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THE QUALITATIVE DESCRIPTION OF THE SOCIAL IMPACTS OF MSAT

FINAL REPORT

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EXECUTIVE SUMMARY

The objectives of this report are: (1) to describe in qualitative terms the expected main social impacts of MSAT on potential users and Canadian society; (2) to indicate the relevance of the specific impact areas to the MSAT program; (3) to provide an indication of the potential magnitude and likelihood of occurance of the selected impacts; and (4) to provide an assessment of the impact of MSAT on selected policy goals defined by the federal government.

This report is the fourth in a series dealing with the social impacts of MSAT on users in Canadian society. It presents a qualitative discussion of the predominant social impacts which have been assessed as having a high likelihood of occurring in relation to the proposed MSAT services within a 10-15 year time frame. This study was preceded by a series of three related reports. The first provided a literature review that identified studies which have examined the social impacts of satellite and mobile communications. The results of that study revealed that impacts can accrue at different levels and over various time horizons. Impacts were identified based on the way new communications technologies affect individuals, groups, organizations, communities and societies.

The second report was directed specifically to the way social impacts have been measured in other studies and reviewed a number of methodological frameworks and techniques which could be used for identifying and quantifying impacts. It revealed that in a study such as this a variety of methodological approaches must be examined and used to assess particular sets of impacts. This is primarily because impacts vary between being purely social and psychological to those which are much more tangible and overlap with economic impacts. The report indicated that no single methodological approach is suitable to address the variety and complexity of impact issues which are likely to arise from the implementation of MSAT.

The third report addressed the issue of specifying a work plan to quantify the social impacts of MSAT on users and Canadian society. It also provided a procedure to examine the Phase B market definition and user benefit study in order to determine study gaps and to provide additional quantitative estimates. Two categories from the overall set of impacts were identified in the report; socio-economic and sociological/social service impacts.

A variety of services are planned for the MSAT program, including mobile radio, telephone, paging services, mobile data, data acquisition and control services. Coverage will be by a number of ultra high frequency (UHF) 800 MHz band radio beams plus a single super high frequency (SHF) back-haul beam. The frequency spectrum allocated to each beam is divided into 5 KHz channels, a small number of which are needed for communications control. The channels are allocated to users as needed by the DAMA (Demand Assigned Multiple Access) protocal thus contributing to the overall efficiency of the system.

The types of impacts and benefits which are discussed in this report are subject to significant variation over time. As well, it is important to recognize that the forecasts currently being provided are under continual revision and change, and the way MSAT is likely to emerge in the marketplace is still as yet unclear. The approach used in this qualitative study is to examine where possible tangible examples of analogous technologies which are utilized for the various applications that MSAT may provide in the future. Using this approach as a basis, a more informed judgment can be made about the likely social impacts of the MSAT services. In some cases it is recognized that MSAT will complement existing terrestrial based mobile systems. In other cases MSAT will substitute for the terrestrial based system because of cost considerations, coverage and quality of service. In some instances MSAT will create new demand for mobile services that were previously inaccessible or non-service territories.

With a new communications technology such as MSAT, there are effects or impacts which may be considered as mainly economic in nature, impacts which may be considered as mainly social, and there is also an area which overlaps between economic and social impacts.

Social impacts are either not monetarily quantifiable or only indirectly monetarily quantifiable. Although measurable in certain indirect senses, social impacts may not be directly related to monetary or economic criteria. Social impacts are also indirect in the sense that they usually involve parties in addition to the direct supplier or consumer of the service.

Social effects of new communications technologies such as MSAT may or may not have associated economic effects, and what we normally consider as economic effects may or may not have associated social impacts. Social impacts may occur at the individual, organizational or societal levels. They may occur over the short, medium or long time frame and have different levels of effects.

This work examines impacts arising from MSAT of either a social nature or those overlapping with economic impacts. Social impact areas have been prioritized in terms of the expected size and magnitude of the impact, and the specific relevance to MSAT is also discussed. In this qualitative discussion, no attempt to analyze the impacts in a detailed statistical fashion is made. However, the discussion of specific impacts does utilize available data, usually from secondary sources, which provides indicators of the possible magnitude of these impacts.

Priority Issues

Table 1 presents priority MSAT social impact issues. The potential impact of MSAT on the associated issue arises from the capabilities of mobile radio and telephone to improve the quality, timeliness, accuracy and efficiency of information. It should also be noted that all priority MSAT social impact issues, but the last, lie in the overlap of social and economic effects.

These priority impacts have been extrapolated from the dozens of potential social impacts of MSAT previously identified. The criteria of selection involved: (1) likely occurrence; (2) magnitude of possible effect; (3) measurability; and (4) time frame of occurrence.

TABLE 1
Priority MSAT Social Impact Issues*
(Seven to Fifteen Year Period)

	Social Impact	Level of Occurance	Examples of Impacts	Sample Measures
1.	Reduced hazardous work conditions, especially travel	Individual, organizational	Increase response for dispatch. Improved recording of emergencies.	Loss of life and compensation costs.
2.	Improved effectiveness and productivity at work sites (mining, oil rigs, road crews)	Individual, organizational	Monitoring of vehicles. Improved organizational capabilities (management).	Cost for services. Effective delivery of goods. Worker satisfaction.
3.	Travel/communications tradeoffs	Individual, organizational, community	Less travel/ changed travel/ flexibility in work locations.	Energy consumption levels. Risk for travel in wilderness and remote areas.
4.	Environmental enhancement and preservation through communications improvements	Organizational, community	Preservation of unique species. Wilderness areas maintained.	Species diversification. Amount of wilderness areas.
5.	Forestry services Forest fire protection	Society, organizational	Improved response to fire hazards.	Available recreation experiences. Safety at work sites.
6.	Improved government services in rural and remote areas (medical, emergency, law enforcement, fire)	Community, individual	Improved levels of services. Increased and improved social contacts.	Social services expenditures/ usage and coverage.
7.	Social/subjective* impacts, perceived relief from isolations, improvements in home and work safety, improvements in job effectiveness	Individual, community	Improved satisfaction. Improved attraction of sites for work and homes.	Welfare and social agency usage. Community services utilization. Interaction for community workers.

* These impacts constitute primarily secondary and tertiary level impacts accruing to individual workers or those living in proposed service territories. All are considered as highly likely to occur in the seven to fifteen year period and also to be manifest by some quantitative measure.

Relevance of Issues to MSAT

The relevance to MSAT of each social impact issue or group of issues in Table 1 is discussed:

Reduction of Hazardous Work Conditions, Expecially Changes in Travel Requirements

Past experience with mobile services makes it very probable that the provision of MSAT mobile services to a wide variety of companies, firms and organizations in rural/remote areas will reduce a range of hazardous work conditions, especially those involved in travel. Through various means -- ranging from increased response capabilities for dispatch services to improved recording of emergency situations -- existing studies of terrestrial-based mobile communications in rural and remote areas have shown that reduced hazardous work conditions will result from MSAT services if properly employed.

Improved Effectiveness and Productivity at Work Sites

The provision of mobile services to remote and rural areas is likely to result in improved effectiveness and productivity at the work location. The main ways the specific socio-economic benefits have arisen from terrestrial-based mobile radio and telephone have involved:

a) increased response and accuracy in the dispatch of services
b) improved monitoring of vehicle locations
c) lower general costs and expenses of communication services
d) reductions in energy consumption
e) overall better organizational capabilities.

Environmental Enhancement, Maintenance and Preservation Through Communication Improvements

Of special interest in the overlap of social and economic impacts of MSAT are environmental concerns. These effects are diverse and far reaching. For example, the preservation and enhancement of coastal marine environments and the Great Lakes will be affected by MSAT due to quality improvements in operations (themselves due to mobile radio usage by ships). There will also be improved protection efficiency by authorities in enforcement of environmental measures such as those involved in the Fisheries Act, the Migratory Birds Convention Act, the Ocean Dumping Act, etc. MSAT adoption by private firms and government agencies will result in an increased ability to prevent, monitor and to measure levels of pollution. On the negative side, MSAT usage by resource and exploration companies may be facilitated by improved communications specifically related to MSAT. This increased activity may have potentially harmful environmental impacts.

Travel/Communications Trade-offs

The introduction of new communication services and improvements to existing services often results in substantial changes in the relationship between travel and communication modes. MSAT is likely to contribute to such a shift in a variety of application areas since it will reduce the need for travel and alter the way travel is conducted. Some of the more obvious results of such developments include:

1. reductions in the amount of travel
2. reorganization of travel
3. improved effectiveness of travel
4. lower incidence of travel related accidents
5. alterations in travel demand by place and time.

Forestry Services
Forest Fire Protection

MSAT will have positive benefits and impacts on the way Forest Fire agencies provide services. The impacts are likely to accrue in terms of the method for fighting fires (improved ground coordination), improved monitoring of fire conditions, and improved reporting of damage statistics. These impacts will reduce losses due to fires, improve management, and result in more effective utilization of the forest resource.

Improved Government Services in Remote and Rural Areas
(for fire, law enforcement and ambulances)

Due to increased information capabilities for dispatch and monitoring services, extension of coverage, improved reporting of emergency situations, it is certain that MSAT will have impacts on the improvement of community services such as those involved in rural and remote medical services, emergency and disaster services and police.

Organizational impacts will include enhanced delivery of social services due to the availability of specific emergency numbers and portable automatic alert. Also, related emergency services will be able to communicate on a more efficient common basis which will lead to increased coordination in times of disaster.

It is anticipated that increased information availability, timeliness and accuracy will aid service efficiency for disaster, search and rescue, forest fires, industrial accidents in rural and remote regions, flood control and ship monitoring.

Social/Subjective Impacts

This category pertains to subjective or perceived effects concerning such things as relief from isolation, safety and work enhancements, and improve

ments in work effectiveness resulting from the adoption of MSAT services. Indeed, past studies of terrestrially based mobile communications services in rural and remote regions have shown improvement of morale of medical and social services staff and the feeling of relief from isolation. There is every reason to expect that these "subjective" changes resulting from terrestrially based mobile communications will also result from MSAT usage among many different kinds of workers and individuals in the service territory. In most cases these impacts cannot be directly valued but can be quantified using surrogate measures based on some nominal scaling approach. They are the most intangible of items in the traditional socio-economic framework of cost benefit analysis.

Impact on Government Policies

Policy areas which have been discussed in detail include space policy, communications, industrial policy, northern development and environmental protection policy. These areas have been selected based on discussions with government policy makers, reviews of federal government policy position papers, and contacts with MSAT federal or provincial working groups.

Population Profile of Service Territory

The specific sets of impacts and the detailed qualitative discussion of their magnitude and likely occurrence was preceded by a description of the population profile of the service territory for MSAT. The Woods Gordon Phase A Market Definition Study indicated the current usage for mobile systems is influenced far more by applications than by overall population density. As a result of that observation, the Woods Gordon study paid very little attention to the social implications and ramifications of the population characteristics and the demographic trends in the proposed service territory. From a social impact perspective, however, the importance to be placed on the indigenous population should not be underestimated. This is because the applications of MSAT will have numerous manifest indirect benefits accruing to local populations who are the beneficiaries of services provided by government and commercial operations. Social impacts analysis must consider not just the users of service but as well those that are going to be directly and indirectly served.

Examination of the rural and remote population of Canada indicates that in 1981 there were a total of 5,900,000 people classified as living in rural and remote areas of the country. Remote areas are defined as those beyond the limits of continuous population distribution where the population density is less than one person per square mile. Rural areas are defined as those non-remote areas which are outside communities of more than 2,500 people. The average population density in remote areas is 0.1 per square mile, while the average population density of rural areas is 10.3 per square mile.

Examination of the percent change in rural population growth between 1976 and 1981 indicates that in most provinces growth in the rural population has been

higher than the growth in the urban population. For example, in Quebec growth in the rural population was 13.9% compared to 0.6% for the urban population. Likewise, in British Columbia the percent growth of the rural population was 17.4% compared to 9.6% for the urban population. For Canada as a whole, growth in the rural population was 8.9% compared to 5% of the urban setting. These trends are likely to continue over the next five to ten years and produce greater pressure on social services and government agencies within the proposed service territory for MSAT. For Canada, the average rural income was $11,500 per year in 1981 compared to $13,400 in the urban areas. A reduction in the disparity between these estimates for the two population groups is likely to be observed over the next seven to ten years, and MSAT will be significant on that process.

An important element of MSAT is the service to be provided to native and indigenous populations. In 1981 there were approximately 200,000 individuals in the country living in rural and remote areas officially classified as native Indians (Statistics Canada 92-910, 1981 Census Population by Language Groups, Rural Farm and Rural Non-Farm). Examination of their distribution indicates that the majority are located in the provinces of Quebec, Ontario and Manitoba. There are not likely to be major changes in their numbers over the next five to ten years.

One of the most important characteristics of rural and remote areas are those related to communications services. It is the communications infrastructure that will be impacted by the introduction of mobile satellite services and the overall improvement in services that are likely to occur in the next fifteen years. A study conducted between 1976 and 1981 by the Department of Communications examined the status of rural communications and found the quality of telecommunications services in rural and remote areas was significantly less than that available to urban areas. It also found there were some 94,000 households in rural Canada without telephone service out of a total number of 1.2 million, representing 7% of all households. About 2% of the rural households were without even a radio receiver. Cost estimates for upgrading telephone services to urban standards were set between $2.3 and $4.4 billion.

Studies examining the future mobile communications requirements in the proposed area for MSAT have identified the need for improvement in coverage areas, higher quality equipment, more privacy, telephone interconnection and less congestion for the current set of users. MSAT type services are likely to provide a significant improvement in the current level of services in rural, remote and northern regions of the country.

Statistics obtained from the Woods Gordon Phase A and Phase B studies indicate that there will be a served population in Canada of some 9.5 million people by 1988. As well, the Woods Gordon Market Study also emphasized the importance of the rural market of the Prairies. It is expected that by 2002, approximately 35% of all mobiles will be in the Prairie provinces, with 22% and 21% in British Columbia and Ontario, respectively.

It is likely that in the future and particularly when MSAT services become widespread, rural and remote population densities will be higher than current levels. This will offset a number of the problems related to the economies of scale

for providing enhanced communication services. The need for services provided by governments are also likely to increase quite dramatically. The provision of MSAT service will be quite significant in enhancing the quality of telecommunications to rural and remote areas relative to those currently available in urban areas.

Government Services

Government services have been identified as one of the prime potential users of mobile services. This study focused on law enforcement, medical and fire services. In each of these three areas, tangible and intangible benefits have been identified. The tangible benefit estimates are based on investments likely to be made in upgrading and updating communications equipment. The intangible and more social benefits are considered to be widespread and to focus on user impacts, such as increased job satisfaction, increased effectiveness of service provision and increased worker autonomy. Related societal impacts include reduction in property loss, increased likelihood of crime prevention and improved quality of rural law enforcement, fire and health services.

A significant amount of mobile radio demand has been projected in the Woods Gordon 1984 Phase B study for government services. Unfortunately this sector has not been systematically disaggregated. However, individual estimates in the special user categories have been provided, and in that study overall demand for mobiles is projected at 108,000 units by the year 2009 with adoption rates set at 8.4%.

Law Enforcement

A review of law enforcement services conducted from the social impact study has revealed substantial interest for mobile radio, voice and data services. When offered together, significant social benefits are likely to accrue to those using such systems. Tangible and intangible benefits have been identified for law enforcement applications. Tangible benefits or impacts are based on estimates of the investments which will be required to be made in updating and upgrading communications equipment to full mobile, voice and data capabilities. Intangible social benefits are much more widespread and have focused on user impacts such as increased job satisfaction, effectiveness of service provision and worker autonomy. Related societal impacts include the expected reduction in property loss, increased likelihood of crime prevention and improved quality of rural law enforcement services, particularly for policing activities that are likely to result as improved communications are provided in currently underserved areas.

Estimates of the tangible benefits based on investment and new services have been attempted in the Woods Gordon Phase A study and the Systemhouse/KVA study. In the Systemhouse study it was noted that the benefits of MSAT for law enforcement would be mainly in terms of increased effectiveness of operation and as a result are somewhat intangible. The efficient use of staff, it was argued, is perhaps the most important consideration in all law enforcement operations. To the extent communications contribute to efficiency, there is a corresponding intangible

benefit. The focus of attention for estimated intangible benefits is placed on the RCMP and their requirement for communications in mostly rural and isolated settlements. The Systemhouse study estimated that the cost of upgrading and changing communications equipment for the RCMP would be $48 million over a ten year period. The total net benefit attributed to MSAT has been estimated based on the cost of providing 500 units for the Quebec police force and a further 2,500 units for the RCMP. In such a situation the capital expenditures were estimated in the Systemhouse study to be $12.5 million, with maintenance accounting for $1.25 million and operations based on an estimate of 20 minutes a day adding a further $32 million. The overall benefit attributed by the Systemhouse/KVA study totalled $108.75 million over a ten year period. It is important to note, however, that these estimates are significantly lower than those currently being made based on the revised pricing structure for MSAT, thus they should only be used as a rough guideline for the amount of benefit that could be assumed under this calculation structure.

The 1984 Woods Gordon Phase B market study estimated a total number of 14,000 mobiles by the year 2001 in the government sector. It is likely that a significant number of these would be used by law enforcement services. Likewise, estimates provided in discussions with RCMP officials indicate anywhere between 3,000 and 15,000 units would be required by the RCMP when full commercial MSAT operations are available.

Current estimates place the total cost of all law enforcement services in Canada to be approximately $2.5 billion per year, of which 90% is estimated to be accounted for by staff costs. The remaining $250 million would be expended for equipment and capital expenses. A preliminary assessment of expenditures for mobile communications services made in the Systemhouse study was $18 million per year.

Consideration was also given to the more intangible benefits associated with the use of MSAT in law enforcement services. Specifically, these are increased job satisfaction among officers, the ability to do one's job more efficiently and effectively, increased independence from a centralized dispatch system, and increased job safety. At the same time, a number of negative social impacts were also identified, including over-reliance on technology and the creation of a false sense of security when using the system.

With respect to the kinds of services that MSAT will extend to rural and remote law enforcement services, the two most positive socio-psychological impacts were increased sense of safety that the worker will feel, and secondly the sense of efficiency and ultimately effectiveness with which a job can be done. More effective operations include faster access to remote data bases and more effective response in the investigation of a particular incident. These are particularly relevant when the isolation of communities and individual workers is considered along with the difficulties encountered in accessing information by traditional means over poor quality, terrestrial based, voice communications lines. MSAT will provide a net overall benefit by enhancing the use of systems which have already been developed. Specifically, such things as vehicle inquiries, registration inquiries, driver licence information, person queries for criminals and potential violent persons -- all could be accessed using a mobile data and voice system.

The third area of consideration is in system and spectrum utilization. Commercial mobile radio systems have their peak utilization capacities during standard business hours. Peak usage for law enforcement services are most likely to occur in off hours compared to those for commercial services. It is expected that there will be a more effective use of system capacity and more efficient use of worker time due to the flexibility introduced by an enhanced mobile system. In the low peak or lull times, different types of messages would be sent than in peak times. These would generally be follow-up queries to events and occurrences that occurred through the busy part of the working day. Thus, not only is there a shift in the spectrum usage, but as well there is a corresponding change in the type and character of messages sent. These changes are in and of themselves social in nature.

There is a significant amount of evidence that mobile equipped systems or cars are more efficient for apprehending criminals than those unequipped, and that they result in a quantitative difference in the arrest rates for systems so equipped. There is a strong possibility that partial benefits of this type should be assumed to provide tangible impacts in the proposed service territory of MSAT.

Enhanced mobile services are likely to have the greatest impact on the role of the dispatcher. This will be manifest in a much greater degree of autonomy among individual workers who are free of the responsibility and necessity for directing all messages and inquiries through the dispatch officer. It is quite likely that this autonomy would become manifest in organizational adjustments made to take full advantage of the technology.

Attitudinal or socio-psychological impacts for law enforcement can be categorized as increased independence for users, less concern about monopolizing voice channels for dispatchers, less monitoring by fellow officers, feelings of doing a job more efficiently, increased job satisfaction and safety in performing one's job.

MSAT would enhance the availability of communications to law enforcement agencies and at the same time, due to its capability for handling both voice and data, the negative effects on the traditional modes of operation would be reduced somewhat, thereby enhancing it's socially desirable appeal. Due to the voice and data capabilities of MSAT, no major alterations in the level of voice activity would be required when performing enforcement services.

Health Care and Emergency Services

A key social impact area is the delivery of health care services, and specifically emergency ambulance services. In the Woods Gordon Phase B market study preliminary results, ambulance services were ranked third in terms of potential air time. MSAT is likely to have impacts on the delivery of these services in a number of respects, including socio-economic impacts related to the overall cost of service provision and the enhancement of the delivery of emergency services. Secondly, there will be organizational effects similar to those outlined for law enforcement agencies. The latter facet relates primarily to dispatching and the organization of services.

Ambulance services are run by provinces in association with emergency health service commissions. In 1981 for the province of British Columbia, emergency health services commission had a budget of $37 million. For Canada these figures are closer to $300 million but vary quite substantially from province to province. Total planned expenditures for communications services were $8,200,000 in 1982, representing approximately 31% of the recorded emergency planning program activity expenditures. In 1982 the total amount of financial assistance resulting from damage claims for rural disasters of various types including floods, rain storms and wind storms, totalled over $12 million for New Brunswick, Alberta, the Yukon, Nova Scotia and Saskatchewan.

