and benefits.

It was observed during the collection of the benchmark data and during the pilot, that a fair amount of variation exists amongst the participating participants, and that sizeable differences also exist between the pilot sites. These aspects are known to the participants and their management, and have come about due to historic patterns of work, individual styles and local conditions.

Because of this and the need to provide analysis that would be useful to other areas of DTIR, it was decided to proceed with the evaluation looking at the overall picture and to report on gross changes. This was supported by the understanding that the above situation was the reality for participants, and probably also for most other parts of DTIR.

This section presents the benefits of implementing mobile telecommunications technology drawn from the experience of the pilot. Costs to roll-out and operate the technology are reviewed, and a costs / benefits analysis model is provided.

It should also be noted that the benefits data presented in the previous section was achieved during the operation of the pilot when the full "mobile office" was not fully functioning. It is expected that the data would show even greater improvements if the electronic mail capability was also available during the whole of the pilot.

Unfortunately this feature became available for the users only for a short period at the end of the pilot, and was insufficient to provide meaningful usage data for evaluation. However, once they'd seen it operate, the ability to send and receive e-mails while in the field was viewed by the participants as being a very valuable function.

3.4.1 Benefits

A range of benefits can be realised with this technology. The DTIR pilot clearly demonstrated benefits to client service and provides an important base to consider work-place and work-practice improvements.

3.4.1.1 Productivity

The Business Case for the pilot suggested that a 10-20% productivity improvement is possible with the use of mobile telecommunications technology. It used 10% in its calculations.

The evaluation data indicates that this is likely, and that higher gains are possible. However, it is not possible from this pilot to calculate a value for productivity improvement that DTIR can use across the board to support the introduction of mobile telecommunications technology.

Even if such a value could be determined, its relevance is questionable as there is a wide range of functions performed in the field by DTIR officers and many technology options that can impact worker performance and costs.

The pilot highlighted variances of work practices within one group of field workers which is also expected to be present in other areas of the department.

There are many factors that contribute to worker productivity. It is also not possible to isolate a single factor, e.g. mobile telecommunications technology, from the others that also provide an influence, e.g. business software systems, administrative support, mobile voice communications, use of vehicle, etc.

3.4.1.2 Savings

In addition to productivity, there are potentially other areas of financial benefits. The Business Case indicated probable savings in these areas:

- Disposal of current desktop PC equipment
- Reduction in FBT for car parking
- Reduction in office accommodation and related costs

As these are not applicable to all areas of DTIR, it is not possible to develop a standard savings model that can be applied across all of the department. These are areas of benefit however that, in addition to others, may provide significant upfront and operational savings, and should be investigated in the development of business cases for deployment.

The pilot clearly proved that there are significant business benefits to be gained, however the points raised above indicate that the determination of exact measures and

values necessary for justification will need to be done on a case-by-case basis. This determination will need to take into account the factors peculiar to each area of the department, e.g. local conditions, work practices and regulations, styles of client interaction, costing framework, etc.

3.4.1.3 Benefit Scenarios

In order to provide a useful framework for evaluation by other areas of DTIR, a range of benefit scenarios has been developed.

The following will provide a model against which costs for different technologies can be compared and therefore provide valuable cost of ownership and pay-back information. The model also provides the ability to analyse the sensitivity of changes to these factors.

For the purposes of calculating the benefit scenarios, the cost of a mobile field worker, with all on-costs included, is assumed to be \$62,000. A range of benefits from 5% to 25% have been used to illustrate the possible scenarios, as per the following table.

Cost Base	Annual Benefit Scenarios				
	5%	10%	15%	20%	25%
\$62,000	\$3,100	\$6,200	\$9,300	\$12,400	\$15,500

This is a gross benefit value per field worker, and of course may vary depending on the case being investigated. For the purposes of this analysis, it essentially represents possibilities of productivity improvements, and excludes other financially calculable benefit measures, such the savings listed in the previous page. These, and others would need to be included, as applicable on a case-by-case basis.

By its nature, this framework also excludes potential once-off savings that may be achieved with the introduction of the mobile technology. Again, these would be specific to the case being considered. The above values are annual gross benefits, taking into account all factors that are possible.

3.4.1.4 Non-tangible Benefits

In addition to the tangible benefits discussed above, the pilot clearly demonstrated that the technology can provide substantial benefits in other areas. While it is difficult to assign a dollar value to these types of benefits, they must be considered when seeking to justify investment in the technology. These include:

- Client service
 - On-the-spot completion of transactions
 - Significant reduction in cycle times for services
 - High level of responsiveness

- Professionalism
 - Field staff viewed by clients and peers as being innovators
 - Field staff have higher confidence and competence levels
 - Access to wider range and greater amount of relevant information
- Competitiveness
 - Provide competitive edge to provision of government services
 - At least maintain equity with similar private sector initiatives

3.4.2 Costs

The pilot provided very valuable information about costs for implementing and operating the trialed mobile telecommunications technologies. The data collected during the pilot was specific to the requirements of, and use made by the participants. However it has helped to develop a “typical usage model” which can be used as a realistic guide for other applications in the department.

