World Transport Policy & Practice
Transport in Israel and the Palestinian Territories
Guest Editors: Yaakov Garb (*Transport-Today and Tomorrow*) with Elaine Fletcher

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Abstracts and keywords

Road Transport, Environment and Social Equity in Israel in the New Millennium

Elaine Fletcher
Keywords: Environment, equity, Israel, road transport, society
Israel stands at a crossroads, culturally, socially and environmentally. It is choosing to pursue the same car-based land use and transportation model which has failed to deliver social cohesion in Europe and the U.S.A. This paper identifies the present-day trends that are reshaping Israel's physical space at the turn of the millennium. It then explores the impact of these transport trends on Israeli society.

The status of transportation in the West Bank

Hanna Maoh and Jad Isaac
Keywords: Bypass roads, dual transportation system, emissions, Jewish settlements, land-use planning, motorisation, Wadi Al-Nar, West Bank.
This paper examines the basic features of the transportation system in the West Bank from a Palestinian perspective, and discusses the dilemmas, both present-day and future, that must be confronted now by planners as Palestinians gain control of West Bank land resources, and create a contiguous political entity where transportation and land use planning will be possible. The paper presents basic data from new research on travel modes, trip destinations and motorisation that until recently was unavailable on Palestinian travel. It describes the factors contributing to increasing congestion and air pollution in the region, particularly in Palestinian urban areas. The legacy of the Israeli-Palestinian political conflict on the system's development is explored, particularly the profound impacts induced by the widespread Israeli construction of 'bypass roads' linking West Bank Jewish settlements. Finally, the paper discusses the potential for creating a more sustainable transport and land use system in the future, in light of problems such as land scarcity and increasingly high population densities.

Responses to parking restrictions: lessons from a stated preference survey in Haifa and their policy implications

Yoram Shiftan
Keywords: Carmel, central business district, Haifa, parking, public policy, commuting, travelling
Parking and its management are key tools in managing traffic. The key is to balance the conflicting interests of business who see parking as vital for customers and commuters who cannot as easily switch destinations or journey times. This paper presents the results of a stated preference survey of drivers in Carmel Center.

Exit or voice? The prospects for public transport user representation in Israel

Meira Hanson
Keywords: Consumer choice, public transport, user group pressure.
There is a persistent crisis in the Israeli public transport system. While the government's agenda for recovery is to introduce more competition to the main service providers, this may not necessarily guarantee an improved quality of service for the user. Currently, the only way in which users can express dissatisfaction at declining quality of service is through 'exit' – abandoning the service, most often in favour of private car use. This article sets out to introduce another option neglected so far by service providers and government alike: granting 'voice' to users via representation in the decision-making and operation of public transport services. To this end, several examples from abroad are brought to bear on the Israeli scene, and possible scenarios for change are considered.

Do telecommunications reduce industrial uses of transportation? An international comparative analysis among Israel, North America and Europe

Pnina Plaut
Keywords: Telecommunications, North America, Europe, complementary effect, substitution effect.
There is a long-running debate about the relationship between transportation and communications. One issue is whether the two services behave as substitutes or as complements. This is important because substitution implies that advanced telecommunications induce a reduction in the need for transportation and the seriousness of transportation system problems. While most research has examined the relationships for commuters and individual travellers, the bulk of transportation and communications services are in fact used by industry.

It is shown that the pattern of complementarity detected in earlier research for Europe is also found in non-European locations, despite their very different conditions. This indicates that complementarity is robust and not dependent on a specific set of geographic conditions, infrastructure or level of development. All of this implies that expectations regarding the ability of telecommunications to reduce travel as well as the negative impacts and environmental costs of transportation may be unfounded.

Editorial

This issue is about transport problems and dilemmas in Israel. It is about the critical choices that have to be made in that country as all its citizens come to terms with a troubled past and an opportunity rich future. Transport problems have risen to the top of the political agenda in this country and the transport discussion is a coded discussion about Jews and Arabs, about disputed territories and about democratic and inclusive processes of government.

It is very appropriate that we zoom in on this part of the world as the world prepares to celebrate the 2000th anniversary of the birth of Christ. Whilst this is significant we all need reminding that its significance is not as clear cut for the adherents of non-Christian faiths. We live in a multi-cultural and multi-faith (including non-faith) world and this anniversary is an opportunity to reflect on what progress we have made in mutual understanding in the past 2000 years and what we can do to advance this process in the next 2000 years.

The transport policies of Israel tell us a great deal about this progress or lack of it. The articles in this special issue make clear the preferences of this government for a substantial new highway that will do very little to advance the cause of understanding in Israel or even the cause of efficient, high quality accessibility. It will damage the hugely important archaeological and biblical heritage of this country (a fine way to celebrate this particular anniversary), it will damage Arab communities, it will damage the future spatial development of this small compact country and it will trigger a huge lurch into the energy intensive, dispersed settlement pattern, polluting and climate change damaging world of fossil fuel mobility. The Israeli government have chosen to mark the expiry of the 20th century with a huge monument to poor quality thought, environmental destruction and damaged communities. All this, of course, is possible because of the lack of mutual understanding. There is no understanding of the importance of history, heritage and continuity, no understanding of the sense of place in the psychology of Israeli citizens and no under-standing of the hurt and damage done to communities.

Israel is not alone in this energetic pursuit of self destruction. The vast majority of countries in the world have grandiose plans for road building. Many of these plans will not see the light of day but some will. Those that do materialise will be monuments to the 20th century's love affair with fossil fuels, mobility and speed. All we can hope as we move into the 21st century is that we can learn to appreciate the worth and delight of our own communities, our own landscapes and our own places. Of course we will still travel but travelling for the privilege of sharing in the delights of someone else's community and place is a totally different activity from the daily, frenzied time compressed experiences we now call travel. The 20th century has seen the conquest of space through the destruction of time. We are now running out of space and time and all we are left with is polluted minds.

John Whitelegg
Editor
World Transport Policy & Practice

Introduction

On learning from – rather than repeating – the mistakes of others

Israelis have an ambivalent and at times obsessive relationship to Israel's singularity, or lack of it. Transport professionals are no exception. Almost no serious transport debate in Israel fails to invoke the question of what 'overseas experience' can or cannot tell us. The use (and misuse) of 'there' to make a point about 'here' is sometimes maddeningly uncritical, even cynical. Transport conservatives draw on Israeli exceptionalism when it comes to importing some sustainable model ('Oh, Israelis will never do that'), and in the same breath insist that Israel is 'just another Western country' when it comes to the need for highways or the 'inevitable' rise of motorisation rates with rising levels of income.

The essays in this special issue of *World Transport Policy & Practice* reflect this preoccupation with the general and the specific in Israel's situation. But they are eager to draw on good practices even where these evolved in highly particular settings, and to refuse bad ones even when these are ubiquitous. Israel has a real, though diminishing, opportunity to leapfrog over common but outmoded practices, since it is motorising and arriving at some major transport investment decisions decades later than many developed countries.

For example, in the first years of the 21st century, the country will make critical decisions about if and how to it is to rehabilitate its public transport services. Currently, these consist almost entirely of urban and interurban diesel buses. As lines were added and lengthened piecemeal over the decades in which Israeli cities grew several-fold, their layout is un-hierarchical (scores of lines converge on the same city centre streets), inconvenient for many trips, and difficult for the uninitiated to comprehend. The density of buses in city centres renders main thoroughfares into noisy polluted 'diesel alleys' that provide little attraction for pedestrians. Most important, buses seldom enjoy independent right-of-way, so that their travel times within cities are slower than cars and thus unreliable. It is no wonder that bus services, which not so long ago carried $^2/_3$ of all travel in the country, have been losing 2%+ of passengers every year for the last 2 decades.

The two bus companies that have almost complete control over all services and enjoy large government subsidies have been loathe to fundamentally alter their operating procedures. The Ministry of Finance is eager to privatise this system, but with an eye toward using competition to reduce salaries and increase efficiency (thus lowering subsidies), rather than building a public transport system that serves its users well enough to end plummeting use.

Rail could complement buses by providing the separate right-of-way necessary for competitive travel times, thus serving the large volumes of travellers in main commuting corridors and boosting the image of public transport. However, until very recently, the Ministry of Finance has been highly skeptical of rail, preferring the smaller up-front investment of a somewhat improved and privatised bus system. Decades of such skepticism, combined with bureaucratic fragmentation, have created a situation in which Israel's rail network today is basically a degenerated subset of the lines it inherited from the British and Turks in 1948, and it is one of the very few countries whose capital (Jerusalem) lacks an active rail link and has no internal rail service of any kind. Despite existing rights-of-way and high building densities that could favour rail, Israel's abbreviated network carries less than 1% of journeys. No political actor has had the foresight and determination necessary to implement the plans for urban light rail, commuter rail and improved inter-urban rail connections which have been on the shelves for decades. Recently, the Ministry of Finance seems more cognizant of the importance of rail, and we can hope that this produces not simply one more refurbishment of ageing plans, but a genuine, massive and rapid turnaround.

Israel urgently needs best practices to unseat road-building as the core of its transport planning. For example, in the very last months of this century, the country signed the financing package for construction of the massive and misguided Trans-Israel Highway. If this proceeds, Israel will enter the next millennium hampered with the construction of a $1.2 billion highway running through its most rapidly suburbanising heartland. We know enough from other places to anticipate the impacts of this superhighway, the half-dozen additional major connecting highways necessary to link it to Tel-Aviv-Jafo, the further 100+ kilometre north- and south-ward extensions now being planned, and the car-dependent peri-urban sprawl these are sure to encourage. Taken together, especially in such a tiny country, they will constitute a nigh irreversible blow to the prospects of a sustainable transport system. Israel's particular circumstances make such indiscriminate repetition of common mistakes particularly disturbing. As several of the essays in this issue attest, with such high population densities, so little land to spare, and so many other spheres in which it faces challenges, we have far less margin for error than most countries. Best practices are not a luxury, but imperative.

On planning and politics

In the mind of most readers of this journal, Israel/Palestine is most familiar for its turbulent politics. And since

mobility and political power are so intimately related, this turbulence leaves traces on the region's transport system as well. In organising and giving differential access to space, transport modes and networks serve and bolster certain sectors of society at the expense of others. Political aspirations and social blind spots are built into transport projects, whether new highways to serve Israel's commuting middle class, or a ring road to serve the new neighbourhoods built to preserve a Jewish demographic advantage in Jerusalem. Nowhere is the politics/mobility link less subtle than in the Occupied Territories.

When these territories (such as the West Bank, then under Jordanian control), were captured by Israel in 1967, they contained a sparse road system like that of other developing countries in the region. Subsequent modifications were heavily shaped by geopolitical motivations. From Israel's point of view, new roads bolster its control, ease movement, and enhance the territorial contiguity of the occupied areas with Israel proper. From the Palestinian point of view, the roads negate the possibility of autonomous control, restrict movement to precisely the bounds set by Israel, and fragment the territories beyond recognition.

Thus, road planning and the maintenance of occupation have been inseparable; movement in and to the Territories is always fraught with political tensions, as the repeated car-stonings, closures, road-block incidents, or car-bombs attest; and key elements in the current Oslo negotiations revolve around the management of mobility (the opening of a port and airport for Gaza, for example, and of a safe passage between Gaza and the West Bank). In such a context, the notion of 'sustainable transport' would seem a dispensable luxury! This would be a loss. Self-determination, justice, and reconciliation must be made visible as essential components of the commitments to environmental integrity and future generations usually connoted by the term sustainability.

On humility for the next millennium

The context (perhaps pretext) for this special issue is the millennium. The date prompts reflection: on the passing of an era, on where we are headed, on new beginnings, on the values signified by the life of a man born in Bethlehem some 2000 years ago.

Curiously, while momentous for Christians in Israel and abroad, the millennial overtones of the year are less pronounced in the contemporary 'Holy Land', where the large majority of people are Jewish or Moslem. Yes, almost everyone here relies on the Gregorian calendar, and the chance for a party has trans-sectarian appeal, but for most, 2000 CE has little theological significance. The closest thing to a Jewish millennium would be sometime in the autumn of 2239, marking 6000 years after the completion of the world's creation. Moslems will wait even longer for their millennium, as their new year, which fell last April, marked 1420 years since the Hijra (the prophet Mohammed's departure from Mecca to Medina).

Because of this, perhaps, and with much millennial reflection already taking place, I would like to offer only a more mundane, minor kind of stocktaking: of our capacity to plan.
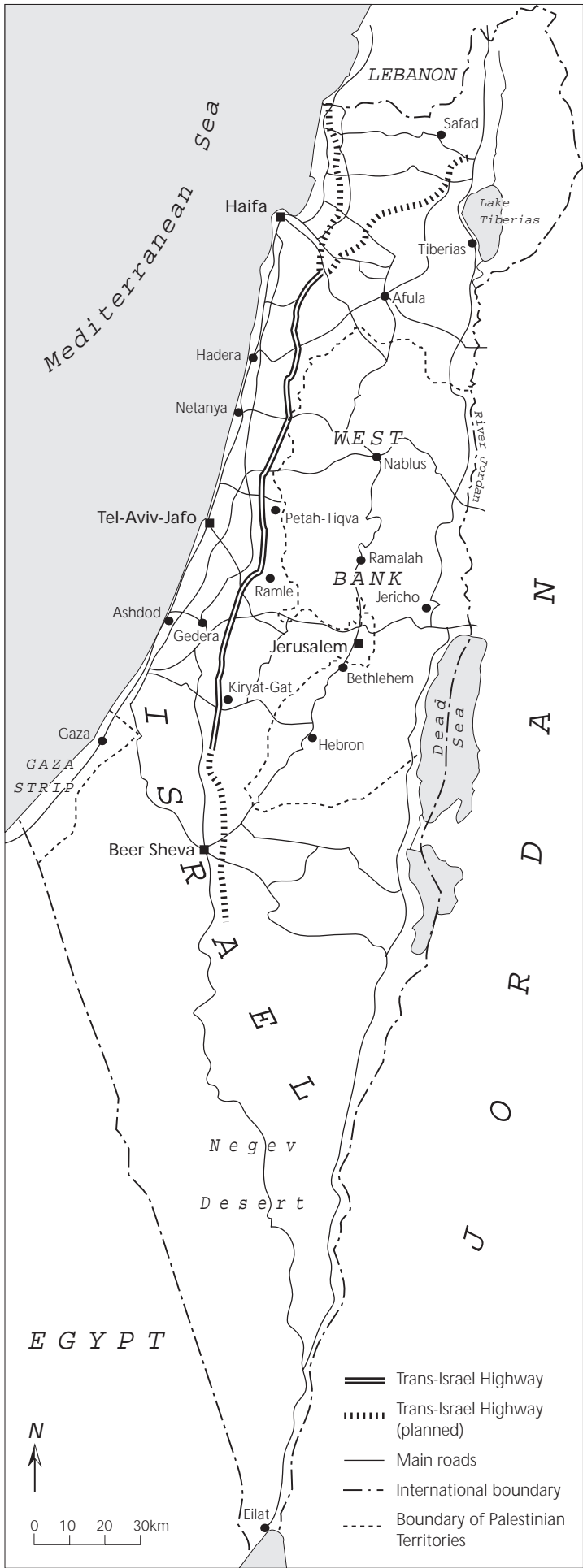
What, after all, is more reliable than the steady passage of time? What is more widely known and unequivocal than the coming of the year 2000, and the precise date of its occurrence? Every calendar in the world is a reminder of our progress. And yet, one of the century's most expensive fumbles, the Y2K bug, is the failure to reflect this surety in the very heart of our most sophisticated of technological achievements: the computer.

On a less global scale, the Israeli government has known for years that the millennium will almost surely bring a massive influx of tourists. Yet, the month before the year's advent finds it still scrambling to build hotel rooms and prepare airports for the anticipated loads, losing tourists because they aren't in place, while efforts to co-ordinate a joint Israeli-Palestinian response to the environmental challenge of this influx are in shambles.

It is good that these beacons of technological and organisational fallibility so clearly mark the threshold to a new millennium. They warn us how hard it is to do things properly, even when it comes to processes far less complex, and eventualities far more predictable than those we face on social, health and ecological fronts. As we end a century in which technological hubris has tested the tolerance of the ecosystems that support our wellbeing to their limit, these beacons should colour our plans for the next one, so that they emphasise carefulness, reversibility, incremental steps, and wide margins for the unexpected.

Yaakov Garb
Transport-Today and Tomorrow
(The Israeli Organization for Sustainable Transport)
1 Yavneh Street
Tel Aviv
Israel
ygarb@cc.huji.ac.il

Map of Israel and the Palestinian Territories

Legend:
- Trans-Israel Highway
- Trans-Israel Highway (planned)
- Main roads
- International boundary
- Boundary of Palestinian Territories

Map labels: LEBANON, Mediterranean Sea, Safad, Lake Tiberias, Haifa, Tiberias, Afula, Hadera, Netanya, WEST, Nablus, River Jordan, Tel-Aviv-Jafo, Petah-Tiqva, Ramalah, BANK, Ramle, Jericho, Ashdod, Gedera, Jerusalem, Bethlehem, Kiryat-Gat, Gaza, GAZA STRIP, ISRAEL, Hebron, Dead Sea, JORDAN, Beer Sheva, Negev Desert, EGYPT, N, 0 10 20 30km, Eilat

Note: The boundaries on the maps in this issue of the journal do not imply that they are accepted by all parties or that they are internationally recognised.

Glossary

The area described over two millennia by western pilgrims and travellers as simply the 'Holy Land' - today embraces a remarkable diversity of ethnic and religious groupings under the umbrella of two modern-day national identities- Israeli and Palestinian.

Yet in the politically charged atmosphere of the Middle East, the very naming of political entities and cultural groupings often implies a political bias. This edition has generally sought to steer as neutral a course as possible by using definitions that are common currency in most international journals and reference materials. However, some clarifications of terminology are essential:

The West Bank and Gaza

Nearly 2.9 million Palestinian Arabs live in the area of the West Bank and Gaza, which together encompasses a little more than 6,000 km² of land. Prior to 1967, the West Bank, which cradles the mountain regions just west of the Jordan River, was under Jordanian control. The Gaza Strip, along the Mediterranean Sea near the Sinai Peninsula, was under Egyptian authority.

The overwhelming majority of the West Bank and Gazan Palestinian population is Sunni Moslem, while a small but significant minority - roughly 2% - are Christians belonging to some of the most ancient sects in Christendom - including Greek Orthodox, Latin (Catholic) and Armenian. Anglicans, Lutherans and other smaller Protestant denominations are also represented, however, within Palestinian Christian society. Most Palestinian Christians live in and around the area of East Jerusalem and Bethlehem, in the towns and villages associated with the major events of Christianity.

Currently, most urban areas of the West Bank and Gaza are under the jurisdiction of the Palestinian Authority, which was created as a result of the 1993 Oslo Peace accords. But the majority of the West Bank's territory remains under partial or total Israeli military control, pending the outcome of peace negotiations now underway. The Palestinian Authority aspires to create a sovereign state within the broad area of the West Bank and Gaza - including Arab East Jerusalem. Some 170,000 Palestinian Arabs live in East Jerusalem, which is regarded by the international community as a part of the West Bank, but was annexed by Israel after 1967. Nearly 300,000 Israeli Jews live in East Jerusalem and in West Bank settlement communities, communities whose presence is disputed politically by Palestinians.

Israel

Israel's pre-1967, internationally-recognised borders encompasses 20,770 km² (1). Standard Israeli statistical references, however, typically refer to Israel as spanning 21,946 km² – including the 1,176 km² of the Israeli-occupied Golan Heights, where Israeli civil law has been extended; and about 70 km² of East Jerusalem which, unlike the rest of the West Bank, was formally annexed by Israel after the 1967 Arab-Israeli war.

However defined, Israel encompasses a wide range of national and ethnic groupings. Most hold Israeli citizenship- although the Arab-Druse residents of the Golan Heights and the Palestinian Arabs of East Jerusalem have generally refused citizenship rights due to the disputed status of the territories in which they are living.

About 80% of Israel's 6.16 million citizens today are Jewish. But three-quarters of those Jews are either themselves immigrants, or the first generation offspring of immigrants. Ethnically, Israel's Jewish population is almost evenly divided between east and west. Roughly half of Jewish Israelis trace their ethnic origins to the Asian countries of Iraq, Iran, Turkey, Yemen, and even as far as the Indian subcontinent, as well as to the North African countries of Morocco, Tunisia, Algeria, Egypt, Libya and Ethiopia - cited here in descending order of numerical importance. The other half of the Israeli Jewish population is comprised of emigrants, or the descendants of emigrants, from the former USSR, Poland, Romania, and Germany, and in smaller numbers from elsewhere in Europe, the Americas, and Australia.