Estimates for the United States indicate that MSAT services will capture 30% of the overall health and emergency services market. Estimates of the dollar value of benefits are provided based on a 2003 population in Canada of 32 million. Cost savings are likely to increase over a time period of ten years from a present value of $37 million. The Systemhouse/KVA study estimated that approximately 2,000 lives could be saved each year as a result of the application of mobile communications to specific classes of emergency responses, resulting in an annual benefit of $107 million. Over the 1994 to 2003 time period, this could grow from 2,200 to 2,500 lives for a present value of $860 million. The overall social benefit attributed to MSAT was approximately $172 million over that time period. The Woods Gordon Phase B study estimated 18% of all ambulance calls could require the use of MSAT services. That would account for 2,592 air calls and 135,000 road calls.

Intangible benefits of MSAT have been noted as better coordination of activities for mutual aid organizations directing operations of a disaster communications network, and providing communications where none were previously available. These types of services generally piggyback on other existing users, such as police, forestry and fire services. There is strong evidence that mobile equipped emergency ambulance services are essential in improving the ability to save lives, resulting from increases in efficiency, dispatch and subsequent delivery of a patient to a central facility. This is particularly relevant to rural areas which are spanned by hundreds of little known or unmarked roads. Arranging for delivery of patients to hospitals is particularly relevant in cases where helicopter transport could be used servicing oil rigs offshore and in the more remote areas of Canada.

Pager services have been identified as likely to have a high demand for MSAT. Consideration of the linkage between pager services and satellite based mobile systems for health care delivery provides further examples of the social impacts that may result. Enhanced mobile pager systems allow staff instant two-way communication capabilities over wide areas. This will result in more effective health care delivery in areas of low population density and allow improvement in the ability of medical staff to react to emergency situations. The market forecasts for wide area paging are considered somewhat speculative due to uncertainties about technological developments. The total number of pager units is estimated to vary between 9,000 and 45,000 by 2001.

Fire Services

Rural fire services are likely to receive significant benefits from the use of MSAT services. These services are typically provided in Canada by volunteer fire agencies or piggybacked on other government agencies. Since rural fire services are almost all provided on a voluntary basis, there is very little evidence and statistical information to indicate the magnitude of these services and therefore the possibilities for MSAT. The attention in this section is therefore directed toward the more intangible benefits. These included improved safety for department personnel and civilian employees, more effective assignment of people and equipment, improved response capabilities and use of data for management purposes.

Other attributes of mobile radio equipped rural fire services include improved reliability in the fire fighting service itself, increased speed of unit status reporting, common operations for more effective allocation of resources, and the ability to provide emergency patient monitoring if there were human lives at stake.

A case study example selected from the United States, involving 1.4 million people, was estimated to cost $5.2 million for an overall investment of approximately $4 per person in the service territory. The direct impacts involve better and more efficient allocation of vehicles and services, improved ability of the fire department to respond to emergencies by making it possible for dispatchers to keep up with calls during peak periods. Mobile services increased the safety for the public and improved the working conditions of the fire fighting personnel. Secondly, it allowed more effective assignment of personnel and equipment and automated the collection of management reports.

The most important impacts are the improved efficiency with which services could be provided, the increased likelihood for reducing loss of life and property, and the ability to coordinate services over wide areas.

Environmental Monitoring, Forest Fire Fighting and Protection

A significant area of social impact is the enhancements to the natural environment and the role that MSAT plays in fostering better protection of forest, wildlife and agricultural regions of the country. Tangible and intangible benefits can also be discussed with respect to the environment, fire protection and agriculture protection applications.

MSAT is likely to influence the ability to control forest fires and in the way organizations are able to respond to the forest fire threat. In British Columbia, which is one of the largest provinces in terms of its forest resources, in 1983 67,000 hectares of forest were claimed by forest fires. Total cost of suppression for those was $13 million. The damage resulting from forest fires was calculated at approximately $20 million, while for the period 1974 to 1983 the total cost of fire suppression was $223 million. The total damage loss resulting from these was approximately $200 million over a ten year period. Figures for Canada in total over the same period are estimated between $800 million to $2 billion of loss resulting from fire.

The forestry industry was ranked in the top ten of the potential users of voice mobiles by the year 2001, representing 9.3% of the market. Accepting the $2 billion damage estimate for forest fires and projecting similar figures over a ten year period would conservatively allow for a 10% impact of MSAT, leading to an estimate of $200 million or $20 million per year of savings through the enhanced reporting of fire incidents.

Intangible benefits for forest fire protection include the substitution of existing methods of observation, such as aircraft activity by monitoring stations, better coordination of ground crews, improved safety and efficient transfer of mapping data. Other specific uses are for monitoring and triangulation of lightning strikes.

The Phase B Woods Gordon study indicated that monitoring using data collection platforms would be one of the main special users of MSAT and projected 1,700 terminals by the year 2001. MSAT was considered capable of achieving a substantial penetration of 70%-80%, representing up to 284,000 minutes of air time per year and 1,190 terminals.

Rural Agriculture Monitoring

MSAT is likely to have an effect on the ability to monitor natural hazards in rural agricultural areas which are likely to cause damage, either to property, crops, livestock or lives, and which can be attributed to the effects of the natural environment through climate. Of critical need is the ability to understand and monitor climatic factors. MSAT's most important role will most likely be assisting in the understanding of the variability of climate which, through its fluctuations, has significant effects on the ability for regions to produce and be economically viable. Enhanced communication services will be used to assist farmers in dealing with variabilities in climate and also providing early warning systems for impending climatic problems. Another key area will be in the ongoing monitoring of agricultural production, including such things as hail, wind damage, drought and snowfall conditions. Dollar impacts related to hail compensation were estimated in one study of Alberta at $438 million; hail losses in that province were estimated at $18 million. A 10% reduction in claims as a result of better anticipation and early warning conditions brought about through monitoring devices and MSAT could save approximately $1.8 million in insurance claims. It is estimated that upwards of $20 million in savings could be anticipated on a yearly basis from losses due to hail and related climatic disturbances in Canada.

The Human Environment and Social Costs

Thomas Berger, in reporting on the Mackenzie Valley Pipeline in 1977, considered social effects of technology development to be one of the most significant areas of investigation. Development of industrial bases, the enhancement of mining and increases in transportation capability are all likely to be affected by the provision of MSAT services. These developments eventually bring a transition from a native majority in the northern and remote regions of the country to a white majority. This clearly has major social implications for the future shape of political

institutions and agencies in those regions. MSAT is likely to impact quite significantly, in a commercial sense, on a variety of industrial developments and large scale projects in the northern and remote regions of the country.

Since it will enhance development in the north, a secondary impact resulting from the investment in the program would ideally be a reduction in welfare payments required to northern communities. It is likely to be very difficult to show that industrial activity in these northern communities will play a major role in absorbing surplus labour and diminishing welfare dependency of those communities. In many instances rather than seeing reductions in welfare payments, the attendant industrial development has led to increases in welfare payments due to higher rates of dependency of individuals on social agencies. This is particularly relevant to native groups in the affected regions, and it should be remembered that the northern and remote regions of the countries and the small communities contained therein are considered highly vulnerable to rapid industrial and technological change.

Lives Saved and Loss Avoided

Of direct relevance to the MSAT program will be the impacts in improving the overall safety of the working and living environment. One of the most important social issues is loss of life and the improvements for safety within the working environment. It has been pointed out that the traditional approach of the calculation of cost and benefit of a life saved are inadequate, and that the calculation of those values should be based on more realistic information. It is recognized that not all rural and remote services will be affected by MSAT, since as the other studies have shown it will not always be economically feasible for the replacement of a terrestrially based communication system with a satellite. However, it is clear that in the case of such things as fire fighting, law enforcement, emergency services, remote work site operations, oil rigs, trucking and forestry operations, a significant portion of mobile communication activities will be shifted to MSAT. This finding is also supported in the Phase A and B Woods Gordon Market and User Benefit Study.

Using statistics provided in background studies and those of the Workers Compensation Board for each province, estimates of the cost of hazardous work environments have been provided. Using these figures and looking at loss of life over the years 1981 to 1982, a value of compensation for loss of life averaged approximately $110,000. Wage loss compensation amounted, on average, to $1,500 per claim, with medical costs accounting for upwards of $500 million in compensation payments. Compensation was greatest in the trade, service, manufacturing, construction and forest product industries. For Canada as a whole, over $100 million was paid out in compensation during 1981-82, with over 900 lives lost in industrial and commercial activities. Over the same period, $1.25 million was paid out for accident claims. This included compensation for lost time, medical costs and hospital care. Approximately of 40% of all deaths are likely to occur in non-urban areas, indicating a social cost of approximately $40 million per year in death benefits. In 1981-82, $1.35 billion was paid in compensation for accidents at work sites in all of Canada. The remote sites are conservatively assumed to account for 30% of this

total, or $450 million. Accepting that MSAT will have a conservation (in present value) net effect of 10%, this would amount to a social cost of $45 million per year in avoiding compensation payments based on the 1981-82 statistics.

In conjunction with these quantifiable dollar estimates for loss of life, consideration has also been given in a number of the other examples to the more intangible social and psychological effects resulting from improvements and safety of the work environment. Reducing uncertainty, fear and isolation of working at a remote site are all impacts which will be felt among individual workers, with the attendent improvements in communication services provided by MSAT.

Trucking and Transportation

The Woods Gordon Phase A study identified trucking as one of the prime future users of MSAT services. Forecasts of projected air time indicate that dispatch will account for approximately 32% of overall use, and traffic control 4.3%. Future projections indicate that by 2001 the transport and trucking industries will account for 18.2% of all voice mobiles, and there will be 44,000 mobile units operated in Canada. The general transportation sector was considered to have significantly more demand with a 2009 projection of 174,000 mobile units.

As in other services requiring dispatch, the attendent impacts of the trucking industry are likely to be quite similar. Increased autonomy, better organization and more efficient allocation of resources are likely to accrue. An overriding need in the trucking industry is constant monitoring of load and emergency notification. In each case the voice capability is the prime method used for notification of disaster and emergency situations. Mobile data usually serves the purpose for routing, monitoring vehicle arrivals and departures, and local management. The ability to monitor has direct benefit in terms of assessing the incidence of breakdowns, accidents, highjackings and overall safety of the driver and the truck contents. Thus, the intangible benefits of an improvement in mobile radio capability which offers both voice and data will be improved safety to the driver, better psychological conditions for work and therefore attendent efficiencies in operation.

As improved communications and transportation linkages are provided in the rural and remote regions of the country, increased volumes of traffic are likely to take place. While today there may be low volume of traffic and therefore low incidence of highjacking and stolen goods in the areas to be served by MSAT, all indicators are that there will be accelerated growth in the near future. As that growth occurs, the incidence of such events is likely to increase.

The intangible benefits that accrue include effectiveness of operation, easing of the work load on the driver, provision of more productive use of work time, reduction in the possibility of missing pick-up and routing situations, increased confidence of employees on the job, increased sense of safety in the job environment, and better overall morale of workers.

While there are definitely going to be commercial benefits in the trucking industry, a great deal of the overall impact of these systems will accrue to workers using them. This will be manifest in increased worker satisfaction, better performance on the job and overall confidence in being able to do one's job better. These types of indirect intangible benefits, it is thought, will lead to corresponding economic impacts manifest in higher productivity for the business and more efficient utilization of overall resources.

United States estimates place expenditures for communications linkages of a typical large truck fleet at $1.3 million per year, representing a value of $39 per month per vehicle in operation. While this example is drawn from the US, there is no doubt that similar potential benefit savings would accrue in the Canadian situation. While today there may be a low volume of traffic and therefore a low incidence of highjacking and stolen goods in the specific areas to be served by MSAT, there is no doubt that accelerated growth will occur in the future. As it does, the incidence of these events is likely to increase. Information obtained in the Woods Gordon Phase B study indicated that the main use for mobile services in the private trucking industry sector is likely to be long haul inter-city movement of freight. Analysis of the regulated truck carriers indicates that the type most likely to equip with an MSAT terminal would be involved in hauling non-scheduled operations. The total number of operators of these services was 6,890 in 1981. Specific factors likely to encourage adoption of remote cargo monitoring are high value items, the need for state-of-the-art technology, adoption of more efficient management techniques and concerns for transport in high crime areas. The Woods Gordon Phase B estimates suggest approximately 4,000 to 8,000 vehicles could be considered as potential MSAT users. Their 2001 estimate was between 5,500 and 11,000 terminals. For remote cargo monitoring the estimates range between 1,700 and 6,500.

Additional users of MSAT services in this sector are public transportation, aircraft and marine services. These were considered in the Woods Gordon Phase B study to represent a major portion of the projected future demand. MSAT suitability for bus transportation, trains, ferries and aircraft were all examined and shown to have a moderate demand in the 2001 time frame.

In all cases reviewed as part of the Woods Gordon study, the principal user was designated as a business traveller. Therefore, as a result, the demand for service reflects the extent to which the transportation medium services the business community. It has also been suggested that MSAT will offer the most potential in improving the way emergency services are organized and in complementing existing emergency services provided to the transportation sector. As revealed in the Phase A Woods Gordon study, the Coast Guard responds to approximately 90 life threatening situations per year where an MSAT type service could be used. While it would be difficult to justify these services on a purely economic basis, the social implications are quite significant. Related services could provide improved private communications with ocean search and rescue operations on the east and west coasts and in the Great Lakes regions.

Oil Rigs and Exploration Activities

A significant amount of economic activity in Canada's northern remote and rural areas is devoted to oil exploration, natural gas extraction and pipeline development. Socio-economic impacts of these developments will be enhanced with the application of MSAT. In 1981 there were 6,900 oil wells being drilled in Canada, and a significant number of these were in remote and northern areas of the country. Thirteen wells were being drilled in the Arctic islands. Forecasts predict that offshore activity will be increasingly important in the next ten to twenty years, and the activities in western Canada will account for approximately 98% of all exploration activity. Forecasts have shown that approximately 14% of all mobile users will be used in mineral extraction in the oil industry by 2001, and that air time usage will be quite significant in this industry sector.

The Woods Gordon Phase B market assessment study indicated that mineral extraction would account for 14% of all voice mobiles by the year 2001. Likewise, an analysis of the percentage of air time use indicated that remote sensing would be one of the top ten users of these services. The major use of MSAT will most likely be voice communications in the oil and mineral extraction industry sectors.

Social impacts result from the enhanced ability to report potential disasters, safety monitoring at sites, conveyance of requests for the activation of emergency service and dispatch of emergency aircrafts, such as helicopters, to remote oil rigs and site operations, early weather warnings and ice flow warnings. The recent Ocean Ranger disaster off Canada's east coast represents one example where mobile communications could play a significant role in averting disasters and minimizing compensation payments due to deaths. This has totalled $5.5 million by 1982.

Social/Psychological Impacts

Associated with all of the previously mentioned application areas are sets of intangle benefits which are not readily quantifiable either as dollars or is economic surrogates. The impacts usually relate for example to, quality of life, quality of working life, psychological well being, community and environmental enhancement. Others include the social ecology of the service territory, individual attitudes toward the living and working environment and improved service provision for emergency, health, fire and ambulance services. These categories of social impacts constitute some of the most important concerns for this study but are restricted to qualitative definition since there are no readily definable monetary or economic criteria attached to them. These impacts occur at all levels, individual, organizational and societal, depending on the particular application area being considered. Specific examples were provided relating to increased worker safety, worker satisfaction, autonomy, relief from isolation, improved soical interaction and improved quality of public services. The latter item typifies the type of indirect social benefit associated with the more tangible user benefits identified for MSAT. The indirect benefits accrue to those individuals receiving services which are enhanced by the use of MSAT for mobile radio, telephone, paging or data services. These types of extralities typify many of the application areas designated for MSAT and are likely to have relevance to many of the estimated 9.5 million people to be within the service territory in 1988.

Impacts on Government Policy

One of the most important aspects of assessing MSAT involves the appraisal of its implications for government policy. This is particularly relevant in this report for environmental policy, space and industrial policy, as well as high technology development.

Environmental Policy

One of the most significant considerations in assessing the social impacts and benefits likely to accrue from MSAT relate to the way it will affect development in northern, remote and rural areas of the country.

The government of Canada has a central role to play in ensuring a positive response to northern opportunities and future development, due to its jurisdiction over the territories. The stated policy of the Canadian government is to achieve resource development at a rate and in a manner compatible with a delicate social and environmental balance, recognizing that northerners will play a growing role in both the decisions and benefits associated with that development. The policy statements indicate that resources and the environment are the main elements of any strategy for northern development. The needs of the people in the north, and environmental balance, however, are also important. The essence of choice for the government is to maintain an appropriate degree of balance among these three critical elements.

In achieving these policy goals it is important that industrial development in the north, remote and rural areas function in harmony with the environment, that it pose minimal risk to human, plant and animal life, and that it produce real net benefit for the local inhabitants. In the process, it is also essential that the special environmental challenges presented by these regions be fully considered.

A number of strategies have been defined amplifying the way specific policy objectives may be achieved. Only some of these have direct relevance to MSAT. One is the strategy for promoting environmentally sound technology and safe operations in northern and remote regions. Specific technical services of relevance to MSAT include the provision of a program of climate, weather, ice and sea state information and forecasting to meet local and regional needs. Secondly, it will provide meteorological, ice and sea state information and forecasting programs designed to serve individual clients on a cost recovery basis. Thirdly, it will provide appropriate access to the environmental baseline information provided by the department's core data generation program concerned with terrestrial and aquatic environments. Specifically, uses for MSAT will relate to water and air quality monitoring, wildlife habitat surveys, wildlife and vegetation studies, ecological land evaluations, and also waste disposal and hazardous materials monitoring.

In addition to the northern policy issues, various sectors of the Department of Environment have expressed interest in the MSAT program. Included are Parks Canada, Atmosphere and Environment and the Environmental Protection Services.

In submissions made to MSAT working groups, estimates of required data collection platforms were set at 955 by the end of 1994 among these departments, with specific uses identified as air quality measurement, ice flow analysis, weather monitoring, stream gauging and real time map generation and transmission. Representatives of the Indian and Northern Affairs department specified such applications as fire protection, lightning triangulation, climatological detection and logistic data transfer. Estimates of 700 mobiles were provided for the 1988-1990 period. Energy Mines and Resources also are potential users of MSAT, primarily for data transmission.

Current mobile communications equipment is estimated to cost between $450,000 and $500,000 per year. Possible uses include ship to shore data and voice and broadcast imagery as well as a significant amount of geological survey work, primarily for voice communications.

Space and Communications Policy

The Department of Communications has identified a number of policy areas which may be impacted by the introduction of MSAT. Specifically, in 1981 the rural communications studies program was completed and found a widespread need for improved telephone service and better mobile radio communications. MSAT is likely to provide the type of services necessary to upgrade rural communication services to the required level.

A three year space program announced in 1980 to cover the financial years 1981 through 1984 was characterized by relatively long term commitment and intention to diversify Canadian space competence and usage and to provide further support for innovative development. It was announced in the belief that the government support for space related research, development, manufacturing and marketing would result in the fulfillment of broad national, social, political and economic activities. According to various policy objectives, domestic requirements are the primary factors that direct the activities in the space sector manufacturers. The benefits of this strategy are expected to result in a high level and quality of Canadian content in domestic software and hardware, leading ultimately to export sales, collaboration with foreign contractors for exploitation of the international market and system level expertise essential to design manufacturing capabilities in subsystems. Canadian government has devoted attention to the space sector with the expectation that it will clearly become a growth industry and a major component of the high technology sector. In general, the Canadian space sector has been regarded as one of the central facets of an industrial strategy. Statements of policy objectives for the Canadian space program plan for 1982 support that belief.

Communications, broadcasting, weather observation and forecasting, remote sensing, search and rescue, aeronautical and marine navigation, data collection, scientific exploration, military applications and surveillance, all will be enhanced by the application of MSAT. Availability of these services will be an essential factor in a continued social and economic development of the country, and control of the facilities and data flow is an important consideration in the maintenance of cultural and economic sovereignty.

A major objective in Canada's space program has been to assist in the movement of technology from the government to industry and to assist in the development of commercial applications in the market economy for mobile type services or for any type of data or voice service. A number of primary applications considered for MSAT will have direct benefit to industry in its ability to offer enhanced commercial services. Already mobile radio, paging and mobile data systems can be identified as areas which will benefit most directly from the application of MSAT.

Finally, another important policy issue is the impact that MSAT will have on generating export sales and in achieving further penetration of Canada's space industry to foreign countries. Examination of past programs and the success of companies such as Spar Aerospace suggest that MSAT will contribute quite significantly. Specific market areas are now being examined. However, countries such as Mexico, Singapore and South Korea are already adopting cellular radio systems as well as US technology, and it will be important that MSAT be able to compete within these particular market areas. The international market, therefore, is seen as quite competitive but offering significant opportunities for MSAT. Current plans for MSAT indicate that to a large extent the program fits in with the overall policy objective, as stated in these program plans. However, it is also clear that the early results from the Woods Gordon manufacturing study suggest at the present time the export potential for MSAT seems rather unclear. However, investigation of foreign markets has only barely begun, and it is quite likely that significant opportunities will be uncovered for export potential for this technology, particularly to third world countries. Those countries which are heavily rural and agriculturally oriented will offer opportunities and include Australia and other parts of Southeast Asia.

Industrial Policy

The Canadian government has been engaged in the process of selecting and implementing "partial" industrial strategies since the late 19th century. Controversy over Canada's prospects as a manufacturer and exporter of finished products has raged through each decade without resolution. With the advent of the information economy and heightened international competition, the problem of developing appropriate strategies has been discussed with a renewed sense of urgency. Interest in recent years has coalesced around several issues; whether some form of industrial strategy is or should be developed for the high technology sector, and Canada's relatively low research development and marketing capability as compared with other industrialized nations.

In principal, MSAT is likely to have some impact on the achievement of overall high technology goals. The exact magnitude of that impact, however, cannot be assessed aside from the fact that it will contribute to the development of new technologies which will most likely be produced by Canadian manufacturers.

