

## **Impact of traffic congestion on trade and strategies for mitigation**

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**Date of submission:** 14<sup>th</sup> November 2003  
**Word count:** 7500

**ABSTRACT**

Traffic congestion is proving to be a major cost and inconvenience for many businesses and companies, particularly those whose activities demand high levels of transport per unit of production. Following the recent period of heightened economic activity against the background of years of under investment in transport infrastructure, Ireland is no exception.

The paper analyses the results of a survey conducted on Irish businesses in three sectors; manufacturing, distribution/sales and services, to estimate the impact of traffic congestion. The opinion of the companies is also sought on how they believe transport strategies by government under the National Development Plan (NDP) and new infrastructure either under construction or proposed will relieve traffic congestion. Finally the survey investigates what type of strategies companies had used or would consider using to mitigate against the negative impacts of traffic congestion. Those policies examined included relocation, flexible working hours, teleworking and provision of alternative transport for staff.

The findings indicate that traffic congestion impacts on a large proportion of companies to a major degree particularly when considering road haulage costs, delivery schedules from the company and staff punctuality. To mitigate against the negative impacts the strategies that have been used most by companies are flexible working hours, teleworking, contracting out the distribution function with relocation and moving the distribution function to the rail mode being less popular.

## INTRODUCTION

Ireland is an island situated on the periphery of Europe on the US side of the UK. It has a population of 3.9 m and a labour force of 1.75 m. 41% of the population is under 25 years of age. Ireland has a small open economy with gross domestic product (GDP) growth of 11.5% in 2000 and 4.71% in 2001. Unemployment is currently over 4.3% with indications that it is increasing. 24% of Ireland's exports are to the UK and 17% to the US (1).

Almost all of Ireland's trade passes through the country's seaports. Driven by an expanding economy, the volume of goods has grown by more than half during the past decade. Of the thirty ports on the island, Dublin on the east coast dominates trade, accounting for a third of the tonnage handled. The port of Dublin is located within the city centre and port related traffic is forced to transit the city, which adds to the congestion in the central business district (CBD), although the situation should improve when a port tunnel which links the port with the motorway ring around the city is complete in 2005.

Data collected by the Dublin Transportation Office (2), (which is charged with developing medium term transport plans and strategies for the greater Dublin area), show that average journey times on the key radial routes have increased by 62% in the period 1991 to 1997. The travel times on the main radial freight routes into the city are badly affected - average speed on the important East West link on the route to the port is now reduced to 11 km/hr at peak times.

Traffic congestion in Dublin has been exacerbated by the unprecedented boom in private car registrations and a related increase in car usage. These have grown from a little over 100,000 in 1990 to 240,000 in 2000 – a very visible sign of the 'Celtic Tiger' economy (1). It is projected that as Ireland moves towards the average levels of car ownership in the EU (454/1000), the number of cars will have doubled by 2016. Heavy goods vehicle (HGV) movements in Dublin are concentrated on a relatively small number of key port access routes where freight movements must compete with other users on congested streets.

Figure 1 shows a map of the city and in Figure 2 volume to capacity ratios (V/C) are presented for the area within the canal ring (marked in blue on Figure 1) and just outside for a typical peak period during a weekday morning (2). Capacities are calculated for each section of roadway and are based on factors which includes junction geometry. It will be seen that commuter and school traffic causes capacities to be exceeded on a significant number of links during the morning peak. Although there are other links on Figure 2 which have low V/C ratios, on the main arterials there are generally one or two links which are working significantly higher than capacity levels causing bottlenecks at those points.

Relief to the congestion caused by the port related traffic which is forced to transit the centre will not be available until a dedicated port access tunnel is open in late 2005 (Figure 1). The construction of the port tunnel and light rail transit systems in Dublin at the moment are creating added congestion levels. The interim arrangements in place for managing traffic must cope with a significant added loss of road-space due to construction work at both ends of the tunnel.

The aim of the paper is to investigate the impact of congestion on Irish business. To do this, the results of a survey undertaken by the Irish Business and Employers Federation (IBEC) (3) of 580 companies are analysed. The survey sought information on the impacts of congestion and strategies undertaken by the businesses to combat the effect of congestion. Another objective of the survey was to seek

views on the expected impact of transport infrastructure projects included in the National Development Plan (NDP) and the performance of the various agencies responsible for traffic. The results from this part of the survey are also presented in the paper.