About one-fifth of Israelis citizens today are of Palestinian Arab origins - although precise self-definition depends on a complex web of ethnic and religious affiliations. About 9% of the Israeli Arab population identify themselves as Druse, members of a secretive offshoot of Islam whose adherents are scattered throughout the Galilee region of Israel, Lebanon, Syria and the Israeli-occupied Golan Heights. Another 6% of Israeli Arabs identify themselves as Beduin, descendants of semi-nomadic tribes which roamed the desert regions of the Holy Land for centuries. Some 15% of Israeli Arabs are Christians, living primarily in the Galilee areas historically associated with Christianity, such as Nazareth. Israeli Christians, like their West Bank counterparts, are primarily Greek Orthodox in practice, although Catholic, Armenian, Anglican, Lutheran and other Protestant evangelical sects are also represented. Israeli Arab Muslims and Christians have familial ties to Palestinians in the West Bank and Gaza, as well as to Palestinian refugees living elsewhere in the Middle East. Israeli Beduin tribes, likewise, are related to clans in the West Bank, Gaza, Jordan and Egypt. Druse Israelis, meanwhile, have family ties to clans in the Golan Heights, Syria and Lebanon.

Against this kaleidoscope of cultures, attempts to create a standard terminology defining overlapping ethnic, religious and national affiliations is generally a politically-charged endeavour – and one almost as challenging as the ongoing political negotiations over land and territory.

(1) Economic Commission for Europe (1995) *Annual Bulletin of Transport Statistics for Europe and North America* United Nations, Geneva.

Elaine Fletcher

Road Transport, Environment & Social Equity in Israel in the new millennium

Elaine Fletcher

Freelance journalist, formerly at the ADVA Equity Institute.

Address for correspondence:
E-mail:
fletch@netmedia.net.il

Abstract

Israel stands at a crossroads, culturally, socially and environmentally. It is choosing to pursue the same car-based land use and transportation model which has failed to deliver social cohesion in Europe and the U.S.A. This paper identifies the present-day trends that are reshaping Israel's physical space at the turn of the millennium. It then explores the impact of these transport trends on Israeli society.

Keywords

Environment, equity, Israel, road transport, society

Introduction

Israelis have only recently begun to experience the severe problems of congestion, pollution and sprawl that have plagued Europe and the United States of America over the past several decades of automobile-oriented development. Yet in tiny Israel, a country that is roughly half the size of the Netherlands, today's rapid pace of road-oriented development is profoundly reshaping the country's urban centres and rural countryside, as well as redefining lifestyles and patterns of social equity. Significantly, the modern Israeli state is built upon an ancient landscape with inestimable cultural, historical and religious significance to Jews, Muslims and Christians around the world. Transport decisions being made now, in a period of high population growth, will determine how much of the historic 'Holy Land' will be preserved for future generations – or whether much of it will be submerged in a sea of car-dependent sprawl.

In today's reality, such a possibility is no longer hyperbole. This paper identifies the present-day trends in population growth, motorisation, pollution, congestion and land development that are reshaping Israel's physical space at the turn of the millennium. Secondly, this paper explores the impact of these transport trends on Israeli society – which is undergoing a shift from the socialist-egalitarian ethic of its early days to a privatised economy characterised both by new personal wealth and a growing gap between rich and poor.

Development Options – Los Angeles or The Netherlands?

Israel's jurisdiction today extends over some 21,946 km² of land – not including territories occupied by the military administration in the West Bank and Gaza. (This figure does include 1,176 km² of land in the Israeli-occupied Golan Heights and 70 km² in Israeli-occupied East Jerusalem – where Israeli law applies today. This figure reflects the present-day dimensions of Israel for day to day planning purposes, and not an opinion vis-à-vis what the fate of these lands should be in Arab-Israeli peace negotiations. Inclusion or exclusion of these lands does not significantly alter the thesis and conclusions of this paper.) To appreciate the small size and delicate nature of the available land resources, it is useful to note that both Denmark and the Netherlands encompass land areas of over 40,000 km², roughly twice Israel's size. As another yardstick, consider the Los Angeles metropolitan region which lies within the borders of the South Coast Air Quality Management Region of California. It comprises some 35,000 km² – an area 62% larger than Israel.

Israel's population growth rate, meanwhile, averages about 2.4% annually, a rate on par with many developing countries and nearly three times the average of the U.S.A. or many European nations. With a population of about 6.1 million today, Israel's projected population for the year 2020 is 8 million people – yielding an average density of 364 persons/km². Already today, population densities north of the sparsely populated Negev desert region, which comprises more than half of the state's area, average 600 persons/km². By way of comparison, population densities today in the Los Angeles region average about 314 persons/km². Densities in the Netherlands and Denmark are about 373 and 120 persons per km² respectively.

Given Israel's growth and density forecasts, it should be clear that this Middle Eastern state is facing a crisis of land resources. And

government transport policy will play a crucial role in determining whether the face of this historic landscape in 2020 will resemble the Los Angeles region with its unbroken stretches of suburbs, highways and strip malls – or the Netherlands, where development is now being encouraged along urban and interurban rail and public transport lines, and in more compact, pedestrianised urban clusters.

Presently, policy has followed the lines of the Los Angeles scenario. Suburbanisation of the countryside is widespread – spurred by the government's own initiatives encouraging kibbutzim to sell off unprofitable agricultural land to real estate speculators, land that is rapidly being transformed into highway hypermarkets, business parks and residential suburbs dependent almost entirely on car access to services. Government transport investment until now has been centred largely around development of an improved national road network – with the planned Trans-Israel Highway running the length of the country from Be'ersheva to the Galilee as the system's linchpin after the year 2000. While highway construction has accelerated, the bus system has been in decline and the development of urban rail systems have been mired in bureaucracy. The extensive British-era interurban rail system has suffered from a chronic shortfall of government funding for decades – slowing the pace of much needed modernisation of vital routes. Last year the rail link between Jerusalem and Tel-Aviv-Jafo, Israel's two most important cities, was closed indefinitely after years of deterioration, due to government unwillingness to undertake safety repairs on the tracks.

Health impacts of projected trends

While motorisation rates remain low by European standards (240 cars/1000 residents), the relatively high density of traffic in Israel's tiny land space has contributed significantly to the generation of ambient air pollution levels that are now roughly on a par with seriously polluted urban areas of the U.S.A., such as New York, Newark, New Jersey and Los Angeles. The figure of 240 cars per 1000 residents is calculated including one third of the fleet of commercial vans/small trucks under four tons. Such commercial vehicles are commonly purchased by individual Israelis as business tax writeoffs, but are often used primarily for private household transport. This formula, which increases the car motorisation rate by about 15%, was devised by the Trans Israel Highway Co. in their national transport assessments and forecasts. We have maintained the same practice in order to make consistent comparisons of motorisation, as well as to reflect the reality of vehicle use in Israel today.

Ozone pollution drifts westward from the Mediterranean coast impacting on the West Bank and Jordan. Average PM_{10} levels in Tel-Aviv-Jafo and Jerusalem appear to be on a par with the average in the Los Angeles region. It is important to note, however, that precise, up-to-date comparisons have been hindered by inconsistent patterns of readings, differing Israeli, European and American measurement techniques, and the absence of a nationwide Israeli air pollution monitoring network – which is only just now being established.

Transport emissions are regarded as a major pollution factor – accounting for roughly 90% of Carbon monoxide (CO) emissions and 32-43% of Oxides of Nitrogen (NO_x) emissions in Israel. Despite new efficiencies in engines, NO_x and particulate emissions can be expected to increase even further in the coming two decades in a 'business-as-usual' scenario – in which there will be a very significant increase in car and truck travel. In the mid-1990s, planners of the Trans-Israel Highway projected that Israel would experience a 266% increase in kilometres of private car travel by the year 2020; a 207% increase in truck kilometres and a 153% increase in bus kilometres. Between 1992 and 1997, actual vehicle travel grew at an even faster rate (about 17.6% higher) than those

Table 1: Maximum recorded Ozone levels (1990/1991)

	City Ozone: Parts Per Billion (Israeli Standard -120 ppb)	U.S. EPA Pollution Rating Measure
Los Angeles (1994)	240	Extreme: 2nd highest average
Ceasarea (1993)	200	Severe: Highest $^1/_2$ hour average
Jerusalem	180	Serious: Highest $^1/_2$ hour average
New York	180	Serious: 2nd highest average
England 4/8/90	169	Serious: Highest nationwide average since 1984
Newark, N.J.	140	Moderate: 2nd highest average
Gush Etzion, West Bank	133	Marginal-Moderate: Highest $^1/_2$ hour average
Pittsburgh, PA	120	Marginal: 2nd highest average

Note: 1.91 ppb = 1 μg/m³. EPA readings are typically averaged in one-hour sequences, rather than in half-hour sequences as in Israel. Ozone readings for Ceasarea were measured in five minute averages daily between May and October, 1993. The maximum daily five minute average was in excess of 230 ppb, yielding an equivalent value of about 200 ppb for a half-hour measurement period.
Sources: U.S. EPA 1991, 1994, 1995; Statistical Abstract of Israel, 1991; Luria & Peleg, 1994; Alper-Siman Tov & Peleg, 1996.

Table 2: Particulate pollution in selected cities in Israel and the US (PM$_{10}$s in µg/m^3 of air, annual average)

Tel-Aviv-Jafo (centre)	56 (1996)
Los Angeles	48 (1992)
Jerusalem	47 (1991)
Newark, NJ	37 (1991)

Sources: Ginsberg *et al.,* 1998; Ben Ami, 1992; South Coast Air Quality Management District, California, 1992; U. S. EPA, 1991.

projections. A model which considers these travel trends and projections, as well as the composition of the vehicle fleet and projected pollution emissions for new European vehicles in the coming two decades, was developed in the context for a longer study. It yielded projections of a 187% increase in vehicle NO$_X$ emissions and a 45% increase in vehicle particulate emissions between the year 2000 and 2020. CO emissions, however, would decline due largely to the near universal application of catalytic converters on gasoline engines. (Fletcher, Ginsberg & Garb, 1999).

A major factor in the increased emissions is the increasing dependence of the Israeli fleet on small diesel trucks and diesel automobiles – a trend which offsets some of the pollution savings enjoyed from the introduction of catalytic converters for gasoline vehicles.

Already today, diesel vehicles account for a disproportionate share of health-damaging pollution from particulates and NO$_X$. Although

Table 3: Transport emissions in Israel (thousands of tons/year)

Year Particulates	Carbon monoxide (CO)	Nitrogen Oxides (NO$_X$)	PM$_{10}$s	Total
1996	487.5	91.3	4.61	4.79
2000	400.1	92.1	3.92	4.07
2010	312.0	125.9	4.25	4.41
2020	325.0	172.7	5.69	5.91

Source: Fletcher, Ginsberg & Garb, 1999

Figure 1: Vehicle travel per km^2 – 1993 and 2010

Source: Fletcher, Ginsberg & Garb, 1999

diesel vehicles accounted for only about 17% of the travel on the country's roads in 1996, they accounted for an estimated 59% of emissions of NO$_X$ from land transport sources, and about 81% of the particulate pollution. (Fletcher, Ginsberg & Garb, 1999).

Comparing European and Israeli transport trends – an environmental perspective

Conventional assessments of Israeli transport trends stress the country's low, but rapidly rising motorisation rate as well as the high rate of cars per kilometre of road space – as an underlying thesis mandating major road construction over the coming two decades. Indeed, during the early years of Israel's existence, austerity measures sharply limited the import of cars with motorisation rates rising sharply from the mid-1980s. As of 1997 the country still had only 234 cars per 1000 inhabitants. Current projections, however, forecast that today's 1.6 million vehicle fleet will more than double in size by the year 2020, and the motorisation rate will climb to about 450 cars per 1000 Israelis. However, the accepted profile of Israel as a country with relatively 'few' motor vehicles compared to European countries and thus a wide open horizon for more vehicle growth is grossly misleading – considering Israel's high population density, travel mode mix, small geographical size, and current rates of pollution. A more realistic analysis of conditions would also consider the following points:
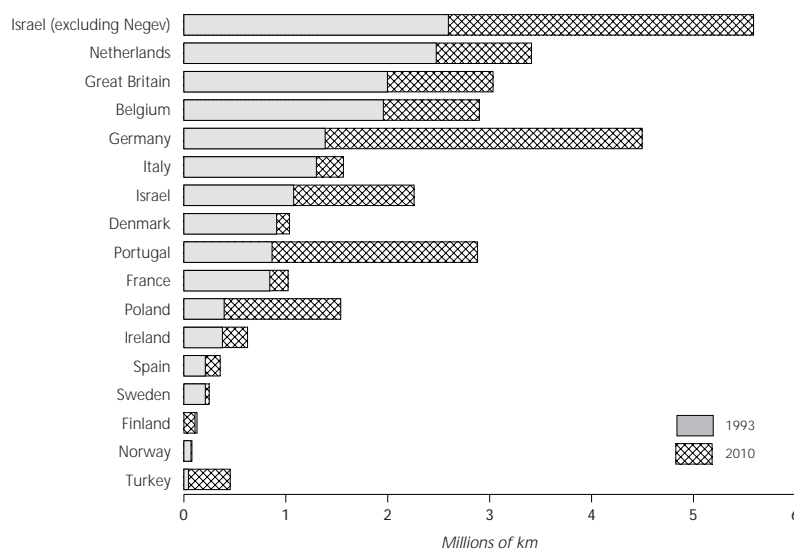
- The amount of vehicle travel in Israel per km^2 north of the sparsely populated Negev desert area already exceeds that of every country in Western Europe. (Fletcher, Ginsberg, Garb,1999)

- A lower proportion of Israelis travel via what could be described as 'clean' modes of transport relative to their counterparts in small European countries such as Denmark and the Netherlands, which are most comparable to Israel in terms of size and population density. Despite Israel's flat coastal corridor and good-weather conditions, travel by bicycle is estimated to comprise less than 1% of total travel, as compared to 7% – 8% of total passenger kilometres travelled in both Denmark and the Netherlands. Train travel, regarded as another 'clean' travel mode, comprises only 1% – 2% of passenger kilometres travelled in Israel, as compared to 7% –
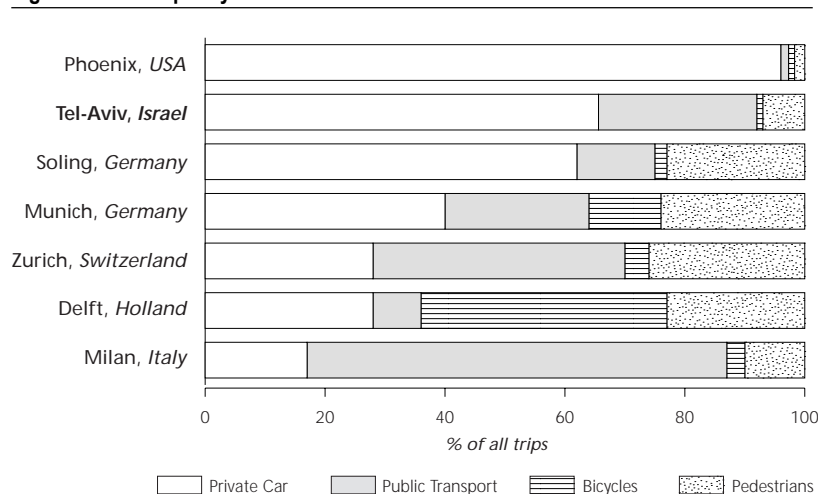
11% of passenger kilometres in the Netherlands and Denmark. In Israel, diesel buses, which are a significant source of NO_x and particulate emissions, are the dominant public transport mode.

Figure 2: Travel modes in three countries
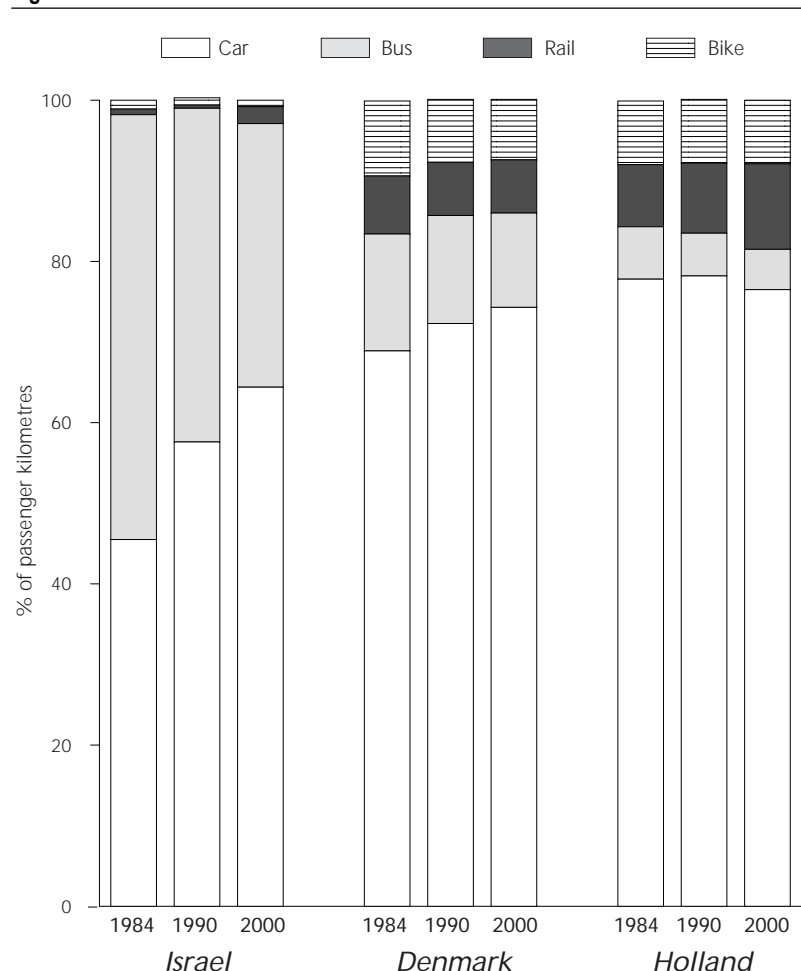
Source: Fletcher, Ginsberg & Garb, 1999

Figure 3: Modal split by selected cities

Source: Fletcher, Ginsberg & Garb, 1999

- While car ownership per capita in Israel overall remains lower than in most European nations, car ownership in major Israeli cities such as Herzliya, Ramat Gan, Haifa and Tel-Aviv-Jafo, has climbed so dramatically that it already meets or well exceeds motorisation rates in major European cities such as Rotterdam, Dublin and Copenhagen. In terms of the modal split, Tel-Aviv-Jafo, in particular, could be described as more automobile-dependent than major European cities such as Munich, Zurich and Milan. In the European cities, a larger proportion of trips are via public transport or pedestrian networks. (Fletcher, Ginsberg & Garb, 1999; ECMT, 1996; Trans-Israel Highway, 1994)

- Pedestrian networks in Israel are poor and deteriorating, and cycle routes are largely non-existent in an era when sustainable transport investment should call for a shift of travel into non-motorised modes. The absence of data on pedestrian travel reflects the overall neglect of the Israeli system by transport planners. Available statistics are cited here. For instance, between 1984 and 1993, the proportion of Israelis who walked to work declined from about 20% to about 10%. (Trans-Israel Highway Co., 1994). In Jerusalem, a compact city in which public transport use is relatively high, the percentage of all residents who walked or cycled to work totalled only 8% in 1996. (Jerusalem Transport Master Plan, 1996.)

- At a time when certain European countries like France and the Netherlands are seeking controls or bans on out-of-town shopping malls, Israel is rapidly developing commercial hypermarkets along formerly rural highway sites, often on former agricultural lands of kibbutz and moshav collectives. The parallel development of car-dependent, single family housing tracts in former rural areas has made the rural sector of Israel the fastest growing population sector today, while older cities stagnate. The consequent sprawl is reflected in a sharp increase in the rate of cross metropolitan travel within the Tel-Aviv-Jafo metropolis, and a decline in travel within local communities (which could more easily be accomplished by foot or bike). Between 1984 and 1994, trips within hometown communities declined by 59%. (Trans-Israel Highway Co., 1994)

Infrastructure development

Over 90% of Israel's transport infrastructure investment is in roads – at a time when priorities in many European countries of comparable size are shifting towards investment in rail.

Public policies that keep fuel costs exceedingly low also can be credited with spurring vehicle travel throughout the past decade. In 1998, the cost of gasoline within Israel was roughly 15% – 20% lower than in western Europe. Diesel fuel was sold on the Israeli market at only about one-third of the European price – with the major difference being the lower rate of tax assessed on fuel by the Israeli government. As of late 1999, however, there were signs that the price of diesel fuel is destined to rise at least moderately, due to a decision by Israel's Ministry of Finance to raise diesel fuel taxes as a revenue-generating measure. It is expected that in the near future Israeli diesel fuel prices would be roughly 45% of the European price.

Table 4: Investment in transport infrastructure (1995)

	Roads	Rail	Total	Currency
Israel	2,775.0	254.2	3,029.2	million shekels
	91.6%	8.4%	100%	
Netherlands	776.0	948.0	1,724.0	million NLG
	45.0%	55.0%	100%	

Sources: Ministry of Transport (The Netherlands) 1995; Ministry of Transport (Israel) 1996.