Another area of concern with respect to the policy implications of MSAT is the extent to which the benefits of R&D and manufacturing capabilities will accrue not mainly to Canadian interests, but will follow a pattern typical of some other ventures in the high technology sector, whereby once the initial prototype and

research work is conducted, usually on the basis of Canadian subsidy, the manufacturing and mass production of the technology and the provision of services occurs by offshore rather than domestic firms, and Canada becomes a net importer of these products.

Support for research and development and promotion of Canadian products and services on an international (mainly US) market stands out as the two centres of Canada's attempt at an industrial strategy. In the 1981 policy statement the targets for growth, funding and performance of research and development were established and are expected to reach $5.2 billion in 1983, or approximately 1.4% of the gross domestic product. It is likely that MSAT will have a positive influence on expenditures for research and development.

Conclusions

This report has described in qualitative terms the expected main social impacts of MSAT on potential users and Canadian society. It has also provided an indication of the relevance of specific social impact areas to the overall MSAT program and provided some indication, where appropriate, of the potential magnitude, likelihood and time frame of occurrence of those impacts. A final section of the report provides an assessment of the impact of MSAT on selected policy goals and objectives for a variety of federal government programs.

To a large extent, this report has used results from the other studies produced in the MSAT series, particularly those related to the Phase A and Phase B market and user benefits study. Many of the social impact areas which have been discussed in depth in this report relate to those areas defined as special markets in the Woods Gordon Phase B study. In particular they focus on fire fighting, fire protection services, emergency services, disaster relief, monitoring services, wide area paging and transportation services. In many cases the anticipated market size is small and the corresponding economic benefits are somewhat restricted. These more tangible areas are complemented by a discussion of the more purely defined social and socio/psychological impacts such as worker satisfaction, improved service to the public, improved quality of life, improved rural communication services and improved public services.

Table 2 presents a summary of all of the social impact areas discussed in the applications section. It illustrates the impact issues which has been identified in association with the relevant MSAT application, with each impact discussed in terms of its quantitative and qualitative characteristics. Much of the quantitative discussion details the associated economic and socio-economic impacts which are reflected in the projected market demand for terminals and air time. The quantitative benefits have been calculated in some instances using cost savings or loss and damage avoided, in other instances the approach has been based on the projected number of users in a particular segment of the population for the defined application area.

The various application areas have associated with them a number of less tangible impacts in addition to those of an economic and socio-economic nature. These

TABLE 2
Summary of Identified Social Impacts and Issues

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
1.	Population/ Demographics	Indirect benefits received by population Improved communications Native populations to be served by new services Quality of life improvements	1988 served population of 9.5 million Current population 6 million Rural growth 1976-81 = 8.9% 200,000 native Indians	Increased rural growth rate Increased need for services Improved access to services Natives groups to be prime users of services
2.	Communication Characteristics of Rural and Remote Areas	Improvements in infrastructure for communications Future requirements in rural areas are likely to grow and MSAT will be important in meeting these needs	1981 - 94,000 households had no phone Estimates for 2002 indicate 35% of all mobiles in the Prairies, 22% in BC, 21% in Ontario	Perceived need for improved mobile services, better coverage, higher quality equipment, improved privacy, better service
3.	Human and Social Environment of the North	Accelerated industrial and commercial growth Increased contact with southern culture Increased demand for jobs and the need for retraining Conflicts with native values and patterns of social organization as development proceeds Access to improved employment opportunities from new developments Increased extent and type of commercial operations/diversified economy	Increased welfare dependence in the past as industrial development proceeds Doubling of welfare payments in newly industrialized urban areas historically Increase crime in the NWT as industrialization increased 30% 1969-75	Changing nature of northern and remote areas Accelerated movement from a native majority to white majority Enhanced industrial development Improved employment and altered welfare dependency Social indicators may alter, eg crime, alcoholism
4.	Environmental Monitoring and Forest Fire Protection	Improved protection of the forest and wildlife resources Reduced rate of depletion of natural resources Improved ability to preserve environment Safer fire fighting services Increased capability to work in marginal areas Improved logging operations, eg transport of materials	Forest protection services demand estimated at 1,600 units by 2001 Forest industry ranks 5th in terms of expected number of mobiles by 2009 BC and Ontario account for 30%-40% of total demand	Value attached to the natural environment and wilderness experiences Unique species of plant and animal life Control of forest fire threat Improved organization and safety at work sites Perception by workers of safer, more effective operations Opportunities develop in new areas

TABLE 2
(continued)

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
4.	cont'd	Overall cost savings in expenditure of public funds Retention of the capital stock of forest resources (inventories) Frequency available for use in other disaster-related activities	Fire losses in Canada estimated at $2 billion 1974-83 Loss avoided benefit estimated at $200 million Woods Gordon estimate 1,700 terminals by 2001 for data collection	Increased safety in the operation of fire fighting and better working conditions Safer living environment for remote communities
5.	Rural Agriculture Monitoring	Ability to monitor natural hazards Assist in understanding and reacting to hazardous climatic influences Enhance the data and voice mobile services in rural areas To reduce risk to farmers for crop loss/ property loss	Hail loss was $18 million in Alberta in 1978 Estimated loss avoided benefit for agriculture $20 million per year in Canada	Increased crop values produce higher risk situations for farmers Generally increased use of technologies in farming operations, particularly communications Increased need for climatic information to reduce risk Familiarity with remote data and advanced technology services
6.	Law Enforcement	Reduced expenditures for providing law enforcement Changed requirements for upgrading and updating equipment Social effects: -increased safety -job satisfaction -effectiveness of service provision -efficiency of service operations -improved dispatch services -better service to public in defined areas/rural communities -improved reliability and quality of services to internal and external operations Socio/psychological effects: -over-reliance, better performance -increased autonomy -perceived improvements in job performance -minimal impact on existing behaviours due to technological flexibility	Demand for mobile in government services estimated at 108,000 units by 2009 Estimated communications expenditures $250 million per year (Canada RCMP) Mobile services estimated at $18 million Estimated benefits from MSAT are $18.07 million per year 2001 estimate of 14,000 mobiles in police service RCMP estimates 3,000-15,000 units	Voice and data capabilities enhance MSAT appeal to police Reduce disruption to existing operations Attitudinal and behavioral effects substantiated in field trials of related systems, eg Vancouver No major alterations in voice activity, therefore socially desirable Less reliance on the role of dispatchers and more control by individuals Increased access to remote data sources and other external sources already in place

TABLE 2
(continued)

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
6.	cont'd	More effective use of the system capacity and more efficient use of worker time Organizational effects/mgmt improved	Evidence of quantitative differences in performance of mobile equipped police units	Time utilization improved with increased system flexibility Improved allocation of policing resources and allocation of vehicles
7.	Health Care/ Ambulance and Emergency Services	Improved delivery of emergency health care Assisting in coordinating during field operations Organizational changes in service provision	Ambulance services ranked third in future use Emergency health care expenditure $300 million annually (Canada) Estimate of possible demand for using MSAT 2,500 air calls and 135,000 road calls	Necessity for the speedy delivery of trauma units to a site Increased ability to direct crews to required sites Demonstrated feasibility in rural areas
8.	Emergency Medical Services	Improved delivery of medical services resulting in more effective service Impacts in disaster relief, transport and marine services Better overall management of services Improved access to the public Positive benefits include savings in time, money, lives and property loss	In US, MSAT type services are expected to capture 30% of overall market Expenditures for services in Canada in 1982 were over $8 million Disaster claims in 1982 were $12.7 million Systemhouse estimated cost savings at $172 million and approx 550 lives would be saved each year	Coordination of activities and directing of facilities to accident sites Reactions to MSAT services for hospitals, ambulances and special rescue vehicles have been positive in field tests
9.	Pager Services	More effective health care delivery in low population density areas Improvements in the reaction to emergency situations Coordination of crews and field teams	Total pager units are expected to total between 9,000 and 45,000 by 2001	Staff access to information, messaging, recording, storing and relaying visual information all enhance service performance
10.	Rural Fire Protection	Improved response to rural fire hazards Improved volunteer worker safety Improved allocation of vehicles and services (efficiency) Reduced property loss to the public	Field trials of system reveal in the US a per person cost of $4	Access to data and fire hazard information Mobile data and voice units lead to faster response when alarms are received Reduced property loss can result in lower insurance rates and savings to owners

TABLE 2
(continued)

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
11.	Worker Safety	Reduction in lives lost Improved work site conditions/rural and remote Lower overall expenditures for compensation claims Reduction in worker isolation Reduction in uncertainty/fear of working in remote areas	Cost of hazardous work estimated from compensation statistics Loss of life value $110,000 Wage loss $1,500 per claim 45% of recorded fatalities in 1982 occurred in rural and remote work sites In Canada over 900 lives lost in industrial activities with compensation $100,000 per life $1.25 billion paid for accident claims	Improvements in communications services will be brought about through MSAT Some proportion of current communications will be shifted Socio/psychological impacts are also likely to occur due to improved communication services
12.	Trucking and Transportation	Improved vehicle and cargo safety Deterrent to hijacking Reductions in property loss Improved driver morale and safety Potentially increased traffic More productive work time Increased employee confidence on the job Indirect benefits likely to accrue in addition to economic benefits Improved travel conditions for the general public by reducing stress Reduction in lost cargo Improved ocean search and rescue	Estimates indicate this industry to be one of the largest users of MSAT - 32% of total use with 18.2% of all voice mobiles by 2001 (44,000 units) 4,000 to 8,000 tractor trailers are estimated users of MSAT by 2001 Terminal demand in 2001 set at 15 for public transportation, 360 for ferry traffic, 180 for commercial aircraft	Trucking requires monitoring dispatch and notification for disasters and emergencies Better coordination and control by drivers Voice channels available for emergency Suitability for bus, train and aircraft have been identified Secondary benefits believed to be the most critical and are psychological in nature Reduction in stress from long haul travel, immediate notification of arrivals and departures, schedule changes Increased incidence of cargo losses due to theft and accidents
13.	Remote Site Monitoring/Oil and Gas Exploration	Reduction in hazardous work conditions Improved reliability and quality of communication services Improved reporting of disasters Safety monitoring Dispatch of aircraft Early warning of weather conditions Data transmission backup to existing services	1981 - 6,900 oil wells being drilled in Canada 6,000 to 8,000 projected over the 1983 period Estimates indicate a demand of 14% of all voice mobiles by 2001 Remote sensing would be one of the top ten commercialusers	Significant activity is related to oil exploration, natural gas extraction and pipelines Offshore and remote area activity will be increasingly important over the next 10-20 years Most uses likely to have more demand for voice rather than data Complementarity for Inmarasat and Anik

constitute intangible and indirect benefits which do not lend themselves easily to quantification. As social impacts however they are extremely important and are central to defining the full range of benefits likely to result from the implementation of MSAT. These have been referred to previously as social/social psychological effects and they occur at the individual, organizational and societal level depending on the particular application area being developed. In some cases these represent improvements in the quality of life such as enhancements to the communications infrastructure of rural Canada. In others they represent organizational changes in the provision of services. The indirect benefits of such organizational changes could include the improved morale of workers and the improved effectiveness for providing services to the public. Improved effectiveness is generally associated with better quality services, improved access and increased availability to the public.

Intangibles have also been linked to the social and psychological improvements in working conditions. Improved operating characteristics and safer working environments are two examples. Others include increased autonomy for the individual worker, which it is suggested leads to improved worker performance and ultimately better service to the public. In the case studies cited, the overiding benefits verified by system operators were often the intangibles rather than those defined by a rigorous cost benefit analysis. Providing safer working environments, reducing the dependancy on dispatchers and increasing autonomy have all been viewed as positive benefits accruing from the introduction of mobile services similar to those suggested for MSAT.

Since many of the social impacts represent secondary and indirect effects they emphasize one of the essential features of the service, namely the property of externalities. This emphasizes benefits which accrue to individuals not directly involved in the provision of services and who may not actually use the services. Indirect social benefits accrue to individuals receiving service which are enhanced by the MSAT operations. In most cases the impacts are only speculative since no operational service is in place and reliance must be placed on extrapolating from analogous services. These impacts are usually assumed to occur in the short to medium time frame of seven to fifteen years.

Attention in the report has also focused on policy issues. Implications for MSAT services have been identified for the areas of communication policy, industrial strategy, space policy, technology transfer, rural and northern development policies, agriculture and environmental protection. In each area a number of benefits likely to accrue from the incorporation and use of improved mobile voice and data services have been defined. The implementation of an MSAT program will have significant benefits in assisting the achievement of a variety of federal government policy objectives in each of these areas. In fact, plans have been drawn up illustrating the possible use of MSAT within each of the defined policy areas and where available these plans were reviewed to illustrate the degree of commitment that a particular government department may have towards the ultimate testing and subsequent use of MSAT.

The results of this study have indicated that there will be significant social, socio-economic and social psychological benefits accruing from the MSAT program to the

Canadian public once implementation of the program takes place. The time frame for the impacts to occur is set between 10-15 years and as well, the conclusions from this report have indicated a number of areas which lend themselves to more formal quantification. To conduct such a quantitative study, a second phase program is now being implemented which addresses a number of key areas in detail and provides inputs for the overall socio-economic quantitative study. Areas that are being investigated include government services, trucking and transportation, environmental monitoring and hazard aversion, and forestry operations using data and voice services. This investigation will serve as a primary input to the overall socio-economic impact study being prepared for MSAT.

1.0 INTRODUCTION

The objectives of this report are:

1. To describe in qualitative terms the expected main social impacts of MSAT on potential users and Canadian society.

2. To indicate the relevance of the specific social impact areas to the MSAT program.

3. To provide an indication of the potential magnitude and likelihood for the occurance of the selected social impacts.

4. To provide an assessment of the impact of MSAT on selected policy goals defined by the federal government.

This report is the fourth in the series dealing with the social impacts of MSAT on users and Canadian society. It presents a qualitative discussion of the predominate social impacts which have been assessed as having a high likelihood of occurring in relation to the proposed MSAT services.

1.1 System Architecture

At the time of writing this report, the actual configuration and system outline for the MSAT services were still under study. A number of options have been considered, each of which could ultimately represent the way MSAT will be configured. These consist of a Canada only system, either spectrum limited or not spectrum limited and a regional Canada-US system. Under all scenarios the MSAT system will provide a domestic Canadian services whether or not the U.S. portion of the system is implemented.

Coverage will be by a number of ultra high frequency UHF 800 MHz band radio beams plus a single superhigh frequency (SHF) back-haul beam. The frequency spectrum allocated to each beam is divided into 5 KHz channels, a small number of

which are needed for communications control. Assignment of channels, by DAMA to users, identification of users, record keeping and generation of billing data is done at the CCS, i.e. Communications Control Station.

A variety of services are planned for the MSAT program. These include mobile radio service, mobile telephone service, paging services, mobile data, data acquisition and control services. Mobile radio services are operationally similar to terrestrial mobile radio services but allow a larger coverage area. An MRS mobile user may communicate from anywhere within the MSAT coverage area regardless of which satellite beam he is in, back to his own base station or to any telco or radio common carrier gateway station. Optional paging services and Videotex may be available with the mobile radio service. At the present time it is not known whether MRS will be interconnected to the PSTN (Packet Switched Network) since a number of technical, regulatory and institutional issues still need to be resolved.

Mobile telephone service (MTS) connects mobile users to the public switched telephone network. Operationally, the service is similar to the existing mobile telephone service and the planned cellular mobile telephone services. As will MRS, calls can be received or transmitted from mobiles virtually anywhere in Canada, including coastal waters and areas in the northern US.

Paging to vehicles and data services will be available to mobile telephone customers. However, direct reception on satellite signals by personal pagers is not assumed to be cost effective. Paging services will present one-way message data service via the satellite to a mobile terminal in a users' vehicle. This could work in conjunction with an in-vehicle retransmitter for extended range or in conjunction with an existing RCC paging system. Simple beep, alphanumeric and speech paging would be possible with the MSAT system.

Mobile data service may be furnished either as an add-on option to MTS or MRS services to provide voice plus data, or may be furnished as a stand-alone data only service. This service is comprised of a mobile alphanumeric display with keyboard which interconnects to fixed MSAT stations or other mobile terminals. A principal application would be for dispatch type services. Facilities to access computer

databases, displays in either alphanumeric or Videotex format would also be available.

Data acquisition and control services are one or two-way data services intended to gather small quantities of data at regular intervals from fixed or mobile data collection platforms for remote monitoring applications. Facilities are provided to pass control or command instructions to the platforms. Service may be structured so that a data collection platform can be polled on a predetermined schedule. As well, the data can be transmitted at predetermined time periods for use by a monitoring agency. Control or command instructions are passed from the user's base station or mobile terminal to the control unit where they are stored and then forwarded to the platform.

At the present time a number of uncertainties still exist about the exact configuration of the space segment proposed for MSAT. However, regardless of what actual configuration is provided, the importance to the social impact study lies in understanding the applications for the service rather than the way that the space sector is configured. The program plan for MSAT calls for the first satellite to provide services between 1988 and 1994, with an initial period dedicated to field trials of various applications.

1.2 Previous Studies

This is the fourth report in a series addressing particular issues in the identification of the social impacts of MSAT. Report No. 1 provided a literature review and identified previous studies which have examined the social impacts of satellite and mobile communications. The results of that study revealed that impacts can accrue at different levels and over various time horizons. Impacts were identified based on the way new communications technologies have affected individuals, groups, organizations, communities and societies. In addition, efforts were directed toward examining government policy objectives and the way MSAT may affect the achievement of the specified goals for a policy area.

The second report in this series was directed specifically to the way social impacts

have been measured. It reviewed a number of methodological frameworks and emphasized specific techniques which could be used for identifying and quantifying impacts.

In the previous studies several different approaches to social impact assessment were examined. These include:

1. cost benefit analysis
2. technology assessment
3. goal achievement analysis
4. compositional analysis
5. social institutional analysis
6. human ecology
7. quality of life

Each of these approaches were utilized to assist in the identification and definition of qualitative social impacts.

Important distinctions were made in the methodology report between the process of social impact assessment and the particular approach which could be used to define the magnitude of an impact and its social benefits. A variety of methodologies were examined for impact assessment which, it was pointed out, are embedded in the overall program of work for any evaluation study. Different types of social impacts and benefits were discussed and the particular techniques to provide quantitative measures were outlined. In most instances an assessment of the economic and social impacts of new technologies has relied on studies of analogous services in order to provide clues and indications of what ultimately might result from the implementation of a program such as MSAT. To date, very little empirical research has been conducted on satellite based mobile communications such as MSAT. It was concluded that efforts to assess the social impacts of MSAT must go beyond simply examining analogous technologies and past research if accurate and reliable impact assessment is to be provided.

No one methodological approach is suitable to address the variety and complexity

of impact issues which are likely to arise from the implementation of MSAT. In fact, methods and procedures which have been used have generally focused on attempts to measure the intangible aspects, but for the most part fail to provide measurable and dollar quantifiable estimates of the overall benefits.

The third report in this series addressed the issue of specifying a work plan to quantify the social impacts of MSAT on users and Canadian society. It provided an outline for a procedure to examine the Phase B market definition and user benefit study in order to determine study gaps and to provide additional estimates which could complement and supplement the measurable social benefits.

The quantification of social impacts and benefits is required primarily to provide inputs to the overall socio-economic study being produced as part of the overall MSAT program. A review and examination of the impacts which have been specified indicates that there will be different types of measures and data required. As well, it is likely that certain impacts are more appropriate to measure than others due to the necessity of collecting primary vs secondary data. Likewise, translating social impacts into measures which are compatible with the overall socio-economic model requires that appropriate units for valuing the benefits be developed. While surrogates can legitimately be proposed for most impacts, problems will emerge if the surrogates cannot subsequently be translated into equivalent dollar values.

The previous findings indicated that only certain sets of social impacts lend themselves easily to the kind of quantification which will be necessary as inputs to the overall socio-economic evaluation. Specifically, these were drawn from two categories of the overall set of impacts which have been identified. These include:

1. socio-economic impacts, and
2. sociological and social service impacts.

The most feasible socio-economic issues for quantification include benefits from environmental protection and monitoring, hazard aversion, reduction in renewable resource loss due to natural and man-made catastrophes, efficiency and effective-

ness changes in the allocation of government services for law enforcement, fire and ambulance services, reduction in hazardous travel and work conditions, and lives saved in emergency situations. Sociological and social service impacts which lend themselves to quantification include alterations in the urbanization of rural areas, efficiencies in the administration of health care delivery services, the provision of emergency measures, and the alterations in the provision of community services.

Taken together, the four reports in the first phase of the social impact study present a comprehensive and in-depth evaluation of not only the types of impacts which are likely to emerge for MSAT, but also provide a framework within which these impacts should be examined. More importantly, it provides the rationale which has directed the investigation and specification of the impacts which, it is believed, will result from and in association with the implementation of MSAT services in Canada.

This qualitative report stems directly from the results of the previous reports, but as well is complemented by a significant amount of additional information used to provide an indication of the magnitude of specific impacts and benefits. This report has also utilized a number of methodological approaches and techniques which are reported and evaluated in this series of studies.

1.3 Methodological Issues, Calculating Social Benefits

The types of impacts and benefits which are discussed in this report are subject to significant variations over time. As well, it is important to recognize that at the present time the various forecasts are under continual revision and change, and that the way MSAT is likely to emerge in the marketplace is still under study. The approach used in this qualitative study is to examine where possible tangible existing examples of analogous technologies which are utilized for the various applications that MSAT may also provide in the future. Using this approach, a basis is provided from which a more informed judgment can be made about the likely social impacts of the MSAT services. In some cases it is recognized that MSAT will complement existing terrestrial-based mobile systems. In some

instances MSAT will substitute for the terrestrial-based system because of cost considerations, coverage and quality of service. In other cases MSAT will create new demand for mobile services serving previously inaccessible or non-serviced territories.