3.4.2.1 Approach to Costing Model

The following cost information is not simply a report on what the pilot cost to operate. Instead, it is considered of more value to DTIR to take this information, the learnings of the pilot, and other knowledge to develop cost information for the technology options which are more realistic and likely to occur.

For example, the pilot only included mobile / wireless and office LAN communications. However the pilot revealed the need to consider all of the communications requirements of a field worker. Because of this, the cost models that follow incorporate technology and services for the following range of communications required by a field worker:

- LAN connections while in the office
- Mobile / wireless capability for data communications
- PSTN dial-up (wireline) for when a standard telephone wall-socket is available (eg. in a motel, at home, or a “friendly” office environment, e.g. another DTIR or government office)
- Mobile voice communications, which is now largely considered a standard requirement for field workers

This should equip the field worker with sufficient capability to communicate effectively in any situation. The cost model that follows includes provision of technology to meet all of these needs, but excludes the costs of mobile voice calls.

Another important lesson from the pilot is the aim of integrating and where possible minimising the technology used by the field worker. The equipment used by the field worker should be as unobtrusive as possible and cause minimal inconvenience.

This can be achieved partly by providing multipurpose equipment, e.g. mobile phones that can provide voice and data communications, and PCs that can be used both in the office and in the field, e.g. high-powered notebook PCs.

3.4.2.2 Cost Framework

The framework used to provide analysis of the costs is as follows:

- Capital and establishment
 - End-user equipment
 - End-user training
 - Network infrastructure
- Operating costs
 - Network infrastructure
 - Service and usage charges

The purpose of the table at the right is to illustrate the differences between the two basic types of communications technologies used in the pilot.

Circuit	Packet
Temporary point-to-point dedicated connection	Permanent multi-location shared connection
Requires connect and disconnect	Always connected
Cost based on connect time	Cost based on volume of data
Generally good geographic coverage	Coverage limited to major metropolitan centres
Different end-user technologies can share infrastructure (complementary)	Different end-user technologies requires different infrastructure (competitive)

This has particular relevance to the costing of the network infrastructure and usage charges. The technologies used in the pilot and those now recommended for consideration for DTIR's field workers are characterised as follows:

Circuit	Packet
<ul style="list-style-type: none"> • Mobile voice communications (via standard mobile cellular network) • PSTN dial-up (land-based wireline connection via standard telephone wall-socket for data communications) • GSM Data (data communications over the GSM digital cellular mobile network) • Mobile Satellite (data communications over a satellite network) • Trunked Mobile Radio (data and voice communications over a shared two-way style radio network) 	<ul style="list-style-type: none"> • Mobile Data <ul style="list-style-type: none"> – Telstra (Motorola based) – United Wireless (Ericsson based)

Cost and evaluation data is not provided for TMR (Trunked Mobile Radio) as it was decided not to proceed with it for the pilot. TMR has a limit of 5 minutes for a data call which was too short for the particular requirements of participants and their style of work. It is possible that there are other areas of DTIR for which TMR is suitable and it should be reviewed for suitability on a case-by-case basis as it has significant cost advantages compared to the other wireless communications services.

The particular suppliers of the trialed services used in the pilot are shown in the box at the right. The costs used in the following analysis are based on the charges for these services from these particular providers.

It should be noted that competitive services are available from other suppliers for the GSM Data and mobile satellite services, while the two mobile data services are the only current market competitors for mobile packet services.

Service	Supplier
GSM Data	Telstra MobileNet
Mobile satellite	Optus MobileSat
Mobile Data	Telstra MobileData
Mobile Data	United Wireless Mobile Data

The other end-user equipment and services required to provide the field worker with an effective communications capability are largely commodity items in today's market and don't require extensive review in this report. The items and cost estimates for these are as follows:

End-user Equipment	Cost Estimate
Notebook PC (inc. LAN and dial-up software)	\$5,200
Portable printer	\$650
In-vehicle power equipment	\$200
Carrying cases	\$70
Dial-up wireline modem	\$400
Mobile cellular telephone	\$400
LAN connectivity (port replicator and card)	\$700
In-office equipment (screen, keyboard, mouse)	\$720
Equipment TOTAL	\$8,340
End-user training	\$1,200
End-user TOTAL	\$9,540

The configuration listed above is the base configuration for further analysis in this report. This represents the basic minimum for an effective field worker.