Table 5: Gasoline prices per litre in Israel and six European countries - September 1998

Type	In Israel	Six-country average	Israel/Europe ratio
Super Premium 98	$0.88/litre	$1.12/litre	78%
Unleaded 95	$0.88/litre	$1.03	85%
Diesel (Jan. 1996)	$0.26/litre	$0.78/litre	35%

Source: Israel Ministry of Energy and Industry, 1998

Social and land use impacts of present Israeli policy

In terms of access to cars, broad social gaps exist within present-day Israel. The number of cars per capita in the affluent Tel-Aviv-Jafo suburb of Herzliya today is almost four times that of the Arab Israeli city of Umm El Fahm or the town of Ofakim, populated largely by the descendants of North African Jewish immigrants who arrived in Israel in the 1950s and 1960s. Moreover, a district by district analysis of the projections generated by the Trans-Israel Highway project reveal that the car ownership gap between Israel's rich and poor communities will likely persist – even if motorisation rates more than double by the year 2020 in a business-as-usual scenario.

Motorisation rates in the relatively deprived

Jewish and Arab Bedouin districts of the northern Negev desert would average 345 cars per 1000 residents, as compared to 656 cars per 1000 residents in the upper income Tel-Aviv-Jafo suburbs of Ramat HaSharon and Herzliya. Higher income groups in Israel not only own significantly more cars per capita, they also travel further by car – and therefore benefit more from a road-oriented infrastructure. For instance, Israeli business executives make twice as many interurban trips weekly as service workers and clerks/secretaries. Executives, professionals, academics and standing Army personnel all travel more than secretaries, sales workers and service personnel.

Table 6: Travel and occupational status

Profession	Interurban trips per week
Standing Army/Police	2.99
Executives	2.68
Skilled Industrial Employees	2.11
Academics	1.93
Unskilled Workers	1.81
Teachers, Technicians and Nurses	1.61
Sales persons	1.56
Secretaries/clerks	1.32
Service Workers	1.27
Average	*1.77*

Source: Trans-Israel Highway Co., 1994

Exodus from the cities

Historically, Israel's major cities were characterised both by a vital economic life and a stronger residential neighbourhood base than their North American (or even European) counterparts, which saw significant urban decline in the past several decades. But in the early and mid-1990s, mass motorisation began to trigger an exodus of middle and upper class Israelis from cities to suburbs, as well as businesses. Over four million Israelis, or 73% of the population, live in or very near urban areas. Yet rural communities and towns of less than 20,000 are growing at rates of 4% – 15% annually, while most cities of over 100,000 are growing by a rate of less than 2% – if that. Gradually, many weaker inner city neighbourhoods are being abandoned to the poor, the elderly, new immigrants from the Soviet Union and Ethiopia, more ultra-Orthodox Jews and foreign workers from Africa, Asia and eastern Europe. Planners are beginning to warn that massive suburbanisation is not only undesirable given Israel's land scarcity, but also problematic socially in a country already plagued by fragmentation between different socio-economic, religious and ethnic groups.

Public transport patrons

Israelis as a whole remain far more dependent on bus transport than their European counterparts – even though travel via bus is declining steadily every year. Nationally, about 36% of travel is by bus – and falling to 25% in the affluent Tel-Aviv-Jafo area. As a measure of the relative decline in bus transport, it should be noted that between 1985 and 1995, Israel's population increased by 31%, while the number of bus vehicle kilometres recorded annually by public buses increased by only 5.3%. Increasingly, bus travel is a 'second class' travel mode frequented by the elderly, the poor, ultra-Orthodox Jews, women and youths.

Table 7: Public transport use by group affiliation in Jerusalem (at least once a week)

Men	59%
Women	79%
Youths (under age 24)	85%
Adults (ages 25-59)	65%
Senior Citizens (65+)	87%
Orthodox/ultra-Orthodox	84%
Secular	62%
Low Income Persons	82%
High Income Persons	57%

Source: The Jerusalem Transport Master Plan and Jerusalem Institute for Research on Israel, 1996

Women – second class Israelis

Employee car allowances also tend to be a 'male' perk in Israel. A 1995 survey by the Israel Women's Network found that 95% of male civil servants receive car allowances, while only 53% of female civil servants receive such an allowance – and the average monthly sum is lower. The lower level of car allowances reflects in general, the lower status of women in the Israeli work force. Women on average, take home salaries that are 52% of the average male salary, due largely to their concentration in lower paying job categories. About 38% of women workers also are employed part-time. As lower income earners, Israeli women have less access to cars overall and are more dependent on public transport than men. They also hold proportionately fewer driving licences. In 1992, 65% of adult Israeli men held driving licences, as compared to 35% of women.

In Israel, women remain primarily responsible for child care and household maintenance. And the combination of role dictates different travel patterns than those of men. Israeli women make more short journeys than men and fewer interurban trips – a factor probably related to their multiple roles in the workplace and home. In metropolitan Tel-Aviv-Jafo, women make about 50% more trips daily in their community of residence, as compared to men. Conversely, men make about 60% more interurban car trips, as compared to women. (Trans-Israel Highway Co., 1994) The special needs of women, however, vis-à-vis good short distance travel networks – including pedestrian and urban mass transit routes – have received little attention from policy makers, who are focused largely on the planning of improved interurban and urban bypass roads.

Children, Elderly and the Disabled

Israelis are relatively younger than their European counterparts. Some 1.9 million Israelis – or more than one-third of Israel's population – is under the legal driving age of 17. An estimated 10% of Israelis suffer from physical disabilities, including injuries sustained in military service. Israelis over the age of 65 constitute about 9.5% of the population, as compared to about 13% – 16% in western Europe. The disadvantaged status of the elderly vis-à-vis automobile access is reflected in the fact that elderly Israelis constitute only 5% of driving licence holders.

For both children and certain sectors of the elderly, independent mobility may be limited to the immediate neighbourhood, and good pedestrian/cycle routes can be crucial to physical and mental wellbeing. Yet those modes that would best serve Israel's elderly and youngsters are the very ones that are most ignored by Israeli transport planners – despite cultural norms which supposedly hold children in high esteem. An estimated 40% of Israelis under the age of 14 own bicycles, for instance, and yet virtually no cycle paths exist in Israel's cramped city neighbourhoods. Both street and sidewalk space in major cities is so congested by vehicles that walking has become increasingly difficult. Sidewalk networks in the

Figure 4: Pedestrian deaths (1991)
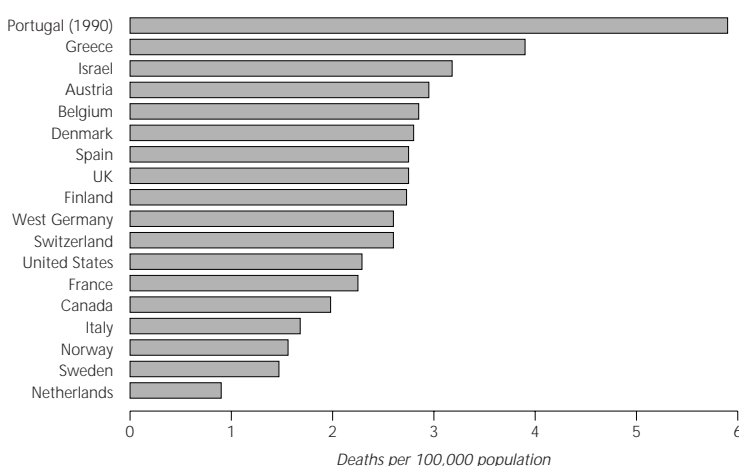
Source: ECMT, 1996.

major urban centres are not contiguous, and are broken by obstacles such as trash receptacles and kiosks. Parking cars on the sidewalk has become an almost universal practice – and is met by official indifference. Crossings at busy intersections are generally timed to optimise vehicle travel, rather than pedestrian movement. The marginal role accorded overall to pedestrian travel may be a factor in Israel's high per capita rate of pedestrian deaths in motor vehicle accidents as compared to Europe.

Arab Israelis
Per capita, car ownership among Israel's one million Arab citizens is only about 70% of the national average – although motorisation rates are now rising even more rapidly than among Jews. Arab towns, which developed a century or more ago around a core of a pedestrianised market, or 'souk', and a network of alleyways, today face pressing transport planning dilemmas remarkably similar to those in newer Jewish cities. Like the latter, Arab municipalities have generally opted to stress road-construction and road widening projects, which are viewed as symbols of western-style progress, over the improvement of degraded pedestrian networks and public transport services. Traffic congestion has thus become a severe problem in core town and city centres, and has helped fuel an exodus of the stronger socio-economic classes to low-density, car-dependent development on the periphery of Arab towns and cities – (where ensuing land conflicts with neighbouring Jewish suburbs often become political flash points). In Nazareth's Old City, for instance, more than 80% of families live below the poverty line, as compared to 35.4% in the city as a whole. So degraded was Nazareth's downtown pedestrian environment, that Christian pilgrims travelling through the historic Galilee typically avoided prolonged stays in Nazareth's historic city centre core. The typical pilgrim's visit to Nazareth consisted only of a brief bus stopover at key church sites, a trip lasting only an hour

or two at most.

Nazareth 2000
As part of the preparations for the millennium, a government funded 'Nazareth 2000' project embarked on an ambitious renovation of the historic city centre core – with the aim of making it more accessible, particularly to pilgrim bus transport and walking tourism. The project could be considered one of the first examples of a 'sustainable' tourism development project in Israel – although Nazareth 2000 was also criticised for focusing exclusively on the transport needs of tourists and less on the patterns of local residents themselves. Despite its faults, Nazareth 2000 has indeed succeeded in closing much of the traffic-clogged souk area to cars, and restoring its original pedestrian flavour. But final renovations on the main city thoroughfare – including the completion of sidewalks, creation of an exclusive bus corridor and the creation of bus passenger landings, were delayed throughout most of 1999 by a political dispute involving Nazareth's Muslims, Christians and the Israeli government. Muslims demanded that an enormous mosque be constructed on a strategic land parcel along the main thoroughfare that had been designated by the city as a pedestrian square and disembarking point for buses of pilgrims visiting Nazareth's famous Church of the Annunciation. All in all, the successes and failures of the Nazareth 2000 plan illustrate both the potential and pitfalls of introducing transport innovations in the present Israeli and Arab social context where ideological and political disputes between competing ethnic, religious and national groups usually take precedence over quality-of-life issues.

Rural Israel
In the first decades of the state, rural Israeli towns and villages were built as compact, integrated units of residential housing and basic services, which reduced travel demand and made bus transport efficient and effective. Since the beginning of the 1980s, however, that trend has changed rapidly. Whole districts of central Israel, such as the Plain of Sharon, which only a decade or two ago were rural areas of orange groves and agricultural villages, have been transformed into sprawling suburban districts characterised by low-density residential housing, malls and big box hypermarkets aimed almost exclusively at car users. Such patterns of low-density sprawl are now encroaching on historic areas of the Galilee, the Jezreel Valley and the Judean hill

Table 8: Populatuion density per hectare in central Israel

	Net Density in Built Space only	Gross Density of urban entity	Transport Potential
Rural/Suburban			
Rosh Ha-Ayin	39.5	14.8	Car-oriented
Gadera	44.5	7.9	Car-oriented
Hod Hasharon	55.4	13.8	Car-oriented
Ramat Hasharon	78.1	21.7	Car-oriented
Urban			
Kfar Sava	88.0	44.5	Public transport
Tel-Aviv-Jafo	144.3	68.2	Public transport

Source: Hasson and Hoshen, 1996

country around Jerusalem.

Israel's major supermarket chains are investing heavily in out-of-town hypermarkets, which are largely car-oriented and which often offer free parking and lower price markups than may be available at urban supermarkets (Telem, 1995). As in the U.K., the corner grocer, the mainstay of neighbourhood shopping districts, is gradually losing its place in the market. Investment in the new suburban developments, moreover, are often marked by financial convergence between real estate developers, shopping retailers and fuel suppliers.

The Kibbutz – a dying model

For decades, Israel's kibbutz and moshav communities represented shining examples of sustainable rural development. Kibbutz housing was clustered on green space, linked exclusively by pedestrian networks. Motor vehicles were limited to the kibbutz perimeter road. Basic services and even employment opportunities were all located within the kibbutz community; public transport and car-sharing were the norm for trips to nearby cities and towns. The result was that a kibbutz of several hundred adult members might own only a handful of cars. Today, this car-sharing model is being dismantled as the old socialist ethic of the kibbutz dies and agriculture becomes increasingly unprofitable. For example, more and more kibbutz members are working outside of the kibbutz, or are being paid personal salaries by the kibbutz itself, facilitating the purchase of a private vehicle. As more kibbutz members acquire cars, more motorised traffic is encroaching on the kibbutzim's pedestrian lanes and alleys – because members insist on parking their cars directly adjacent to their homes. In areas where cars cannot penetrate, motorcycles and diesel golf carts have become popular transport modes, replacing walking and cycling, although there has been some development of electric golf carts and special tricycles for elderly kibbutzniks.

In terms of land use, government policy has encouraged debt-ridden kibbutzim to convert agricultural fields to commercial and residential real estate in order to restore their financial solvency. The result has been a rash of private development of former kibbutz agricultural land into tract subdivisions which are not an integral part of the kibbutz social and economic fabric. Residents of such new developments often must commute by car for every basic need from shopping to schools and employment. Many kibbutzim are themselves investing heavily in roadside shopping malls

that draw thousands of Israelis for weekend shopping. In so doing, they have exploited a loophole in Sabbath 'blue' laws in which as 'private' entities, kibbutzim are entitled to operate businesses that are closed by law in the centre cities from sundown Friday to Saturday.

In addition to the widespread changes underway in kibbutzim, the government has encouraged even more rural sprawl in the form of new 'residential communities'. These communities, usually consisting of only a few hundred households were first created in the 1980s in sparsely settled areas of the Galilee and the Negev, where strategic and national ideology called for increased Jewish settlement. But today, spurred by land speculation on former agricultural areas and by new highway construction, the 'residential community' has become a lucrative form of real estate development in the country's crowded central region. All around Israel, such communities are, for all effects and purposes, commuter suburbs almost entirely dependent on automobile transport. Such suburbs lack the critical population mass to provide local shops and services, and are often socially monolithic, catering largely to affluent Israelis fleeing the cities. If the Trans-Israel Highway project is completed, a significant surge in such projects can be expected along the new highway corridor.

Rural archeological, recreational and historic sites

The preoccupation with motorised vehicles does not end in the cities or even in the agricultural periphery. In recreational settings pedestrianised activities such as beach walking and hiking are being degraded by motor vehicles. Jeep tourism is increasingly popular in Israeli nature reserve trails of the northern Galilee and the Negev Desert. In the peak summer months, unsupervised beaches along the Mediterranean coast are transformed into de facto parking lots and roadways for four-wheel drive campers and jeeps – even though public beaches in Israel are exceedingly crowded with bathers, and less than 100 kilometres of coastline are accessible for public use. Indeed, the design of many beaches, nature and historic sites tends to sanction the pre-eminence of motorised vehicles, by placing parking in direct proximity to the site itself. In the case of beaches, this makes the destruction of natural landscapes and dunes inevitable. In the southern Negev desert, meanwhile, jeep tourism has become such a predominant mode that backpackers are literally in danger of being run over by vehicles, should they choose to

spend the night in the open. At archeological and historic sites around the country, tourist bus operators typically leave their diesel bus engines idling for hours merely to keep the buses cool for the return of a tour group – reflecting the blatant disregard of pollution and noise impacts from transport that is pre-eminent among Israeli drivers.

Even in areas of the country designated primarily for tourism and nature preservation, road widening together with the expansion of roadside shopping services is encouraged by the authorities as a method of tourism development. For instance, a major road widening and illumination project, complete with a bridge, a new interchange and bright urban-style lighting, has left the highway as the dominant feature on the once scenic landscape that winds its way east from the northern Galilee town of Kiryat Shmona towards the mountain sources of the Jordan River. Alongside the highway, a new roadside gas-station and shopping centre represents the creeping encroachment of Kiryat Shmona's urban sprawl to the very edges of some of the country's most water-rich nature reserves.

Conclusions

In almost every measurable respect, the dramatic increases in motorised traffic over the past two decades has paralleled increases in transport noise, pollution, congestion and sprawl, and expanded the gap in access enjoyed by rich and poor, drivers and non-drivers, to employment opportunities, services and housing. There has been a marked new incursion of motorised traffic into areas featuring natural, historic and archeological sites of priceless value. Highway-oriented sprawl also is wreaking irreversible changes in an ancient 'Biblical' landscape, degrading or erasing the traditional 'context' of historic and archeological sites – landscapes that reveal to us the multi-faceted history of the land from the era of the early Zionists and British Mandate administrators to the time of the Ottoman pashas, Crusader fighters, Islamic caliphs, Roman generals and ancient Israelite tribes.

How can it be, it might be asked, that a society that possesses such natural and archeological assets, assets of inestimable value to Jews as well as Christians and Muslims can be so oblivious to their imminent destruction – possibly within the coming generation or two? How can it be, that so many elements of the young Israeli state's 'sustainable' transport and land use policies – i.e. a wide and effective bus network, compact communities with vital city centres – have been so rapidly undermined to

the point where planners now make comparisons with Southern California? How can it be that a society in which traditional Jewish law even banned driving on the Sabbath – and established walking as the preferred travel mode – has become so indifferent to pedestrians and so addicted to the culture of the automobile?

The fact is that such changes are largely driven by the powerful economic interests which sense the ready profits which are to be made in new road construction, and the accompanying real estate development along road corridors. The profits are particularly lucrative, given Israel's land scarcity, population pressures and rising per capita income. Government planners have found it politically expedient to respond to the new market pressures by discarding old socialist planning tools wholesale in the name of a 'privatised' economy. Israeli Treasury officials historically have justified massive new road projects, and impeded or stalled funding for desperately needed rail development, on the basis of primitive and outdated cost-benefit analyses which utterly fail to consider the social, health, and environmental consequences of road-building. Average Israelis, who in fact have little experience with automobile culture, rarely understand the broader social implications of the personal choices they are making vis-à-vis transport – whether it is to move to the suburbs and buy a second car, or drive on the beach, to stop walking to the local grocery or take the bus downtown. Popular trends, moreover, are driven by social dynamics comparable to those underway in some parts of Eastern Europe today, where public transport is often viewed as a degraded symbol of Israel's collectivist past. New highways and interchanges are a presented as a taste of the American dream – despite the swelling traffic jams that soon reappear. For young Israelis a car is an important symbol of status and individual freedom – in a society which began as a spartan state of citizen-soldiers.

There are also strong undertones of religious-secular tensions in the Israeli transport debate. Secular Israelis have waged a fierce – and generally losing battle – against Orthodox rabbinical authorities to permit the opening of urban businesses and public transport lines on the Jewish Sabbath, when Orthodox Jewish law traditionally forbids commercial activity as well as motorised travel. As more secular Israelis acquire cars, therefore, and driving to a Kibbutz-operated shopping mall on the weekend has become a proud form of defiance against religious coercion by the Orthodox establishment which still holds sway on many

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matters of religion and state. That same attitude of defiance, too often, also extends to anyone seeking to limit motor vehicle access at all – in the inner city, on beaches, on sidewalks or in nature settings.

The current Israeli obsession with motor-driven vehicles is therefore a reflection of a society undergoing dramatic change. Israel at the turn of the millennium has discarded its own Zionist-socialist ethic – as well as the restrictions of Jewish traditionalism – for the 'good life' of affluence and personal fulfilment in a hoped-for new era of Middle East peace. How Israelis can reclaim the positive values of their own heritage, both religious and secular, while moving forward into the future, is a central question for the entire society today – and no less for transport planners.

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The Status of Transportation in the West Bank

Hanna Maoh and Jad Isaac

Applied Research Institute – Jerusalem (ARIJ)

Address for correspondence
Hanna Maoh
Applied Research Institute –
Jerusalem (ARIJ),
GIS and Remote Sensing
Unit, Caritas Street,
P.O.Box 860, Bethlehem,
West Bank, Palestine
Email: hanna@arij.org

Abstract

This paper examines the basic features of the transportation system in the West Bank from a Palestinian perspective, and discusses the dilemmas, both present-day and future, that must be confronted now by planners as Palestinians gain control of West Bank land resources, and create a contiguous political entity where transportation and land use planning will be possible. The paper presents basic data from new research on travel modes, trip destinations and motorisation that until recently was unavailable on Palestinian travel. It describes the factors contributing to increasing congestion and air pollution in the region, particularly in Palestinian urban areas. The legacy of the Israeli-Palestinian political conflict on the system's development is explored, particularly the profound impacts induced by the widespread Israeli construction of 'bypass roads' linking West Bank Jewish settlements. Finally, the paper discusses the potential for creating a more sustainable transport and land use system in the future, in light of problems such as land scarcity and increasingly high population densities.

Keywords

Bypass roads, dual transportation system, emissions, Jewish settlements, land-use planning, motorisation, Wadi Al-Nar, West Bank.