While the studies dealing with manufacturing, commercial and market sectors are also speculating on future events, the analytical tools and available data are better developed than those available for use in this social assessment. The problem of social forecasting is compounded further when it is realized that many of the social impacts are likely to accrue not simply to operators of mobile services or prime users, but to indirect beneficiaries of services. These would include to a significant extent the general public, as in the case of enhanced health care delivery and rural fire services.

The approach in this report is to identify and discuss those impacts which have the highest likelihood of occurring within seven to fifteen years after the planned 1988 launch. The policy assessment was restricted to federal government programs and discusses the impacts relative to particular policy objectives. In some cases, particularly in relation to space policy, MSAT has a very direct impact, while in others such as northern development the impacts are more indirect.

Much of the discussion in this report is directed by the consideration of the most likely future application areas for mobile radio, telephone, paging and data services, as identified in the Phase A and B market and user benefit studies. While it is recognized there are numerous application areas for MSAT, those of most direct relevance to a social analysis include[1]:

1. disaster and hazard relief
2. remote work sites -- oil drilling, mining, oil rigs
3. transportation services/transmission services -- oil and gas pipelines, energy corridor development and monitoring
4. environmental protection and hazard monitoring
5. government services -- fire fighting, law enforcement, ambulance and emergency services (rural and remote services)

6. community and social services
7. forestry and agriculture.

The policy areas which are discussed include: space policy, communications and industrial policy, northern development and environmental protection policy. These policy areas have been selected based on discussions with government policy makers, reviews of federal government policy position papers and contacts with the MSAT federal and provincial working groups.

When evaluating impacts, whether economic or socio-economic, the fundamental consideration is to identify whether changes in specific base measures will change with the implementation of the MSAT program. In most instances this is measured in a "with" and "without" scenario, comparing what occurs now with what is likely to occur in the future. Assessing the impacts is really a matter of assessing what factors will change, over what time frame and to what extent, and interpreting the extent of change into a tangible measure, usually expressed in dollar terms. While economic impacts are most readily quantifiable in dollar terms, this is not the case for many social impacts. In most cases these are characterized as intangible and not capable of being directly transfered to equivalent dollar amounts. Social impacts are also most often thought of as being characterized by indirect benefits stemming from the public good characteristics of a project's outputs. MSAT has a number of public good features due to the nature of government involvement and to the types of applications which it will service. Examples include government services for law enforcement, disaster relief, emergency measures, environmental monitoring and ambulance services.

Calculating the overall benefits of the MSAT program requires the linking of the quantifiable and tangible economic impacts with the appropriate tangible and quantifiable social impacts. However, since only a portion of the total set of social impacts is quantifiable, other intangible and qualitatively defined impacts and benefits must also be included.

The types of impacts which are most readily quantified fall into the category of socio-economic impacts, and might include the value of forests saved or the

reduction in compensation paid for loss of life at remote work sites. These types of impacts can be measured using available statistics on current operations combined with assumptions about the penetration and adoption of MSAT in specific application areas.

Quantification and interpretation of other less tangible social impacts is somewhat more difficult. For example, organizational benefits which fall within the social impact classification include more effective operation of services and increased worker satisfaction. These impacts can be directly measured only by assessing the subjective views of workers about their degree of happiness or increased ability to perform job tasks subsequent to the introduction of MSAT. The function of MSAT is to enhance the flow of information either using voice or data and to indirectly affect job performance. Translating such intangible benefits into quantifiable measures compatible with other economic and socio-economic criteria can only be accomplished by using indirect and surrogate measures. At the organizational level this would require examination of job turnover, absenteeism or vandalism. Likewise, assessing the tangible benefits of MSAT on the quality of the working environment could be measured by calculating the costs necessary to attract workers to a site. Net benefits of MSAT would be expressed as an overall real cost change as the environment was made safer and a better place to work.

The difficulty of establishing tangible and dollar quantifiable estimates for <u>all</u> social impacts and benefits is recognized as a major limitation to providing input for the overall socio-economic assessment. As a first step, however, to providing inputs to the overall study,[2] this report examines the social impacts in a qualitative manner. A second phase study has been proposed which will provide quantitative estimates of selected social impacts in the socio-economic and social services categories.

The qualitative assessment of impacts was carried out by utilizing several approaches reviewed in the methodological report. First a systematic review of application areas for MSAT was made along with a review of analogous mobile communication technologies. A set of possible impact areas were then defined which varied between those which are closely related to economic impacts and

benefits and those which are purely social in nature. The purely social impacts were drived by considering quality of life measures, human ecology, compositional models and the externalities associated with MSAT services. Once the range of benefits were defined along with the specific impacts they were associated with the level of occurance, applications and the time scale of occurance. The levels of occurance were defined as individual, community and society. The magnitude of impacts was defined on the basis of the size of the population to be directly affected by MSAT with consideration given to the population likely to experience externalities or indirect benefits. The results of this process are presented in Table 1. This represents the initial specification of social impact issues with an indication of the time frame of occurance and the level of measurement.

Subsequent investigation of the various issues and application areas of MSAT allows a more precise identification of main impacts with the associated socio-economic and social/social psychological effects. This analysis proceeds therefore with a further refinement of the impact issues and a detailed discussion of the most relevant areas for qualitative appraisal. The purpose is to illustrate the nature of impacts and the extent of additional benefits to those already specified in the market and user benefits study.

The criteria used to select specific impacts from the broader set includes the scale of impact, time frame of occurance and overall effect on Canadian society. Table 2 presents the revised list of items categorized according to socio-economic, organizational/institutional, social psychological, sociological, social service and policy impacts.

TABLE 1

MSAT/Social Impact Issues and Measurement Capabilities

	Social Impact Issue	Impact Time Frame	Level of Measurement
1.	Community development/new services in remote areas/rural areas	Short term Medium term	Community
2.	Health clinic/linkage Improved response to trauma cases in rural and remote areas	Short term	Individual/Community
3.	Minimizing travel for sick, injured and handicapped	Short term	Individual
4.	Cultural impact	Long term	
5.	Psycho-social effects on local people	Medium term	
6.	Closer family ties for individuals in remote or rural and marine environments	Short term	Individual/Community/ Organizational
7.	Improved delivery of social services/ health care	Short term	Community
8.	Improved administration of services for social applications	Medium term	Organizational

TABLE 1
(continued)

	Social Impact Issue	Impact Time Frame	Level of Measurement
9.	Living conditions in remote areas	Short term	Individual
10.	Increase southern influence on northern areas	Long term	Societal
Enhanced Communication:			
11.	Increased urbanization of rural areas	Long term	Societal
12.	Improved living conditions in rural areas, better communications, faster access to services	Medium term Long term	
13.	Improved privacy for individuals and organizations, communications	Short term	Individual/Community/ Organizational
14.	Reduction in morale problems in remote work sites	Short term	Organizational
15.	Improvements in the quality of life in northern native communities	Medium term	Individual/Community
16.	Reduction in hazardous travel in remote areas	Short term	Individual
17.	Alterations in communications quality	Short term	Individual/Organizational/ Community/Societal
18.	Varying response to technology, depending on current stage of development	Medium term	Community/Organizational

TABLE 1
(continued)

	Social Impact Issue	Impact Time Frame	Level of Measurement
19.	Improved entertainment and discussion capabilities	Long term	Community
20.	Community participation	Medium term	Organizational/Community
Mobile Services:			
21.	Improved dispatch services for emergency vehicles	Short term	Organizational
22.	Efficient allocation of service resources	Short term	Organizational/Community
23.	Improved reporting of emergency situations	Short term	Individual/Organizational
24.	Improved safety of work areas and living areas	Short term Medium term	Community/Organizational/ Societal
25.	Perceived improved rural work situation	Medium term	Individual
26.	Improved law enforcement capabilities	Short term Medium term	Community
27.	Better control on search parties	Short term Medium Term	Organizational/Community
28.	Relief from isolation	Medium term	Individual
29.	Delivery of social services to special needs groups	Short term	Organizational/Community

TABLE 1
(continued)

	Social Impact Issue	Impact Time Frame	Level of Measurement
30.	Better disaster relief co-ordination	Short term	Community
31.	Specialized services for the handicapped	Short term	Individual
32.	Job displacement	Medium term Long term	Societal
33.	Occupational shifts Skill requirements	Medium term Long term	Societal
34.	Altered work times	Medium term Long term	Community/Societal
35.	Changed work activities in same job	Medium term Long term	Community/Societal
36.	Enhanced worker participation	Short term	Individual/Organizational
37.	Altered reporting structures	Short term	Individual/Organizational
38.	Dispersed work sites	Medium term	Organizational/Community
39.	Increased autonomy for workers	Short term	Individual/Organizational
40.	Reduction in urban/rural dicotomy	Long term	Societal
41.	Induced employment	Medium term	Community/Societal
42.	Population change	Long term	Societal

TABLE 1
(continued)

	Social Impact Issue	Impact Time Frame	Level of Measurement
43.	Education requirements, training	Short term	Individual/Community
44.	Access to MSAT services	Short term Medium term	Societal
45.	Relations with developing countries Technology transfer	Medium term	Societal
46.	Integration with other high technology industries	Medium term	Societal
47.	Improved civil defence	Medium term	Community/Societal
48.	Northern development strategy	Long term	Societal
49.	Environmental monitoring		
50.	Chemical/toxic waste management	Medium term	Community/Organizational
51.	Agricultural monitoring and operations	Medium term	Community
52.	Safer marine working conditions	Short term	Individual
53.	Increased reliance on technology	Short term Medium term	Individual/Societal
54.	Perceived improvement in job performance capabilities	Short term	Individual
55.	Perceived worker status in relation to access to mobile services	Short term	Individual/Organizational

TABLE 1
(continued)

	Social Impact Issue	Impact Time Frame	Level of Measurement
56.	Equity of access to services	Short term Medium term	Community
57.	Reduction in unnecessary travel	Short term	Individual
58.	Flexible scheduling in human and physical resource allocation	Short term Medium term	Organizational/Community
59.	Information overload Increased stress	Short term	Individual

TABLE 2
Potential MSAT Social Impacts

I Socio-Economic

1. Enhancement in environment monitoring.
2. Renewable resource monitoring.
3. Preservation of unique wilderness and rural habitats.
4. Hazard aversion.
5. Reduction in renewable resource loss due to natural and manmade catastrophe.
6. Efficiency and effectiveness changes in the allocation of government agency resource allocations for public services in rural and remote areas.
7. Leisure and recreational enhancements.
8. Alterations in subsidies for travel services, rail/air, etc., to rural and remote sites.
9. Reduction in hazardous travel by substitution of mobile communications services.
10. Lives saved in emergency situations.

II Organizational/Institutional

1. Induced employment.
2. Changed skill requirements.
3. Dispersed work site (increase).
4. Reduced hazardous work conditions.
5. Improved response to work site problems.
6. Alteration in work site/task alterations (centralization).
7. Alterations in decision making capabilities.
8. Increased possibilities for non-traditional remote jobs/occupations.
9. Enhanced worker participation.
10. Improved work and resource co-ordination.

III A Social/Psychological

1. Perceived improvements, quality of life.
2. Relief from isolation (perceived).
3. Perceived safety enhancements.
4. Perceived sense of autonomy/privacy.
5. Perceived reduction in social segregation.
6. Perception of worker alienation.
7. Perceived improvement in worker performance.
8. Perceived status change by having access to mobile services.
9. Perceived improvement in job effectiveness.
10. Increased stress resulting from information access overload.

TABLE 2
(continued)

III B Sociological

1. Improved ties to family members in remote areas.
2. Enhanced rural social interaction.
3. Specialized and handicapped services (special needs).
4. Improved work site/home site connectivity.
5. Alteration in urbanization of rural areas.
6. Privacy.

III C Social Services

1. Improved community services provision.
2. Improved quality of law enforcement.
3. Alterations in disaster relief capabilities.
4. Reorganization in emergency response organizations.
5. Remote health service linkage - enhancements.
6. Efficient administrative changes in health and trauma care services.
7. Improved reporting of emergency situations.

IV Policy

1. Environmental Policy/Monitoring and Preservation
2. Space and Communications Policy
3. High Technology and Export Strategy
4. Rural and Northern Development Policy

2.0 SOCIAL ECONOMIC OVERLAP

With a new communications technology such as MSAT, there are effects or impacts which may be considered as mainly economic in nature; impacts which may be considered as mainly social in nature; and there is also an area involving overlap of economic and social impacts.

Social impacts are either:

a) not at all monetarily quantifiable, or
b) only indirectly monetarily quantifiable.

Although they may be measurable in certain indirect senses, social impacts may not be directly related to monetary or economic criteria. Social benefits, in other words, are characterized by the fact that they must usually be quantified by secondary measures (which themselves may or may not be translated into dollar amounts). Social benefits are also indirect in the sense that they usually involve parties in addition to the direct supplier or consumer of the service.[3]

In other words, impacts may be thought of as:

1. Mainly economic in nature (such as MSAT sales to RCC's, maintenance of Spar Aerospace as a "chosen instrument" for space policy, etc.).

2. Social (such as improved likelihood for emergency response capabilities).

3. Involving areas of overlap between economic and social impacts (such as the reduction in travel time due to communication/travel tradeoffs).

The latter case may economically directly benefit the traveller due to the reduction in travel costs and indirectly benefit the entire society since it results in less air pollution. As well, indirect benefits may include additional time availability or money saved.

Social effects of new communications technologies may or may not have associated economic effects, and what we normally consider as economic effects may or may not have associated social impacts. Social impacts may occur at the individual, organizational or societal levels. They may occur over differing time frames and have differing levels of effects.

The following sections examine impacts arising from MSAT of either a purely social nature and those overlapping with economic impacts. Social impact areas have been prioritized in terms of the size and magnitude of the impact. The relevance to MSAT is also discussed. Since this represents a qualitative discussion, no attempt to analyze the impacts in a detailed statistical fashion is made. However, the discussion of specific impacts does utilize available data, usually from secondary sources, which provides indicators of the possible magnitude of these impacts.

Of the dozens of likely social impacts resulting from MSAT which have been identified in previous Wescom studies in the series, primary attention is given to social impacts of major size and magnitude, likely to occur between the 1988 and 2002 time frame.

Secondary, or what have been referred to as tertiary impacts of the technology, are also examined. While less attention is given to these in this report, their importance should not be underestimated. These most often emerge as socio-psychological impacts such as perceived improvements in the job or living environment, quality of life measures and sense of psychological well-being.

Of particular concern is this overlap between social and economic impacts, since it may ultimately prove crucial in the overall evaluation of the cost/benefits of the MSAT program. The following are considered to be primary examples of overlap impacts:

2.1 Environmental Protection

Environmental and species protection lies in the area of overlap between economic and social effects. If it is assumed, for example, that MSAT will be utilized by government agencies such as the Environmental Protection Service for the purposes of environmental and species protection, and that such usage leads to a certain degree of improvement in the capability for northern environmental protection, then some form of indirect cost savings may be actually calculated which will reflect MSAT's effects on changes in overall expenditures for environmental protection of specific forest and resource areas.

It is obvious that stocks of forest areas may be considered as real resources, and a certain portion of stock saved from disasters such as forest fires, as a result of MSAT services, may be estimated.

On the other hand, within the area of environmental protection, it is also apparent that MSAT usage may have purely social effects which may not be directly economically valued, such as improved capabilities for species preservation and maintenance. Substitution of travel through the use of enhanced communications and the more efficient use of travel services are likely impacts of MSAT. These impacts may mean reduced energy requirements and less pressure on environmentally sensitive areas.

2.2 The Cost of Lives Saved

Another example of overlap involves the cost of lives saved, e.g. MSAT improvements to disaster and emergency services. Regardless of possible earning capacity involved in living a full lifetime, western society views preservation of human life as a value. A life saved, of course, also has economic impacts involved in the discounted future earnings (DFE) of that person. But a purely economic approach to this overlap area also leads to quite unrealistic estimates. (The Systemhouse/ KVA study, for example, estimates the cost of a Canadian life at about $66,000.)

Beyond discounted future earnings, another approach to this area involves the required compensation approach. Discounted future earnings, as noted by Granlich (1981, p.69), involves the addition of all present discounted future earnings of the deceased. This approach looks at the present market to indicate how valuable a person is or may become.

The required compensation (RC) approach entails a market evaluation which is a more reasonable approximation to the value of a human life:

> "According to required compensation, we should not let the imperfect market for your services value your life ... but let you value it. The difference is precisely the same as the difference between the market price (valuation by others of a good you consume) and the demand curve (your evaluation or willingness to pay for the same good). Looking at the market price ignores consumer surplus, and looking at DFE ignores all the added utility you and your family gain from your life ... however sceptically one views this market attempt to value human lives, it is clear that the logical basis for the RC standard is far superior to that of the DFE standard." (Granlich 1981, p.69)

In this study the value of a human life had been conservatively estimated at $90,000 to $110,000. This value is based on actual compensation paid for lives lost and makes no allowance for the subjective evaluation of human lives in addition to such compensation. The calculation is derived from a sample of compensation payments to working people killed in on-the-job activities. The values are expressed in 1982 dollars.

Although a purely economic approach to "lives saved" is somewhat arbitrary (organ replacement costs would be higher than either of the economic approaches discussed), it is apparent that this impact has both an economic and social dimension.

2.3 Priority Social Impact Issues

Table 3 presents the priority MSAT social impact issues. It should be noted that in almost every instance listed, the potential impact of the MSAT program on the associated issue arises from the potential effects of mobile radio, telephone, paging and data transmission to improve the quality, timeliness, accuracy and efficiency of information transfer. It should also be noted that all priority MSAT social impact issues, but the last, lie in the overlap between social and economic effects.

These priority impact items have been extracted from the set of potential social impacts of MSAT identified in Table 1. The criteria of selection involved:

1. likely occurrence
2. time frame of occurance.

The items presented in Table 3 are all considered to have a likelihood of occuring in the seven to fifteen year time period. The likelihood of occurance is based on the impact being direct rather than a more speculative and long term transformative impact. The magnitude of impact considers whether effects are restricted to a very narrow sector of society or are expected to occur in a variety of sectors. This also relates to the expected tangible or quantifiable character of the impact. Significant dollar or economic effects are also assumed for many of the selected issues. The items are also considered to be quantifiable, allowing the possibility of further verification based on dollars or related surrogates.

TABLE 3
Priority MSAT Social Impact Issues*
(Seven to Fifteen Year Period)

	Social Impact	Level of Occurance	Examples of Impacts	Sample Measures
1.	Reduced hazardous work conditions, especially travel	Individual, organizational	Increase response for dispatch. Improved recording of emergencies.	Loss of life and compensation costs.
2.	Improved effectiveness and productivity at work sites (mining, oil rigs, road crews)	Individual, organizational	Monitoring of vehicles. Improved organizational capabilities (management).	Cost for services. Effective delivery of goods. Worker satisfaction.
3.	Travel/communications tradeoffs	Individual, organizational, community	Less travel/ changed travel/ flexibility in work locations.	Energy consumption levels. Risk for travel in wilderness and remote areas.
4.	Environmental enhancement and preservation through communications improvements	Organizational, community	Preservation of unique species. Wilderness areas maintained.	Species diversification. Amount of wilderness areas.
5.	Forestry services Forest fire protection	Society, organizational	Improved response to fire hazards.	Available recreation experiences. Safety at work sites. Stocks of forest resources.
6.	Improved government services in rural and remote areas (medical, emergency, law enforcement, fire)	Community, individual	Improved levels of services. Increased and improved social contacts.	Social services expenditures/ usage and coverage.
7.	Social/subjective* impacts, perceived relief from isolations, improvements in home and work safety, improvements in job effectiveness	Individual, community	Improved satisfaction. Improved attraction of sites for work and homes.	Welfare and social agency usage. Community services utilization. Interaction for community workers.

* These impacts constitute primarily secondary and tertiary level impacts accruing to individual workers or those living in proposed service territories. All are considered as highly likely to occur in the seven to fifteen year period and also to be manifest by some quantitative measure.

2.4 Relevance of Issues to MSAT

In a brief overview, the following section examines the relevance of each social impact issue or group of issues in Table 2 to the MSAT program:

Reduction of Hazardous Work Conditions and Changes in Travel Requirements

Past experience with mobile services makes it very probable that the provision of MSAT mobile services to a wide variety of companies, firms and organizations in rural/remote areas will reduce a range of hazardous work conditions, especially those involved in travel. Through various means -- ranging from increased response capabilities for dispatch services to improved recording of emergency situations -- existing studies of terrestrial-based mobile communications in rural and remote areas suggest that reduced hazardous work conditions may result from MSAT services if properly employed. Mobile telephone, radio and wide area paging all contribute to the impact in this area.

Improved Effectiveness and Productivity at Work Sites

The provision of mobile services to remote and rural areas likely to result in improved effectiveness and productivity at the work location. The main ways the specific socio-economic benefits have arisen from terrestrial-based mobile radio, telephone and paging services have involved:

a) increased response and accuracy for dispatch services
b) improved monitoring of vehicle locations
c) lower costs and on-going expenses for communication services
d) reductions in energy consumption
e) overall better organizational capabilities for the provision of services.

Travel/Communications Trade-offs

The introduction of new communication services and improvements to existing services often results in substantial changes in the relationship between travel and communication modes. MSAT is likely to contribute to such a shift in a variety of application areas since it will reduce the need for travel and alter the way travel is conducted. Some of the more obvious results of such developments include:

1. reductions in the amount of travel
2. reorganization of travel
3. improved effectiveness of travel
4. lower incidence of travel related accidents
5. alterations in travel demand by place and time.