### **RELATED STUDIES**

Weisbrod et al (4) looked at data from Chicago and Philadelphia in the NCHRP Study 2-21 to examine how various producers of economic goods and services are sensitive to congestion. They showed, using statistical models, that sensitivity to traffic congestion varies by industry sector and effectively shrinks business market areas and reduces the 'agglomeration economies' of businesses operating in large urban areas, thus raising production costs.

Another NCHRP Project 2-17 (5) examined the impact of congestion on businesses. They found that business managers do not track the costs of congestion and seldom therefore do not identify any of their business costs as costs associated with congestion. Another study which looked at the cost of congestion was that of Lomax (6). It describes why a jurisdiction should measure congestion, how a congestion measurement program should be organized, and discusses how to interpret the measures of congestion.

Golob et al (7) looked at freight industry attitudes towards policies to reduce congestion. Their survey found that improved traffic management, enhanced truck urban arterial priority, appeared to be the most cost-effective. Hensher et al (8) and Hensher and Golob (9) looked at freight industry preferences regarding alternative transportation planning policies in New South Wales in Australia.

Golob et al (10) examined traffic congestion and trucking managers' use of automated routing and scheduling. One of their findings was that the demand for routing and scheduling software was found to be influenced directly by the need to re-route drivers and indirectly by the need to operate in congested periods (dictated by customers schedules).

Bjorner (11) found the elasticity of freight traffic in Denmark to be  $-0.81$  i.e. for a 10% increase in shipping costs truck traffic reduced by 8% but total shipping volume decreased by only 5% because some freight is moved by rail. Button (12) and others (13) found higher elasticities for road freight.

Other related research looks at innovative strategies to reduce road freight demand. One example is a project called City Logistics (14) whereby shipments are consolidated outside the city limits and better organized within the city. About 80 German cities are involved in this initiative.

La Rochelle has promoted the use of electric passenger cars and delivery vehicles in conjunction with an urban distribution centre (UDC) within the city centre (15). Goods are transferred from HGVs and large vans into smaller electric vehicles where their design makes them well suited to the narrow medieval streets (4 Citroen Berlingo vans and larger IVECO vehicles for pallet loads).

The authors are currently evaluating the feasibility of such a strategy in Dublin in a research project funded by the Department of Transport, the first part of which is to develop an OD matrix of delivery movements to premises in the CBD. This will be followed by location of the sites for UDCs and evaluation of other strategies such as the traffic management regime to be incorporated into the city when the Dublin port tunnel is complete and HGVs are banned from city streets.

## **SURVEY**

A survey of Irish businesses was undertaken by the Irish Business and Employers Confederation to investigate several issues, all relating to the impact of traffic congestion on businesses in Ireland (3). The survey was based on a questionnaire that and was conducted by fax. The questionnaire requested information on the characteristics of the company and whether they transported goods by road followed by a request for an indication of the impact that traffic congestion was having on business. A set of impacts were posed to the respondent such as 'road haulage costs', 'delivery schedules from your company' etc and they were asked to tick the level of impact; major, slight or none.

The survey also sought feedback on the strategies companies were using to deal with traffic problems and impacts on their business. Again in this case a number of strategies were listed including 'relocation of business', 'move goods distribution to rail freight' along with a number of others. Questions were also posed in the survey focusing on the expected impact of various transport management and infrastructure measures either currently underway or proposed by the transport authorities in Ireland.

### **Company characteristics**

584 companies out of a total of 2,910 contacted responded to the survey; a response rate of 20%. 50.9% (297) of the companies are based in Dublin, 4.3% (25) in Cork (the next largest city to Dublin – in the south of Ireland), 5.8% (34) in the west, 8% (47) in the midwest (area near Shannon airport – a regional industrialized area), 6.8% (40) in the southeast, 3.4% (20) in the northeast, 4.5% (26) in the northwest, 2.6% (15) in Wicklow, 3.6% (21) in Kildare, (both Wicklow and Kildare are within Dublin's commuting footprint) 2.7% (16) in the midlands and 7.4% (43) did not state their location.

The responding companies have 67,000 employees between them. 53.3% (311) of the companies had less than 50 employees, 18% (105) were in the range of 50-99 employees, 16.3% (95) had 100-249 employees, 7.5% (44) had 250-499 employees, 4.1% (24) had over 500 employees and 0.9% did not state the number of employees.

36.8% (215) of the companies were in manufacturing, 14% (82) in distribution, 7.7% (45) in sales, 41% (239) in services and 3 companies did not state their type. 64% (374) were Irish owned, 31% (179) were foreign owned and 5% (31) did not state their ownership. The responses to the survey represent roughly 10% of the employee population in industry and traded services, half of the companies being based in Dublin where congestion is most severe.