Introduction

The varied, often mountainous, topography of the West Bank's 5659.34 km², as well as the region's hot and primarily dry climate, helped shape an ancient system of road links which was distinctively impacted by the natural geography of the land. Mountains or harsh desert regions separated many cities and villages that might be in close proximity, requiring circuitous systems of access. High altitude cities such as Nablus or Hebron, which are 600m – 800m above sea level and might even receive snow in winter, are separated by steep mountain passes and ridges from low-altitude areas in the Jordan Valley, located at or below sea level and which experience semi-tropical conditions. Access between major West Bank population centres, therefore, was via a historical road system that followed the mountainous contours of cultivated valleys or ancient desert river beds, known as wadis. The topography of the region is described by Map 1 where a digital terrain model for the West Bank is presented.

In recent years, however, the political

Map 1: West Bank Digital Terrain Map
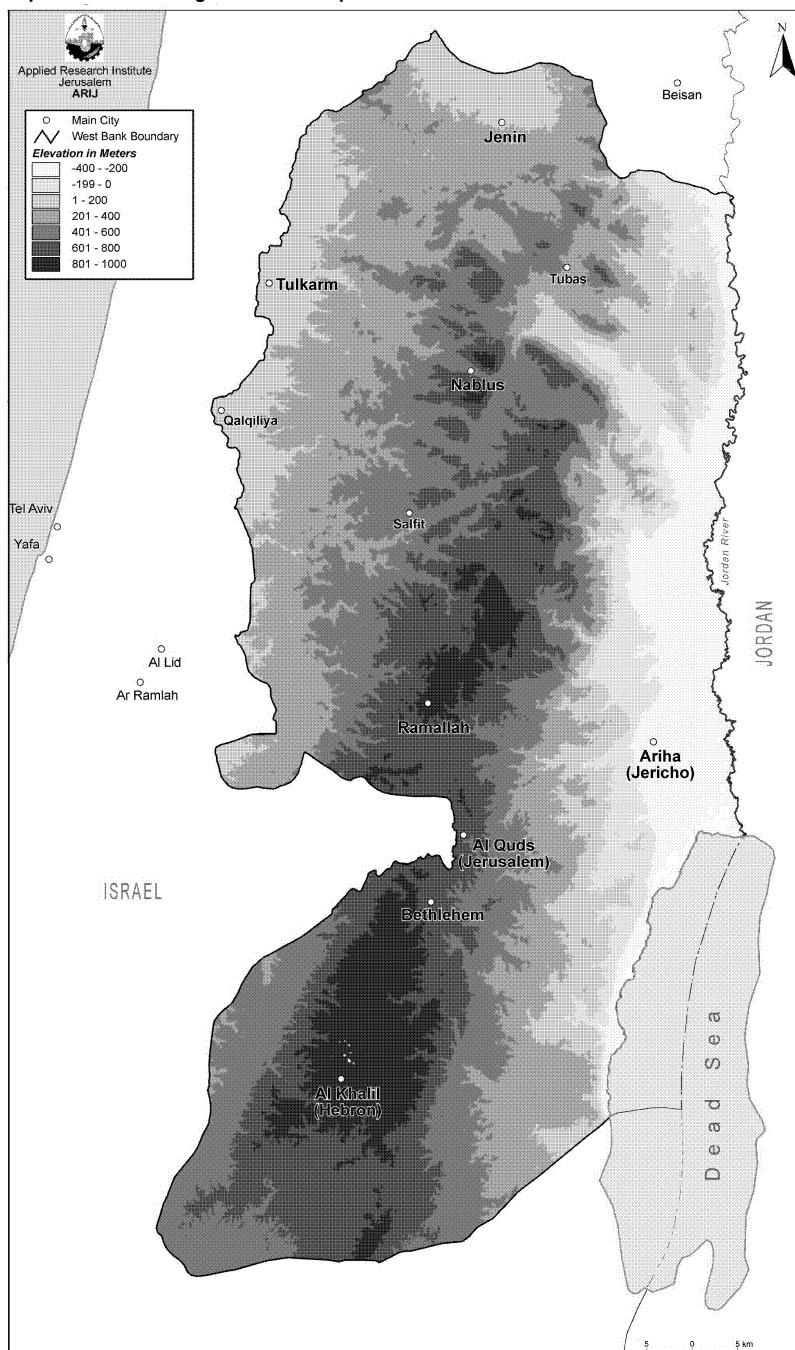
conflict over the West Bank has become the major factor impacting on the modern development of transportation. During thirty years of Israeli occupation, large tracts of West Bank land were confiscated from Arab villages and private land owners for the establishment of Jewish settlements, and more recently, for the construction of an extensive system of bypass roads linking these settlements to each other and to Israel. Land use has thus been drastically altered in a relatively short period.

Another period of transition began in 1993, when the Israeli-Palestinian peace process commenced. Palestinians, for the first time, secured the right to develop lands in the major West Bank urban centres that came under their control. Since then, Palestinian institutions and agencies have begun to formulate plans for land use and natural resource development in both the West Bank and Gaza, where respectively 1,873,476 and 1,022,207 Palestinians live today (PCBS, 1997). One of the most pressing challenges facing Palestinians now is the planning of the current casual transportation system in both the West Bank and Gaza. This study focuses on the larger and more complex West Bank system, although many of the observations noted here may also be characteristic of Gaza.

Road transportation is the only mode of transport available in the West Bank, and motorised vehicles are by far the dominant mode on the network, while ancient forms of animal transport are gradually disappearing. Most West Bank roads suffered from a lack of maintenance for decades, and were inferior in quality to those in neighbouring Israel. During the more than 30 years of Israeli occupation, no serious attempt was made to plan for Palestinian future travel demands. The rapid growth of population – over 3% annually in the West Bank and 4% annually in Gaza – as well as the dependency on the automobile as the primary mode of travel, combined to create serious defects in the system on the eve of the new millennium. Increased rates of vehicle accidents, traffic congestion and air pollution, as well as disorder in systems of urban street signalling, etc., are just a few examples of the problems today.

The remainder of this paper is in four parts. The first section presents original data on the growth in the rate of motorisation, the makeup of the car fleet, travel modes and trip destinations – data which has primarily been collected in surveys by the authors as part of an ongoing project designed to develop a comprehensive West Bank transport dataset that previously did not exist. The second part describes the land use composition in the West

Bank in an attempt to show linkages between land use and transportation. Moreover, the section presents a preliminary model of pollution emissions for the Palestinian and Jewish settler car fleets in an attempt to test how the presence of settler cars affect air pollution in the West Bank. The third section presents the dual structure of the road network in the West Bank, both Palestinian and Israeli settler, and offers a case study of how that dual network worsens pollution levels, travel continuity and the Palestinian economy. Finally, the last section outlines the pressing problems in land use and transport planning that must be confronted in the system – and offers recommendations and scenarios for sustainable future development.

Basic features of the vehicle system: Motorisation, fleet composition and trip destinations

The number of motorised vehicles has increased in the West Bank by an average of 12% per annum over the past two decades. In 1975, there were only 12,964 vehicles in the West Bank. By 1996, there were 133,386 vehicles registered in the names of Palestinians living in West Bank areas other than east Jerusalem (ARIJ, 1977). There are, meanwhile, an estimated 25,000 cars for a population of 152,000 Israeli settlers who are residing in West Bank settlements other than east Jerusalem (ICBS, 1997).

Despite such growth, the motorisation rate in the West Bank remains very low when compared to Israeli rates. In its 1997 census survey, the Palestinian Central Bureau of Statistics reported that there were 80,000 private cars in the West Bank – yielding a rate of 42.7 cars per 1000 Palestinians. In comparison, there were over 171 cars per 1000 for the Jewish inhabitants of the West Bank and over 208 cars per 1000 for Israel as a whole (ICBS, 1997). Only about 23.2% of Palestinian households own a car, and there is an average of 1.3 cars per household, and within those households owning cars – reflecting the relatively low access to motor vehicles even among more affluent sectors of Palestinian society.

Rapid growth in Palestinian car ownership can be expected to continue under almost any transport development scenario – particularly in view of the fact that the median age of the Palestinian population is 17 years old, and cars are increasingly viewed as a symbol of mobility and social status. Dependency on car transport in the West Bank urban centres is growing especially fast, as more and more Palestinians

Table 1: 1997 Motorised vehicles in the West Bank

	Private cars	Trucks & Commercial cars	Buses & minibuses	Taxis	Motorcycles & Scooters	Tractors	Special Services and Other Vehicles	Total
Jenin	7,604	2,262	46	72	6	952	4	10,946
Nablus	16,267	3,791	165	556	23	520	16	21,338
Tulkarm	11,231	2,654	14	102	25	416	11	14,453
Ramallah	14,083	3,691	152	642	23	350	19	18,960
Bethlehem	10,816	1,862	67	84	22	121	5	12,977
Hebron	18,161	4,097	84	108	108	1,006	15	23,579

Note: Figures on motorised vehicles for Jerusalem and Jericho is not available in this dataset

Source: Palestinian Ministry of Transportation, 1997

Table 2: Private cars as a proportion of the total vehicle fleet

Jenin	Nablus	Tulkarm	Ramallah	Bethlehem	Hebron
69%	76%	77%	74%	83%	77%

Map 2: Percentage of motorised vehicles per district
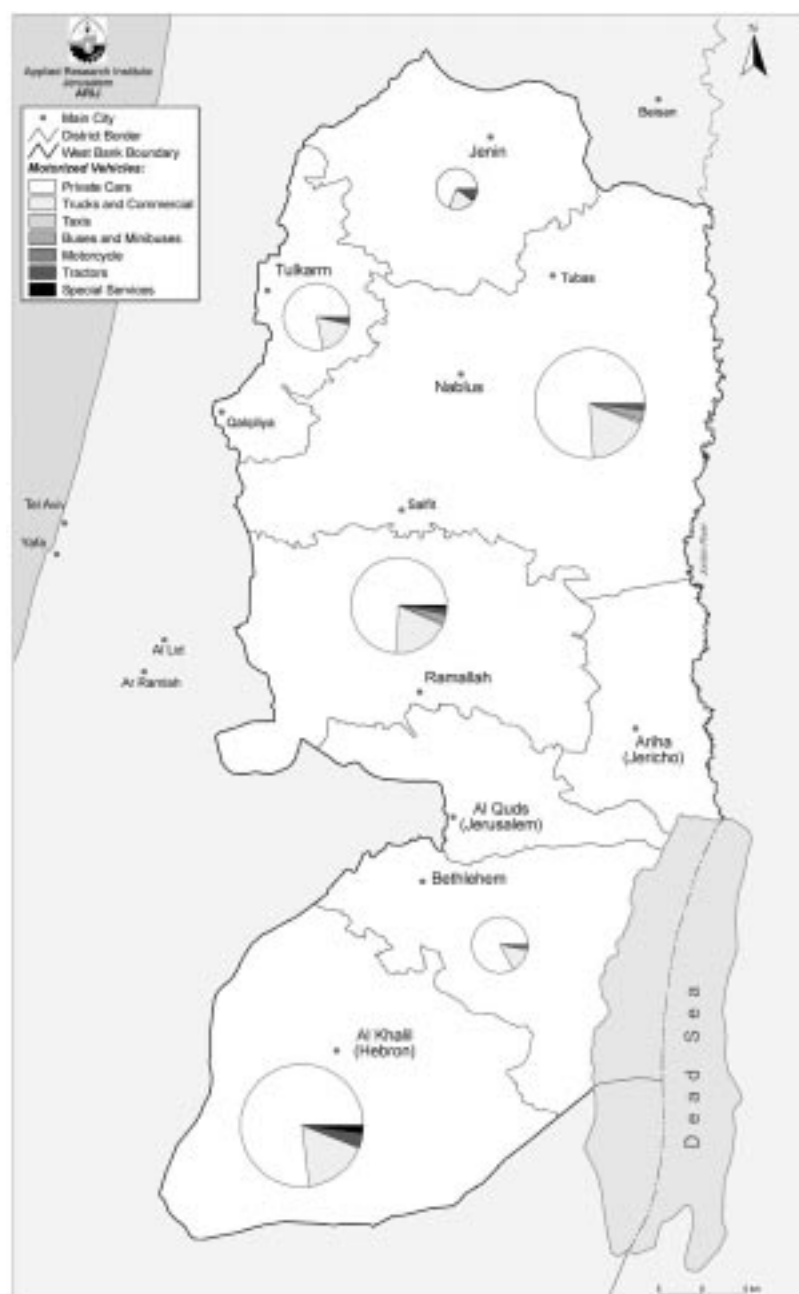
leave traditional vocations on farms and villages and commute to factory, construction and service jobs in Palestinian cities or even in Israel.

The overall age of the Palestinian fleet has grave implications for pollution emissions. About one-third of the private cars on the roads today were manufactured in the 1970s. About 60% of the fleet is composed of cars manufactured between 1980 and 1989 and only 10% are relatively new cars that were manufactured between 1990 and 1996 (ARIJ survey, 1996). Comparing the age composition of the Palestinian car fleet to Israeli car fleet, one can see that there is a huge difference. 1997 statistics indicate that 5.95% of cars in Israel were built before 1981, 29.17% between 1982 and 1989 and the majority of the fleet – about 64.88% – are seven years old, having been built between 1990 and 1997.

Table 1 summarises the distribution of vehicles over the major West Bank cities, excluding Jericho and Jerusalem. Despite the low motorisation rate, there is a relatively high incidence of road traffic accidents. The most recently available figures from 1993 indicate that 2,781 accidents resulting in injuries occurred in that year – with 128 accidents resulting in fatalities. The relatively high rate of accidents – nearly 2% of vehicles annually – is partly attributed to the poor quality of the road network, which is discussed below.

The distribution of vehicles per district as percentages is provided in Map 2.

The proportion of private cars to total vehicles varies widely among the various cities of the West Bank. Overall, those differences reflect a greater dependence on public transportation in the cities of Ramallah, which is today's affluent centre of commerce, culture and political life, as well as the northern West Bank city of Nablus, which was a traditional economic and cultural stronghold in the pre-1967 period of Jordanian rule. Notably, Ramallah and Nablus contain 41% and 35.5% of the total number of taxis in the West Bank respectively. Some 28.7% of the West Bank bus fleet is located in Ramallah and 30.0% in Nablus.

Travel Destinations

Results of a month-long traffic survey conducted by the authors indicate that a large majority of Palestinian intra-district trips are work trips. The exception noted is in the

northern West Bank district of Jenin, where family farming is still a primary vocation. Special trips, such as family visits and recreational excursions, are the second most common destination, while shopping ranks third, except for Jenin. Map 3 and Table 3 shows the distribution of these trips for each district.

Table 3: Intra-district journeys by type for one month (%)

Location	Work	Shopping	Official	Special
Jenin	35.00	41.00	0.00	23.00
Tulkarm	63.00	8.00	3.00	26.00
Bethlehem	60.00	10.00	0.00	29.00
Ramallah	63.00	8.00	3.00	27.00
Nablus	66.00	13.00	1.00	20.00
Jerusalem	61.00	8.00	5.00	25.00
Hebron	66.00	7.00	6.00	21.00

Source: (ARIJ survey, 1997)

Map 3: Types of intra-district trips in each district of the West Bank, based on a month-long survey in 1997

Land use and its impact on transport

The West Bank has a total area of 5659.34 km². Land use in this region is given in Table 4.

Most Palestinian cities have been in existence since antiquity, and have developed around a traditional Middle Eastern souk (a mixed commercial and residential area noted for its narrow, winding streets and covered alleys) housing small shops, craftspeople and cottage industries that formed the basis for the traditional economy. Pedestrian transport was and is the dominant mode in this environment. Western-style business districts shaped along two-lane paved roads eventually developed around that core, gradually encroaching somewhat on the pedestrian areas. But the basic design of the Palestinian town and city today remains a relatively compact model – although higher rates of motorisation are now generating much new residential development on former farmland and orchards at the far-flung peripheries of cities.

Jewish settlements, unlike the traditional Palestinian cities and villages, are at most only 30 years old. With approximately two hundred settlements and neighbourhoods around the West Bank, most settlements are marked by low population densities and function primarily as suburban satellites of existing Israeli cities. A marked feature of the settlements, therefore, has been their dependence on automobile transport due to the absence of employment and services within the settlements themselves. Per capita car ownership in the settlements reflects this far greater dependency on private car travel for work, shopping and recreational functions.

A comparison of the population densities of Palestinian and Jewish settlement built-up areas reflects the generally more dispersed and car-dependent pattern of the Jewish settlements

Table 4: Land use in the West Bank

Land Use	%
Palestinian built-up area	6.53
Israeli built-up area	1.91
Palestinian cultivated land	28.31
Israeli cultivated land	0.95
Nature reserves and forests	5.84
Closed Israeli military areas and bases	22.14
Other (including grazing and unused land)	34.32

Source: ARIJ's GIS database, 1999

on an approximate order of 2:1. There is approximately 369.55 km² of built-up space for a population of 1.87 million Palestinians as compared to 108.09 km² of built space for a West Bank Jewish settlement community of 300,000 including East Jerusalem. That translates to a population density of 2,775.46 Israelis per km² of built space in the Jewish settlements, as compared to 5,069.61 Palestinians per km² of built space.

Congestion and pollution emissions

The rapid increase in motorisation and the age of the car fleet have combined to create severe problems of traffic congestion and air pollution in and around major Palestinian cities over the past decade. Given the higher motorisation rate of the settler population, settlement cars add to the pollution load disproportionately. A preliminary model of pollution emissions for the Palestinian and the settler car fleets suggests that total emissions of major pollutants from cars may be 27% – 32% higher in the West Bank due to the presence of the settler vehicles.

This preliminary model of pollution emissions is based on figures surveyed by the authors for the Palestinian car-fleet and by the Israeli Census Bureau of Statistics (ICBS, 1997) for the Israeli settler car fleet. The model is sensitive to differences such as the older age of the Palestinian car fleet and the greater average annual travel distance per Palestinian vehicle. The pollutant values are based on the transportation air emission inventories (Economopoulos, 1993). These inventories provide the emission factors for the following pollutants: CO, SO_x, NO_x, HC and Pb and varies according to the age and engine capacity of a vehicle.

The values of harmful pollutants are summarised in Table 5 for both the Palestinian and Israeli settler car-fleets. With regard to the Palestinian figures, emissions were calculated for cars in the following age categories: 1970 – 1979, 1980 – 1989, and 1990 – 1996. In all cases we assumed an engine capacity of 1.4l – 2.0l. The annual average kilometrage per vehicle for the Palestinian cars is estimated to be 20,000 km (ARIJ, 1997). The same calculation was carried out for the Israeli car

fleet according to the age composition. The 1997 Israeli statistics (ICBS, 1997) indicate that the annual average kilometrage per vehicle is approximately 17,000 km. Moreover we made the assumption that the average engine capacity for the settlers' cars is in the 1.4l – 2.0l. category.

The West Bank road system – the dual Israeli-Palestinian system

While Israel's road system is sometimes described by highway planners as relatively underdeveloped by North American and European standards, the West Bank system suffers from far greater deficiencies. There are 0.51 km of road per km² in the West Bank, as compared to 0.70 km per km² in Israel. The West Bank has 1.86 km of road per thousand inhabitants as compared to 2.5 km per thousand inhabitants inside Israel. (ARIJ, 1997). Moreover, the road system in the West Bank is essentially comprised of three systems which at times duplicate each other and in other instances fail to provide adequate travel continuity. Some 1255 km of 'Main roads' are shared by both Israelis and Palestinians but usually under Israeli control; Israeli 'bypass' roads comprising 225 km link Jewish West Bank settlements and are used primarily by Israelis. Another 2556 km of secondary roads are poorly maintained and are used primarily by Palestinians. Due to this multi-tiered system, road access and road development have become key issues in the political conflict.

Map 4 shows the 1997 road network in the West Bank, along with the complex division of Palestinian and Israeli jurisdictions that has existed since the 1993 Oslo accords. It should be noted that since signing the Oslo accords, Palestinians have wielded control over land use, road planning and maintenance only in the limited geographical area of seven major Palestinian urban areas, known as Area A. (Accessibility in the region is governed by the Oslo I and Oslo II agreements signed between the Palestinians and the Israelis in the early 1990s. Oslo II agreement divided the land use of the West Bank into three major classes. These are area A, area B and area C (Map 5). Land in area A cover the main cities of the West Bank, except for Hebron, which has a special agreement. The city of Hebron is divided into areas of different control called H1 and H2. Area H1 is defined as area A and area H2, which houses 400 settlers, remains under Israeli control. In area B, the Palestinians have full control over civil society except that Israel continues to have overriding responsibility for security. These areas comprise most of the

Table 5: Estimated emissions from private cars in the West Bank

	Emissions (Tonnes/year)			
	Emissions from Palestinian Cars	Emissions from Israeli Cars	Total Emissions	% Change in Emissions due to presence of Israeli settlers' cars
CO	52,534	16,762	69,296	31.91
SO_x	2,985	875	3,860	29.31
NO_x	2,879	786	3,666	27.31
HC	5,015	1,497	6,512	29.84
Pb	198	60	257	29.74

Map 4: Road system in the West Bank, 1997

Palestinian towns and villages. Area C covers the area, which falls outside areas A and B. In this area, the Palestinian Authority provides civil services. However, Israel retains full control over land, security, people and natural resources. The majority of Palestinian agricultural land lies in these areas.)