Forestry Services

Forest Fire Protection

MSAT will have positive benefits and impacts on the way Forest Fire agencies provide services. The impacts are likely to accue in terms of the methods for fighting fires (improved ground coordination), improved monitoring of fire conditions, and improved reporting of damage statistics. These impacts will reduce losses due to fires, improve management, and result in more effective utilization of the forest resource.

Environmental Enhancement, Maintenance and Preservation Through Communication Improvements

Of special interest in the area of socio-economic impacts of MSAT are environmental concerns. These effects are diverse and far reaching. For example, the preservation and enhancement of marine environments such as the Great Lakes and other regions will be affected by MSAT due to quality improvements in marine operations (themselves due to mobile radio usage by ships). There will also be improved protection by authorities in the

enforcement of environmental measures such as those involved in the Fisheries Act, the Migratory Birds Convention Act, the Ocean Dumping Act, etc. In the area of pollution by toxic chemicals, MSAT adoption by private firms and government agencies may result in an increased ability to prevent, monitor and also to measure levels of pollution. Alternatively, MSAT usage by resource and exploration companies may at the same time conceivably facilitate destructive extraction techniques through enhancing their ability to operate in remote areas. A related area involves the ability to monitor agriculture, particularly in marginal areas where incipient dangers of storms and cold weather can have devastating effects through crop losses. MSAT capability to facilitate polling of monitor stations offers an ideal way of reducing losses and dependence on subsidies by farmers.

Improved Government Services in Remote and Rural Areas
(for fire, law enforcement and ambulances)

Increased information transfer capabilities for dispatch and monitoring services, extension of coverage and improved quality of transmission of emergency situation information will have impacts on medical, emergency, disaster and law enforcement services in rural and remote areas. This could result in a reduction in the number of required emergency evacuations in any region adopting MSAT-based mobile services.

Associated organizational impacts include the enhanced delivery of social services due to the availability of specific emergency numbers and portable automatic alert. Related emergency services will be able to communicate on a more efficient common basis which will lead to increased coordination in times of disaster.

In summary, it is anticipated that increased information efficiency, timeliness and accuracy will aid service efficiency for disaster, search and rescue, fires, industrial accidents in rural and remote regions, flood control and ship monitoring.

Secondary/Tertiary Impacts (Socio-Psychological Impacts)

All of the priority MSAT social impacts discussed so far have been in the overlap area between social and economic effects. This last category pertains to subjective (perceived) effects concerning relief from isolation, safety and work enhancements, and improvements in work effectiveness resulting from adoption of MSAT services. These impacts usually accrue to individuals using mobile communication within an organization or commercial business. Some aspects, it is believed, would be manifest simply to individuals residing in the service territories. This would be the case for a family in a rural area maintaining good quality and efficient local communication with each other using mobile telephone or radio services. These impacts cannot be directly valued but can be quantified using surrogate measures based on some nominal scaling approach. They are the most intangible of items in the traditional socio-economic framework of cost benefit analysis. Indeed, past studies of terrestrially-based mobile communications services in rural and remote regions have shown, for example, improvement of morale for northern medical and social services staff and the relief of feeling from isolation. There is every reason to expect that these "subjective" changes resulting from terrestrially-based mobile communications will also result from MSAT usage.

After first discussing the population profile of MSAT's service territory, the following sections examine components of the above areas in more detail and, when data is available, provides estimates of the possible magnitude of the social effects of MSAT adoption.

3.0 POPULATION AND COMMUNICATIONS PROFILE OF SERVICE TERRITORY

The Woods Gordon Phase A Market Definition Study (1981, p.17) indicated that it is generally accepted that land-based mobile communication systems can most cost effectively serve major metropolitan areas, but that the satellite systems would be more advantageous within thinly populated areas. The probability of an area being served by a satellite system will occur on some sliding scale related to population density. This concept has been formalized in the Woods Gordon study (1981, p.17) to yield a proportion of the population that could be best served by a mobile satellite system. This proportion, it is indicated, would serve as a measure of the potential value of the system.

However, an examination of the expected population to be served by MSAT represents not simply the value of the service, but rather it provides an indication of the beneficiaries of the service. In effect, it represents the population likely to receive the secondary and tertiary impacts from the MSAT technology. These groups, it has been revealed, are likely to experience significant impacts from the various applications associated with MSAT. Examination of the current population for the service territory and demographic trends provide an indication of the likely served population for MSAT in the 1988 to 2002 time frame.

In the Woods Gordon Phase A survey of mobile communication users, it was indicated that current usage is influenced far more by applications than by overall population density (1981, p.16). Usage, it is stated, is almost exclusively related to business operations and employment rather than consumer or individual use. As a result, the Woods Gordon approach did not utilize population as a basis for estimating regional usage. Instead, they used an industrial sector approach to evaluate current and projected mobile communication usage.

From a social impact perspective, however, the importance to be placed on the indigenous population should not be underestimated, since the applications of MSAT will obviously have benefits which accrue to local populations. For example, if improved emergency medical services are provided, benefits will accrue directly to

the operator of the service, but the beneficiary of that service will very likely be the population within the service territory. Thus, the social impact aspect must consider not just the primary users of services but, as well, those that are going to be directly and indirectly served. These constitute very important elements in assessing the overall mix of social impacts and benefits accruing from MSAT.

Examination of the rural and remote population of Canada indicates that in 1981 there were a total of 5,907,254 people classified as living in rural or remote areas of the country. Remote areas are defined as those areas beyond the limits of continuous population distribution where the population density is less than one person per square mile. Rural areas are defined as those non-remote areas which are outside communities of more than 2,500 people. The average population density in remote areas is 0.1 per square mile, while the average population density in rural areas is 10.3 per square mile.[4]

The distribution of rural and remote populations across Canada is uneven with higher proportions of populations being classified as rural and remote in the provinces of Alberta, Saskatchewan and Manitoba, than in other regions. However, Ontario has the highest number classified as rural or remote at 1.5 million, with Quebec second at 1.4 million. Third is British Columbia at 605,000, followed by Alberta at 510,000, Saskatchewan at 400,000 and Manitoba at 300,000. The Atlantic provinces also contribute to significant numbers of rural and remote populations with Nova Scotia having 380,000; Newfoundland, 240,000; and New Brunswick 343,000; Prince Edward Island at 77,000; and the Yukon Territory and Northwest Territories contributing 31,000, respectively.[5]

Projections provided in the Woods Gordon Phase A study indicate a total served population in Canada for MSAT by 1988 of 9.5 million people.

Examination of the percent change in rural population growth between 1976 and 1981 indicates that in most provinces the growth in the rural population has been higher than the growth in the urban population. For example, in Quebec, growth in the rural population was 13.9 percent in that 5 year interval compared to .6 for the urban population. Likewise, in British Columbia, the percent growth in rural

population was 17.4 percent compared to 9.6 percent for the urban population. And for Canada as a whole, growth in the rural population was 8.9 percent compared to 5 percent in the urban setting.

Examination of the income distribution between rural and urban populations shows consistently lower average incomes for the rural population than is the case for the urban population. For Canada as a whole, the average rural income is $11,500 per year in 1981 compared to $13,400 a year[6] in the urban areas. In all provinces the rural average income is consistently lower than the urban average income.

In 1981 there were approximately 200,000 individuals in the country living in rural and remote areas classified as native Indians. Examination of the distribution of these indigenous native peoples indicates that the majority are located in the provinces of Quebec, Ontario, and Manitoba, which together accounted for 48 percent of that rural population. Other provinces with significant proportions of native peoples were the North West Territories and Saskatchewan.[7]

Perhaps of most relevance to the examination of the charcteristics of rural and remote areas, in addition to population characteristics, are the communication characteristics of the region. It is the communications infrastructure that will be impacted by the introduction of mobile satellite services and the overall improvement in services that are likely to occur in the next 15 years.

A study conducted between 1976 and 1981 by the Department of Communications examined the status of rural communications in Canada and found that the quality of telecommunication services in rural and remote areas was significantly less than that available to urban areas. It also found that there were some 94,000 households in rural Canada without telephone service out of a total number of 1.2 million, representing approximately 8 percent of all households; about 2 percent of the rural households were without even a radio receiver. Cost estimates for upgrading telephone services to urban standards were set between $2.3 and $4.4 billion.[8]

Studies anticipating future mobile communication requirements have identified improvements in coverage areas, higher quality equipment, more privacy, tele

phone system connection and less congestion of current mobile users as essential. In addition, current private mobile users have indicated a need for better range, more modules, telephone connection and lower cost. As well, there was a feeling that future planning for mobile services should take more account of the characteristics and needs of the population in rural areas (DOC 1981).[9]

The Woods Gordon Phase B market study emphasized the importance of the rural market areas of the prairies relative to all other areas of the country. It revealed that by 2002, 35% of all mobiles (MTS and MRS) will be in the prairie provinces, with 22% and 21% in B.C. and Ontario, respectively.[10]

Recent statistics on the growth and change in the population of rural and remote areas indicates that, in general, depopulation has been declining and overall growth of population has been greater in rural areas. It's quite likely, therefore, that in the future and particularly when MSAT services are likely to become widespread, the rural and remote population densities will be somewhat higher than they currently are, thus offsetting some of the problems related to the economies of scale inherent in providing communication services to areas of low population density.

4.0 THE HUMAN AND SOCIAL ENVIRONMENT OF THE NORTH

Thomas Berger, reporting to the MacKenzie Valley Pipeline Enquiry in 1977, considered the social impacts of technology development to be one of the most significant areas for investigation. In discussing the kinds of social impacts and the magnitude of impacts that are likely to occur on northern, rural and remote communities, he noted that:

> "In considering the social impact of large scale developments, very few figures are available. All that can safely be said is that the social costs will be borne by the local population, and that the financial costs will be borne by industry and by government. There is a strong tendency to underestimate and to understate social impacts and social costs, and there is a tendency to believe that whatever the problem may be they can be overcome. The approach then is curative rather than preventive. No one asked for proof that the problems anticipated really can be ameliorated in a significant way. The assumption is that they can be. The assumption has been made with respect to problems of a number of high technology projects." (Report of the Mackenzie Valley Pipeline, Vol. 1, 1977, p.143)

In the northern regions of the country one of the most significant processes is the changing nature of the local population. The population estimates for 1981 indicate there were approximately 15,000 white people living in the Yukon and Arctic regions, approximating the number of native people. Development of industrial bases, the enhancement of mining, oil drilling activity and increases in transportation are all likely to be affected by the provision of MSAT services. That development, it is believed, will eventually accelerate the transition from a native majority in the northern and remote regions to a white majority. Such developments have major implications for the future shape of the political, social and cultural institutions of those regions.

Typically technology developments such as MSAT have been justified on the basis of the claimed beneficial economic impacts for northern areas. These have included reductions in unemployment, welfare dependence, crime, violence and alcoholism. But people in the north and in the remote and rural regions of the country have values and patterns of social organization which are quite different

from those that underlie the modern industrial world to the south and in urbanized regions of the country. As a result, solutions based on the industrial system easily become problems when they're naively applied to rural and remote regions.

MSAT is likely to impact quite significantly, in a commercial sense, on a variety of industrial developments and large scale projects in the northern and remote areas of the country. First of all, MSAT is likely to enhance the pace of industrial development in the north, and therefore a secondary impact resulting from the investment in this program would ideally be a reduction in welfare payments required to northern communities. This line of thinking is based on the assumption that as employment is created through spin-off activities of satellite development and subsequent assistance to activities such as mining and transportation, there would be increased employment and a reduced need for welfare payments. In fact, it was noted in the Berger commission report that no one has been able to show that increased industrial activity in northern communities has played a major role in absorbing surplus labour and diminishing welfare dependents in those communities. It is worth noting that the increase in welfare payments and in related social problems that have been observed in northern communities involve one basic cause -- the suddenness with which industrial development has been thrust upon the region. Strains have been evident on the individual organizations, families and social institutions, and these strains are reflected in the amount of welfare payments that have to be provided. In some northern communities directly affected by rapid industrialization, these payments more than doubled between 1973 and 1977.[11]

Examples of other technology developments in northern communities have indicated that where high employment or new employment has been created, particularly among native populations, there has been a corresponding increase in social problems such as high rates of alcohol abuse, crime, violence and family breakdown. This contrasts with the belief that there would be a reduction in social costs due to enhanced employment opportunities.

In other studies dealing with northern communities and the impact of industrial development, it has been noted that there is also a high correlation between social

disorder and industrial development. Crime in the Northwest Territories increased more than 30% between 1969 and 1975, a period of rapid industrial expansion.

It has also been noted that the communities which are least involved in wage labour and least dominated by the frontier mentality are the communities with least crime and violence. (Violent crime accounts for approximately 20% of the deaths in northern and remote communities anually. This compares to 10% in the rest of Canada.) It would be extremely difficult to attribute a specific rise in welfare requirements in northern, remote or rural areas to MSAT. The actual labour or employment effects are likely to be minimal and the direct inducement for job creation small. The role of MSAT, through its various applications, will be to enhance the infrastructures around which industrial and commercial developments may take place. Thus its role will be to increase the extent and range of commercial operations in the proposed service territories. It is these commercial and industrial activities which are speculated to have associated social and economic impacts of the type detailed in the Berger report.

5.0 ENVIRONMENTAL MONITORING AND FOREST FIRE PROTECTION

One of the most significant areas of social impact is the role that MSAT will play in fostering better protection of the forest and wildlife resources in northern, remote and rural regions of the country. For the purposes of assessing the impact of MSAT in these areas, it is necessary to develop a perspective which reflects an economic or utilitarian approach to conservation, which as Petulla (1980 p.23) has stated, focuses on the optimal use of the natural resources and their benefits for the longest period of time and allows the assignment of cost to those who take away public environmental amenities. The overriding concerns in this economic perspective lie in the desire to achieve higher and higher levels of economic efficiency in the utilization of resources, and as well to examine the rate of natural resource depletion and the loss of significant natural environments.

It should be noted there are a variety of different ways of valuing the natural environment. Specifically these can be classified in terms of (1) the biocentric perspective, (2) the ecological perspective, and (3) the economic perspective. It is quite often the case that if one values the environment for the purposes of social assessment one way, there are bound to be conflicts with the way it is alternately valued by one of the other methods.

The fundamental problem in terms of coming up with overall quantitative values of the social impact of the loss of environment, is that the values that individuals place vary. Commercial operators, for example, may examine a stand of timber purely in terms of its potential cost or revenue generation if cut down. A naturalist would place an extremely high value on the irreplacable loss of a unique species of trees. No capability for assessing the overall impact in quantitative terms can therefore be satisfactory to all parties.

The most common way of estimating the social benefits which accrue in the savings of a species is in using the values attached to preserved natural environments in a type of benefit estimation model. In other words, the value of animal and plant species is considered to be equal to the costs that people would pay to have wilderness experiences. (An alternative view would take account of the

subsequently discovered social value of plant and animal species. For example, the costs of wildnerness destruction lies not mainly in the loss of timber or "recreational experience", but in the loss of uncounted plant species yet-to-be discovered and which may provide a medicinal use, for example. The effects of such losses cannot be excluded from MSAT consideration.) Likewise, the importance of specific plant and animal species to the maintenance of the balance of the ecosphere must be considered. This is particularly important in the north where the most fragile ecosystems exist.

There is no doubt that the various MSAT services are likely to have a significant demand generated by users for applications relating to the protection of the natural environment. The Woods Gordon Phase B results (1984, p.38) reveal emergency communications for forest fire control and lightening detection would account for approximately 1,600 mobile terminals by 2001. In addition, the forest industry and government operations were expected to rank 5th and 3rd, respectively, in terms of the number of mobiles by 2009. That report (1984, p.132) also suggested that British Columbia and Ontario's demand could represent approximately 30% to 40% of total demand by forest services in Canada. Voice services accounted for the majority of projected demand at 455 units by 2001 with lightening detector stations projected at 35 units (1984, p.132). Government agencies include the Environmental Protection Service and those provincial agencies involved in forest fire protection.

In British Columbia, a province with one of the largest forest resources, 67,000 hectares[12] of forest were claimed by fires in 1983. The total cost of suppression for those fires was $13,209,000. An examination of the costs of fire prevention services reveals in general about 20% of the overall cost is taken up by things other than administration and actual suppression activities. The damage resulting from forest fires was calculated at approximately $20 million, and for the period 1974 to 1983 the total cost of fire suppression was $223 million, while the total damage loss resulting from fires was approximately $200 million over a ten year period. Figures for Canada in total over the same period total well over $800 million to $2 billion of loss resulting from forest fire activity. Clearly, assuming even a modest savings in loss of 10% brought about by MSAT provides a theoretical total benefit in current dollars of between $80 and $200 million.

MSAT is likely to have an influence in terms of the ability to control forest fires and in the way organizations are able to respond to the forest fire threat. In either case, the outcome is likely to be an improvement in the ability to preserve stocks of the natural environment.

One of the most fundamental social impacts would be in the organizational effectiveness of the forest fire protection services. Currently most fire prevention operations involve local district offices coordinating ground crews with an aircraft complementing their activity. It is quite likely that a satellite-based service would act as a complement to or substitute for the aircraft activity. Most likely it would be used to improve the ability to coordinate ground crews. Such changes improve the safety and and working conditions and improves the efficiency with which a fire can be approached.

Another way MSAT could be used is in monitoring of lightening conditions in forest areas. In British Columbia a terestrial based system of direction pointers is used to automatically pinpoint forest fires. The information is currently transmitted over telephone lines to a mapping and plotter centre which can indicate where fire may occur.

The Phase B Woods Gordon study indicated that monitoring using data collection platforms would be one of the main special users for MSAT and projected 1,700 terminals by the year 2001. MSAT was considered capable of achieving a substantial penetration in this market, possibly as high as 70%-80%, representing up to 284,000 minutes of airtime per year and 1,190 terminal stations (Woods Gordon, 1984, p.41).

6.0 RURAL AGRICULTURAL MONITORING

MSAT is likely to have an effect on the ability to monitor natural hazards in the rural and remote regions of the country. Of particular relevance in this respect are occurrences in rural agricultural areas which are likely to cause damage -- either to property, crops, livestock or people -- and which can be attributed to the effects of the natural environment.

The increasing vulnerability of agriculture as it moves to more marginal growing habitats and the need to achieve greater efficiency in resource use have made it imperative that there be increased use of climatic information in planning, design and development of rural and remote regions. The need to monitor the environment is directly related to the accrued economic and social values in these areas. Of critical need is the ability to understand and monitor climatic factors and to provide the capability for the conversion of climatic data to information that can be used for decision making and the development of appropriate delivery systems for that information.

The weather and how a farmer deals with it plays a large part in determining his net income and net worth position. Climate affects agriculture in two ways. First, the prevailing or normal climate provides a boundary defining what kind of agriculture can be practiced. Secondly, the variability of climate affects how that agriculture is practiced.

Since a large part of the service territory proposed for MSAT includes rural areas, it is worth examining some of the implications of climate on farming and to consider some of the ways that MSAT would help mitigate losses and problems resulting from climatic disasters.

MSAT's most important role in this respect will be in assisting and understanding the variability of climate, which often, through its fluctuations, has significant effects on the ability for regions to produce and be economically viable. Enhanced communication services can be used to assist farmers in anticipating and dealing with variabilities in climate by providing early warning systems for impending

climatic problems. The use of mobile services on ranches and farms apply not only to everyday operational aspects, such as voice communication for workers or family members, but could also be used for monitoring transmission of data.

Systems such as MSAT will assist not only in the collection of information, but in the transmission of such information from remote collector sites scattered thorugh the remote and rural regions of the country. Such systems will aid in the overall improvements for planning and development, and subsequently in the ability to extend forestry and agricultural areas into previously marginal regions. MSAT will provide on-going monitoring services using mobile data platforms of hail, wind, moisture, drought and snowfall conditions.

A study reported by Sterling (1979),[13] examining the impacts of climate on agriculture, suggested that the dollar expenditures of weather modification related to hail coverage alone was estimated at $438 million in 1978. Hail loss insurance claims, for example, in 1978 for Alberta were estimated at $18 million. A 10% reduction in claims as a result of better anticipation and earlier warning of hail conditions brought about through monitoring devices and MSAT would save approximately $1.8 million in insurance claims made in that year.

Comparative figures for Canada are not available; however, if the Alberta case represents 10% of all hail loss claims then upwards of $20 million savings could be anticipated from that one climatic occurrence. While these represent crude approximations of potential benefits, they do nonetheless provide some indication of the magnitude of impacts to be realized with the implementation of a mobile data monitoring service in rural, remote and agricultural areas.

7.0 LAW ENFORCEMENT SERVICES

A significant amount of mobile radio demand has been projected in the Woods Gordon 1984 Phase B study for government services. Unfortunately this sector has not been systematically disaggregated according to police, fire or ambulance services. Individual estimates in the special market categories have been provided, but these have not been examined in any systematic way. In that study, overall demand for mobiles was projected at 108,000 units by 2009, with penetration set at 8.4%.

The review of law enforcement agencies conducted for the social impact study has revealed substantial interest for mobile radio, voice and mobile data services. When offered together, significant social benefits are likely to accrue to those using such systems.

Tangible and intangible benefits have been identified for law enforcement applications. Tangible benefits or impacts are based on estimates of the investments which will be required to be made in updating and upgrading communication equipment to full mobile, voice and data capabilities. Intangible social benefits are much more widespread and have focused on the user impacts such as increased job satisfaction, increased effectiveness of service provision and increased worker autonomy. Related societal impacts include the expected reduction in property loss, increased likelihood of crime prevention and improved quality of rural law enforcement services, particularly for policing activities.