## **RESULTS**

The results of the survey were analysed in their entirety and then by region and by sector. The results are presented in that order below.

### **Analysis using All Data**

The companies were asked whether they transported goods by road. 65% (379) indicated that they did and 189 (32%) indicated that they did not with 16 (3%) not answering the question. The companies were asked if they considered traffic congestion to be an issue for their business. In response, 78% (456) stated that it was, 15% (85) said it was not and 7% (43) did not answer the question. They were also asked to indicate if traffic congestion had an adverse impact on any aspect of their

business to which 85% (498) indicated that it had, 13% (74) stated it had not and 12 (2%) did not answer the question. The companies which indicated that traffic congestion had an adverse impact (498) were then asked more detailed questions concerning specific impacts, the results of which are presented in Figure 3.

Of all the impact types examined in Figure 3, between 25-40% of companies indicated that traffic congestion was having a major impact on road haulage costs, delivery schedules from company, delivery schedules to company and staff punctuality. Less than 10% of companies said that traffic congestion had a major impact on general production costs and staff absenteeism. About 30% of companies indicated that traffic congestion had a slight impact on road haulage costs, delivery schedules from company, general production costs, staff turnover, staff recruitment, staff absenteeism and labour costs. About 40% of companies indicated a slight impact on delivery schedules to companies and on staff punctuality. 10% of companies or thereabouts indicated no impact on road haulage costs, delivery schedules both to and from the company and on staff punctuality. 20-35% of companies indicated no impact on general production costs, staff turnover, staff recruitment and staff absenteeism. As can be seen from Figure 3, quite a number of companies did not participate in rating the impacts.

The companies were then asked to indicate if they had adopted any of the following strategies for dealing with the impact of traffic congestion; relocation of their business, move goods distribution to rail freight, contract out distribution function, adopt flexible working hours for staff, remote or teleworking for staff, encourage staff to use transport modes other than car or provide alternative transport for staff. The results are presented in Figure 4. Less than 10% of companies have adopted relocation, moving distribution to rail freight or have provided alternative transport for their staff. Between 10% and 20% of companies have contracted out their distribution function, adopted teleworking for their staff or encouraged their staff to use other modes. The strategy adopted by the largest proportion of companies (35%) is allowing flexible working hours for staff. Over 60% of companies indicated that they had not relocated their business, moved their distribution activities to rail freight or provided an alternative transport mode for their staff. About 50% of companies indicated that they had not adopted teleworking as a strategy for dealing with traffic congestion. Between 30% and 45% of companies had not contracted out their distribution function, adopted flexible working hours for staff or encouraged staff to use alternative modes of transport.

In terms of companies contemplating strategies to deal with traffic congestion (but who had not already responded in this way), the strategy receiving least consideration (less than 5% of companies) was the transfer to the rail mode for their goods distribution. The lack of a comprehensive rail network in Ireland could account for this low level of interest. The existing rail network is an arterial set of lines linking Dublin to major regional centres. Less than 10% of companies indicated they would consider contracting out the distribution function, adopting teleworking for staff and providing alternative transport for staff. The strategies which companies were most likely to consider (between 15% - 20% of companies) were relocation, flexible working hours for staff and encouraging staff to use other modes.

The companies were then asked about their level of satisfaction with current transport infrastructure implementation and strategies in dealing with traffic congestion. This question was asked in relation to what had been delivered already and the expectation of what might be delivered by 2007. The strategies to be completed by 2007 include upgrade of some sections of main roads between regional

centres, the construction of a port tunnel to facilitate freight traffic to and from Dublin port and improved public transport solutions including the implementation of two corridors of light rail transit in Dublin.

Other issues examined were the levels of satisfaction with infrastructure and strategies being used to reduce journey times and relieve congestion, the results of which are presented in Figure 5. 239 (41%) companies are currently dissatisfied with the impact infrastructure and transport authority strategies are having on reducing journey times and this is supported by a comparative figure of 232 (40%) in response to a similar question relating to relieving congestion. When looking at the very dissatisfied set of results there is a higher discrepancy between 'reducing journey times' and 'relieving congestion'. In this case, 241 companies (41%) are very dissatisfied with how congestion is being relieved but only 190 (32.5%) express the same level of dissatisfaction with how journey times are being reduced. Generally it would appear from the results, that companies are more optimistic about the impacts when the infrastructure and strategies promised for 2007 are implemented.