The Israeli bypass system, comprising some 25 roads today, is by far the most modern and well-maintained part of the West Bank road system. The system is designed to improve accessibility between the different Jewish settlements in the West Bank and the rest of Israel. The bypass roads average 25m – 30m in width, with an average 120m buffer zone around the road.

The bypass roads are located in Israeli-controlled Area C. Along with providing a

Map 5: Geo-political map of the West Bank

traffic bypass around major Palestinian cities and communities in the West Bank, the roads also create a rigid boundary limiting Palestinian growth and development (see Map 6). This is particularly evident on the crowded urban outskirts of Jerusalem, i.e. Bethlehem and environs. In rural areas, the bypass roads also consume open space as well as valuable farmland in fertile valleys and river beds, as well as fragmenting agricultural land use.

Although, technically, Palestinians may travel on the bypass roads, in most cases the system doesn't serve Palestinian travel destination needs efficiently and Palestinians are also discouraged from travelling on the system by army roadblocks. The total land consumed by today's existing network of bypass roads is 27.8 km². Plans are underway, however, for the construction of another 14 bypass roads in the West Bank, extending 196.01 km and consuming another area of 23.5 km² (ARIJ GIS, 1999). Once constructed, bypass roads will comprise nearly 1% of the West Bank's total land area.

The main roads in the West Bank were constructed during the British mandate period (1917–1948) and the period of Jordanian administration (1948–1967). Their primary function is to link major Palestinian urban areas with each other, even though these roads often provide intermediary links between different sectors of Israeli bypass roads as well. Typically, main roads in the Palestinian network average only 10m – 12m in width. Even after 1993, major Palestinian road works programs became feasible only in areas under the jurisdiction of the Palestinian Authority – resulting in very visible road improvements along limited stretches of urban systems. Access to the main roads also is sometimes blocked by Israeli military checkpoints which control traffic to and from West Bank areas that remain under partial or full Israeli security control (Areas B and C).

Secondary roads are typically 4m – 8m in width, and most began as unpaved tracks. The curve structure of many roads follow ancient trails around mountains and hillsides making them dangerous for modern traffic. However, in cases where main roads are blocked by military checkpoints, secondary roads may become primary travel arteries, as we shall see in the case study of the Wadi Al-Nar route below.

Roads and access – Wadi Al-Nar as a case study

Wadi Al-Nar became a critical commercial and passenger road link for Palestinians in the late 1980s, when Israel began to limit Palestinian

access to Jerusalem's main north-south highway, blocking the historical road artery that links the northern West Bank cities of Nablus and Ramallah to the southern West Bank cities of Bethlehem and Hebron along a relatively flat mountain plateau. Map 7 shows the geographical location of the main Jerusalem road and the Wadi Al-Nar road.

Once a series of dirt tracks and footpaths, Wadi Al-Nar was paved by the Israelis, as an improvisational move after direct access to

Jerusalem was blocked in the early 1990s by repeated curfews. Today's two-lane road averages 4m – 5m width in total. The road descends from the north-eastern Bethlehem hills into a steep mountain valley, and then ascends around another mountain in that area revealing many hidden curves along the route. The curved sections of the road are impassable to two lane traffic when one lane is occupied by a freight vehicle. Due to the slopes, winter rain conditions enhance the risk of skidding and accidents. Such conditions impede trade between key West Bank economic centres such as Bethlehem and Ramallah that lie in close geographical proximity to each other on the northern and southern outskirts of metropolitan Jerusalem. Although the Wadi Al-Nar road skirts the eastern outskirts of Jerusalem, it fails to serve the vital functions of a bypass road due both to design and trajectory.

The distance between Bethlehem and Ramallah on the Wadi Al-Nar road is 47 km as compared to 26 km on the main Jerusalem highway, and travel time as well as fuel consumption is nearly double, yielding increased travel costs as well as increased pollution emissions. Daily pollution emissions were estimated for cars travelling on both the Jerusalem road and Wadi Al-Nar from Bethlehem and Ramallah. Figure 1 indicates that the amount of emissions increase by a rate of 2:1 using Wadi Al-Nar road. The increased emissions might even be higher were factors such road conditions and capacity considered.

In terms of the economic toll, the total cost for one car of travelling from Bethlehem to Ramallah on the Wadi Al-Nar route and the

Map 6: By-pass roads in the West Bank

Table 6: Economic impact of using Wadi Al-Nar road – Travelling from Bethlehem to Ramallah

Road used	Fuel consumption	Time consumption	Car maintenance
Wadi Al-Nar	7 litres	45 minutes	US $100 /month
Jerusalem	3 litres	25 minutes	US $30 /month

Source: (ARIJ survey, 1998)

Figure 1: Daily Harmful Emissions on Wadi Al-Nar and Jerusalem Roads
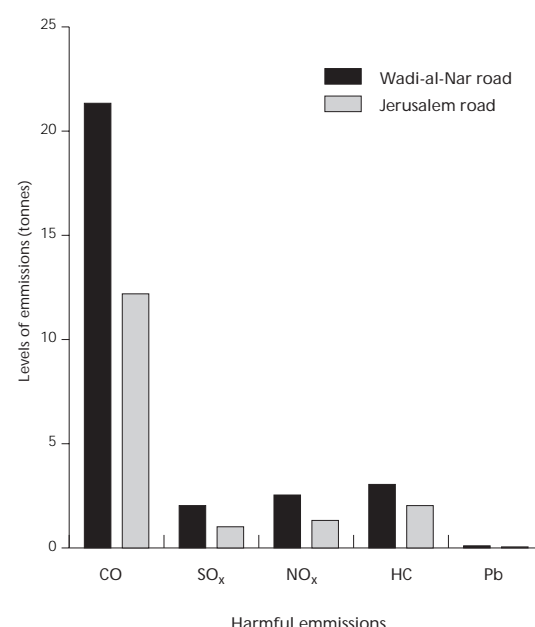
Map 1: Relative location of Wadi al Nar and Jerusalem roads
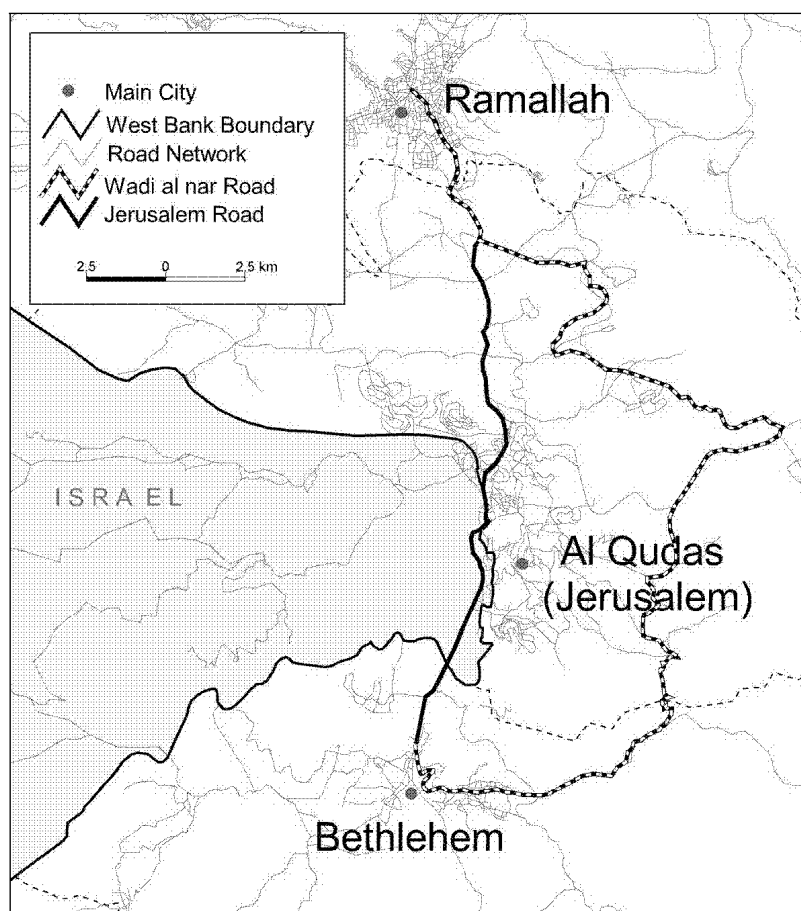
main Jerusalem highway is estimated at US $310 and US $120 respectively. Such an excess cost causes significant and severe damage to Palestinian GNP, estimated at US $22.8m (Qattoush, 1999), considering the significant amount of commercial traffic travelling between these two cities.

Transport and land use in Palestine – dilemmas and choices

While research so far has focused on the very burning questions of travel discontinuity and Palestinian access to the present transport system, new issues loom on the horizon as the Palestinian Authority expands its jurisdictional authority over West Bank land use and transport systems, and simultaneously develops the planning mechanisms of a sovereign state.

The experience of the west teaches us that the modern urban structure gains its formation from the linkage between urban land use and transport road system. Historically, this change in shape began first with the onset of public transportation, when cities became more dispersed and greater separation between land uses such as commercial, industrial, and residential became possible (Anderson *et al.,* 1996). The post World War II construction of highways and expressways achieved another

revolution, spawning vast new suburbs particularly in the United States, and effectively turning the historic metropolitan core inside out. (Hanson, 1986)

As noted earlier, during the Oslo peace process, land development in many areas on the outskirts of major West Bank Palestinian cities has remained under Israeli control (Area B or C), and thus remained tightly restricted. In addition, the bypass roads have created a physical obstacle to development. Yet even so, the trends of suburbanisation are also beginning to make their impact in Palestine. In areas on the periphery of major Palestinian cities like Bethlehem and Ramallah, the conversion of farmland to residential housing has accelerated. Fruit orchards and vineyards are giving way to residential housing, spurring sprawl as well as a high dependency on motor vehicles.

As Palestinians gain more control over their own urban periphery, residential and commercial land use development is likely to accelerate even more dramatically. The question then must be asked, how can this development be channelled or shaped to gain the widest benefit for millions of Palestinians?

In Palestine, most cities today still retain their monocentric urban form, where business is concentrated in the central core. Planners now must decide whether they want to encourage even greater urban centralisation, or promote a polycentric development pattern. The first strategy would require decision makers to strictly limit residential development in the outer suburbs and encourage intensified development of inner suburbs and urban corea via the construction of high rises that could accommodate the growing population densities that can be forecast for the future. The second, polycentric option, would create new nodes of commercial and residential development outside of the traditional central business district.

In either scenario, however, forms of mixed land use and a job-housing balance which offers people places to work in close proximity to where they live, and opportunities for walking or public transport is essential to overcome growing problems of sprawl and commuting. However, more awareness of land use issues needs to be built at the municipal level and the national level before transport and land use planning can become effective development tools.

Whether the decision is for a centralised urban core or for a polycentric form, public transport planning is key to reducing the dependency on the private car. Improved public transport can make Palestinian society more equitable – by offering transport solutions

to social sectors with moderate incomes that cannot afford to own a private vehicle.

Shared taxis and small para-transit vehicles, accommodating 5-12 passengers are the dominant modes of transportation in the West Bank today. One visible change evident since the arrival of the Palestinian Authority, is the fact that multiple private taxis companies have come under a single regulatory agency. 'Service' taxis and small vans which will accommodate 5 to 12 passengers have been painted a uniform bright yellow colour, allotted special license plates, and are now readily identifiable in all areas of the West Bank as public transport vehicles. Para-transit vans are used not only in urban situations, but also as in interurban transit, as a mode of transport for workers crossing the Israeli border to work in Israel or for travellers moving from the northern part of the West Bank to the southern part. Still, these privately run taxis and service vehicles – which don't run on a fixed schedule of stops and frequencies – are not a comprehensive alternative to a public bus system, which remains skeletal. Moreover, there is no organised system of route planning and control even for the para-transit vehicles.

Most of the new para-transit vehicles are also diesel-powered. As these types of vehicles are used increasingly in the cities, respirable particulate emissions can be expected to increase significantly (Whitman, 1988). Yet given the far lower cost of diesel fuel in the West Bank, these vehicles also represent significant economic savings for the Palestinian economy. Environmental drawbacks thus are weighted against economic benefits.

Within Palestinian cities, there is a dearth of traffic signals and signs, as well as a lack of directional planning in the form of one-way roads and downtown bypasses. These features, together with a partial social disregard for traffic law, adds to the sense of disorder that permeates the transport system, as well as to the noise and congestion burden of the urban core.

Planning for the millennium has provided an opportunity to grapple with some of these problems, at least in the context of the Bethlehem 2000 project, which is revitalising the ancient city's historic downtown area. Bethlehem 2000 has seen a major revamping of the traffic routes throughout the city, to ease the flow of tourist vehicles, but particularly in the ancient old city core.

One of the chief features of the project is the extensive re-pedestrianisation of Bethlehem's Old City that is now underway, reversing a trend which saw narrow alleys of the Crusader and Byzantine period converted into streets for

car access over the past several decades. The area around the famous Church of the Nativity, once a neglected parking lot, has been converted into a pedestrian plaza with elegant paving stones, benches and trees. The program has already made a marked impact on residential quality of life in the core area and the benefits of reduced congestion and noise and air pollution should become even more apparent over time, as the centre city becomes more attractive for residential living, as well as to tourism.

Similar programs should be undertaken in most of the core Palestinian urban areas, which share similar urban street patterns and contain buildings and facades of great historic and religious value – even if those cities are not as universally known as Bethlehem. Such pedestrian precincts would not only prove environmentally-friendly, but also improve living standards and provide better living amenities in the core, where restaurants, parks and leisure sites could become more readily available even to populations that don't own cars. Pedestrian districts would make other Palestinian cities more attractive and accessible to foreign tourists, and generate new economic growth by boosting open-air markets, souvenir industries, hotels and restaurants.

In certain cases, where the terrain is not too hilly, cycling networks could even be integrated into such precincts as they have been in the west, and be supported as a cheap and low-pollution alternative to motorised transport. Cycling is not a popular transport method among Palestinians today. Perhaps the greatest potential for cycling today lies in the flat Mediterranean seacoast area of Gaza where urban densities are also very high. While a thorough review of Gaza's transport system lies outside of the scope of this paper, it seems obvious that cycling should be supported by the Palestinian Authority as a transport mode in Gaza holding great potential.

As mentioned earlier, road vehicles constitute the only mode of long distance transport in the West Bank and Gaza today. In a new era when Palestinian land is controlled by Palestinians, decision-makers should consider other modes as well. A rail link has already been proposed as a means of connecting the southern West Bank to Gaza, via Israel. A rail link should also be considered as a means to connect the major population centres of the West Bank along the north-south axis of Hebron, Bethlehem, Jerusalem, Ramallah, Nablus and Jenin, where population densities are highest, pollution and traffic are most intensive, and where a natural transport corridor already exists through otherwise

mountainous terrain. Rail should be a travel mode available for both commercial and personal trips, and should eventually become part of a regional system connecting Israel, Jordan and Syria.

A Palestinian national rail system would help promote economic growth, regional economic integration, and support the existence of a Palestinian state – not only by providing a link between Gaza and the West Bank, but also by increasing interaction between different sectors of the Palestinian economy and easing the passage of goods through border crossings. However, given the investment capital that would be required for basic infrastructure investment in rail, such a project could only become reality with the assistance of a co-ordinated effort from the world community. International donors, as well as the Palestinian Authority, should consider such a project, however, as they look for solutions to problems of high population density and land scarcity that a Palestinian state in the West Bank and Gaza will face in the first decades of the new millennium.

Recommendations

The transportation network in the West Bank suffers from years of neglect during three decades of Israeli occupation, and major investments will be needed in order to restructure the system, beginning with a greater investment in planning, as well as in travel demand modelling.

Congestion and pollution are becoming commonly observed phenomena in the West Bank cities and urban centres due to increases in motorisation, the placement of Israeli military checkpoints, and an inadequate system of roads, signalling and public transport. Traffic pollution is exacerbated by the presence of Israeli settlers' cars. The Israeli confiscation of land for settlements and bypass roads has created obstacles to rational land use and transport planning – such land confiscation and settlement expansion should cease.

Other measures are imperative:
- Palestinian road access must be improved. Israeli checkpoints that still mark the entrances to West Bank Palestinian cities should be removed. Free access for Palestinians on the critical Jerusalem road axis must be ensured in order to facilitate traffic and commerce between various West Bank cities.
- Due to the substandard nature of the road system, and the rapid growth in population and motorisation, the road network in the West Bank will have to be improved and expanded over the future. The natural geography of the region does not allow for the easy construction of roads. New technology using GIS techniques is essential to identify suitable corridors.
- More emphasis should also be placed, however, on managed land use. Decision-makers should promote policies that reduce car dependency and long travel times and promote public transport, including alternatives to road transport. Current patterns of land use development must be assessed, and strategies promulgated for the prevention of urban sprawl through the development of mixed land uses and/or compact urban forms in city centres. These strategies will help reduce air pollution and promote social equity by allowing better access to education, jobs, services and shopping for women, children, elderly and poor people who do not typically have access to cars.
- Simultaneously, the Palestinian Authority should promote walking and cycling as a means of reducing air pollution.

Modern-day research on transport systems in Palestine is very meagre indeed. More studies will be required in transportation modelling and modelling of land use planning, in addition to utilising modern methodology as well as the experience of developed countries in developing a more sustainable transportation system in Palestine.

Acknowledgments

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Response to parking restrictions: Results & policy implications of a stated preference survey in Haifa

Yoram Shiftan

Transportation Research Institute, Technion City, Haifa, Israel

Address for correspondence:
Yoram Shiftan
Transportation Research
Institute
Technion
Technion City
Haifa 32000
Israel
Fax: 972-4-8225716
Email:
shiftan@tx.technion.ac.il

Abstract

Parking and its management are key tools in managing traffic. The key is to balance the conflicting interests of business who see parking as vital for customers and commuters who cannot as easily switch destinations or journey times. This paper presents the results of a stated preference survey of drivers in Carmel Center.

Keywords

Carmel, central business district, Haifa, parking, public policy, commuting, travelling

Introduction

Historically, zoning ordinances specified the minimum amount of new parking that have to be provided in conjunction with new development (U.S. DOT, 1982). In many cities in Europe and North America this policy was altered and even reversed by eliminating the minimum requirement for parking spaces or placing a ceiling on the number of parking spaces. In these cities, parking restrictions have been used as part of a strategy to reduce the use of private cars in city centres. Governments are increasingly recognising the use of parking policies as a means of reducing urban road traffic (Barde & Button, 1990; Verhoef *et al.,* 1996; Voith, 1998) and many researchers believe that they are effective means of reducing congestion in city centres (McShane & Meyer, 1982; Barde & Button, 1990).

Examples of parking restrictions in North America include San Francisco where the ordinance limits to 7% the amount of gross floor area that may be allocated for parking. Chicago adopted a parking policy that reduced the supply of parking in the CBD by 10% between 1975 and 1982, despite new office construction in the CBD in this period. In 1976, Boston adopted a freeze on construction of downtown parking spaces limiting commercial parking spaces to 35,500 which is the number of spaces that existed or were committed in 1973. In 1980, Portland set the maximum number of parking spaces that are permitted in the CBD at about 40,000 (U.S. DOT, 1982).

Portland, however, recently moved to relax the previously imposed restrictions somewhat, and allow for an increase of about 5,000 parking spaces over the next 20 years in response to retailers and other businesses that argued that a perception of parking scarcity was hurting business (Voith, 1998).

Examples in Europe include Amsterdam which adopted a parking policy known as the ABC policy that classifies sites in the city into categories (A, B, and C) according to their transit accessibility. Areas with high transit accessibility and low car accessibility are defined as region A. In such areas the parking policy allows for one parking space for 10 employees. Areas with lower transit accessibility and higher car accessibility are defined as region B and in such areas the policy allows for two parking places per 10 employees. Finally, areas that are accessible mostly by car are defined as region C and have no parking regulation. London allows a maximum of one private non-resident parking space per $1,500m^2 – 1,600m^2$ of floor area in the city centre (Palmer, 1996). Helsinki also adopted a policy that divides the city into regions and limits the number of parking spaces in the central areas; the more central the area the less parking is permitted. In addition, the parking limits are defined by the land use in the area. For example, in the city centre up to one parking space is permitted for $150m^2$ of shopping area, compared to one parking space for $350m^2$ of office area.

Parking restrictions, as with other auto restraint policies, are always subject to opposition from state and local officials, business interests, and the general public (Howitt, 1980). For a long time it was an article of faith that when it comes to parking, more is better, and this view is especially strong among downtown retailing communities which see parking restrictions as a threat to their business (U.S. DOT, 1982). In a survey of CBD retailers in Philadelphia, 36 out of 98 respondents suggested that improving parking would be the most important change that could help their businesses (Voith, 1998). In a recent survey conducted by the author in Haifa, it was found that parking is the second most important factor in location decision-making for business,

second only to rent. Because of such opposition and other barriers to implement parking restrictions, many parking restriction policies have not been approved or restrictions adopted were subject to controversy, delay, or incomplete implementation (Howitt, 1980; Kamili & Potter, 1997; Valleley, 1998).