3.4.2.3 Network Infrastructure

Both the circuit and packet based services require DTIR to implement technology that links the field workers with DTIR's corporate network.

For the purposes of this analysis and in order to provide a per user cost for this infrastructure, an infrastructure configuration suitable for up to 32 users was costed for each technology type. This per user cost can be used as a guide to apportion the costs of establishing and servicing the infrastructure up to approximately 150 users.

The costs in the following table include all necessary equipment and services to establish and operate the network infrastructure. These values do not include any service usage costs.

	Setup for 32 user configuration		Annual Service Provision Costs	
	Total	Per user	Total	Per user
Dial-up wireline (a)	\$7,200	\$225	\$320	\$10
GSM Data (a)	\$7,200	\$225	\$320	\$10
MobileSat (a)	\$7,200	\$225	\$320	\$10
Telstra MobileData	\$21,400	\$669	\$4,000	\$125
United Wireless Mobile Data	\$21,500	\$672	\$7,300	\$228

NOTE:

(a) Circuit-based services can utilise the same network infrastructure equipment

The following equipment and services are included in the above infrastructure costs:

Circuit		Packet			
(a) from above table		Telstra		United Wireless	
1 x 8-port terminal server	\$2,000	Packet server computer	\$20,000	Packet server computer	\$20,000
8 x dial-in modems	\$3,200	X.25 line	\$1,400	X.25 line	\$1,400
8 x PSTN line connections	\$2,000			Connection fee	\$100
TOTAL	\$7,200	TOTAL	\$21,400	TOTAL	\$21,500

Note that it is possible for the same packet server computer to simultaneously support both mobile data services. Although this was done in the pilot, it is considered unsuitable for production use. Mobile data services are really an either/or choice.

3.4.2.4 Operating and Usage Costs

The costs of using the communications services for this report are listed in the box at the right.

These usage costs have been determined through actual costs of the pilot, and via published material from the suppliers. It is possible that better prices can be achieved, however for the purposes of analysis these standard prices have been used.

Determining costs for the circuit based services (PSTN, GSM Data and MobileSat) is fairly straightforward, as the suppliers charge on a simple connect time basis.

However, the packet based services are more complex to compare because each supplier has a different charging model. United Wireless has a straightforward model of charging for the amount of data transmitted. Telstra charges on a per packet basis, where the amount of data in a packet may vary considerably due to the software design of transactions.

Communications Service	Usage Cost
PSTN Dial-up wireline	Standard local/STD call costs
Telstra MobileNet (GSM Data)	\$0.38 per minute
Optus MobileSat	\$2.40 per minute
Telstra Mobile Data	\$0.04 per packet
United Wireless Mobile Data	\$0.30 per Kbyte

It is not intended to enter into a deep technical discussion of the merits and otherwise of these respective approaches. Suffice to say, that each approach can provide advantages in the areas of their strengths, with resultant savings in costs. To take advantage of these benefits, however, requires a good understanding of the respective system and the technicalities of transaction design.

3.4.2.5 Typical Usage Model

In order to provide a standard cost model that can be of use to DTIR, a typical usage model has been developed. This model characterises communications use by a DTIR field worker and is based on the experience of the pilot and other input. The model permits cost comparison between the technology solutions and provides data for the cost / benefit scenario analysis.

Based on data collected during the pilot, and the expected changes due to the use of electronic mail and the PSTN dial-up access, the table on the following page illustrates the typical usage model used in this report.

The model indicates that a DTIR field worker, who is equipped to make PSTN dial-up calls (eg. from a motel, home, etc.) and to communicate via a wireless device (eg. with GSM Data or Mobile Data), would, on average, utilise this profile of communications.

Note that this model does not include any provision for mobile voice calls.

Circuit	Packet	
	Telstra	United Wireless
1 x local call equivalent per working day with PSTN dial-up wireline	(same)	(same)
30 x 5 minute mobile calls per month	8,941 packets per month	842 Kbytes per month

In order to cater for the expected use of electronic mail and other office services, e.g. fax and calendar management, the usage trends observed in the pilot were increased by 30%. The above model incorporates this factor.

In addition, for the circuit based services, the pilot utilised a software product that didn't have the disconnect / reconnect feature, so on many occasions the field workers were staying connected (and hence incurring costs) for periods when a connection wasn't necessary.