The survey finished with two further questions; one relating to tolling of infrastructure which is a relatively new concept for road use in Ireland although there are two examples of tolled bridges on the motorway ring around Dublin. The second question was relating to public private partnerships (PPP) for use in implementation of infrastructure. Again this has been used only recently in Ireland on a number of projects but is currently the subject of current debate where on the one hand people are skeptical about its use whereas others see it as a good way to deliver transport infrastructure on the island. The Government has promoted the use of PPP for many of the new public transport and road projects in Ireland as well as for other projects outside the transport sector such as schools.

In relation to the question dealing with tolls which sought an opinion as to whether the company supported the approach for finance of infrastructure, 199 (34%) stated yes, 277 (47%) stated no, 43 (7%) stated they did not know and 65 (11%) did not respond to the question. Interestingly, the level of positive response is higher than what the author would have expected from anecdotal evidence and comment on the subject of tolling and road pricing. To the question relating to PPP, the companies were asked what they would regard as the priority areas for application of public private partnerships. The reason for including this questions was to see if the businesses considered transport projects to hold priority in terms of getting funds to them faster (as this is what PPP has been used to do in several sectors in Ireland recently). 68 (12%) selected generating employment opportunities, 214 (37%) selected funding roads and infrastructure, 78 (13%) selected funding health, education and social services, 16 (3%) selected promoting development, 33 (6%) selected funding the privatization of state assets and 173 (70%) did not answer. The majority therefore identified it as a funding mechanism for dealing with transport infrastructure provision.

### **Analysis by Region**

The analysis by region was done on Dublin and the non-Dublin area (the rest of Ireland). Dublin is the major urban conurbation in Ireland and although there are others none have developed to the degree Dublin has in relation to agglomeration of activities. Before analyzing the results, there was some expectation that the perceptions of companies in the non-Dublin region would be different to that in the Dublin region due to the level of services of transport infrastructure and differing

congestion levels. 43 of the companies did not answer the question about where they were based so the analysis is done on the 541 companies who did answer the question.

When asked if they considered traffic congestion was having an adverse impact on their business, 86% of the total of 297 based in Dublin indicated that it was compared with 71% of the total of 244 companies based in the non-Dublin area. Although it was not investigated in the survey explicitly, the difference may be due to the higher levels of congestion reported in the Dublin area generally. 8% in the Dublin area said it was not an issue compared with 21% in the non-Dublin area. 5% and 9% did not answer the question in Dublin and in non-Dublin respectively.

When asked if traffic congestion was an issue for their business 90% of the Dublin companies said yes compared with 82% of the non-Dublin companies. 8% and 16% answered no for Dublin and non-Dublin respectively and 2% and 3% did not answer the question.

Figure 6 presents the results of how traffic congestion has impacted on companies in the Dublin and non-Dublin regions. 40% of companies in the non-Dublin region indicated that traffic congestion has had a major impact on road haulage costs compared with 28% in the Dublin region. This can be explained by the longer distances and travel times that non-Dublin companies have to cover to markets, ports and airports and the greater impact congestion will have in relation to those distances. In the case of delivery schedules from the company, companies in the Dublin appear to be suffering more with 41% indicating a major impact due to congestion compared with 38% in the non-Dublin region. A similar difference exists for the impact on delivery schedules to companies. A low percentage of companies, 9% and 12% for Dublin and non-Dublin respectively, indicated that traffic congestion had a major impact on their general production costs. The degree of severity was left up to the respondent. In terms of staff turnover, 20% of Dublin companies indicated a major impact due to congestion whereas only 5% of non-Dublin companies indicated a major problem with this. When the next impact, staff recruitment, is examined it seems that this is presenting more of a problem in Dublin (27% indicating major impact) than in the non-Dublin region (6%). Traffic congestion is blamed by 42% of companies as having a major impact on staff punctuality in the Dublin region compared with 15% in the non-Dublin region. Staff absenteeism related to congestion has a lower impact in the non-Dublin region (4% indicating major impact) compared with 9% in the Dublin region. Finally, the impact on labour costs is highlighted as a problem by 24% of companies in the Dublin region compared with 8% in the non-Dublin region.

In relation to the question about strategies that companies have used to deal with the impact of traffic congestion, the results by region are presented in Figure 7. In the case of all strategies except one i.e. moving freight distribution to rail, more companies in Dublin have adopted strategies for dealing with impact of congestion than in the non-Dublin area. In that one case, rail freight would be a more feasible option for companies in the non-Dublin region as there demands more likely involve interurban travel, for which some of the network would be catered for by rail. In the case of the other strategies examined, flexible working hours for staff has been adopted by 50% of the companies surveyed in Dublin compared with 23% in the non-Dublin group. There is little difference in the response in terms of region for contracting out the distribution function although slightly less of the non-Dublin companies have done this. About 20% of the Dublin companies use teleworking and encourage staff to use other forms of transport compared with less than 10% in each



case for non-Dublin companies. A very low percentage in each case provide alternative transport for staff.