Israel is now at a crossroad at which it has to decide about its parking policy. Given the political fragility of parking policies, there is need for much more evidence of the potential effects of such policies on the response of drivers and on their impact on city centres. The purpose of this paper is to explain the role of parking policy in developing a sustainable transportation programme and to study the potential response of travellers to city centres to a parking restraint policy through a stated preference survey. The problems of stated preference are well recognised (see, for example, Beaton *et al.,* 1997; Bates, 1988). The aim is not to provide an accurate estimate of potential travel changes as a result of a specific parking policy, but to get an initial indication of the likely behavioural changes of travellers under such policies and thereby better understand their implications for the development of sustainable transportation.

Parking Policy in Israel

In 1983, Israel adopted a parking policy specifying the minimum number of spaces required for various land uses. This minimum does not vary according to the location and transit accessibility of the facilities. In 1994, after a decade in which motorisation rates had almost doubled, the Ministry of Transportation prepared a proposal to further increase the minimum parking spaces required. For example, the 1983 standard for office space was at least one parking space for each 25m² – 30m² depending on the type of offices; the 1994 proposals standard was at least one parking space for each 25m² for all offices. This proposal was rejected and a 1997 report on transportation development policy in Israel suggested changing the minimum parking requirement to a maximum parking requirement and varying it according to transit accessibility. The report proposed a maximum of one parking space per 150m² of business in areas that are less than 250m from a mass transit station. While mass transit is being planned in some cities in Israel, currently there is no mass transit system in Israel, and most public transportation is bus based. The Israel Institute of Transportation Planning and Research (IITPR) is now in the process of developing a new parking policy for city

centres based on the 1997 policy report. This policy will define a maximum number of parking spaces per *lot area* that will be the same for the entire city centre, but higher building densities will be allowed in areas with good transit accessibility resulting in less parking spaces per *floor area* where there is good transit accessibility. The report also suggests an interim policy for the transition period until mass transit is fully operational, that allows higher densities of development in places where mass transit stations are planned, and defines maximum parking standards which are less restrictive than the final objective.

The role of parking restraint in managing city centre traffic

Parking can be managed through intervention along several dimensions, including the number of parking spaces and their spatial distribution, parking cost, time limits, residential parking permits, taxes, provision of employee parking and level of enforcement. The total amount of parking available in the city centre can affect the amount of traffic entering the area, and the location and layout of these spaces can affect the movement of traffic within the centre. On-street parking reduces the traffic capacity of roads in and approaching the centre. Parking programmes, however, do not affect through-traffic and they can actually increase it, and they may also increase the number of chauffeur-driven cars if these two types of trips use the added capacity released by less city centre destination trips.

Parking management can be used to encourage people to shift from private car to public transportation. Parking policy, however, can have other effects on travel patterns. It may encourage people to go to other destinations, change the time of day of the trip, and change or cancel their activities. In the long run, it may even cause businesses to move outside the business district, thereby dispersing activities and increasing dependency on the private vehicle. Such a response to a new parking policy may increase congestion and air pollution in the long term, thus achieving the reverse effect of the one intended by implementing the measure.

The objective of a parking-management programme should be to increase the attractiveness of the central business district (CBD) as much as possible by encouraging people to change their choice of travel mode and travel time without discouraging them from coming to the city centre. A good parking policy should restrain commuting by car without hindering shoppers and people doing

personal business, as commuters can only shift mode and sometimes time of day, but shoppers and other visitors can also shift destination or even cancel the trip thus affecting the economics of the centre. Therefore, a good parking policy should ensure that commuters do not fill all available parking and that some unoccupied parking space is spread over the area so that shoppers and other visitors are not discouraged from visiting the centre.

Potential parking schemes to achieve these focused objectives include varying parking rates by time of day, charging higher rates for longer periods and limiting parking time. Parking measures should be imposed only during congested peak periods so as not to discourage shopping and other types of midday trips that are important for the vitality of the downtown.

A key consideration for parking policy is its likely effect on downtown economic activity. Parking measures are often presumed to increase the cost of doing business in the downtown area by making the auto trip more expensive and inconvenient. On the other hand, the reduced congestion resulting from such measures may lessen travel time, thereby reducing the cost of doing business. The net impact of these effects is hard to predict.

To evaluate the potential benefits of parking measures, we need a good understanding of people's responses to them. We need to understand how parking policies affect the demand and supply for parking, how parking demand and supply affect the vitality and value of the CBD, and how parking policy functions as a powerful transportation-planning tool. Little data and information, however, are available either on the potential impact of parking measures on people's travel behaviour patterns or on the long-term effects of such measures. The few existing studies are either empirical looking at the before-and-after implementation of a parking policy or simulation studies in which travel demand models are used to evaluate the potential effect of a parking policy. Examples of empirical studies are as follows: Thomson (1967); U.S. DOT (1982); Mehranian *et al.* (1986); Surber *et al.* (1984); Willson (1997); Willson & Shoup (1990); Shoup & Willson (1992). Examples of modelling and simulation modelling studies include Gillen (1977), and Gomez-Ibanes & Fauth (1980).

The Stated Preference Survey for Haifa

A stated preference survey of 200 car drivers arriving at the Carmel Center CBD in Haifa was conducted to study their response to changes in parking policies. Carmel Center is one of the city of Haifa's few business districts. This centre is of mixed land use (catering to residential, commercial, service, and leisure activities) and as such, serves as a regional business district for the nearby neighbourhood as well as constituting one of the major business districts in Haifa. It is a traditional urban CBD, with small shops, services, offices, and leisure activities and no major shopping malls. In addition, it does have a small shopping mall that is part of an apartment and hotel complex.

The survey was conducted in the Carmel Center and focused on auto drivers asking them about the specific trip that they just made to arrive in the area. The survey included questions about the trip origin, arrival time, purpose, the time needed to find parking, and to walk from parking location to destination, and the type of parking (paid/free and on/off street). The stated preference part of the survey included experiments asking drivers for their potential response to an increase in hourly parking rates from their current 3.70 New Israeli Shekels (NIS) to 5, 7, and 10 NIS and to a reduction in the number of available parking spaces. The reduction in parking spaces was presented to the respondents in term of an increase in the time needed to find a parking space of 10, 15, or 20 minutes. For each question, respondents were given the option to cancel their trip, to change destination, to change the time of the trip, to shift to public transportation or to taxi, to walk, or not to change their travel behaviour. Finally the survey contained some demographic and socio-economic questions in regard to age, marital status, household size, children, auto ownership, number of drivers, and income.

The Sample
The sample had 29% work trips, 20%-shopping trips, 25% entertainment trips, and 26% errand trips. 61% of the drivers drove alone and 39% had at least one passenger with them. Parking search time was almost evenly distributed among the three ranges provided: 0-5 minutes, 5-10 minutes, and more than 10 minutes. Some 47% of the auto users said they walked for up to 5 minutes from their parking location to their destination, 39% walked for between 5 and 10 minutes, and 14% walked for over 10 minutes. A total of 67% of the respondents parked for free on the curbside, 11% parked in employee parking, 13% paid for curb parking and 9% paid for garage parking. Most parking was for short duration: 27% of the respondents expected to stay in the Carmel Center for less than an hour, 28% for less than a couple of

hours, and 17% for less than three hours. The rest of the sample, 28%, expected to stay for more than 3 hours; 80% of this group were people who had come to work.

Results

Figure 1 shows the response to price increases to 5, 7, and 10 NIS. For a fee of 5 NIS per hour, 71% of those who arrived at the centre would not change their travel behaviour. Of the 29% who would, 12% said they would change mode, 9% would change destination, 4% would change the time, and 4% would cancel their trip. Increasing the price to 7 NIS would cause 50% to change their behaviour and a fee of 10 NIS would cause 58% to change their behaviour. Although these results are interesting, it is more important to look at them by trip purpose. Figure 2 shows the results for only work trips.

There is no destination change or

Figure 1: Response to price increase – all trips

Figure 2: Response of work trip to increase price

Figure 3: Response of non-work trips to increase price

Legend:
- ■ no change in travel
- ☐ change mode of travel
- ▨ change destination
- ▦ change time of travel
- ▤ cancel trip

elimination of trips for work trips. For non-work trips (Figure 3), all types of changes occur, the most common being mode shift and destination change, both at about the same rate.

A good parking policy should encourage workers to shift mode and time of day, but not discourage visitors from coming to the centre. For purposes of analysis, therefore, all travel-behaviour responses were categorised into three groups:

- no change in behaviour;
- change in mode or time of day – this is considered a positive change, as it will reduce traffic without reducing the number of visitors to the centre;
- change in destination or cancellation of the trip – this is considered a negative change, as it will reduce the number of visitors to the centres and, therefore, may affect the vitality of the centre.

Figure 4 shows the response by these groups to a price increase to 10 NIS for both work and non-work trips. For the whole sample, there is an equal number of people who state they would change mode or time and who state they would change destination or cancel their trip. A look at these results by trip purpose shows that among those on a work trip, 30% would change mode or time and only 4% would change destination or frequency. This result suggests that the policy can be a good one for work trips. The proportion of non-work travellers who state that they would shift mode or time of day is similar (28%) to that of commuters; however, there is an additional 39% who stated they would either change their destination or cancel their trip. In other words, non-work travellers are far more likely to respond undesirably to parking restrictions by shifting their activity to other centres, an option that does not exist for commuters, at least in the short run. However such a travel-behaviour response by shoppers and other visitors can have a significant effect on the vitality of the centre and eventually cause businesses to move out of the centre, as well. In the long run commuters to these businesses will also shift destination as a result of the policy.

The responses to parking availability measures show similar trends to those of parking prices. Figure 5 summarises the positive and negative responses for the 20-minute parking-search time for work and non-work trips. All trips have similar positive responses: 39% of the work trips will shift mode or time of day and 35% of the non-work trips will make such shifts. There is only a negligible negative response for work trips (of 4%), whereas there is a significant negative response for non-work trips of 49%. This result
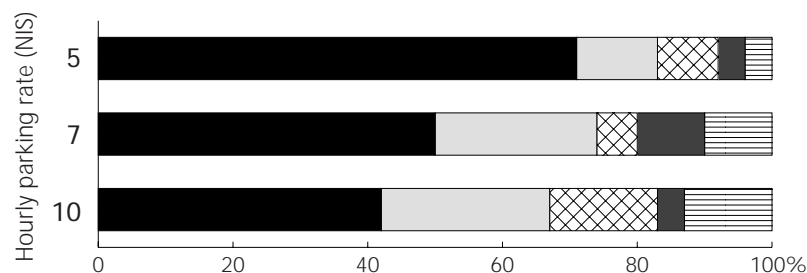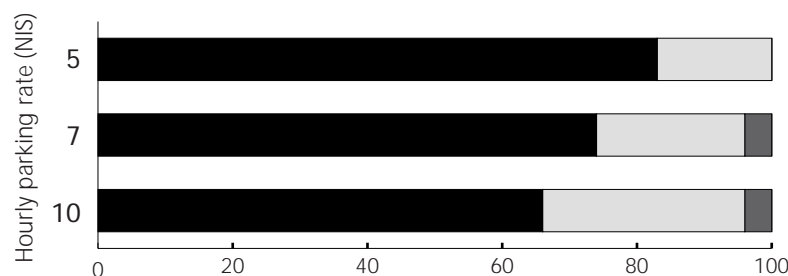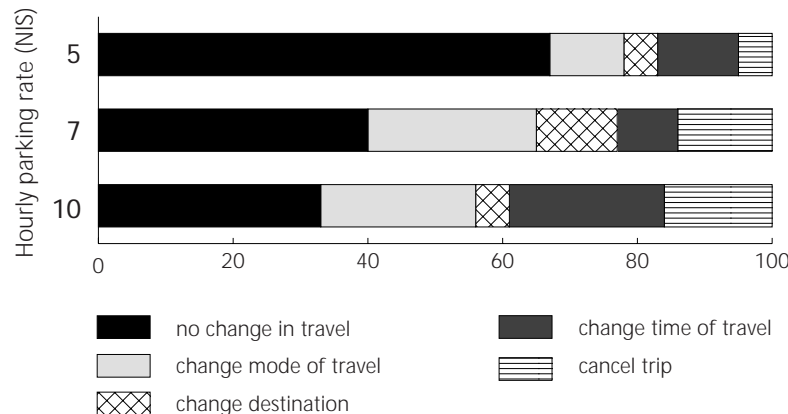
has significant policy implications. While work trips will continue to arrive at the centre, the exclusion of non-work trips will gradually cause the centre to deteriorate and in the long run may cause businesses to leave the centre. In the long run, too, work trips will also shift destination, and this shift may even result in a shift from transit to auto mode if the new location is not served well by transit.

Figure 6 compares the response of both work trips and non-work trips to parking supply measures versus parking-charges measures. As expected, non-work trips are more flexible and, therefore, more likely to change their behaviour. As discussed above, this higher percentage results from a tendency to change destination and to cancel the trip in addition to change mode and time of day, which occur at a similar rate for work and non-work trips. For

the range of measures tested, parking availability appears to influence behaviour more than pricing.

Conclusions

The main results of this study show that the introduction of parking measures will cause people who travel to work by car either to continue to travel by car or to shift to public transportation (rather than cancelling trips or shifting their destination). Parking availability had a stronger influence on mode shift for the range tested. For non-work trips there was a smaller shift to transit, but a larger destination shift, more activity cancellation, and some time-of-day change. Overall, for non-work trips, more people indicated they would change destination or cancel the activity than change mode or time.

The results suggest that parking measures may be effective in reducing congestion in the business district. However, they may also have a negative effect on the vitality of the business district. Their effect on regional travel patterns and air quality is not yet clear. Further research and detailed local studies are required before such measures can be implemented.

The implications of these results to the development of parking policies that will support sustainable transportation include the need to base parking policy on land use. Parking restrictions can be efficient in employment centres, but can have a negative effect in commercial areas. Parking restrictions should be applied only where there is a good public transportation as an alternative mode of travel, so people can shift mode rather than choose one of the bad alternatives of shifting their destination outside the centre or cancelling their activity. In addition, targeted manipulation of time limits and parking charges can ensure that car commuting is discouraged while short-term parking still remains available for visitors and shoppers.

Figure 4: Response to price increase to 10 NIS
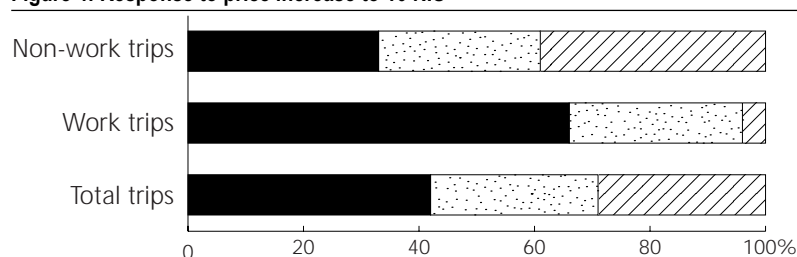
Figure 5: Response to parking supply resulting in 20 minutes search
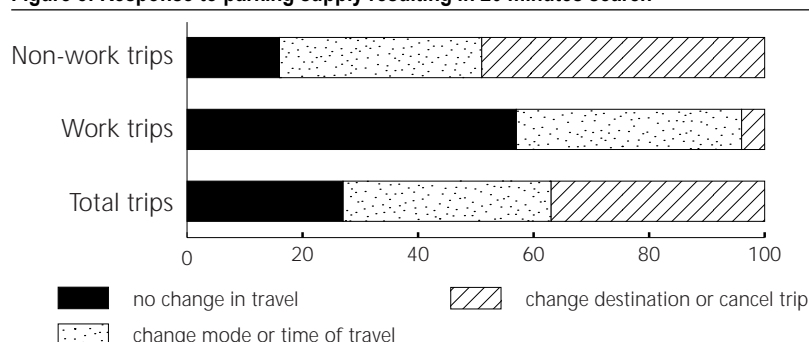
Figure 6: Changing travel patterns in response to Price increase vs. Supply decrease

Shiftan: Response to parking
restrictions: Results & policy
implications of a stated preference
survey in Haifa

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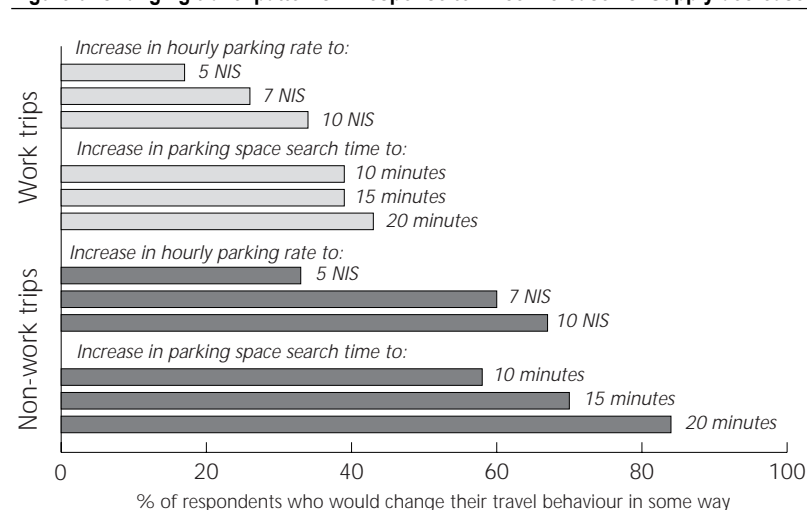
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Exit or Voice: the Prospects for public transport user representation in Israel

Meira Hanson

Department of Political Science, Hebrew University of Jerusalem

Abstract

There is a persistent crisis in the Israeli public transport system. While the government's agenda for recovery is to introduce more competition to the main service providers, this may not necessarily guarantee an improved quality of service for the user. Currently, the only way in which users can express dissatisfaction at declining quality of service is through 'exit' – abandoning the service, most often in favour of private car use. This article sets out to introduce another option neglected so far by service providers and government alike: granting 'voice' to users via representation in the decision-making and operation of public transport services. To this end, several examples from abroad are brought to bear on the Israeli scene, and possible scenarios for change are considered.

Keywords

Consumer choice, public transport, user group pressure,

Introduction

The multiple ills of Israel's public transport system are enough to satisfy the needs of even the most devoted transport hypochondriac. There is a continuous decline in public transport users, going hand-in-hand with limited government investment, a rigid network of bus service lines and lack of integration between public transport services. As if this was not enough, any discussion between public transport providers and users, and between users and regulatory authorities, is virtually non-existent.

In the past, the lack of such mechanisms would have been expected within an overall pattern of centralised government taking a strongly paternalistic view of citizens, such as perceived in Israel until recent years. However, as Israelis increasingly become savvy consumers on the one hand, and as the crisis in transport intensifies with corresponding environmental decline, the need for communication between public transport suppliers and users – actual and potential – is

obvious. This lack of communication is particularly glaring when compared to the wide range of mechanisms for user-representation which exist in other countries. And yet, so far the idea of user representation in public transport has received little attention from either the authorities, transport planners or the public at large. This article – and the paper on which it is based – aim to fill missing gaps of knowledge, conceptualisation and assessment of feasibility on this subject in Israel.

User representation in general is helpful in adjusting services, dynamically and positively, to the needs of users and establishing greater trust between providers and users. Such trust can encourage a greater resilience on the part of users, faced by service interruptions which could be temporary and, conversely, enables suppliers and regulators to gain valuable early insight into the impact of any changes which they might wish to implement.

Beyond these general points, there are specific circumstances that lead us to advocate the immediate introduction of user representation in public transport in Israel, and for doing it urgently. The public transport sector has started to feel the winds of structural changes induced by the Ministry of Finance and the Ministry of Transport (MoT). The government through these ministries is determined to break the stranglehold that the two long-established bus co-operatives hold on urban and inter-city transport. Government policies involve putting parcels of lines out to competitive tenders, which will result in new operators gaining a foothold in the market. The hoped-for result is the driving down of operating costs, fares and government subsidies.

However, economic efficiency is only one element in a high-quality public transport system that should also imply reliable, accessible and convenient public transport services. There is an important role for public transport users in determining what the aims of quality public transport should be. Furthermore, as it stands, there is no certainty that the above-mentioned structural changes will be accompanied by suitable regulatory authorities. The absence of some form of a

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strategic authority at a national, metropolitan or local level, makes it likely that the public transport system will remain highly fragmented, limiting its benefits for the user.

In view of all the above, it would indeed seem timely to consider the current, and potential, role of users in the Israeli public transport system. This article is based on interviews with the main public transport suppliers in Israel and officials in the MoT and on information and correspondence with user groups and public transport officials abroad.

Trends in Israeli public transport – The passengers' perspective

The public transport scene is Israel today is dominated by bus services. The rail system had been badly neglected over the years and while recent investment has enabled current services to run at close to maximum capacity, further improvements in the quality and scope of services have been hindered by low government investment. As the Figure 1 shows, 20% of daily trips are made by bus, but less than 1% are made by rail (and so do not register in the Figure). More dominant than rail are the service taxis which command 2% of the market (the remaining 1% being regular taxi services). These service taxis run between the main cities and in areas which lack regular bus services (Arab villages, for example).