Estimates of the tangible benefits based on investments in new services have been attempted in the Woods Gordon Phase A study and in the Systemhouse/KVA study (1982, p.223). In the Systemhouse study it was noted that the benefits of MSAT for law enforcement would be mainly in terms of increased effectiveness of operation, and as a result are somewhat intangible. The efficient use of staff, it was argued, is perhaps the most important consideration in all law enforcement operations and the extent to which communications contribute to that efficiency, there is a

corresponding and tangible benefit. The focus of attention for estimating the tangible benefits was placed on the RCMP and their requirement for communications in mostly rural and isolated settlements.

The cost of all law enforcement services in Canada has been estimated to be approximately $2.5 billion per year (constant 1981 dollars), of which 90% is estimated to be accounted for by staff costs. The remaining $250 million would be expended for equipment and capital expenses. A preliminary assessment of expenditures for mobile communication services made in the Systemhouse study (p.232) was $18 million per year. It is important to note, however, that these figures were based on initial cost estimates for the MSAT system and for the purchase of MSAT earth stations and radio equipment. These estimates have been shown to be significantly lower than the current estimates and should therefore be used with extreme caution. The cost of upgrading and changing communications equipment for the RCMP was estimated at $48 million over a ten year period. The total net benefit attributed to MSAT has been estimated based on the cost of providing 500 units for the Quebec Police Force and a further 2,500 units for the RCMP. In such a situation, the capital expenditures were estimated in the Systemhouse study to be $12.5 million, with maintenance accounting for $1.25 million and operations, based on an estimate of 20 minutes per day, adding a further $32 million per year. The overall benefits attributed by the Systemhouse/KVA study total $180.75 million over a ten year period. These estimates, it is believed, are significantly lower than those currently being made based on the revised pricing structure for MSAT. Thus they only provide a rough guideline of the amount of benefit that could be assumed under this benefit calculation structure.

British Columbia approximately $50 million per year is spent on communications equipment services by all law enforcement agencies. There are currently 2,000 mobile radios in cars operated by the RCMP, many located in rural and remote areas of the country. The cost, in the interior or rural and remote areas of British Columbia, for the provision of communication services is approximately $15 million per year.

As evidence of the expected incidence rate for the use of mobile services, the 1984 Woods Gordon Phase B market study estimated a market of 14,000 mobiles by the year 2001. It is likely that a significant number of these would be used by law enforcement services. Likewise, estimates provided in discussions with RCMP officials indicate anywhere between 3,000 and 15,000 units will be required by the RCMP when full commercial MSAT operations are available.

Consideration of the more intangible social benefits reveals that in remote areas MSAT would be useful in providing the RCMP with voice communications, particularly in small isolated villages. The overall benefits that are likely to accrue include increased reliability of service, improved service to the public, generally improved officer safety and morale, a facility for data communications and the provision of a standard communication system across jurisdictions.

Discussions of the MSAT concept with RCMP personnel have indicated there are likely to be significant benefits for mobile radio services provided in the 55^{o}N regions of the Prairies and British Columbia and in the 50^{o}N regions of Ontario, Quebec and Labrador. Specific applications which have been mentioned include policing for land and marine based services, illicit drug trafficking offshore and for VIP protection services.[14]

Using the results of a report investigating the Vancouver Police Department's mobile radio data system, it is possible to specify the more intangible social impacts likely to result from MSAT. This system allows police officers to use small computer terminals in their patrol cars for access to centralized data bases along with voice services (Palyse 1983). While these results are provided for an urban based system, they have direct relevance to the future rural based MSAT police services.

Three sets of issues are addressed:

1. attitudes
2. system utilization
3. implications for policing and radio spectrum utilization.

Attitudinal or socio-psychological impacts can be categorized as increased independence for users, less concern about monopolizing voice channels for dispatchers, less monitoring by fellow officers, feelings of doing a job more efficiently, increased job satisfaction and feelings of safety in performing one's job. Negative socio-psychological impacts were over-reliance on the system and potential reduction in officer safety.

Consideration of system utilization indicates a high likelihood that mobile data use will be increased in the evenings and on weekends. Good quality voice communications will be valued highly by officers, particularly for its efficiency for extremely short and trivial messages, e.g. reporting status changes and extremely important interactions requiring immediate response and undivided attention. The mobile data services will be the prefered choice for vehicle and suspect queries and for messaging between operational units.

An MSAT enhanced system would probably not require major alterations in the level of voice activity among law enforcement services which today fulfills a very important social role in their interaction with the community. In fact, it is possible that because MSAT offers both voice and data, the number of instances where unnecessary voice communications are now conducted to collect bits of information would be avoided. Thus the negative effects on the traditional modes of operation would be reduced, thereby enhancing its socially desirable appeal.

With respect to social organizational issues and economic impacts, there was evidence that air time will be less cluttered with the enhancements of a mobile system. Officers are likely to take advantage of periods of reduced occupancy to use the radio for communications they had previously withheld. As a result, the advent of the mobile system may reduce the need for more voice channels.

The previous examples provide clear support for the types of socio-psychological impacts likely to result from the application of MSAT to law enforcement services. These are:

1. increased job satisfaction
2. the ability to do one's job more efficiently and effectively
3. increased independence from the centralized dispatch system
4. increased on-the-job safety.

At the same time a number of negative social impacts were identified, including:

1. too much information to be able to be an effective worker
2. creation of a false sense of security in doing one's job.

Autonomy was one of the group of socio-psychological impacts which have been hypothesized as likely to occur when and if MSAT were used with police services. Increased autonomy is realized through the reduction in the need to utilize a dispatcher. With these types of enhanced mobile systems, one does not have to impose upon dispatchers for information nor are other workers, in this case officers, able to monitor one's activity. Consequently, officers seem better able to establish their own level of activity, and increased job satisfaction appears to be the result. This consideration of increased autonomy supports as well another one of our hypothesized impacts for MSAT in the working environment, which is the increased decision-making capability to the individual. As information is made more readily available, the individual worker can act upon that information without reliance on an intermediary.

With respect to the kinds of services that MSAT will extend to rural and remote law enforcement agencies, the two most positive socio-psychological impacts of terrestrial-based mobile systems were (1) the increased sense of safety the worker feels as a result of having this type of system, and (2) the sense of efficiency and ultimately effectiveness with which a job can be done. There were, however, a number of negative socio-psychological impacts that were identified. Specifically, these would include lessening of contact between the worker, in this case police and law enforcement officers, and the public. Instead of cultivating information and contacts and dealing with individuals on a personal basis, it was felt that a mobile type system would create a type of buffer between the officer and the community and encourage a gradual loss of what is viewed as an important policing skill (Palyse 1983, p.51).

The second set of impacts which relate to the use of mobile services for law enforcement concern those which result in more effective operation. For example, access to remote data bases and faster and more effective response in the investigation of a particular incident are two ways that mobile services could enhance the provision of law enforcement services in rural and remote areas. These are particularly relevant when the isolation of communities and individual workers is considered, along with the difficulties that are often encountered in accessing information by traditional means either over voice communication lines or in hard copy. For example, a mobile police system that would be enhanced by MSAT would be used to link into other provincial and federal data bases, thereby giving a net overall benefit from systems which have already been developed. Specifically, such things as vehicle inquiries, registration inquiries, driver licence information, person queries for criminals and potential violent persons all could be accessed using mobile data and voice systems.

Commercial mobile radio systems have their peak utilization capacities during the standard business hours. Peak usage for law enforcement services are most likely to occur in off hours for commercial services. In a study of the urban mobile systems in Vancouver, for example, the peak mobile data usage was between 9 pm and 1 am of the following day (Palyse 1983, p.60). Evidence indicates that those time periods when utilization would traditionally be low are in fact increased due to the capabilities of the system to do maintenance work and to follow up on reports. Thus, a more effective use of the system capacity and a more efficient use of worker time results. In the low peak or lull times different types of messages would be sent than in peak times. The types of messages would generally be follow-up queries to events and occurrences throughout the rest of the working period.

Research on other related mobile systems has indicated they are a valuable aid to law enforcement, since they enhance the efficiency of operation by increasing the likelihood of apprehending criminals. Mobile equipped systems of cars are considered in most cases to be more efficient than those unequipped. This would support the notion that mobiles could in fact induce a quantitative difference in the arrest rates for systems so equipped. There is a strong possibility that at least

partial benefits of this type should be assumed to provide tangible impacts in the proposed service territory of MSAT.

Organizational impacts are most likely to be manifest in changing the traditional role of the dispatcher. It is quite likely that the introduction of an MSAT-based mobile data and voice system into a law enforcement agency will first see its impact on the way services are dispatched from a central location. This will be manifest in a much greater degree of autonomy among individual officers. However, there are other short term impacts which are likely to be felt as well. In particular, these relate to the "learning curve" required and to technological adjustments which are necessary when such a system would be introduced. Problems would be observed through an increase in the time required to access pieces of information relative to the traditional mode of going through the dispatcher. In the short term one would see a negative organizational impact. However, it is quite likely that over a fairly short period of time these types of negative organizational impacts would be alleviated, and organizational adjustments would be made to take full advantage of the technology and to foster the kind of positive social effects which have already been outlined.

8.0 HEALTH CARE AND AMBULANCE SERVICES

One of the main social impact areas identified for MSAT is the delivery of health care services, and specifically emergency ambulance services. In the Woods Gordon Phase B Market Study (1984), ambulance services were ranked third in terms of potential future air time usage for MSAT. This study also reported that an MSAT telemetry service would be well suited to air ambulance operations (Woods Gordon 1984, p.137). The main use of these services would be in assisting personnel in the field when dealing with emergency situations. MSAT is likely to have impacts on the delivery of these services in a number of respects. First, there will be the socio-economic impacts related to the overall costs of provision of services and equipment and the ability of the equipment to enhance the delivery of emergency services. Second, there will be organizational effects similar to those outlined for the law enforcement services. This latter facet primarily relates to dispatching and the way services will be provided.

The importance of the socio-economic impact of MSAT on health care delivery is underscored when one examines the overall expenditures for these types of services in Canada. In general, ambulance services are run by provinces in association with emergency health service commissions. For the province of British Columbia, the Emergency Health Services Commission had a 1981 budget of $37 million. For Canada, these figures are close to $300 million overall, but vary quite substantially from province to province. In 1981 there were 4,050 air ambulance flights in British Columbia, with assistance given to 4,100 patients. This represented an 18% increase over 1980. For road ambulance services there were a total of 226,034 calls, representing an 11% increase over 1980.[15] Volume of flights for the air ambulance services represent, in the majority of cases, incidences in rural and remote areas of the province. These are therefore good candidates to be affected by MSAT services.

In the provinces of British Columbia, Alberta, Saskatchewan, Manitoba and Ontario, Woods Gordon (1984, p.137) reported in 1982 14,400 air ambulance calls and 750,000 road ambulance calls, with 39% occurring outside main cities. They estimate further that approximately 18% of all ambulance calls could require the

use of MSAT services. That would account for 2,592 air calls and 135,000 road calls. The estimate for base stations and terminals for 2001 were 27 and 16, respectivley.

8.1 Emergency Medical Services

MSAT is a prime technology to influence the way information exchange, control and flow will affect the overall delivery of emergency medical services in the proposed northern, remote and rural service areas.

Emergency services are generally provided on a provincial basis in Canada, with agencies responsible for coordination and relief operations in a natural or man-made disaster. Within this category one would include emergency medical services, disaster relief, school bus emergencies and marine and boating facilities services. Mobile communications would serve the following specific purposes:

1. Co-ordination of activites for local and larger mutual aid organizations during a disaster

2. Direct operations as part of a disaster communications network established for the purpose of providing disaster communication for organizations that have no other frequencies available

3. Providing disaster communications where otherwise no communications are available.

These types of services may piggyback on other existing users such as police, forestry, fire or ambulance services. Estimates for the US indicate that for remote area coverage only, MSAT type services would be expected to capture 30% of the overall market (page 44, Eco Systems Study, November 1, 1980, Land Mobile Market Integration Study).

Total planned expenditures related to communications services for emergency planning in Canada in 1982 totalled $8,209,152.[16] This represented approximately 31% of the recorded emergency planning program activities expenditures.

An indication of the magnitude of the costs of these emergency services in Canada can be examined by looking at the summary of claims settled for disaster assistance. In 1982 the total amount of financial assistance resulting from damage claims from disasters of various types including floods, rainstorms, windstorms, etc., totalled $12,764,854 (this claim of over $12 million represented one single year in 1982 and covered only New Brunswick, Alberta, the Yukon, Nova Scotia and Saskatchewan).

The Systemhouse/KVA study noted that changes over the next ten years will make emergency medical services more accessible to the Canadian public in rural and remote areas. At present rural ambulance services serve solely as transportation. In the future, however, it is hypothesized that provincially licenced ambulances would be manned by paramedics capable of monitoring a patient and giving first aid and basic medical care. British Columbia, Alberta and Manitoba have active paramedic organizations, while Ontario and Quebec are now preparing for such programs. It is recognized that the provision of paramedic services may not, in the short run, be cost justifiable in remote and rural areas. In fact, the Woods Gordon study pointed out the lack of economic justification for such services. In interviews with government departments, the reaction to an MSAT service concept was very positive with hospitals, ambulances and special rescue vehicles all identified as likely to adopt MSAT. Initial estimates suggest a potential of up to 1,000 terminals in this sector.[17]

Estimates of the dollar value of benefits for these services were provided in the Systemhouse study, based on a population growth in Canada from 28 million in 1994 to 32 million in 2003, and assuming continuing urbanization. Cost savings were likely to increase over time for ten years from a present value of $37 million. Furthermore, the Systemhouse study estimated that approximately 1,900 lives could be saved each year as a result of the application of mobile communications to specific classes of emergency responses, resulting in an annual benefit of $107 million. Over the 1994 to 2003 time period this would grow from 2,290 to 2,500 lives for a present value of $860 million. Of this amount, about one-quarter could be attributable, based on the Systemhouse information, to the use of MSAT, resulting in an overall benefit savings of 550 lives, or approximately $172 million

(Systemhouse/KVA User Cost Benefit Study for Mobile Satellite Radio System, Final Report, p.172, March 1982).

The application of MSAT to emergency services will have tangible and intangible benefits. Intangible benefits of such services have been illustrated in a study recently conducted in Georgia which examined emergency rural medical services using enhanced mobile data communication. Benefits included savings in time, money, lives and property. The system in question was designed to cover 11,000 square miles of area and to communicate with offshore oil rigs. In the area under study, there were 46 ambulances serving over 900,000 people. An assessment of its activities indicated that the system was essential in saving lives through a number of processes involved in the dispatch, servicing and subsequent delivery of a patient to a central health care facility. In particular, ambulances en route could call ahead to inform others at various destinations that they were en route and could clarify any directions for getting to a particular location. This is particularly relevant to rural areas which are spanned by hundreds of little known or unmarked roads. Helicopter transport could use the same services. Paramedics could interconnect with a base station and find out which hospital the oil company would prefer the employee to be taken to. This procedure speeds the delivery of a patient to an acute care facility.

8.2 Pager Services and Health Care Delivery

MSAT is likely to have high demand, according to the Woods Gordon Phase B Market Study, for wide area paging. Consideration of the linkage between pager services and satellite based mobile data systems provides further evidence of the kind of social impacts accruing from MSAT. The market forecasts for wide area paging are considered somewhat speculative due to uncertainties about the technological developments in this area (Woods Gordon 1984, p.127); however, the total number of pager units is estimated to vary between 9,000 and 45,000 by 2001 (Woods Gordon 1984, p.128).

Typically, emergency service organizations and hospitals in particular require two types of paging: short range paging for use within a complex and long range paging

when personnel are away from the central location. This would be a typical situation in rural areas where the distribution of patients would be over a much greater area than in an urban region. The application of mobile pager systems allows staff to access information and dial directly into a computerized paging terminal, thereby providing instant two-way communication capability over a wide area. Display or digital paging systems are used for recording, storing and relaying visual information to hospital staff. Unlike their beeping counterpart, display pagers relay 24 bit messages visually. These services would provide more effective health care delivery in low density areas and improve the ability of medical staff to react to emergency situations. At the present time the costs of services are not available and as a result the consideration of more tangible social impacts using the previously defined expenditure approach is not possible. This example illustrates only one of a number of possible applications for paging services. Demand is likely to exist in many cases where staff or crews are "on call" either for emergency or non-emergency situations.

9.0 RURAL FIRE PROTECTION SERVICES

Fire services for rural areas will represent a significant part of the overall social impacts of MSAT. Since these services are almost all provided on a voluntary basis, there is only minimal information available relating to the costs of service provision in any of the provinces or territories to be served by MSAT. Most of this discussion, therefore, focuses on intangible benefits such as the effectiveness of services and user enhancements. However, some insight can be gained by examining a case study where costs of service provision and expected benefits are illustrated.

The findings of a recent study conducted in the United States of a rural fire service using a digital radio system in the 800 Megahertz band included:[18]

- improved response to emergencies
- improved safety for departmental personnel
- more effective assignment of people and equipment
- improved use of data for management purposes.

Mobile data services for fire fighters, of the type which will be impacted directly by MSAT, have recently been tested in field situations. Fire fighters and teams of paramedics in the field received dispatch orders along with updates on the status of personnel and equipment for the emergency being transmitted. Using a mobile data system, information about the location, type and intensity of the fire was made directly available to the vehicle. In addition, tactically significant data such as the size, type of area and number of people involved was also provided. The attributes of such a system have been identified to be:

- improved reliability in the fire fighting service itself
- increased speed of unit status reporting
- common operations for more effective allocation of resources
- the ability to provide emergency patient monitoring and direct connection to centralized health, medical services and personnel.

The particular service under investigation was designed to serve 1.4 million people over 540 square miles in the Phoenix, Mesa and Temple areas in Arizona. The cost of this system was $5.2 million, representing an overall investment of approximately $4 per person in the service territory. Each dispatch console had a 20 channel radio control system, which is microprocessor controlled and fully redundant. In an average 24-hour period the system would transmit and receive a total of 130,000 messages. The system was designed for 200 fire and emergency service vehicles, 12 dispatch consoles, 20 remote administrative CRT terminals and 65 fire station terminals and printers. The system was capable of handling both voice and data through the telecommunications circuits and voice and data radio links to the field. These types of systems lend themselves very nicely to the kinds of services that MSAT is likely to enhance in rural areas of Canada.

The overall impacts resulting from the implementation of these services were both direct and indirect. The direct impacts involved better and more efficient allocation of fire fighting vehicles and services. There was an improved ability of the fire department to respond to emergencies by making it possible for dispatchers to keep up with calls during peak periods. Thus, it increased the safety for the public as well as improved the working conditions of the fire fighting personnel. Secondly, it allowed more effective assignment of personnel and equipment, and automated the collection of management reports.

From a social impact perspective, two of the most significant findings of these studies were the improved efficiency with which services could be provided and the likelihood for reducing loss of life and property. The ability to coordinate over wide areas, and the improved working conditions that accrue to the fire fighters themselves, were also significant.

10.0 WORKER SAFETY: HAZARDOUS WORKING CONDITIONS

One of the most important social issues considered for MSAT is loss of life and the improvements for safety within the working environment. It is recognized that not all rural and remote services will be affected by MSAT since, as the other background studies have shown, it will not always be economically feasible for the replacement of a terrestrial based communication system with a satellite. However, it is clear that in the cases of such things as fire fighting, law enforcement, emergency services, remote work site operations, oil rigs, trucking and forestry operations, a significant portion of mobile communications activities will be shifted to MSAT. Therefore, it is legitimate to assume that improvements in communications services will be brought about directly through the use of MSAT. Likewise, it is reasonable to assume that with these improvements there will be some reduction in the loss of life and overall improvements in safety and working conditions at work sites.

While it is difficult to quantify the direct impact of MSAT, it is possible to provide some indication of the magnitude of the current situation with respect to hazardous work situations. Using statistics provided in the background studies and those of the Workers Compensation Board of each province, it is possible to provide some indication of the cost of hazardous work environments. These statistics are presented for the most recent years available and are useful as indicators of the incidence of industrial accidents, while providing estimates of the dollar values of the cost of such accidents. The dollar values are based on total paid compensation for the sample years.

In the province of British Columbia during 1981 there were 222 fatalities which fell under the jurisdiction of the Workers Compensation Board. The majority of these, 197, were liable for payments by the Board. For loss of life, over $19 million was paid out by the WCB, averaging approximately $110,000 per life. Wage loss compensation accounted for $150 million in the same year based on 10,000 claims or $1,500 per claim. In 1982 medical aid costs accounted for $56 million, wage loss costs $127 million and fatal accidents $104 million in compensation payments.

In British Columbia approximately 48% of the total benefits were paid out in areas other than large urban agglomerations. Rural and remote areas accounted for between 40% and 50% of the total compensation costs and a substantial portion of reported accidents and deaths at worksites.

Compensation was greatest in the trade, service, manufacturing, construction and forest products industries. The forest products industry in British Columbia accounted for 15.4% of the claims, transportation 6%, mining and smelting 4.4%, and fishing and fish packing 1.3%. In the majority of cases a significant number of accidents were assumed to occur in rural and remote areas and at remote work sites associated with the industries of forestry and mining.

Of the 197 lives which were lost in 1982 in industrial accidents, statistics indicate about 45% occurred at rural and remote work sites. It is most likely similar trends will exist in the future, and that there would even be increases in the number of workers and therefore increases in the likely incidence of fatal accidents. Based on paid compensation, each life saved would be worth approximately $90,000. Accepting only the present calculations, based on 1982 dollars, indicates that well over $15 million was paid in compensation as a result of accidents at remote work sites.

Quebec statistics reveal that slightly less than 30% of all deaths occurred in the forestry, mining, transportation and public administration sector. In Nova Scotia these industry sectors accounted for 23% of the recorded and compensated deaths.