### **Analysis by Sector**

A similar analysis was done based on the characteristics of the companies in relation to the sector in which they work; manufacturing, distribution and services. The number of companies in each sector were 215, 127 and 239 respectively. When asked whether congestion was an issue for their business 88% of those companies in the distribution sector said yes compared with 73% and 77% in the manufacturing and service industries respectively. A similar difference was apparent when asked whether traffic congestion had an adverse impact on business. 91% of those in the distribution and sales sector indicated that it had compared with 83% and 85% for the companies in the other sectors. The companies who answered yes (496 in total) were then asked in what way the impact had been experienced, the results of which are presented in Figure 6.

Looking at the number of companies who indicated 'major impact' in terms of the response (Figure 8), and comparing each impact between the three sectors manufacturing, distribution/sales and services one can note the following findings. About 45% of manufacturing and distribution companies indicated that traffic congestion had a major impact on their business compared with 13% of service companies. Given the nature of the different sectors, it is likely that transport plays a bigger role in the activity of manufacturing and distribution companies and therefore the impact is much greater on their business activities.

When looking at the impact on delivery schedules from the company, again many more of the manufacturing (45%) and distribution (56%) companies indicated a major problem compared with 27% in the service sector. However, the large difference is not repeated when looking at the impact on delivery schedules to the company. The percentage of companies indicating a major problem in this case are 32%, 31% and 21% in each of the sectors respectively. It is not clear why the manufacturing and distribution companies are not experiencing the same level of difficulty with this particular type of impact. One reason could be that deliveries to the company have less deadline impact on the companies themselves in meeting delivery schedules to consumers but this is speculative as no feedback was obtained in relation to this in the surveys.

In the case of the impact on general production costs, manufacturing exhibits the highest level of major impact at 16% compared with distribution and services at 8% and 7% respectively. Staff turnover seems to be more of a problem in the services sector but only marginally, 16% compared with 13% and 11% for the others. The impact in the service sector is even more evident in terms of staff recruitment at 25% compared with the others at around 14%. All sectors indicate between 20% and 40% of companies stating that congestion has a major impact on staff punctuality with the services sector showing the highest level at 39% and manufacturing at 20%. Staff absenteeism is impacted upon in all three sectors at around the same level in relation to those companies indicating a major impact – at about 7%, with the impact on labour costs ranging from 10% to 20%, distribution and services indicating the highest level.

Also presented in Figure 8 is the number of companies indicating 'slight impact' and 'no impact' due to traffic congestion. The impact type generating the largest number of 'no impact' responses was staff absenteeism at 52%, staff turnover at 46% and staff recruitment, all in the manufacturing sector. This may be due to the

specific skill types required in the manufacturing sector that may not be as easily transferable from one company to another.

Finally, the level of use strategies that companies have used to combat the impact of traffic congestion are presented in Figure 9. The policy that seems to have been used to combat congestion most is flexible working hours, particularly in the distribution and services sector (44% and 46% of companies have used this policy) compared with 27% in the manufacturing sector. The other strategy used to a relatively high level is contracting out the distribution function with almost 30% of companies in the manufacturing sector, 35% in the distribution/sales sector but much less, which might be expected due to the nature of the work, 6% in the services sector. Moving freight distribution to rail and providing alternative transport for staff have been used the least as a policy for combating impacts of traffic congestion. In terms of the policies that companies would consider, flexible working hours, encouraging staff to use alternative transport and relocation were options. This is particularly so for the distribution and services sector. The policy receiving the least positive response in terms of possible usage was moving distribution to rail but this could well be due to the nature of the companies, the lack of a dense rail network in Ireland and not that many existing services to satisfy this type of demand.