The bus services are dominated by two main bus providers: Egged which handles most of the nation's services and Dan which services the Tel-Aviv-Jafo metropolitan area. Apart from these two main providers there are also several local service providers such as in Beer-Sheba and Nazareth. Integration between these services is minimal. Egged and Dan operate

Figure 1: Travel Mode Split

Source: National Bureau of Statistics' 1996-7 Travel Habit Survey. Special transport is organised transport to workplaces, etc.

one, relatively expensive, combined monthly travelcard and Israel Rail, the governmental company which runs the rail services, has recently negotiated a policy for through-ticketing with Dan. Israel Rail and Egged have recently been at odds regarding connecting services to rail stations, a debate which reached its height when the rail company expressed its interest in running its own connecting services.

The lack of integration in the system is accompanied by a rigid and increasingly obsolete structure of bus lines. These have developed as point to point routes over the years when the need arose and so lack coherence as a system. Users who wish to circumvent the city centre in Jerusalem, for example, will find the venture extremely difficult – and expensive if they lack a monthly travel-card (only Dan offers daily travelcards at present). The bus providers have little incentive to reconstruct the system and many incentives not to (changes in equipment, bureaucratic hassle, etc.).

The pressure for systemic changes should be coming from the MoT. However, the government's current policy regarding public transport is focused on creating more competition in the system by putting particular bus routes out to tender. The general assumption is that increasing competition will improve services while reducing prices by forcing the providers to cut down on costs. Underlying this agenda is an attempt to pressure the two main providers to cut expenses – the main one being workers' salaries (both providers are worker co-operatives with extremely good conditions for their permanent workers). The MoT required that competition be combined with the setting up of transport authorities to properly regulate the system. The Ministry of Finance, however, supported introducing competition without these transport authorities. So there is currently no authority responsible for effective transit between services or for co-ordinating between the timetables of the different providers. Finally, and particularly problematic for users, there is no forum for redress aside from approaching the MoT directly – a rather cumbersome route which is not often used for public transport issues, as will be noted next.
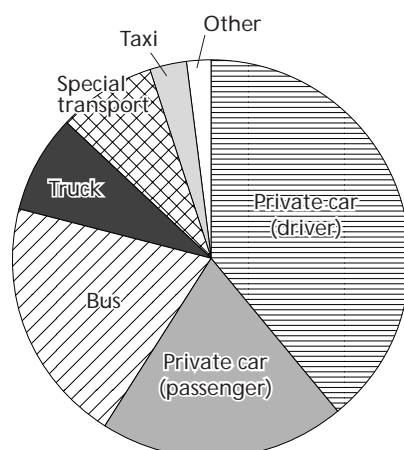
'Voice' for Users?

Facing current and future problems in public transport services in Israel, what options are open to users? Following Cartledge (1992), I adapt Hirschman's (1970) discussion of Voice and Exit to identify public transport users' response when faced with a deteriorating

Table 1: Travel Mode Split by access to car

Cars per household	Private car [driver]	Special transport	Private car [passenger]	Bus	Taxi	Other
0	5	12	24	45	8	6
1	45	8	20	15	3	9
2	56	5	16	8	2	13
3	55	4	15	6	2	17
Total	39	8	20	20	3	10

Note: The 'other' category includes the 'truck' option noted in Figure 1.
Source: National Bureau of Statistics' 1996-7 Travel Habit Survey.

service. Users could exit by switching to some other form of transport (public or private), or they could choose voice, that is, some means of articulating their disappointment with the service provided.

For public transport users in Israel, there are no comparable exit options within the public transport system, so that the main alternative is private transport. As Table 1 indicates, the use of public transport among those who have access to a car is below average with a drastic drop in use once a household has two or more cars. The bus service is clearly not a viable option for those who have some alternative means of transport – a fact which service providers, as well as policy-makers, are well aware of.

But, as Hirschman (1970) notes, exit need not be the only option to express dissatisfaction with a deteriorating service – nor is it always the best means to engender change in an organisation. A voice option could serve equally as well, particularly when the provider monopolises the service leaving no option for those who need the service to keep using it while voicing their displeasure. Similarly, voice can replace exit in a case where the firm or service provider can fall back on government subsidies, as is the case with public transport in Israel. The idea that voice can be a viable option for a service-provider to correct itself in a non-competitive system is particularly pertinent to the Israeli system in view of the government's interest in introducing competition into the system.

However, there is no formal channel for public transport users in Israel to collectively give vent to their dissatisfaction, or to articulate their demands, regarding public transport services. Individual users can approach service providers' complaints department and if they are not satisfied with the results they can file a complaint with the MoT. The MoT's complaints department also deals with criticisms regarding the work of the Ministry itself. While service providers claim they follow up on the complaints, all information accumulated is distributed internally, so the public is unable to access this important source of quality control.

The Ministry's complaints department does make a report of its activities available to the public, even though it is not required to do so by law, but only a small section of these complaints relates to public transport users (most complaints deal with car imports and related issues).

Some local authorities, particularly the main cities and regional councils, have traffic planning committees which deal with local traffic arrangements. The committee in Jerusalem, for example, is composed of the head of the traffic department in the local municipality, a representative of the local bus provider (Egged) and a representative of the MoT. Though in theory a potential channel for user representation, in practice these committees deal less with the quality of service and mostly with the positioning of stations and traffic problems which might arise. The local authority has a very limited official say vis-à-vis the MoT concerning public transport traffic arrangements (such as bus routes). As for the quality of services, prices and the like, these are not within the remit of the local authority since the bus providers are not accountable to it.

Informal lobbying concerning public transport service, when it occurs, is confined mainly to prices and usually directed at politicians rather than public transport officials. Attempts have also been made to adjust services to the needs of groups with particular requirements. Efforts on the part of the ultra-religious to segregate the genders on their bus services have raised considerable opposition by the general public, but can be classified as an articulation of user demands (particularly as the ultra-religious have one of the highest percentages of users relative to their number in society). A more successful lobbying effort was carried out by representatives of the physically-disabled population, as part of a law on equal rights for the disabled, to make buses accessible to their needs. But in this case the requirement for changes was imposed on the MoT and on the providers by force of law and has not yet been implemented.

The above examples are exceptions to the rule: they do not represent the majority and deal with very specific elements of the bus service. At the same time, they actually enhance the claim that public transport users in Israel have no effective voice, since the groups involved were more likely than not to circumvent the providers and even the MoT via political channels, rather than approach them directly.

As I will claim in the next section, this lack of effective voice options reflects a persistent

trend in the Israeli public services arena regarding the substance of service provider, regulator and user relations.

Service Provider – Regulator – User Relations

There are at least three approaches which can be adopted to outline the relations between public transport service users, providers and regulators: paternalistic, consultative and market.

A paternalist approach assumes that the service provider or regulator can identify the needs of users. With such an approach there is no need for user representation: the decision-making system incorporates information about users but there is no need for inputs from the users themselves.

A consultative approach acknowledges the need to integrate user inputs into the planning of public transport services, so as to supply a service attuned to the users needs as they express them. The structure of consultation may vary, as does the degree to which user inputs affect actual decision-making, that is, the degree in which the flow of decision-making is from the bottom-up.

A market approach assumes that the best thing for the user/consumer is to offer her a wide selection of options and then let the user choose between them. If there is true competition between service providers, users express their needs in the choice between products, rather than being represented in the decision-making process.

Relations between users and service providers in Israel can be defined as 'paternalistic'. Service providers identify users' needs via surveys and by counting the number of users on different services. They predict future needs by keeping updated on local planning issues and sitting in on municipal traffic planning committees. Contact with the public is limited to the individual complaint or request (for example, providers are approached by schools requesting changes in bus routes). There is no place (and from talks with representatives of Egged and Dan there would appear to be no need either) for consultation with public transport users.

The public authority that currently regulates the bus and taxi services is the MoT, specifically the department responsible for public transport. The MoT regulates the setting of service routes, prices, subsidies, vehicle configuration, etc. However, their contact with users is limited to the complaints received by the office and to surveys regarding public opinion on public transport. Judging by this I would characterise user-regulator relations in Israel as another example of a paternalist approach. One exception, though, is a committee currently considering the implementation of the 1998 law requiring equal rights for the disabled. This committee includes representatives of the MoT and a representative from the umbrella organisation for disabled people in Israel. This is not a permanent committee, unlike the Disabled Persons Transport Advisory Committee in the U.K. Department of the Environment, Transport and the Regions, but it's a step in the right direction.

Several examples may be found of a more 'consultative' approach, though none should be considered the perfect model for user-provider-regulator interaction. The prime component of a consultative approach is that it provides institutionalised (that is, more or less permanent) channels of communication with users. These may be statutory, such as the Rail Users' Consultative Committees in the U.K. – official watchdogs monitoring the quality of rail services on a national and regional level, or the London Regional Passenger's Committee which has similar responsibilities regarding all London Regional Transport services, as well as the railways around London. In these cases the service providers are required by law to consult with representative user committees.

There are also many examples of non-statutory channels for consultation. In San Francisco, the Metropolitan Transportation Commission – the planning, co-ordinating and financing authority in the Bay Area, has several citizen advisory committees including the MTC Advisory Council which includes representatives from nine interest categories, one of which are transportation users. Similarly, in Victoria, Australia, several consultative committees advise the Minister of Transport, of which the Victorian Public Transport Forum deals with customer concerns regarding metropolitan and non-metropolitan public passenger services

In the Netherlands, the 'Overlegorgaan Personenvervoer', which represents interests in transport such as local governments, trade unions, transport corporations and consumers, advises the government on policies and laws. In addition to this forum, the recently formed

Table 2: Three Approaches to Users

Approach	Characteristics
Paternalistic	Needs identified by service provider, one-way communication channels, top-down pattern
Consultative	Needs identified by service users, two-way communication channels, bottom-up pattern (to varying degrees)
Market	Needs identified by market, communication channels secondary, bottom-up pattern

'Landelijk Overlegorgaan Consumentenbelangen Openbaar Vervoer' – the national consultative body for consumer interests in public transport – is consulted by the Ministry of Transport and by the national railway corporations on plans regarding, among other things, schedules, fares, passenger information, services and facilities at railway stations, and railway privatisation.

All the above are mainly fora for consultation of varying influence. While they differ from the paternalistic approach in enabling some form of dialogue, or 'tri-alogue', between service provider, regulator and user, they are not all strictly bottom-up forms of decision-making.

A 'market' approach would command a separate category as it implies a system with no essential need for user inputs beyond those users' needs determined by the market. To adopt Hirschman's terminology, this approach would perceive the system as regulated via users' having options to exit when service quality deteriorates.

A market approach suits a situation where there is competition between different public transport service providers. One could identify such an approach underlying the opening of the UK bus service market outside London to competition. There are no formal channels of communication between users and bus providers in the UK, though user organisations such as the National Federation of Bus Users do exist and lobby bus providers on an informal basis. This is not to say that bus providers do not seek out users' views on their services in competitive systems. Indeed some public transport providers in countries such as the UK or the US have user groups working with their local services. However, with no public control over services, user representation can only ever be secondary to the demands of the market.

The market approach is not foreign to the Israeli scene and can be perceived, for example, in the liberalisation of the market for overseas phone calls. In the field of public transport, the government's current policy is to bring more providers into the system, break the monopoly of the two public transport co-operatives, and reduce costs for government. However, the market for public transport is not being opened up to competition; rather, particular lines are being put out to tender. The government is not, therefore, offering users a choice between services since it is choosing the service on each line. It is also increasing the number of services it must regulate with the likely consequence of less regulation altogether, as indicated above. At the moment this looks effectively like a case of no voice and no exit (except to private transport).

Future Scenarios

In view of the above, what are the prospects for user representation in Israel? Future scenarios depend on whether or not two-way channels of communication between users, service providers and regulators are institutionalised. By institutionalised I mean permanent, independent consultation channels or recognised user organisations that offer effective forms of redress and an effective say on public transport policy that has an impact on users.

In the most desirable scenario, such channels would be formed, preferably as part and parcel of the reorganisation of the public transport system, there would at least be a basic framework for user representation in Israel. Such a framework could serve as an integral part of a public transport authority (national and/or metropolitan), monitoring current – and future – providers. The London Regional Passengers' Committee could serve as a fairly useful model for this type of channel, though ideally it ought to have more effective powers. In any case, formal channels should not cancel out options for informal user representation. Many independent user groups such as the Dutch ROVER or the Australian Action for Public Transport also participate as user representatives on the formal consultative fora.

There is another (not inconceivable) scenario, which is the effective continuation of the status quo, whereby there is no formal dialogue between users and providers or between users and the system's regulator. Future prospects in this case would depend on whether or not users organise to represent their interests despite the lack of institutionalised communication channels of the type described above. There are at least three main options that would seem likely for this type of informal organisation, each seeking out a different source of leverage to compensate for the absence of an institutionalised national or local mandate.

The first would be to set up user groups alongside local authorities that are very slowly opening up to more public participation. The effect of such groups may be circumscribed from the start by the limited scope local authorities have, formally, to encourage and originate local public transport. But this would not rule out a range of informal contacts officials in charge of traffic in some local authorities have with service providers, a channel user representatives could use to their

advantage. To date, both the two main metropolitan areas – Tel-Aviv-Jafo and Jerusalem – are undergoing major restructuring of their public transport systems which could (and should) involve users, although any plans reached would eventually be subject to central budgetary decisions.

Another option is to set up user groups with some of the smaller public transport providers if found to be more open to user representation. Since new providers are being introduced to the system on particular routes or in a specific area, they are more likely to have a localised clientele (as does, for example, Margalit – the company that serves the new city of Modi'in). This type of system could commit the provider to a particular group of users and making the technical side of user representation slightly less cumbersome. Naturally, users' forms of redress in such frameworks are limited to the provider's goodwill, as in the case of the Bus Appeals Body in the UK, which was set up by the Confederation of Passenger Transport (the industry's trade association) in collaboration with the National Federation of Bus Users as an independent body to review bus and coach complaints.

The final option has users organising at the community level and employing familiar forms of appeals to the media and decision-makers and – when necessary – protest. This would seem the most viable option at the moment, provided there is enough interest at the grassroots. Several examples exist of groups such as Action for Public Transport in Sydney and the Public Transport User Association in Melbourne, the South London Line Travellers' Association in London or the Straphangers in New York. The Bus Riders' Union in Los Angeles is a good example of a successful grassroots campaign to improve public transport services – and reduce prices. Israel has experienced a proliferation in third sector community organisations in the recent years, so there seems good ground for user organisations to take root – provided the right seed is planted.

Conclusions

For Israel to seriously alter its growing car dependency, serious changes must be made in the way public transport is prioritised, promoted and operated. All three of these aims require that the policy-makers and transport providers engage with the public beyond the basic retail operation (user buys ticket and uses service). The latter limited contact may have worked in a system in decline, but indicates a serious deficiency for a system geared towards promoting public transport. While policy-makers are geared towards a more market-oriented model of public transport provision, the purpose of this article is to introduce the equally viable mode of voice.

There is an in built tendency within Israeli planning systems whereby interests involved in the initial stages of the planning process are often incorporated into the permanent structure of the system. Thus the current major reformation of public transport services in Israel offers a unique opportunity. Steps to introduce user representation into this changing system are likely to influence the shape of things to come.

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Do telecommunications reduce industrial uses of transportation?: An International Comparison of Israel, Canada, U.S.A. & Europe

Pnina O. Plaut

Faculty of Architecture and Town Planning, Technion – Israel Institute of Technology

Address for correspondence
Pnina O. Plaut
Faculty of Architecture and
Town Planning
Technion – Israel Institute of
Technology
Haifa 32000 Israel
Fax: 972-4-824-9194
Email:
Splaut@econ.haifa.ac.il

Abstract

There is a long-running debate about the relationship between transportation and communications. One issue is whether the two services behave as substitutes or as complements. This is important because substitution implies that advanced telecommunications induce a reduction in the need for transportation and the seriousness of transportation system problems. While most research has examined the relationships for commuters and individual travellers, the bulk of transportation and communications services are in fact used by industry.

It is shown that the pattern of complementarity detected in earlier research for Europe is also found in non-European locations, despite their very different conditions. This indicates that complementarity is robust and not dependent on a specific set of geographic conditions, infrastructure or level of development. All of this implies that expectations regarding the ability of telecommunications to reduce travel as well as the negative impacts and environmental costs of transportation may be unfounded.

Keywords

Telecommunications, North America, Europe, complementary effect, substitution effect.

Introduction

There is a widely-accepted presumption that the spread of advanced information technologies mean that location no longer matters. The economy is increasingly concerned with the 'movement' of information and less focused on the movements of things and people. Sophisticated technologies then should diminish the role of the transportation system, reducing the seriousness of transportation externalities in tandem. This conjecture is equivalent to presuming that advanced technologies (such as telematics and information technologies and especially telecommunications), act in and of themselves to redress and resolve the problems created by use of the transportation system, such as congestion, energy consumption, air pollution, and safety costs. In addition, reduced utilisation of the transportation system would imply significant changes in land use patterns and constraints (for example, by freeing up land used for parking, roads, and office space for other uses). The relationship between telecommunications use and transportation also carries important implications regarding possibilities of developing 'sustainable transportation', an issue increasingly at the centre of academic and public debate.

In recent years the relationship between telecommunications and transportation has undergone considerable rethinking. Originally it was commonly accepted that telecommunications services serve as substitutes for transportation services, leading to reduced commuting behaviour and a contraction in transportation when telecommunications improve and expand: for example, people who 'telecommute' instead of commuting physically, or people who maintain social and business contacts through telecommunications instead of physical visits and face-to-face interactions. But an alternative school of thought has arisen that argues that the two sets of services are in fact complements, not substitutes. There are a variety of conceivable reasons for this, including responses to consumer needs in real time made possible by telecommunications, increased flexibility in production, economies of scope (cost savings when two or more activities are produced or used together), shifts from manufacturing to a 'service economy', and so on.

Most previous research focused on travel behaviour and final demand for transportation and telecommunications by households and commuters. There has been little analysis of the relationship between industrial uses of transportation and communications services. These industrial uses are of particular interest because the bulk of transportation services in industrialised countries are in fact purchased by industry as intermediate goods rather than as final goods by consumers, and the same is true for much (often most) of communications services as well. For example, in the European

Union (EU), in 1980, 64% of all transportation services were sold to industry as intermediate product, and only 29% were purchased by consumers. For maritime and air transport, 31% of output was purchased as intermediate services by industry, with only 14% purchased as final product by consumers. For auxiliary transport, 80% were purchased by industry as intermediate inputs, while only 7% were purchased by consumers as final product. For communications, most of the output is sold to non-consumers. Industrial intermediate use accounted for 63.5% of output in the EU, and consumers purchased 32.5% in the same year. The proportions consumed by industry in the U.S.A. in 1992 are: 54.5% of the gross output of the transportation service sector is used as intermediate inputs by other industrial branches. Only 26.8% of the gross output is purchased as final product by consumers (the rest is purchased by other final users, such as capital investment, exports, or governmental consumption). For communications, the domination of industrial use is less overwhelming. 41.3% of the gross output of communications services is purchased as intermediate input by industry. 45.4% is purchased as final product by consumers.

Transportation and communications services play a productive role throughout the various industries and sectors in the economy. They contribute directly and indirectly to final uses, including consumption, capital investment, government consumption, etc. The urban metropolitan or regional system is constructed upon residential and non-residential activities and the interactions, such as transport and communications, occurring among them. Telecommunications developments may relax time and place constraints resulting in changes in where and how goods are produced and consumed. These, in turn, may affect

transportation use and development.

There are good reasons to suspect that the extent of complementarity or substitution between these services would vary across countries, as a function of differences in levels of development, urbanisation, and other economic, demographic and social factors. In Figure 1 the variables involved are represented.

The basic hypothesis is that country characteristics, economic policy measures and existing technology affect the relative cost-price structures (such as energy prices and prices of various industrial components and inputs) and the industrial mix (the combination of outputs of various products) in that country. These relative prices and the industrial mix are, in turn, influenced by the existing technology, by the physical and economic characteristics of the country, and by economic policy. Patterns of production and use reflect political and planning considerations. Economic policy variables include subsidies, taxes, import and export policies, regulation, and public investments. The characteristics of any country that affect transportation-communications relationships in industry include at least two sets of factors:

(1) general conditions, including things such as population density, GDP, unemployment, wage levels, etc.; and

(2) indicators specific to the transportation/ communications infrastructure, including, for example, total road mileage, rail length and capacity, telephones per capita, air traffic capacity, etc.

A clear pattern of strong complementarity of transportation and communications services in industrial intermediate use was previously documented for Europe in Plaut (1994 & 1997). However, the relationship for other parts of the world has not yet been evaluated. Hence relations outside of Europe are of particular interest. There are dramatic differences across industrial countries in their geographic, economic and infrastructural characteristics. Specifically there are tremendous differences in population densities, and these should be related to the ways in which transportation and communications services are used across countries. For example, Newman and Kenworthy (1991) found that higher density of urban land was associated with shorter average travel distances and greater transit patronage. It is of interest to investigate whether the patterns found in Europe are unique or of more general occurrence.