Comparative statistics for Canada revealed that over one hundred million dollars were paid out in compensation during 1981/82 for 900 lives lost in industrial activities. This equates to approximately $100,000 per life. Over the same period $1.25 billion dollars were paid out for accident claims. This includes compensation for lost time, medical costs and hospital care.

The breakdown of accident and death claims by industry class is not available for all provinces, making the allocation of benefits paid by area and industry difficult. British Columbia statistics suggest that at least 40% of all deaths are likely to

occur in non-urban areas, which indicates a social cost of approximately $40 million per year in death benefits.

In 1981/82 $1.35 billion dollars was paid in compensation for accidents at work sites in Canada. The remote sites are conservatively assumed to account for 30% of this total or $450 million. Accepting that MSAT will have a net effect reducing payments by 5%-10% would amount to a social cost of $45 million per year in avoided compensation payments for all of Canada based on these 1981/82 statistics.

In conjunction with these quantifiable dollar estimates for loss of life, consideration should also be given to the psychological effects resulting from the improvements in the safety of the work environment. Reducing uncertainty, fear and isolation of working at a remote site are intangible social impacts which will be felt among individual workers.

TABLE 4
Workers Compensation Benefits for Canada by Province
1981 - 1982

Province	Year	Accidents	Accident Benefits $	Deaths	Death Claims $
*Newfoundland	1982	15,320	8,180,800	-	-
Nova Scotia	1982	29,700	34,000,000	26	6,113,315
P.E.I. (1979)	1974	4,204	890,286	6	3,500
N.B. (1981)	1982	29,531	27,816,750	19	900,000
Quebec	1982	310,557	541,484,000	189	22,901,000
Ontario	1981	415,044	332,578,000	232	300,000
Manitoba	1982	16,420	28,000,000	16	10,000,000
Saskatchewan	1981	40,280	36,288,319	76	-
Alberta	1982	74,349	108,869,000	169	135,451,000
British Columbia	1982	132,965	269,215,360	176	19,452,587

Source: Workers Compensation Board Statistics for Each Province 1981/1982

11.0 TRUCKING AND TRANSPORTATION

The Woods Gordon Phase B study identified trucking and transportation as one of the prime future users of MSAT services. Forecasts of projected air time indicate that dispatch will account for approximately 32% of overall use and traffic control 4.3%. Future projections indicate that by 2001 the transport and trucking industries will account for 18.2% of all voice mobiles, and there will be 44,000 mobile voice units. The general transportation sector was considered to have significantly more demand with a 2009 projection of 174,000 units, thereby ranking number one of fourteen selected industry sectors under investigation.

An overriding need in the trucking industry is constant monitoring of truck loads and the ability for emergency notification. In each case a voice capability is the prime requirement for notification of a disaster or emergency situation. Mobile data usually serves the purpose of monitoring routes, vehicle arrivals, departures and local service management. There is ample evidence that where dispatch services utilize mobile data systems complemented with voice, there are significant social impacts.

The 1982 Eco Systems International study noted that in recent years the frequency of truck highjackings in North America has increased substantially. Highjackings result not only in a loss of cargo but also represent a significant element of danger to drivers. A mobile capability to locate and monitor the movement of vehicles would be an effective deterrant to highjackings, and a valuable tool in recovering equipment and cargo, thereby reducing overall property losses ultimately requiring some form of compensation.

U.S. estimates place expenditures for communication linkages of a typical large truck fleet at $1.3 million per year, representing a value of $39 per month per vehicle in operation. While the example is drawn from the U.S., there is no doubt that similar potential benefit savings would accrue in the Canadian situation. It is also worth considering that as improved communications and transportation linkages are implemented in rural and remote areas of the country, increased volumes of traffic will take place. While today, there may be a low volume of traffic and

therefore low incidence of highjacking and stolen goods in the areas to be served by MSAT, there is no doubt that accelerated growth will occur in the future. As it does the incidence of these events will also increase.

Information obtained in the Woods Gordon Phase B study has indicated that the main use for mobile services in the private trucking industry sector is likely to be in long haul intercity movement of freight. No detailed assessment of that sector has been made. Analysis of the regulated truck carriers indicates that the type most likely to equip with an MSAT terminal will be involved in non-scheduled hauling operations (Woods Gordon, p.96). The total number of operators of these services was 6,800 in 1981.

Analysis of the industry response to mobile services revealed a concern for customer oriented and safety related issues. An industry survey revealed the majority of firms showing an interest in MSAT were attracted by the wide area voice and dispatch services (Woods Gordon, p.94). Specific factors likely to encourage adoption of remote cargo monitoring were high value items, the need for state-of-the-art technology, adoption of more efficient management techniques and concerns for transport in high crime areas.

Woods Gordon Phase B estimates (p.103) suggest approximately 4,000 to 8,000 tractors could be considered as potential MSAT users. Their 2001 estimate was between 5,500 and 11,000 terminals. For remote cargo monitoring, these estimates ranged between 1,700 and 6,500.

An experiment conducted by Federal Express using a mobile data system with capabilities for a direct linkage to a satellite provides evidence of more intangible social benefits. By 1984 the company expects to equip 2,500 vans with mobile terminals. These form part of a large multi-level communication system that includes digital-aided dispatch systems, enabling information to be sent directly to vehicles operating in a network. The necessity for working through a dispatcher or third party is minimized and drivers can access their route, pick-up and delivery points directly through a CRT terminal in their truck. Operators can review information, combine new calls with regular calls and work up a route. The driver's

progress can be maintained by simply pressing keyboard buttons which transmit messages back to a dispatch centre. Likewise, new pick-up services can be notified to the driver directly without interruption. The driver can monitor the line-up of dispatches awaiting pick-up by route and by fleet and can scan the list of dispatches awaiting assignment.

In assessing the social impact of the technology, learning and efficiency of operation were the prime benefits. Other benefits included easing of the workload on drivers, providing more productive use of their work time and reducing the possibility of missing key pick-ups in a routing situation. Other findings indicate such systems help increase the confidence of employees on the job and increase their sense of safety in the job environment. Workers are likely to be more confident, have higher morale, feel more relaxed on the job and have a greater sense of safety. Voice channels would be used for emergency broadcasting. Within the truck routing and dispatch mode, these kinds of systems could provide more accurate transmission of messages and information, provide information in a timely manner, and allow better management and control over workload route size.

These results support the contention that MSAT has direct relevance in terms of the impact on worker satisfaction, and secondly that dispatch and trucking services will be significant users of MSAT. While there are definitely going to be commercial benefits, a great deal of the overall impact of these systems will accrue to workers using them. As found in the case study just cited, increased worker satisfaction, better performance on the job and overall confidence in being able to do one's job are likely to have corresponding economic impacts manifest in higher productivity for the business and more efficient utilization of resources.

Public transportation, aircraft and marine services represent an additional area for the consideration of MSAT social impacts. These were considered in the Woods Gordon (1984) Phase B study to represent a major portion of projected future demand. MSAT suitability for bus transportation, trains, ferries and aircraft have all been examined. For public transportation, terminal demand in 2001 was set at 15, for train travel 360, for ferry traffic 45 and for commercial aircraft 180. In all cases reviewed as part of the Woods Gordon study, the principal user was

designated as the business passenger. Therefore, as a result the demand for services reflects the extent to which the transportation medium services the business community.

The social impact of this MSAT application is believed to be primarily in the area of secondary benefits and to a large extent is socio-psychological in nature. This includes business people being able to maintain contacts with offices and homes while travelling. That ability would lead to improved efficiency of business operations through the maintenance of closer contact and co-ordination with offices. Other social impacts stem from the reduction in the stress of long haul travel and the ability to provide immediate notification of arrivals, departures, delays or route changes.

Other applications for the transportation sector include the monitoring of cargoes and vehicles while en route. MSAT will have use for these purposes but primarily as a complement to existing locator devices. MSAT will provide increased safety to the operators of vehicles and in rural areas will allow for more efficient routing and effective operations in service territories. It is likely that such operational features will only be necessary in the more densely serviced rural areas rather than remote regions. Other possibilities include the monitoring of ships for search and rescue operations. These, however, will have to be compatible with existing international distress services.

The Woods Gordon Phase B study (p.141) suggested that MSAT will offer the most potential in improving the way emergency services are organized and in complementing existing emergency systems. It was revealed in the Phase A Woods Gordon study that the Coast Guard responds to approximately 90 life threatening situations per year where MSAT type services could be used. While it would be difficult to justify these services on a purely economic basis, the social implications are quite significant. Related services could provide improved private communications with ocean search and rescue operations on the east and west coasts and in the Great Lakes regions. These services are likely to improve the effectiveness of operations and in general ensure better services to the public.

12.0 REMOTE OIL AND GAS SITE MONITORING

A significant amount of economic activity in Canada's northern remote and rural areas, particularly in western Canada, is devoted to oil exploration, natural gas extraction and pipeline developments. The socio-economic impact of these developments will be enhanced with the application of MSAT services, i.e. the process of industrialization as resource extraction activity proceeds is likely to be enhanced with the use of increased and better communication services. Typical uses include data transmission of drilling activity to voice communication in exploration activity on land.

In 1981 there were a total of 6,927 oil wells being drilled in Canada with a significant number in the more remote and northern areas of the country. Thirteen wells were being drilled in the Arctic islands. Recent estimates indicate over 7,000 wells drilled in 1983 with a projection of 6,000-8,000 per year over the 1984-89 period.[18] Activities in the western part of Canada are likely to remain dominant, accounting today for about 98% of all exploration. Oil industry forecasters predict that off-shore activity will also be increasingly important over the next ten to twenty years. Growth rates for the post 200 year period are difficult to speculate on but generally fall in the 2%-5% annually range.

The Woods Gordon Phase B Market Assessment Study indicated that mineral extraction would account for 14% of all voice mobiles by the year 2001. Likewise, an analysis of the percent of air time use indicated that remote sensing would be one of the top ten users of these services. In comparison, the mining industry currently accounts for 6% of mobile use. This figure is projected to grow quite significantly over the next fifteen to twenty years.

Much of the work required for resource extraction and oil development, as well as other types of mining and resource extraction, can be classified as very hazardous. The need for efficient, reliable and good quality communication services, particularly for voice transmission, is therefore critical. In fact, most of the social impacts which would result from the use of an MSAT type service involve voice communications rather than data monitoring services.

The oil and mineral exploration applications for MSAT will have both economic and social impacts. Social impacts result from the reporting of potential disasters, safety monitoring at sites, conveyance of requests for the activation of emergency services, and dispatch of emergency aircraft such as helicopters to remote oil rigs and site operations, weather warnings and ice flow.

A study conducted by Eco Systems International in 1982, examined the oil and gas industry market for land mobile communication satellite services. The applications which relate to social impacts and benefits were worker safety and hazard aversion. In the activity of inland exploration, mobile communications were identified for emergency services, activation and coordination. In the offshore exploration areas they were identified for crew advisement and early warning of weather conditions. In the inland drilling activities mobiles would be used for emergency services activation and coordination, facility security coordination, and early warning of weather conditions.

The recent Ocean Ranger disaster off Canada's east coast represents one example where efficient mobile communications could play a significant role in averting disaster and minimizing compensation payments to survivors for injuries and lives lost, which in that situation, totalled $5.5 million in 1982.

The Woods Gordon Phase B study indicated that in most instances the major use of MSAT would be for voice communications in this industry sector and emphasized the somewhat limited number of possible terminal sales for such purposes. The social benefits relate, however, to the way MSAT services will affect individual workers and the improvements in the overall safe operation of pipelines, drilling rigs and offshore platforms. In many cases MSAT will complement existing communication services such as INMARSAT and Anik to provide further improvements in working conditions and efficient site operations.

13.0 POLICY IMPLICATIONS

One of the most important aspects of assessing MSAT involves the appraisal of its implications for government policy. Consideration is given here to the way MSAT is likely to affect federal government policies and the role which selected government departments have identified for MSAT in the conduct of their activities. The areas to be examined include environmental, communications, space and industrial policy. In most cases several different government departments are involved in a policy area. This is particularly relevant for environmental policy where the Departments of Environment, Indian and Northern Affairs, and Energy Mines and Resources are discussed.

13.1 Environmental Policy

One of the most significant considerations in assessing the social impacts and benefits likely to accrue from MSAT relate to the way it will affect development in the northern, remote and rural areas of the country. In addition, concern has also been expressed about the impact of MSAT on the rate of change in the northern and remote regions of Canada. A policy report recently produced by the Department of Environment (1983) focused on the north and noted that recent changes are only a prelude to even more pervasive transformations to come over the remaining years of this century and beyond. Much of the change is being precipitated by resource projects undertaken and proposed which focus on the development of the north's hydrocarbon, mineral and hydroelectric resource potential. Many of these projects are massive in scale and involve the application of state-of-the-art technology. It is clear that the north's resource use and demographic structure will be altered markedly, as will its regional economy and administrative structures. As a consequence, major changes will occur in the opportunities and lifestyles open to northern residents. Concerns are being expressed about the maintenance of environmental quality in the north, conservation of the northern renewable resource base and the rights and welfare of the north's native population. These concerns embrace political, social, ethical, economic as well as environmental considerations.

The government of Canada has a central role to play in ensuring the positive response to northern opportunities and future development due to its jurisdiction over the territories. The stated policy of the Canadian government is to achieve resource development at a rate and in a manner compatible with the delicate social and environmental balance, recognizing that northerners will play a growing role in both the decisions and benefits associated with that development. Further, the policy statements indicate that resources and the environment are the main elements of any strategy for northern development. The needs of the people in the north, it is stated, are more important than resource development, and the maintenance of ecological balance is essential.

The Department of Environment's northern policy goals have been further amplified:

> "To ensure that the department's programs and activities contribute efficiently and effectively to the protection and enhancement of environmental quality in Canada's north, and to the achievement of environmentally sound, safe and sustainable northern development." (1983, p.29)

The four specific northern objectives adapted by Environment Canada are directly linked to the priority needs in northern environmental management. These are:

1. To promote the establishment of a comprehensive network of protected areas in the north to provide adequate protection and management for areas and site of significance in the preservation of Canada's natural and cultural heritage, or in the provision of opportunities for public appreciation and enjoyment of the north's natural and cultural features.

2. To promote environmentally sound technology and safe operations in northern resource exploration and development activities, transportation and other infrastructure systems, and in community development programs.

3. To encourage the sustainable utilization of the north's renewable resources, sensible use of its non-renewable resources and resolution of boundary and environmental issues of concern in the north.

4. To increase the information available to Canadians on the state of environmental quality and resource use and facilitate public consultations on northern environmental management policies and programs.

A number of strategies have also been defined, amplifying the way specific policy objectives may be achieved. However, only some of these strategies have direct relevance to MSAT. One is the strategy for promoting environmentally sound technology and safe operations in northern development. Specific technical services of relevance to MSAT include the provision of a program of climate, weather, ice and sea state information and forecasting to meet local and regional needs. Secondly, it will provide meteorological, ice and sea state information and forecasting programs designed to serve individual clients on a cost recovery basis. Thirdly, it will provide appropriate access to the environmental baseline information provided by the department's core data generation programs concerned with terrestrial and aquatic environments; water and air quality monitoring, wildlife habitat surveys, wildlife and vegetation studies, ecological land evaluations and, also of relevance to this study, proposes to provide information for use and design in waste disposal systems and handling of hazardous substances.

To achieve these objectives and to institute these technical capabilities, it is proposed that the department will undertake research dealing with such things as:

1. spills of oil and other hazardous substances to develop understanding of wildlife populations and their susceptibility to industrial development

2. to examine the siting and design of land-based transportation facilities and new settlements, taking into account weather, sea ice and biological factors

3. to develop environmental design guidelines for the application of industrial technology in northern environments

4. develop codes of good practice for air, water, marine and pollution control

5. develop criteria and appropriate technology for the collection, transport, storage and disposal of wastes in northern operations.

The second major strategy area is the encouragement of sustainable utilization of the north's renewable resources, sensible use of its non-renewable resources and the resolution of transboundary environmental issues. In this respect, the department's functions are focused on the industrial technology being applied to develop the north's natural resources. Functions are focused on the natural resources, their use and management. Key parts of this strategy include:

1. undertaking research to improve the management and allocation of northern species, particularly those that are rare, endangered or threatened in the north

2. to promote in conjunction with other responsible agencies the adoption of jurisdictional accords to protect and manage caribou, polar bears, seals, whales and anadromous fish in their habitat

3. to undertake research on the dynamics of fire, pests and diseases in northern forests to assess opportunities for making beneficial uses of northern forests on an environmentally sound basis, and to advance the knowledge of the role vegetation plays in northern eco-systems.

This review of strategies for development and programs proposed for the northern and remote regions of Canada emphasizes a number of areas which have direct relevance to the MSAT program. These can be defined on the basis of impacts which will assist the federal government in understanding more about the environment. For example, MSAT services can be employed in the monitoring of toxic

wastes, and they would be used in the research programs outlined as part of the strategy to provide greater understanding of the north. Specifically MSAT could provide voice and data services in a variety of previously unserved areas, wildlife monitoring through polling services and monitoring of facilities considered environmentally hazardous.

As well, there are much more direct impacts that can accrue from MSAT in the operational aspects of the services provided by government agencies. The specifics of these have already been reviewed and focus on such things as more efficient allocation of fire protection resources and more effective emergency services in promoting a safer environment for development.

Several agencies of the Department of Environment have expressed interest in the MSAT program. Included are Parks Canada, Atmosphere and Environment and the Environmental Protection Services. Specific interest has been expressed for service which will assist in these department's carrying out programs such as air quality measurement, ice flow analysis, weather monitoring, stream gauging and real-time map generation and transmission. In submissions made to the MSAT working group, estimates of required data collection platforms were set at 955 by the end of 1994. These requirements, it was revealed, would be in addition to existing platforms using the 401-403 MHz range. The operating expenditures for such a system of platforms were set at approximately $2 million per year.

Related to the proposed incorporation of MSAT within the various sections of the Department of Environment are the possible uses outlined by representatives of Indian and Northern Affairs. In submissions to the MSAT working group, specific applications suggested for the Northwest Territories were fire protection, lightening triangulation, climatological detection and logistic data transfer. A requirement of 700 mobiles was estimated for the 1988 period.

Energy, Mines and Resources are also potential users of MSAT for data transmission services. This could be utilized for field parties doing geologic survey work with the prime requirement voice communications. Current mobile communica tions equipment for this purpose is estimated to cost at present between $450,000

and $500,000.[19] Possible uses include ship to shore data and voice and broadcast imagery.

13.2 Space and Communications Policy

The Department of Communications has identified a number of policy areas which may be impacted by the introduction of the MSAT program. In 1981 the rural communications study program was completed and found a widespread need for improved telephone service and better mobile radio communications. Two technological solutions to these problems were identified. These included use of a rural interface device and the use of rural mobile/fixed radio. The department has noted that for a longer range, there is a large market for the "right type" of rural radio service in Canada and abroad. It suggested further research be done on a new mobile/fixed radio network architecture for rural communications. MSAT may provide the type of services necessary to upgrade rural communications to required levels.

A three year Canadian space program was announced in 1980 to cover the financial years of 1981 through 1984. The Minister of Science for State and Technology (MOSST) presented a plan that was characterized by relatively long term commitment and intention to diversify Canadian space competence and usage, and to provide further support to innovative development. It was announced in the belief that the government support for space related research, development, manufacturing and marketing would result in the fulfillment of broad national, social, political and economic objectives:

> "Use of space can contribute significantly to the attainment of social, cultural and economic goals. There are economic benefits to be obtained from the creation of a strong industry to meet our needs and which is able to compete in the international marketplace."*

* MOSST, The Canadian Space Program Plan for 1981-82-83-84, Background Paper #19, Ottawa, Supply and Services, 1981, p.1.

An extension of the space plan announced in December of 1981 increased the space budget significantly through to 1985. Of the total expenditures of $475.8 million

over the 1981-85 period, 32.8% of the total funding was devoted to technology development, 28% to remote sensing, 21% to communications related projects, 15% to space science and 1.6% to the European space agencies. Seventy percent of the announced funding was to be directed to industry. The examination of expenditures by member departments between 1980 and 1981 illustrates some of the importance which is attached to specific areas of the space program. Specifically, Communications accounted for 45%, Energy Mines and Resources 16.8%, and the Environment 5%. (Calculated from Canada, Interdepartmental Committee on Space, Annual Reports, 1976 through 1980, also Department of Communications Annual Report, 1981-82, Supply and Services Canada, 1983.)

According to various policy objectives, domestic requirements are the primary factors that direct the activities of the space sector manufacturers. The benefits of this strategy are expected to result in a high level and quality of Canadian content in domestic software and hardware leading to export sales, collaboration with foreign contractors for exploitation of the international market, and system level expertise essential to design manufacturing capability and sub-systems. The Canadian government has devoted attention to the space sector with the expectation that it will clearly become a growth industry and a major component of the high technology sector.

An important policy issue with respect to these goals is the impact that the MSAT program will have on generating further export sales and in achieving further penetration of Canada's high technology space industry into foreign countries. Examination of past programs and the success of companies such as Spar Aerospace suggest that MSAT may contribute significantly. However, a number of countries -- including Mexico, Singapore and South Korea -- are considering adopting cellular radio systems and US satellites. Also in a number of countries, for oppressive political reasons, all mobile systems are restricted to use by the national police.

In 1974, "A Space Policy for Canada" was adopted and contained a number of pertinent objectives:

"Canada's primary interest in space should be to use it for applications that contribute directly to the achievement of national goals. Government purchasing policy should encourage the establishment of viable research development and manufacturing capability in Canadian industry."