## Conclusions

The paper examined the impact of traffic congestion on businesses in Ireland. The conclusions of the research are as follows:

1. Between 25-40% of companies indicated that traffic congestion was having a major impact on road haulage costs, delivery schedules from the company, delivery schedules to the company and staff punctuality.
2. The strategy adopted by the largest proportion of companies to mitigate impact of traffic congestion (35%) is allowing flexible working hours for staff.
3. Less than 10% of companies have adopted relocation of their business, moving the distribution function to rail freight or have provided alternative transport for their staff as measures to reduce the impact of traffic congestion.
4. Between 10-20% of companies have contracted out their distribution function, adopted teleworking or encouraged staff to use alternative modes of transport.
5. Of the companies who indicated that they had not yet adopted particular strategies to combat impact of traffic congestion, the strategies which they were more likely to consider were relocation of the business, flexible working hours for staff and encouraging staff to use other modes.
6. When looking at the regional impacts, 90% of the companies based in Dublin (capital city of Ireland) indicated that congestion was having a major impact on their business compared with 82% in the non-Dublin region (rest of Ireland).
7. The results of the survey were also examined on the basis of the sector in which the company works; manufacturing, distribution/sales, and services. About 45% of the companies in the manufacturing and distribution sectors indicated

that congestion had a major impact on their business compared with 13% of service companies. Similar differences between the sectors were reported for impact on delivery schedules .

It will be important to conduct a similar study when the new transport infrastructure in Dublin is complete to establish it has made a difference to congestion levels.