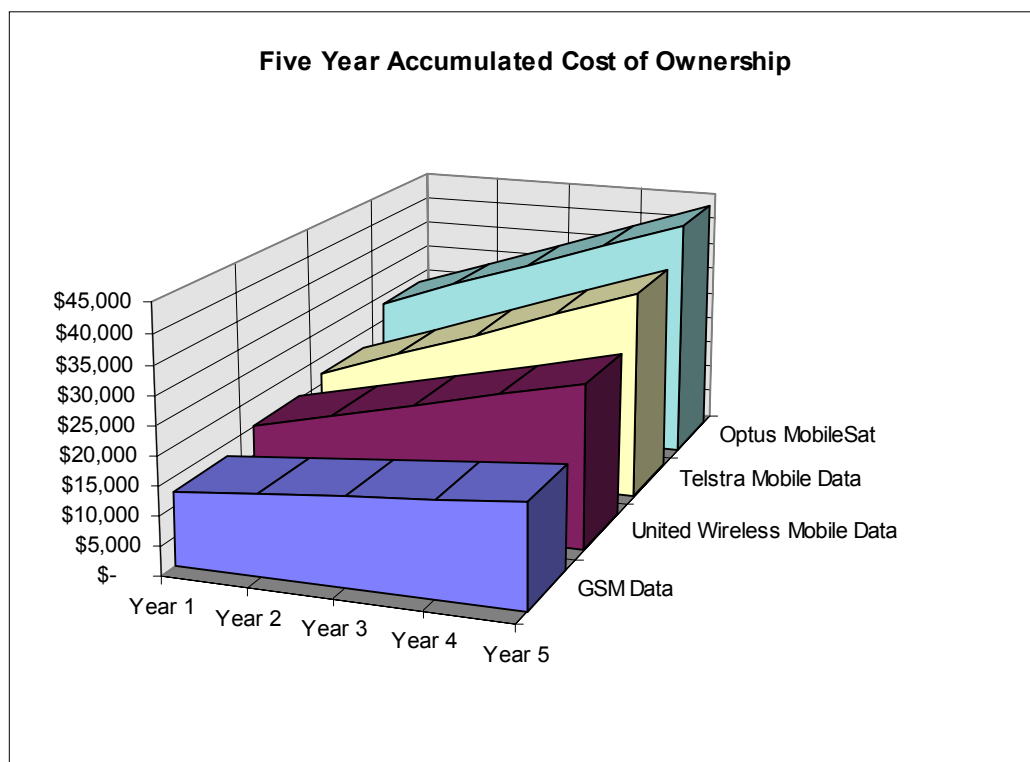
This was a limitation of the particular software used in the pilot and should not be viewed as a general limitation of this type of mobile telecommunications. Software is now available that can disconnect and then reconnect when required, thus providing a much more cost-effective approach. This style of configuration has also been incorporated into the above model.

3.4.2.6 Cost of Ownership

The following table summarises the per user costs of establishment and operation for each of the trialed technologies using the typical usage model introduced above.

Cost Item		Wireless Technology Option			
	Base config	GSM Data	Optus MobileSat	Telstra MD	United W. MD
End-user equipment	\$8,340	\$1,200	\$7,800	\$900	\$900
End-user training	\$1,200	\$500	\$1,000	\$500	\$500
Network infrastructure	\$225	\$50	\$100	\$719	\$722
Wireless increment	(n/a)	\$1,750	\$8,900	\$2,119	\$2,122
TOTAL Set-up	\$9,765	\$11,515	\$18,665	\$11,884	\$11,887
Annual service and usage costs (Total)	\$76	\$1,238	\$4,922	\$5,033	\$3,336

Taking the previous data into account, the following diagram illustrates the cost of ownership, on a per user basis, for each of the trialed technologies over a 5 year period.



The purpose of this diagram is not to suggest that GSM Data is the best technology option for mobile telecommunications in all of DTIR.

If the benefits to be gained from mobile telecommunications are technology neutral and the preceding cost models are generally applicable across DTIR, then it does appear that GSM Data has advantages in terms of costs of ownership.

However, it is not clear that the benefits are technology neutral or that the previous cost models are applicable in every case. For example, in rural and remote areas of Queensland, where field workers spend 3-5 days travelling a circuit to visit clients, etc., it may be that a small number of mobile satellite systems can provide a relatively greater benefit than from a larger group of GSM Data equipped city based field workers. These types of aspects need to be considered on a case-by-base basis.

Despite the possible variances, if the typical usage model is accepted as an appropriate average for DTIR and the establishment costs are close to accurate, then the above represents a viable comparative framework.

3.4.3 Cost / Benefit Scenarios

As previously discussed, it is not possible from this pilot to develop a standard value of benefits that is applicable across all of DTIR. The degree of variance due to different working styles, local / remote conditions, methods of client interaction and the many types of field work would make such an estimate of little value to managers looking for input to support the case for mobile telecommunications technology.