In general, the Canadian space sector has been regarded as one of the central facets of an industrial strategy. Statement of policy objectives for the Canadian space program plan for 1982-85 includes the following:

"In increasing its financial committment to Canada's space program, the government is reiterating its belief in the importance of science and technology to the social, cultural and economic well being of the country. We are reaffirming our commitment to developing a strong industrial sector in high technology so that Canada's economic development strategy for the eighties may be realized. The industrial strategy for space is geared to the continuing development of successful export oriented high technology industry that is located in several provinces."*

* MOSST, Canadian Space Program Plan, 1982-83-84-85, Background Paper #20, Ottawa, Supply and Services, 1981, p.17 and p.14.

Another major objective of the space program is the transferring of technology from the public to the private sector:

"From the beginning, however, a sustained effort was made to bridge the technology gap from government to industry, not only in communications but in space technology generally. This effort was designed to stimulate an industrial capability that would, in due course, develop profitable high technology products and services."*

* Theodore R. Hartz and Irving Paghis, Editors, Space Bound, Ottawa, Supply and Services, 1982, p.13.

Perhaps of most relevance to the current state of MSAT, where both the domestic and export opportunities are only now being evaluated but which seem to offer some opportunities, is the following statement from the Interdepartmental Committee on Space made in 1980, which concluded:

> "Canada's activities in space, spurred by timely government policies, have been instrumental in bringing to Canadians new services which are not economically available by other means. Government programs have provided the necessary incentives and support to the development of a diversified and competitive space industry in Canada. Current performance notwithstanding, Canada's space industry requires further support to achieve the base of strength sufficient to meet foreign competition."

Communications, broadcasting, weather observation and forecasting, remote sensing, search and rescue, aeronautical and marine navigation, data collection, scientific exploration, military applications and surveillance -- all of these will be enhanced by the use of MSAT. The availability of these services will be an essential factor in the continued social and economic development of the country, and control of the facilities and data flow is an important consideration in the maintenance of cultural and economic sovereignity. (Department of Communications, Canada Space Program, p.41)

Another major objective in Canada's space program has been to assist in the movement of the technology from government into industry, and to assist in the development of commercial applications in the market economy for mobile type services or for any type of data or voice service. A number of primary applications considered for MSAT will have direct benefit to industry in its ability to offer enhanced commercial services. Already mobile radio, paging and mobile data systems can be identified as areas which will benefit most directly from MSAT. It is likely that the stated policy objectives of Canada's space program would be enhanced with the introduction of MSAT. Some concern, however, can be expressed about the possibility that the benefits in the commercial sector may not be totally realized by Canadian industry. It is possible that through the stimulation provided by this program the market for mobile data platforms, earth stations, mobile radios and telephones will be expanded, but the expansion of that market will have the most direct benefits to foreign suppliers. The possibility exists that the total benefits which are assumed to exist and which are embodied in the policy statements for the Canadian space program may not be fully realized.

13.3 High Technology Industry Strategy

The Canadian government has been engaged in the process of selecting and implementing industrial strategies since the late 19th century. Controversy over Canada's prospects as a manufacturer and exporter of finished products has raged through each decade without resolution. With the advent of the information economy, the problem of developing appropriate strategies has been discussed with a renewed sense of urgency. Interest in recent years has coalesced around several issues. First, whether some form of industrial strategy is or should be developed for the high technology sector, and second Canada's relatively low research, development and marketing activity as compared with other industrialized nations has been a major concern.

In May 1983 Donald Johnston, Minister of State for Science and Technology and Economic Development, announced a technology policy for Canada. (Ministry of State for Science and Technology, "Toward 1990, Technology Development for Canada") In a report accompanying the announcement, technology policy was defined as the development, application and diffusion of technical and scientific knowledge in the Canadian economy. A review of these objectives indicates:

> "The first objective of the technology policy is to strengthen the Canadian economy through the creation, application and diffusion of the state of the art technologies. Second, we intend to manage the process of technological development so that Canadians are aware of both the opportunities and the problems that might arise. Well informed Canadians will make the right choice for themselves and for this country. Thirdly, we must ensure that the benefits of technology development are shared equitably among Canadians in every region, and last but by no means least we must encourage a social climate that places a premium on scientific and technological excellence, curiosity and innovation." (Ibid, p.3)

MSAT is likely to have a significant impact, if implemented, on the achievement of the goals embedded in this government policy. The exact magnitude of that impact, however, cannot be assessed aside from the fact that it will contribute to the development of new technologies, which will most likely be taken up by a number of Canadian manufacturers. The related MSAT socio-economic studies (the

manufacturing sector study, the RCC study*) should verify the extent to which this will be the case. From a social policy perspective, it is not possible at this time to quantify the precise impact, only that the benefits will be substantial and positive in achievement of specific goals.

One area which raises some questions is in the specific consideration of the employment impact. The overall socio-economic study** will determine quantitative changes in employment opportunities that will occur in the high technology sector as a result of the MSAT program and its attendant manufacturing impacts. It is quite possible that not only will employment be created, but as well occupational impacts will accrue through retraining and changing skill requirements for product development.

Another concern, with respect to the policy implications of MSAT, is the extent to which the benefits of R&D and manufacturing capabilities will accrue not mainly to Canadian interests, but will follow a pattern which is typical of other ventures in the high technology sector, whereby once the initial prototype and research work is conducted, the manufacturing, mass production and provision of services occurs by offshore companies rather than by the domestic firms. Canada thus becomes a net importer of these products and services, despite the fact that significant amounts of federal funding for research and development have gone into the initial stages of the development and introduction of that technology. Such development would of course represent a major negative social policy impact.

* Woods Gordon, The Study of the Manufacturing Impact of MSAT, 1984, Dept. of Communications, Ottawa 1984.

KVA, The Impact of MSAT on the Radio Common Carrier, Dept. of Communications, Ottawa 1984.

** Econanalysis, The Overall Socio-Economic Impact Study of MSAT, Dept. of Communications, Ottawa 1984.

Support for research and development and promotion of Canadian products and services in international (mainly the US) markets stands out as the two centres of Canada's attempt at an industrial strategy. In the 1981 policy statement the targets for growth, funding and performance of research and development were established and expected to reach $5.2 billion in 1983, or approximately 1.4% of the gross domestic product. At the present time the export opportunities for MSAT remain uncertain due to the existence of competing systems, desires offoreign governments to develop internal space industries, regulatory structures and a weak international economy. Only the United States represents a tangible opportunity for exporting MSAT services and expertise at the present time.

14.0 CONCLUSIONS

This report has described in qualitative terms the expected main social impacts of MSAT on potential users and Canadian society. It has also provided an indication of the relevance of specific social impact areas to the overall MSAT program, and where appropriate, the potential magnitude, likelihood and time frame of occurrence of those impacts. The final section of the report assessed the impact of MSAT on selected policy goals and objectives for a variety of federal government programs.

Numerous social impacts have been defined along with their associated benefits. These have ranged from those closely related to economic impacts and those which are strictly speaking social and even psychological in nature. The report has also reviewed the level of occurrence for the particular sets of impacts and identified these levels in terms of the individual, organization, community and society. This organizational framework is consistent with the methodological approaches and outlines for the assessment of impacts which have been provided in the three background studies prepared prior to this report.

To a large extent, this report has used results from the other studies produced in the MSAT series, particularly those relating to the Phase A and Phase B market and user benefits studies. However, since the Phase B user benefit study was not yet available, the results have not been incorporated into this report.

Many of the social impact areas that have been discussed in-depth in this report relate to those areas defined as special markets in the Woods Gordon Phase B study. In particular, they focus on fire fighting, forest fire protection services, emergency services, disaster relief services, monitoring services and wide area paging. In many cases the anticipated market size is small and the corresponding economic benefits are somewhat restricted. In fact, these special market areas account for somewhat less than 20% of the overall projected demand for MSAT, as defined by the Woods Gordon study.

The approach taken for this social impact assessment was to try where possible to provide tangible examples of the way an impact or benefit would be manifest. The assumption has been made that in most cases the social impacts that would accrue from MSAT will not be quantifiable in dollar terms. As a result, these rather intangible impacts have been identified in a qualitative manner and are expected to represent additional benefits to those of a purely economic nature. What is most critical, however, when examining and assessing social impacts is to consider not simply the dollar quantifiable or economic aspect of the impact, but rather the overall effect on society that a particular application for the MSAT program may have. For example, a significant amount of attention in this report was directed toward the calculation of the value of compensation paid for deaths occurring in remote and rural work sites. This led to a calculated value of approximately $100,000 for a human life. While from a purely economic standpoint that calculation provides some indicator of the way MSAT may affect both commercial and non-commercial operators of mobile services, its importance lies more in terms of the avoidance of loss that will accrue with improved communication services. Thus, the calculation of $100,000 is only a reflection of part of the overall social impacts accruing from MSAT.

Impacts in this study have been defined in terms of a continuum where at one end are the economic and socio-economic impacts and at the other are the secondary and tertiary indirect impacts. Essentially these define impacts which will accrue to the public receiving services from commercial, government, private or public mobile operators. Between these two extremes are those impacts which accrue to operators and users of mobile services, whether for data, voice or combinations of each. These types of impacts would tend to be operational, organizational or perceived. The most tangible set of impacts occur in the socio-economic and organizational sectors while the most intangible impacts are ones which are not likely to be quantified or even made more tangible through a normative measure and are largely psychological. These have been discussed in each section of the report and focus in many cases on such things as perceived safety in the environment, improvements in the overall quality of life for northern, remote and rural areas, increased quality of service for mobile radio and mobile telephone, and

overall improvements in the quality of the communication infrastructure for regions outside of the main urban areas.

The approach used in this study has been to discuss each of the main application areas for MSAT -- mobile radio, mobile telephone and data -- within a broad user or market area as defined in the related studies, i.e. Woods Gordon market study, and within each of these user sectors to specify the range of impacts whether social, socio-economic or socio-psychological, and then to illustrate the presence of each type within each user area. Thus, for example, in the law enforcement section impacts were defined which included those measured on the basis of expenditures for communication services which would utilize MSAT as well as those which were measured on the basis of individual user benefits. These would include operational and organizational measures and be reflected in both effectiveness and efficiency of operations. Finally, impacts which were perceptual and psychological, such as perceived safety and perceived improvements in the ability to do a job, were defined. Discussions were provided about the overall benefits accruing to society as a result of the improvements in police services.

14.1 Summary of Social Impacts and Benefits

Table 5 presents a summary of all of the social impact areas discussed in the applications section. It illustrates the impact issues which have been identified in association with the relevant MSAT application areas, with each impact discussed in terms of its quantitative and qualitative characteristics. Much of the quantitative discussion details the associated economic and socio-economic impacts which are associated with the projected market demand for terminals, and air time. The quantitative benefits have been calculated in some instances using cost savings or loss and damage avoided, in other instances the approach has been based on the projected number of users in a particular segment of the population for the defined application area.

TABLE 5
Summary of Identified Social Impacts and Issues

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
1.	Population/ Demographics	Indirect benefits received by population Improved communications Native populations to be served by new services Quality of life improvements	1988 served population of 9.5 million Current population 6 million Rural growth 1976-81 = 8.9% 200,000 native Indians	Increased rural growth rate Increased need for services Improved access to services Natives groups to be prime users of services
2.	Communication Characteristics of Rural and Remote Areas	Improvements in infrastructure for communications Future requirements in rural areas are likely to grow and MSAT will be important in meeting these needs	1981 - 94,000 households had no phone Estimates for 2002 indicate 35% of all mobiles in the Prairies, 22% in BC, 21% in Ontario	Perceived need for improved mobile services, better coverage, higher quality equipment, improved privacy, better service
3.	Human and Social Environment of the North	Accelerated industrial and commercial growth Increased contact with southern culture Increased demand for jobs and the need for retraining Conflicts with native values and patterns of social organization as development proceeds Access to improved employment opportunities from new developments Increased extent and type of commercial operations/diversified economy	Increased welfare dependence in the past as industrial development proceeds Doubling of welfare payments in newly industrialized urban areas historically Increase crime in the NWT as industrialization increased 30% 1969-75	Changing nature of northern and remote areas Accelerated movement from a native majority to white majority Enhanced industrial development Improved employment and altered welfare dependency Social indicators may alter, eg crime, alcoholism
4.	Environmental Monitoring and Forest Fire Protection	Improved protection of the forest and wildlife resources Reduced rate of depletion of natural resources Improved ability to preserve environment Safer fire fighting services Increased capability to work in marginal areas Improved logging operations, eg transport of materials	Forest protection services demand estimated at 1,600 units by 2001 Forest industry ranks 5th in terms of expected number of mobiles by 2009 BC and Ontario account for 30%-40% of total demand	Value attached to the natural environment and wilderness experiences Unique species of plant and animal life Control of forest fire threat Improved organization and safety at work sites Perception by workers of safer, more effective operations Opportunities develop in new areas

TABLE 5
(continued)

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
4.	cont'd	Overall cost savings in expenditure of public funds Retention of the capital stock of forest resources (inventories) Frequency available for use in other disaster-related activities	Fire losses in Canada estimated at $2 billion 1974-83 Loss avoided benefit estimated at $200 million Woods Gordon estimate 1,700 terminals by 2001 for data collection	Increased safety in the operation of fire fighting and better working conditions Safer living environment for remote communities
5.	Rural Agriculture Monitoring	Ability to monitor natural hazards Assist in understanding and reacting to hazardous climatic influences Enhance the data and voice mobile services in rural areas To reduce risk to farmers for crop loss/ property loss	Hail loss was $18 million in Alberta in 1978 Estimated loss avoided benefit for agriculture $20 million per year in Canada	Increased crop values produce higher risk situations for farmers Generally increased use of technologies in farming operations, particularly communications Increased need for climatic information to reduce risk Familiarity with remote data and advanced technology services
6.	Law Enforcement	Reduced expenditures for providing law enforcement Changed requirements for upgrading and updating equipment Social effects: -increased safety -job satisfaction -effectiveness of service provision -efficiency of service operations -improved dispatch services -better service to public in defined areas/rural communities -improved reliability and quality of services to internal and external operations Socio/psychological effects: -over-reliance, better performance -increased autonomy -perceived improvements in job performance -minimal impact on existing behaviours due to technological flexibility	Demand for mobile in government services estimated at 108,000 units by 2009 Estimated communications expenditures $250 million per year (Canada RCMP) Mobile services estimated at $18 million Estimated benefits from MSAT are $18.07 million per year 2001 estimate of 14,000 mobiles in police service RCMP estimates 3,000-15,000 units	Voice and data capabilities enhance MSAT appeal to police Reduce disruption to existing operations Attitudinal and behavioral effects substantiated in field trials of related systems, eg Vancouver No major alterations in voice activity, therefore socially desirable Less reliance on the role of dispatchers and more control by individuals Increased access to remote data sources and other external sources already in place

TABLE 5
(continued)

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
6.	cont'd	More effective use of the system capacity and more efficient use of worker time Organizational effects/mgmt improved	Evidence of quantitative differences in performance of mobile equipped police units	Time utilization improved with increased system flexibility Improved allocation of policing resources and allocation of vehicles
7.	Health Care/ Ambulance and Emergency Services	Improved delivery of emergency health care Assisting in coordinating during field operations Organizational changes in service provision	Ambulance services ranked third in future use Emergency health care expenditure $300 million annually (Canada) Estimate of possible demand for using MSAT 2,500 air calls and 135,000 road calls	Necessity for the speedy delivery of trauma units to a site Increased ability to direct crews to required sites Demonstrated feasibility in rural areas
8.	Emergency Medical Services	Improved delivery of medical services resulting in more effective service Impacts in disaster relief, transport and marine services Better overall management of services Improved access to the public Positive benefits include savings in time, money, lives and property loss	In US, MSAT type services are expected to capture 30% of overall market Expenditures for services in Canada in 1982 were over $8 million Disaster claims in 1982 were $12.7 million Systemhouse estimated cost savings at $172 million and approx 550 lives would be saved each year	Coordination of activities and directing of facilities to accident sites Reactions to MSAT services for hospitals, ambulances and special rescue vehicles have been positive in field tests
9.	Pager Services	More effective health care delivery in low population density areas Improvements in the reaction to emergency situations Coordination of crews and field teams	Total pager units are expected to total between 9,000 and 45,000 by 2001	Staff access to information, messaging, recording, storing and relaying visual information all enhance service performance
10.	Rural Fire Protection	Improved response to rural fire hazards Improved volunteer worker safety Improved allocation of vehicles and services (efficiency) Reduced property loss to the public	Field trials of system reveal in the US a per person cost of $4	Access to data and fire hazard information Mobile data and voice units lead to faster response when alarms are received Reduced property loss can result in lower insurance rates and savings to owners

TABLE 5
(continued)

	Impact Issue	Impacts	Quantitative Characteristics	Qualitative Characteristics
11.	Worker Safety	Reduction in lives lost Improved work site conditions/rural and remote Lower overall expenditures for compensation claims Reduction in worker isolation Reduction in uncertainty/fear of working in remote areas	Cost of hazardous work estimated from compensation statistics Loss of life value $110,000 Wage loss $1,500 per claim 45% of recorded fatalities in 1982 occurred in rural and remote work sites In Canada over 900 lives lost in industrial activities with compensation $100,000 per life $1.25 billion paid for accident claims	Improvements in communications services will be brought about through MSAT Some proportion of current communications will be shifted Socio/psychological impacts are also likely to occur due to improved communication services
12.	Trucking and Transportation	Improved vehicle and cargo safety Deterrent to hijacking Reductions in property loss Improved driver morale and safety Potentially increased traffic More productive work time Increased employee confidence on the job Indirect benefits likely to accrue in addition to economic benefits Improved travel conditions for the general public by reducing stress Reduction in lost cargo Improved ocean search and rescue	Estimates indicate this industry to be one of the largest users of MSAT - 32% of total use with 18.2% of all voice mobiles by 2001 (44,000 units) 4,000 to 8,000 tractor trailers are estimated users of MSAT by 2001 Terminal demand in 2001 set at 15 for public transportation, 360 for ferry traffic, 180 for commercial aircraft	Trucking requires monitoring dispatch and notification for disasters and emergencies Better coordination and control by drivers Voice channels available for emergency Suitability for bus, train and aircraft have been identified Secondary benefits believed to be the most critical and are psychological in nature Reduction in stress from long haul travel, immediate notification of arrivals and departures, schedule changes Increased incidence of cargo losses due to theft and accidents
13.	Remote Site Monitoring/Oil and Gas Exploration	Reduction in hazardous work conditions Improved reliability and quality of communication services Improved reporting of disasters Safety monitoring Dispatch of aircraft Early warning of weather conditions Data transmission backup to existing services	1981 - 6,900 oil wells being drilled in Canada 6,000 to 8,000 projected over the 1983 period Estimates indicate a demand of 14% of all voice mobiles by 2001 Remote sensing would be one of the top ten commercialusers	Significant activity is related to oil exploration, natural gas extraction and pipelines Offshore and remote area activity will be increasingly important over the next 10-20 years Most uses likely to have more demand for voice rather than data Complementarity for Inmarasat and Anik

The various application areas have associated with them a number of less tangible impacts in addition to those of an economic and socio-economic nature. These constitute intangible and indirect benefits which do not lend themselves easily to quantification. As social impacts however they are extremely important and are central to defining the full range of benefits likely to result from the implementation of MSAT. These have been referred to previously as social/social psychological effects and they occur at the individual, organizational and society level depending on the particular application area being developed. In some cases these represent improvements in the quality of life such as enhancements to the communications infrastructure of rural Canada. In others they represent organizational changes in the provision of services. The indirect benefits of such organizational changes could include improved moral of workers and the improved effectiveness for providing services to the public. Improved effectiveness is generally associated with better quality services, improved access and increased availability to the public. Intangibles have also been linked to the social and psychological improvements in working conditions. Improved operating characteristics and safer work environments are two examples. Others include increased autonomy for the individual worker which it is suggested leads to improved worker performance and ultimately better service to the public. In many of the case studies cited the benefits verified by system operators tended to be these intangibles rather than those more rigorously defined by cost benefit analysis. Providing safer working environments, reducing the dependancy on dispatchers and increasing autonomy have all been viewed as positive benefits accruing from the introduction of mobile services similar to those suggested for MSAT.

Many of these social impacts represent secondary effects and therefore emphasize one of the essential features of the service namely, the property of externalities. These are benefits which accrue to individuals not directly involved in the provision of services and who may not actually use the services. Indirect social benefits accrue to individuals receiving service which may be enhanced through the MSAT operations. In most cases these are only speculative since no operational service is in place and reliance must be placed on extrapolating from analogous services.

Attention in the report has also focused on policy issues. Implications for MSAT

services have been identified for the areas of communication policy, industrial strategy, space policy, technology transfer, rural and northern development policies, agriculture and environmental protection. In each area a number of benefits likely to accrue from the incorporation and use of improved mobile voice and data services have been defined. The implementation of an MSAT program will have significant benefits in assisting the achievement of a variety of federal government policy objectives in each of these areas. In fact, plans have been drawn up illustrating the possible use of MSAT within each of the defined policy areas and where available these plans were reviewed to illustrate the degree of commitment that a particular government department may have towards the ultimate testing and subsequent use of MSAT.

The results of this study have indicated that there will be significant social, socio-economic and social psychological benefits accruing from the MSAT program to the Canadian public once implementation of the program takes place. The time frame for the impacts to occur is set within a 10 to 15 year period. As well, the conclusions from this report have indicated a number of areas which lend themselves to more formal quantification. To conduct such a quantitative study, a second phase program is now being implemented which addresses these areas in more detail. The areas that are being investigated include government services, trucking and transportation, environmental monitoring, hazard aversion, forestry operations, police and medical services. These areas will be examined within the context of providing tangible dollar quantifiable estimates of the impacts which have been discussed more generally in this qualitative report. This will serve as primary inputs for the overall socio-economic impact and benefit study of MSAT.

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