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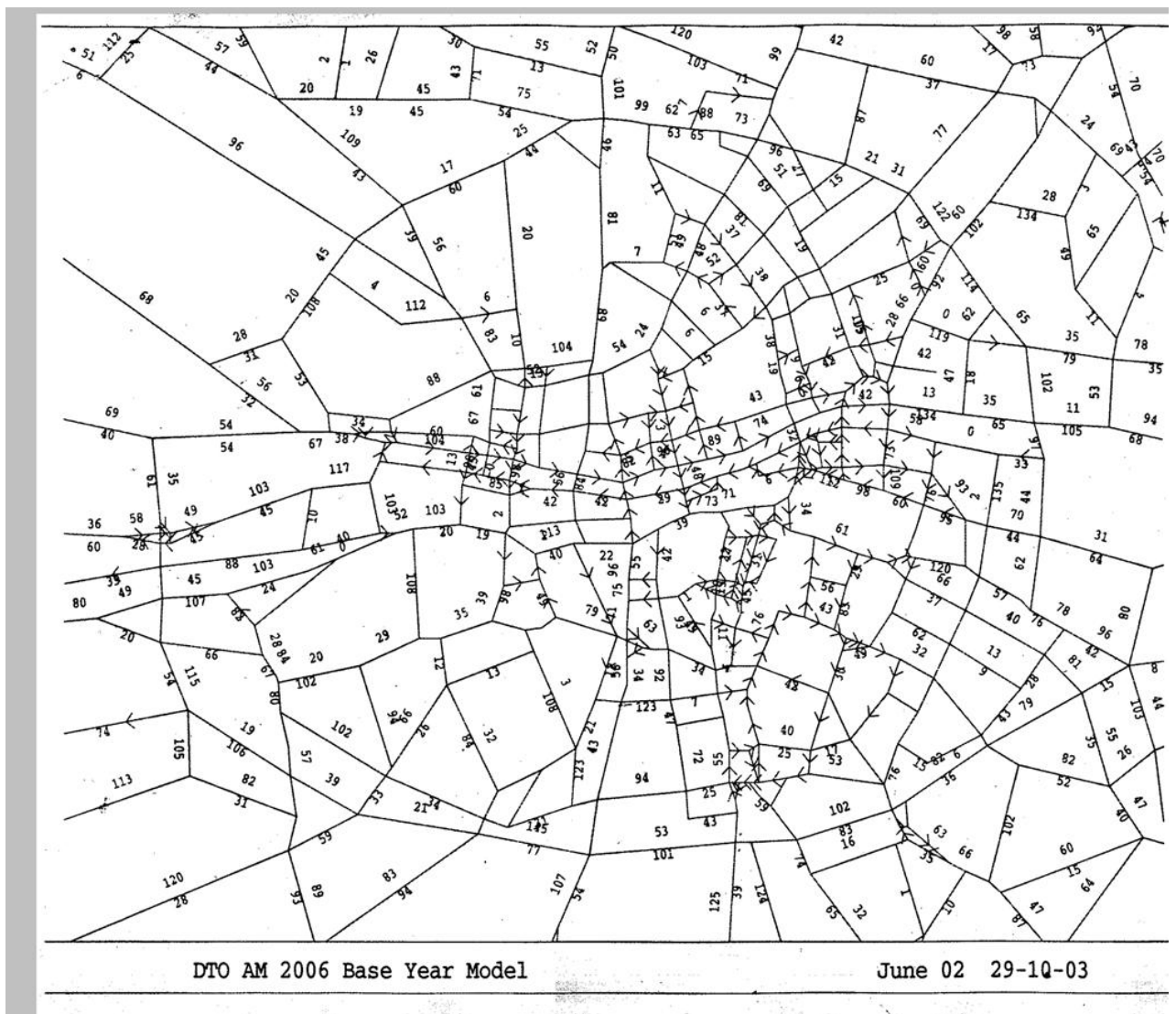
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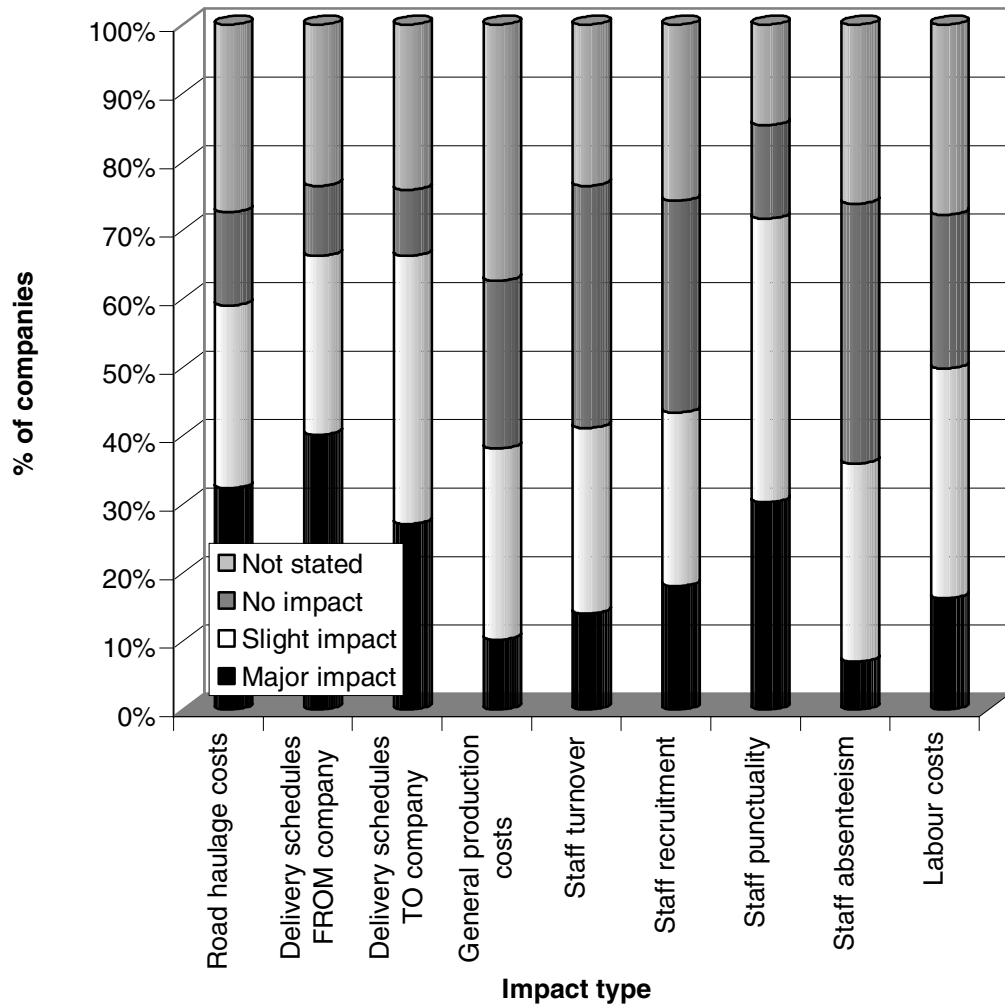