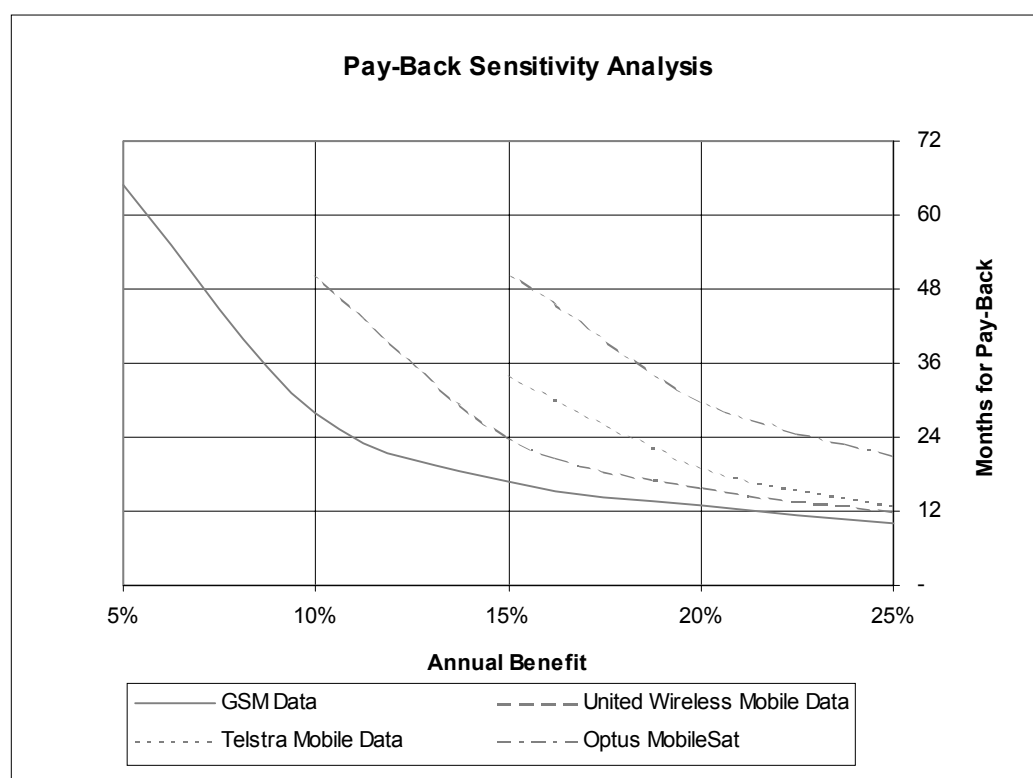
The pilot has shown conclusively that there are significant benefits to be achieved, however, the extent and nature will depend on the particular circumstances being considered. For example, cost savings benefits like replacing an existing desktop PC, or reducing FBT for car parking, are not applicable to all areas of the department.

For the purposes of providing a useful analysis of the cost / benefit situation, the previously presented range of benefit scenarios has been combined with the costs of ownership data. This will provide guidance to the expected pay-back for each trialed technology, and input as to the sensitivity of changes to benefits.

This table indicates expected payback time for each technology type, using the previously presented costs and usage data.

Technology	Annual Benefit Scenarios				
	5%	10%	15%	20%	25%
GSM Data	>60 mths	28 mths	17 mths	13 mths	10 mths
United Wireless MD	never	50 mths	24 mths	16 mths	12 mths
Telstra MD	never	never	34 mths	19 mths	13 mths
Optus MobileSat	never	never	51 mths	30 mths	21 mths

The following diagram provides this data in graphical form and permits an analysis of the sensitivity of changes to the levels of annual benefits for each technology type.



This data indicates that the GSM Data technology provides the earliest pay-back overall and would require a minimum gross annual benefit scenario of approximately 12% before being a reasonable investment. This of course would vary should the cost base for the benefits calculation or the technology usage models be different to that used in the above calculations.

3.4.3.1 Factors to Consider

The analysis highlights the individual cost / benefits characteristics of each of the trialed technologies. The purpose of the pilot was not to identify a single technology that would be suitable for all of DTIR. This is not possible due to the diversity of functions and types of field workers in the department. It is possible that a combination of a number of technologies is appropriate.

Another factor that can change the above analysis is the extent to which the software application is custom-built to take advantage of a particular technology's characteristics. For example, with the packet-based services, significant improvements in performance and costs can be achieved by reducing the amount of data transmitted and the number of non-critical transactions.