In order to investigate the extent to which geographic and economic differences affect transportation-communications relationships in industry, this paper conducts an investigation

Figure 1: Theoretical Model
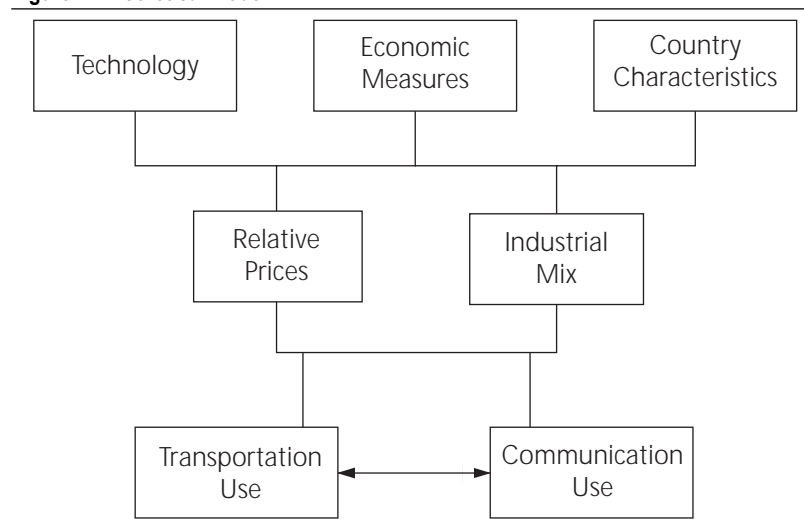
of these relationships in Israel, the U.S.A. and Canada, with comparison to Western Europe. The non-European countries to be analysed differ markedly from Western Europe in many ways, enabling an evaluation of whether the complementarity relationship holds broadly, or whether it differs across countries with markedly different characteristics. The countries in questions provide significant diversity for this examination. On the one hand, Israel is a densely populated small country, whose level of development was until recently considerably below Europe and North America, but also a country that has long been at the forefront in telecommunications technology. On the other hand, North America and particularly Canada represents a developed region with very low density. Comparing experience in these countries with that in Europe can contribute to a clearer and more general understanding of these relationships. The population densities and number of telephones per 100 residents for a sample of countries and roughly similar dates are shown in Table 1.

As can be seen, the countries with the highest densities are the Low Countries, followed by Germany, the UK and Israel. At the low density extreme is Canada, with the U.S.A. and Sweden somewhat denser, but still far less so than the rest of Europe. The countries of course differ from one another in many other ways as well, most notably in the total area of each. Israel combines a very small and quite dense geography with a level of development only now catching up with Western Europe.

In the next section the literature on the relationships between transportation and communications uses is reviewed. Then these relationships in industry are examined for

Israel, Canada and the U.S.A., and compared with Western Europe, using input-output data. Input-output data is an economic/statistical methodology that analyses interdependence among industries and is described in more detail below. It is shown that a strong pattern of complementarity exists in all the countries examined. The implications of this are discussed.

Transportation and communications relationships

The rapid developments in information technology and data processing have inspired a growing interest in the interactions between telecommunications and transportation. Cost reductions in data acquisition, access and processing and capacity expansion have been the driving forces behind the expansion of information telecommunications. Technological advance has by now created conditions under which telecommunications can be a very close substitute for face-to-face communication. This has led many to speculate about the ability of telecommunications to substitute or replace 'old-fashioned' commuting for business, productive and leisure activities. In the analytic literature there are two hypotheses regarding the relationships between transportation and communication: substitution and complementarity (Salomon, 1986; Mokhtarian, 1990). The most common and prevalent hypothesis regarding the relationship between transportation and communication raised in the theoretical literature is one of *substitution*. In some research, substitution is defined as the total elimination of a trip, such that travel is entirely replaced by telecommunication (Lee and Meyburg, 1981). Others use a less extreme definition, such as one based upon the alteration of trips (Nilles, 1988; Mokhtarian, 1991). The basic assumption behind the substitution hypothesis is that the *total* amount of interactions (including both travel and communication) is not affected by the specific assignments to either mode. It follows that as communications technology becomes more advanced, cheaper and more accessible, telecommunication will increasingly displace and replace travel.

The notion of substitution for transportation appeals to planners because it does not entail the massive social costs and externalities of automobile use, such as congestion, energy consumption, air pollution and safety costs. There are hopes that other urban problems, such as office and parking space constraints, may be similarly relieved. In addition, the incidence of benefits and costs in

Table 1. Selected Country Characteristics

Country	Population, 1995 (millions)	Density, 1995 (People per km^2)	Telephones per 100 Inhabitants, 1994
Belgium	10.11	331	44.9
Denmark	5.23	121	60.4
France	58.14	105	54.7
Germany	81.6	229	48.3
Greece	10.46	79	47.8
Ireland	3.58	51	35.0
Italy	57.19	190	43.4
Luxembourg	0.41	157	55.4
Netherlands	15.45	378	50.9
Portugal	10.80	117	35.0
Spain	39.21	77	37.1
Sweden	8.83	20	68.3
United Kingdom	58.26	239	48.9
Israel	5.55	263	39.4
Canada (1991)	29.6	3	57.6
U.S.A.	263.03	28	60.2

Source: Statistical Yearbook, United Nations.

communications uses might be distributed more equitably. (For example, low-income people can afford a computer or telephone line much more easily than a car.)

The second hypothesis regarding the relationship between transportation and communication is one of *complementarity*. This encompasses two distinct phenomena. The first is *enhancement*, which refers to a situation in which the use of telecommunications causes additional travel that would not have occurred in the absence of the use of communication (Batten, 1989; Dickey, 1985; Salomon, 1986). This argument is based upon trip generation models and the functional approach to explain trip-making behaviour. Underlying this approach is the question of how travel time saved due to telecommunications is then to be used. For example, travel time saved could be used for other individual activities, for travelling to greater distances on those trips still undertaken, or even for generating new trips due to previously latent demand. The second phenomenon refers to any situation in which one of the two services contributes to the efficiency of the other (Wigan, 1985; Meyburg (1983) quoted in Salomon, 1986). For example, it may be possible to increase the efficiency of transportation systems through more intensive use of telecommunications. This could result in increased utilisation of *both* services.

There has been quite a lot of research on the contribution of telecommunication technology to the efficiency and logistics of the transport system and its operations, both public and private (Cooper, 1989; Giannopoulos & Gillespie, 1993; Giannopoulos, 1989 & 1993; Hepworth & Ducatel, 1992; Meyere, 1989; Wandel, 1989). Expressions such as 'just in time' and 'total quality control' or references to the five Olympic zeros – no stock, no time lag, no fault, no breakdown, no paper – point to a new form of logistics based on tighter flow control and the desire to enhance productivity and meet the challenges of the competitive economy (Frybourg, 1993). These also imply changes in production processes.

The freight system will also be affected by the enhancement of the consumer's ability to search for products with reduced travel and the ability to deliver directly to purchasers from factories and warehouses. This in turn may intensify price competition (Wigan, 1985). In the freight transport system the decision to travel is determined by the need to move a physical item from one location to another. One of the key elements in road and other freight operations is the costs of documentation and delays. This is more visible and problematic in

international trade. Therefore data access cost reductions will decrease freight movement costs (Giannopoulos 1993). Most research does not deal with the effects of any telematically-enhanced efficiency in the transportation system on transportation demand. It is not clear whether enhanced efficiency will create greater demand or less demand, where a smaller fleet of vehicles can provide existing needs. For example, 'no stock' and 'just-in-time' production require smaller, but more frequent, deliveries (Frybourg, 1993). Both the substitution and the complementarity / efficiency hypotheses have important implications for the activities and methodologies of planners and transportation planners in particular.

The literature on the relationships between transportation and communication has largely concentrated on specific forms or applications of telecommunications: these include remote work (i.e. teleworking, telecommuting), teleconferencing, teleservices (such as teleshopping, telebanking, information access facilities including videotext), mobile communications (such as two-way radios, driver advisory systems, vehicle monitoring systems) and electronic message transfer. The main issue addressed in most of this literature is how uses of one or another of these technologies affect the travel behaviour of individuals. The first examination of the relationships for industrial uses was in Plaut (1997) for Western Europe. It was found that a pattern of complementarity is evident. This means that increased uses of communications tend to be accompanied by *greater* uses of transportation. In this paper these findings for Europe will be extended to several non-European countries. Such a broader comparison is of interest because of the wide differences in the geographic nature, transportation systems and economic infrastructure of industrialised countries outside of Europe.

To what extent is the complementarity between transportation and communications found to exist in Europe a peculiar phenomenon? Do similar patterns exist elsewhere? In the next section industrial uses of transportation and communications services will be discussed for Israel, Canada and the U.S.A. and these are compared with the earlier results for Europe in Plaut (1997).

Transportation and communications uses in industry across countries

Industrial uses of transportation and communications are documented in input-

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output data. An input-output table records the uses of the production output of industrial sector 'i' by industry 'j' (for example, the uses of transportation by other industries). An input-output table describes the flow of goods and services among all the individual economic sectors or industries in a national or regional economy over a stated period of time (usually one year) and for a given pattern of disaggregation into different sectors of the economy. Direct input-output co-efficients measure the direct purchases of output 'i' by industry 'j', this per one dollar's worth (or one currency unit's worth) of output of 'j'. Total input-output tables show the value of purchases both direct and indirect of output of industry 'i' used when producing 'j', that is, not only the 'i' purchased directly from its producing branch but also the 'i' embodied within other inputs purchased by industry 'j'. For example, the farming sector purchases transportation services directly, but also indirectly, through the transportation embodied within other farm inputs such as biocides, machinery and equipment. Total inputs would capture *all* of these uses of transportation.

The relationship between industrial uses of transportation and communications can be evaluated by computing correlations between the input-output co-efficients of these two sectors across the economy. If the two tend to be used in a substitution role, the correlations should be negative. If they tend to be used as complements, the correlations will be positive. Since the input-output co-efficients are based on a dollar's worth of output for each sector, the sizes of the purchasing industries are neutralised and do not affect the results. (Data are generally published by the national official statistical authorities. For Israel, they are collected by the Central Bureau of Statistics; for Canada by Statistics Canada; for Europe by Eurostat; for U.S.A. by the Bureau of Economic Analysis. While there are differences across countries, the data are generally computed once every 5-10 years. Levels of aggregation, that is, the number of industrial sectors appearing in the tables, differ sharply across countries.) The correlations between industrial uses of transportation and communications are shown for Israel, Canada, U.S.A. and Europe in Tables 2, 3, 4, 5 & 6.

Industrial Uses of Transportation and Telecommunications in Israel

Input-output data for Israel is collected and reported at a number of levels of aggregation, the most disaggregated being 191 industrial sectors. Transportation and communications services appear with the same transport type divisions at the 191 and 92 sector levels of disaggregation. Transportation services consist of buses, taxis, trucking, rail, pipelines, maritime transport, harbour services, air transport, airport services warehousing, and other transport services (such as travel agencies). Communications services contain telecommunications and postal services. The most recent full tables were constructed in 1988.

The correlations between transportation and communications service uses in Israeli industry appear in Table 2 for both direct and total co-efficients. The correlations are 'Spearman' estimates, which means they are non-parametric and based on correlations between the rank orders of uses. The correlation numbers are computed for pairs of sectors. The number that appears in cell 'i-j' shows the correlation between the rankings of input-outputs co-efficients for all sectors in the Israeli economy for purchases from sector 'i' with those from sector 'j'. A large positive value indicates that throughout the economy, whenever large (small) purchases are made from sector 'i', large (small) purchases are also made from sector 'j'. In other words, the different industries in the economy tend to use sectors 'i' and 'j' as *complements*, using them together. If the correlation co-efficient is negative and large in absolute value, this indicates that throughout the economy, when purchases from sector 'i' are large, purchases from sector 'j' tend to be small, and vice versa. In other words, the two sectors tend to behave as *substitutes* throughout the economy. Correlation co-efficients close to zero indicate that the uses of the two sectors are unrelated. The numbers in parentheses within the cells indicate the level of significance. (It should be noted that the terms 'substitute' and 'complement' are not being used in their strict economic senses, namely the cross-derivatives of the production function, but rather indicate that one of two services tends to be used less or more when use of the other increases.)

Interestingly, every single one of the correlations was positive and *significantly* positive, and in almost all cases, significant at 0.000% significance. Clearly, the relationship in Israel between communications and transportation is one of complementarity and not substitution across the entire range of transportation subsectors.

Industrial uses of transportation and telecommunications in Canada

Canada lies on the opposite extreme from Israel in terms of population density. It also has a high level of communications infrastructure

Table 2: Spearman Correlation co-efficients between pairs of input-output co-efficients – Israel (1988) [N = 191 industries] Transportation subsectors with communications services

	Communications with Direct co-efficients	Total co-efficients
Buses	0.6816	0.953
Taxis	n.a.	0.404
Trucks	0.7154*	0.508
Railway *	0.291	
Pipelines	n.a.	0.650
Maritime	0.7051	0.276
Harbour Services	n.a.	0.906
Air Transport	0.6240	0.741
Airport Services	n.a.	0.662
Warehousing	n.a.	0.778
Other Transport Services	0.8577	0.462

(Levels of Significance of Correlation = 0.000)
* = Includes both trucking and rail.

Table 3: Relationships between direct input-output co-efficients for transportation and communications service uses – Spearman Correlations, Canada 1991

Transportation Branch	Telecommunications	Postal Services
Air Transport and Related Services	0.6757	0.5736
Railway Transport & Related Services	0.6758	0.5649
Water Transport & Related Services	0.6326	0.6340
Truck Transport Industries	0.6333	0.6147
Urban Transit System	0.7391	0.5592
Interurban and Rural Transit System	0.6105	0.4776
Taxicab Industry	0.7491	0.7265
Other Transport and Services	0.7519	0.7281
Highway and Bridge Maintenance	0.8189	0.8180
Pipeline Transport Industries	0.6099	0.5883
Storage and Warehousing	0.6473	0.6026

(Levels of Significance of Correlation = 0.000)

Table 4: Correlations for direct input-output co-efficients for the U.S.A.

Communications		
Rail Transportation	0.790	(N=93)
Of that, local rail service only	0.775	(N=75)
Trucking	0.730	(N=106)
Water Transportation	0.763	(N=78)
Air Transportation	0.594	(N=107)
Freight Forwarding	0.698	(N=76)
Warehousing	0.884	(N=90)

Note: N refers to the numbers of pairs of non-zero co-efficients (only) used in the computations.

development. It is also one of the few countries in which communications are broken down separately into telecommunications and postal services. Canadian input-output data is constructed at various levels of aggregation, with 216 being the most disaggregated; a somewhat less disaggregated table of 161 industries was used for computation of the correlations in Table 3.

As can be seen, the pattern in Canada closely resembles that found in Israel, despite the extreme differences in the geography of the two countries. As in Israel, in all cases large positive significant correlations appear for all transportation and communications subsectors. Once again, this suggests that transportation

and communications services are being used together as complements by the other industries in Canada. By and large, the magnitudes of the positive correlations are similar for Canada and Israel.

Industrial uses of transportation and telecommunications in the U.S.A.
Comparable computations for the U.S.A. appear in Table 4. These are Pearson correlations for the direct input-output co-efficients, based on the communications sector 66.01 in the U.S. classification. The U.S. tables are far more disaggregated than those of other countries, with 592 industrial sectors.

Once again, a strong pattern of complementarity is evident. All correlations are large, positive and significant, indicating that U.S. industry tends to use all transportation subsector services together as complements with communications. The magnitude of the correlations is comparable with that of Canada and Israel.

Industrial uses of transportation and telecommunications in Europe
The above findings for non-European countries are analogous to those found for Europe by Plaut (1997). These results are reproduced in part here in Tables 5 and 6. The countries examined were most of the member countries in the European Union. The input-output data was provided by Eurostat, the EU official statistical office. The European input-output data is based on disaggregations of 44 (or 59 sectors for a smaller set of countries). Therefore it is much less disaggregated than the data for the considered countries above. In particular, the transportation sector is broken down into only three subsectors. For Europe the analysis was performed on two sets of data: direct input-output co-efficients and total co-efficients. Once again, the direct numbers are based on direct purchases only of transportation and communications by other sectors. That is, here indirect purchases of transportation and communications by different industries (such as purchases of transportation that are embodied in purchases of farm goods) are NOT included. In the total co-efficients, such indirect purchases ARE included.

In tables 5, Spearman correlations for direct uses of transportation and communications are shown for the different European countries. It is quite clear that communications and transportation tend to be used in the EU as complements and not as substitutes. This is true for all three transportation subsectors and for almost all countries within the EU. For the EU as a whole the correlations are everywhere positive and highly significantly so (at the 1%

Table 5: Relations between intensity of communications and transportation use – Spearman Correlation co-efficients. Based on direct I/O co-efficients (44 branches for each correlation)

Communications with:	Inland Transport services	Maritime & Air Transport services	Auxiliary Transport services
Belgium	0.231 (0.13)	0.234 (0.13)	0.266 (0.08)
Denmark	0.455	0.618	0.628
France	0.138 (0.37)	0.405 (0.01)	-0.093 (0.55)
Germany	0.198 (0.20)	0.726	0.102 (0.51)
Italy	0.267 (0.08)	0.529	0.507
Netherlands	0.607	0.574	0.571
Portugal	0.687	0.453	0.086 (0.58)
Spain	-0.140 (0.36)	0.119 (0.44)	0.035 (0.82)
United Kingdom	0.364 (0.02)	0.438	0.414 (0.01)
EU7*	0.600	0.848	0.478
EU9**	0.582	0.833	0.469

* All the above, except Spain and Portugal
** All the above
(Level of Significance = 0.00 unless stated in parentheses)

Table 6: Relations between intensity of communications and transportation use – Spearman Correlation co-efficients. Based on total I/O co-efficients (44 branches for each correlation)

Communications with:	Inland Transport services	Maritime & Air Transport services	Auxiliary Transport services
Belgium	0.377 (0.01)	0.463	0.229 (0.14)
Denmark	0.543	0.634	0.637
France	0.142 (0.36)	0.545	0.134 (0.38)
Germany	0.273 (0.07)	0.630	0.232 (0.13)
Italy	0.465	0.677	0.686
Netherlands	0.690	0.689	0.640
Portugal	0.600	0.637	0.415 (0.01)
Spain	0.176 (0.25)	0.404 (0.01)	0.310 (0.04)
United Kingdom	0.446	0.542	0.525
EU7*	0.539	0.833	0.502
EU9**	0.521	0.806	0.488

* All the above, except Spain and Portugal
** All the above
(Level of Significance = 0.00 unless stated in parentheses)

level). Indeed, they are higher for the EU as a whole than for most of the individual countries. This is probably because the individual national peculiarities are 'averaged out' as random noise at the Community-wide level, yielding higher and more significant correlation. For the individual countries, every correlation except for two is positive, and the two negative ones (Inland Transport in Spain and Auxiliary Transport in France) are non-significantly so. Not only are the other correlations all positive, but in 18 out of 25 cases the correlation was significant at 10% (and in two more cases was borderline significant 13%).

The same issue of substitutability versus complementarity may be explored using correlations for *total* input-output co-efficients, rather than direct co-efficients. These are shown in the Table 6.

As can be seen, the results indicating complementarity for total co-efficients are even stronger and clearer than for the direct co-efficients. All of the correlations are positive, and most correlations are more significant for the total co-efficients than for the direct co-efficients. For some countries and subcategories, such as for Spain, significant complementarity between transportation and communications is apparent from the total correlations, but not from direct co-efficients. Hence, it appears that transportation and communications in Europe act in complementary roles even more unambiguously when taking into account indirect purchases of their services.

Conclusions

A common, though unverified, expectation has arisen that the growth of the information economy has the potential to lessen the importance of location, thereby reducing the volume of travel and its attendant problems. But this expectation is based on telecommunications substituting for transportation services, a relationship open to empirical inquiry. In fact, it appears that in many cases relationships of complementarity between communications and travel may erode any transport-reduction benefits, or even generate greater amounts of travel.

This article demonstrates this to be clearly the case for the industrial uses of travel, which account for a large majority of overall transport use. It shows that the findings for European countries – that greater use of communications tend to be accompanied by greater uses of transportation – are highly robust, holding reliably across countries with markedly different geographic and economic characteristics, including Israel.

These findings must give serious pause to popular hopes that the spread of high-tech communications will make travel obsolete, reducing problems such as pollution and congestion. They suggest the high likelihood that the opposite may be true. Caution is especially warranted in thinking about Israel's transport future. Here the impacts of transportation (pollution, congestion, car-dependent sprawl) are aggravated by the very high population densities, and reaching crisis proportions. Israel is placing much emphasis on a future based on a high-tech information economy, and one might have hoped that this could help reduce the demand for travel and ease these problems. This article shows that the opposite may be true, and that the solutions to the country's transport crisis must be found elsewhere.

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