These changes may make the custom-built application unsuitable for LAN based access, but may provide a highly appropriate system for a "field-only" application. This trade-off between generic applications for broad use, versus niche applications for specific use should be explored as they can alter the usage costs and therefore the overall costs of ownership in some instances.

3.4.4 Technology and Industry Capability

The purpose of this pilot was to evaluate the business benefits rather than the trialed technologies in detail. As such, detailed identification and testing of comparative technologies was not undertaken. A good working knowledge of the technologies included in the pilot was achieved, and an awareness of some alternatives was attained.

3.4.4.1 Industry Participants

The technology used in the pilot performed as specified after problems in a few areas were rectified. Industry in general were very responsive to the pilot and co-operation between vendor organisations was good when it was required. The following table lists the participating industry organisations:

- | | |
|------------------------------------|---------------------------------|
| • Telstra | • Digital Equipment Corporation |
| • United Wireless (was Bell South) | • Lotus Development Corporation |
| • Motorola | • AMS |
| • Datacraft | • GEC Alsthrom |
| • Phillips | • Optus |
| • JP Consulting | • Queensland Case Agencies |

The contribution made by these industry participants to the overall success of the pilot is greatly appreciated. This included loan equipment, discounts, training and technical and project support, which was provided in addition to contracted products and services.

The contribution to the pilot from industry is valued at approximately \$60,000.

In terms of benefits, the industry participants gained:

- Experience and further skills from the involvement in the application of their technology and services
- Enhancements to, or at least the opportunity for the enhancement of their products and services
- Recognition and profile in the government market of their abilities
- Proof that the technology can provide significant business benefits

3.4.4.2 Industry Capability

The pilot involved some relatively standard, off-the-shelf technology and some technology that was new. The new technology provided some challenges to the pilot, as did using the standard technology when used in a mobile / wireless configuration.

The pilot provided the suppliers of the standard technology with an opportunity to see it operate in a different environment and to fine-tune aspects of it to make it more suitable for mobile field workers. This was particularly the case with Lotus's cc:Mail product when used with Digital's RoamAbout product.

The mobile / wireless market is viewed by industry as being an area of significant future growth. This is supported by continuing development of products and services to match the expanding and evolving needs of the market. New products and services and new entrants to the market are occurring quite frequently. It is important to continually monitor this and to be aware of technology and industry trends as plans are developed for use of the technology in DTIR.

In terms of maturity, the industry is growing and has now largely overcome most of the teething problems expected in the early stages of growth. Options will continue to expand as mobile / wireless telecommunications technology becomes an established part of the technology scene.

In the local context, organisations such as BHA Computer and ceMis (Centre for Excellence in Mobile Information Systems) are continuing to grow their mobile business and are developing products and capabilities to a wide-range of clients.

The government program that enabled the DTIR pilot to occur, the Q-TEL/IIB Mobile Telecommunications Applications Services Panel, is currently being reviewed and revised to accommodate changes to industry's capabilities and also to implement improvements to the process for agencies to undertake projects.

This indicates continued support to the program from the government and industry, and presents DTIR with an opportunity and framework to review vendor capabilities for further mobile projects.

3.4.5 Evaluation Conclusions

The pilot presented DTIR with a unique opportunity to develop skills, knowledge and experience in the technology, and the opportunities it presents for improvements to service delivery and work-place efficiency. It is clear that the technology can provide positive benefits to DTIR in both these areas.

The concept of the “mobile office” was proven to be implementable and of relevance to DTIR’s field work-force. Extending the corporate network with mobile telecommunications technology to provide field workers with business systems at the point of client contact can cause improvements in all key performance measures.

3.5 Achievement of Pilot Objectives

The following lists the objectives of the pilot, as per the Business Case, and describes the extent to which they were achieved.

Objective	Result
1. Demonstrate support of DTIR’s business	Achieved
2. Prove the concept	Achieved
3. Test the Business Case	Achieved
4. Evaluate industry and technology capabilities	Achieved
5. Evaluate impact on work practices	Largely Achieved
6. Define resource requirements for implementation, operation & maintenance	Achieved

The pilot provided very valuable information that can help DTIR plan with confidence the introduction of mobile telecommunications technology knowing that it can provide benefits to the business of the department.

4. Recommendations

4.1 Introduction

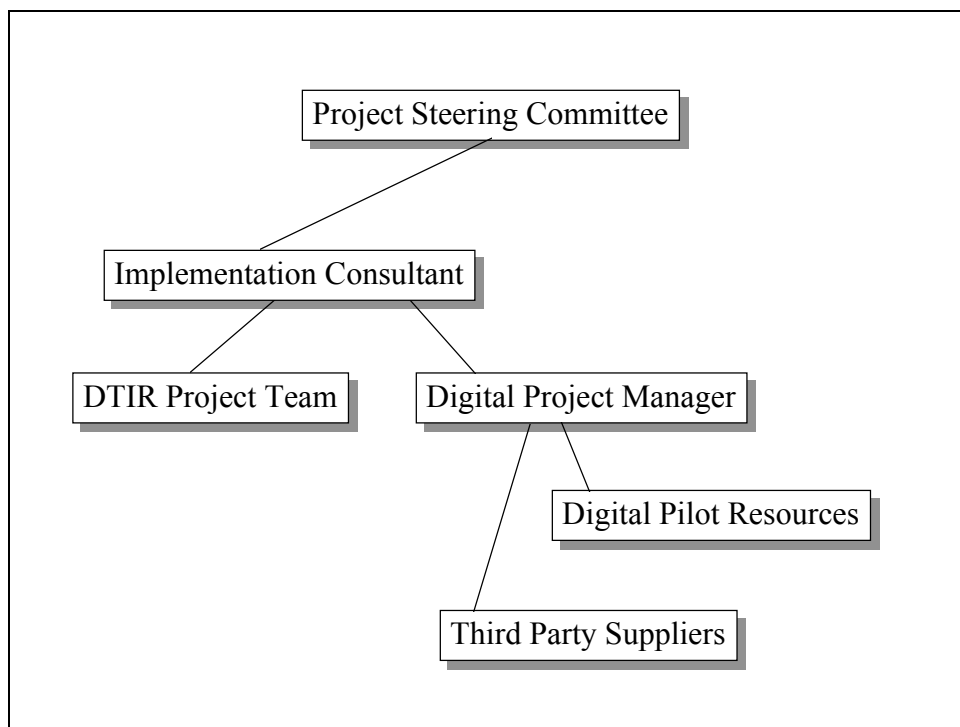
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Appendix A. Pilot Information

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Project Management

The following diagram illustrates the project management structure for the pilot.



DTIR contracted JP Consulting (Aust) Pty Ltd to provide the services of an Implementation Consultant to assist with overall project management of the pilot.

As indicated in the Business Case, DTIR chose Digital Equipment Corporation to provide products and services for the pilot. Digital was contracted, via a GISC Systems Integration agreement, to provide an operational mobile telecommunications environment for the pilot, which included their RoamAbout software, and equipment and services from themselves and other suppliers.

The Project Steering Committee comprised the following people. [table removed]

Technology used in Pilot

The following wireless telecommunications technologies were included in the pilot:

Mobile Data	Telstra	Brisbane area
Mobile Data	Bell South (now United Wireless)	Brisbane area
Trunked Mobile Radio	Telstra	(not proceeded with)
Mobile Satellite	Optus	Townsville
GSM Data	Telstra	Townsville and Cairns

In addition to the above telecommunications technologies, the following equipment and software was included in the pilot:

Notebook PC	Digital	inc. related equipment
Portable Printer	Hewlett Packard	
RoamAbout software	Digital	
Radio Packet Server	Digital	DEC Alpha system
Terminal Server	Digital	
Dial-in modems	Netcomm	
cc:Mail Mobile	Lotus	
Job Placement	DTIR	
Mobile telephone	Nokia	inc. PCMCIA modem
Wireless Modem	Motorola	Telstra - two varieties
Wireless Modem	Ericsson	Bell South - Mobidem
Radio & Modem	Phillips	
Carry Cases	Qld Case Agencies	

Comments on Telecommunications Technologies

The pilot included the evaluation of several technologies which enable wireless data communication. These can be divided into two main groups; circuit switched and packet switched. In the top list on the previous page, the first two (Mobile Data) are packet switched, and the others are circuit switched services.

Circuit switched is essentially the concept that is used in the familiar telephone network - a circuit is established and maintained throughout the period of communication. Charging is based upon the duration of the connection, regardless of the volume of data transmitted.

Packet switched technology divides the data to be transmitted into small chunks (currently up to 512 bytes) called packets, each with the target address included. Charging is based on the amount of data transmitted - either by calculating the total bytes sent (as for the Bell South service), or the number of packets (as for the Telstra service).

Currently, packet switched infrastructure in Queensland is only available in Brisbane, with Telstra intending to roll-out to Cairns and Townsville in the near future, with other major centres like Toowoomba not long after.

All of the technologies included in the pilot performed satisfactorily. There are three main factors that will determine which would be suitable for a given requirement. These are: coverage, throughput, and cost. Each of the technologies also has different limitations and requirements for end-user equipment, which will impact the useability and potentially the design of the application.

The following is a summary of each of the mobile telecommunications technologies:

Service Name	Coverage	Throughput	Cost (approx) *	Limitations
Telstra Mobile Data	Brisbane only - reasonably good	medium	Entry: \$1,200 Ongoing: medium	Charging based on packets
United Wireless Mobile Data	Brisbane metro only - limited	medium	Entry: \$1,200 Ongoing: medium	Charging based on actual data
Telstra Trunked Mobile Radio	Wider Brisbane area - good	medium	Entry: \$1,500 Ongoing: very low	5 minute length of data call; in-vehicle only
Optus MobileSat	National plus 200km to sea - excellent	medium	Entry: \$10,000 Ongoing: high	In-vehicle only, or heavy luggable system
Telstra GSM Data	Large proportion of mass populated areas - poor in remote	good	Entry: \$2,000 Ongoing: low to medium	

* Cost is per unit. Excludes any costs for necessary server systems

The cost-effectiveness of the various implementations of the technologies depends greatly upon the pattern of usage - such things as how much data is transmitted, how often, and the number of small or large messages. However, provided care is taken in application design, it is possible to replace the communication method without redeveloping the application or changing working patterns.

The geographic coverage of the wireless technology is an important matter. The mobile phone network now covers a large percentage of the population (but not land mass). The Optus mobile satellite service covers 100% of Australia's land mass and 200km out to sea. As stated above, the packet switched networks are metropolitan only at this stage.

Satellite phones have a physical limitation in that they are usually vehicle based. There are "luggable" systems, but these are not currently practical for frequent changes of location.

In terms of throughput, wireless data communications is relatively slow. As a rough guide the actual throughput for the packet-based services would equate to approx. 2400bps, although with optimised transaction design and clear signals this could be two or three times higher. For the circuit-based services: the satellite system is limited at this stage to 2400bps, as is TMR. The GSM Data service operates at 9600bps.

In addition to the entry cost estimates listed in the above table, each technology also requires some back-end equipment that integrates the wireless and corporate networks. The mobile data services have a higher requirement in that they need a computer to accept and dispatch packets of data. The circuit based services require a terminal server and banks of dial-in modems with connected PSTN telephone lines.

Comments on Design and Suitability of Technology to Application Types

In order to evaluate the "mobile office", and in taking into account DTIR's approach to information architecture, the pilot sought a technology design that kept the applications separate from the underlying communications technology. A related goal was to implement an environment that permitted the user to run multiple, simultaneous applications while in wireless mode. This means that applications that have a "vertical" approach, ie that manage the GUI, the application and the communications technology, are not suitable.

To achieve this design requirement, it is necessary to utilise wireless middleware software. In the case of this pilot, Digital's RoamAbout software was used. This approach has resulted in the application software requiring no changes at all for it to operate in wireless or in LAN mode. The wireless middleware software essentially permits the client PC to communicate with the corporate network using TCP/IP and TCP/IP supported transaction protocols.

While the applications can be operated without change, there is the opportunity for improved performance if the nature of the transactions for the application are designed and implemented to suit the wireless technology. This relates mostly to the size and frequency of data transfers and control transactions. The objective is to minimise the "chat" over the wireless communications channel.

As the throughput of wireless data communications is relatively low, it is not suitable for applications that have a requirement to transfer large volumes of data, e.g. images

or VT style applications that require fast response times. Intelligent client/server and e-mail or message-enabled applications are well suited to this technology.

The pilot has concentrated on wireless data communications, and has not addressed all the communications requirements of a mobile worker. For example, it may be beneficial to consider requirements for mobile voice communications when considering appropriate equipment for a mobile data application. Similarly, it may also be appropriate in some instances to equip the user with a standard dial-in type modem for use in remote offices, motel rooms, etc. where access to a telephone socket is available.

Technology-related Conclusions

As the primary aim of the pilot was to evaluate the business benefits that are possible for DTIR with a “mobile office”, the focus of the evaluation has concentrated on work place and business issues, and not primarily on the technical aspects. As such, comparisons of competitive products were not performed, e.g. laptop computers, mobile phones, modems, wireless middleware software, etc.

This means that none of the particular products used can be specifically recommended as they have not been compared to their market rivals. It should also be borne in mind that this is a rapidly developing area of technology, and that changes are always occurring.

The pilot has revealed that it is necessary to have a clear understanding of the work practices of the users and to match these with the characteristics of the available wireless data communications services. In doing this it is also necessary to take account of the factors outlined earlier, ie. coverage, throughput and cost.

The importance of an architectural approach that includes wireless data communications as a part of the communications infrastructure has also been identified as a critical consideration for DTIR. This will help to achieve the goal of users being able to use multiple, simultaneous applications in the office, and in the field, as well as maintaining consistency in the information technology environment.