**Figure 2. Volume to capacity ratios for Dublin city centre**

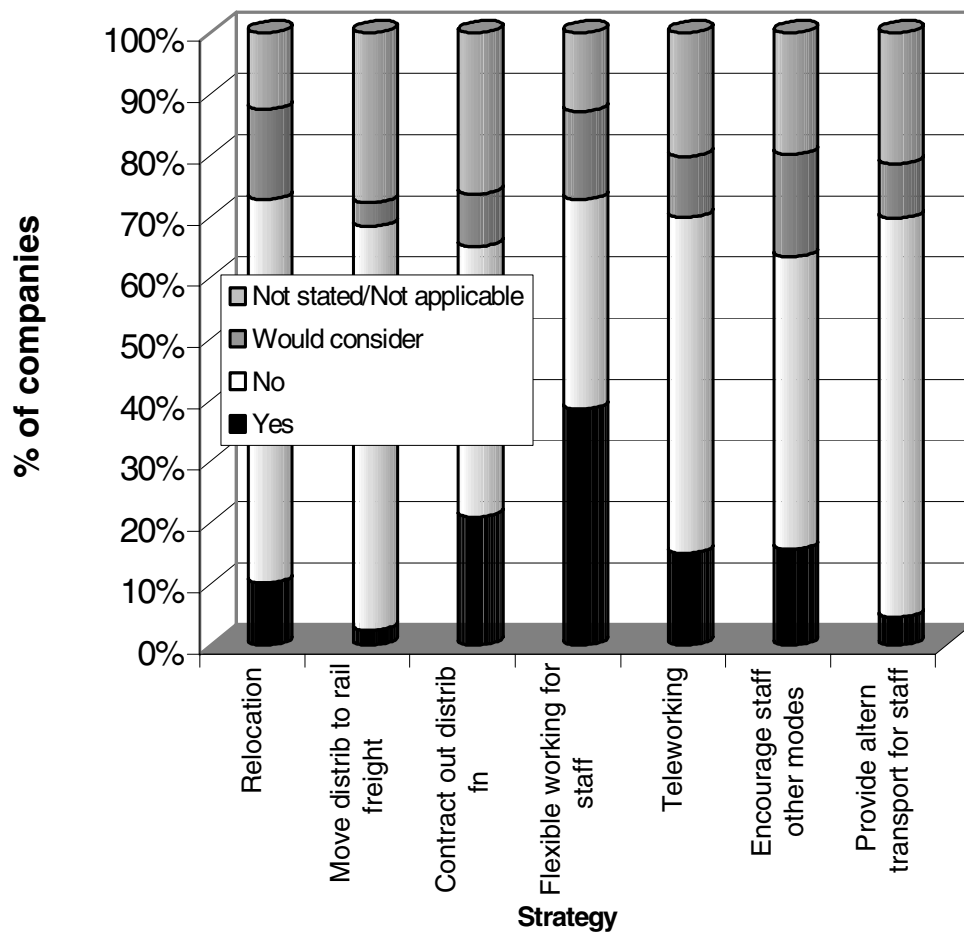




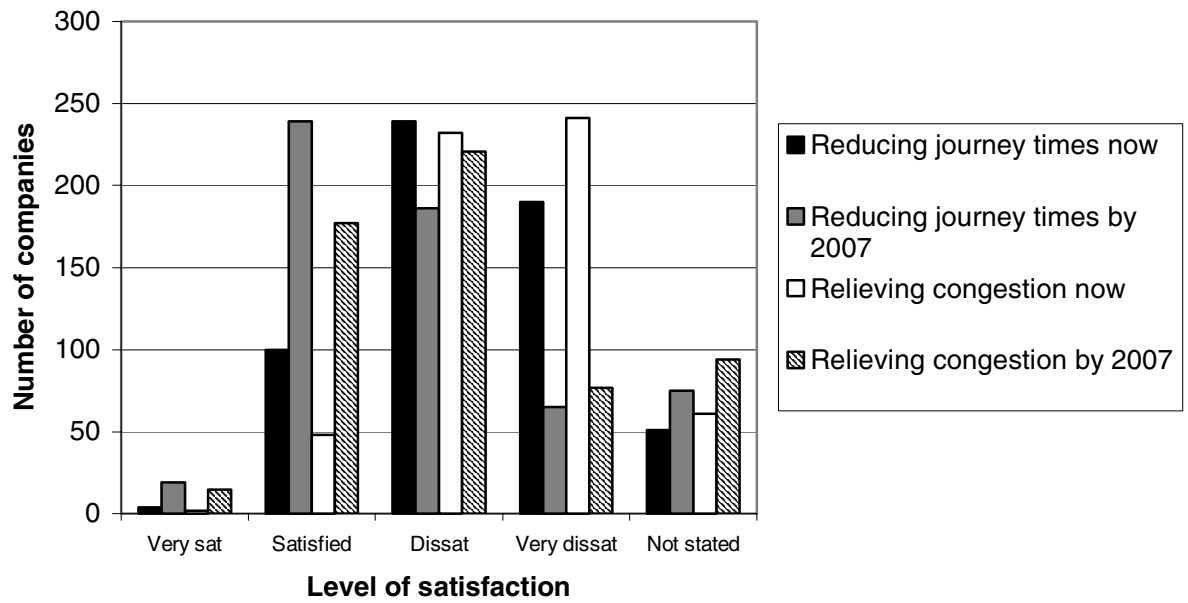
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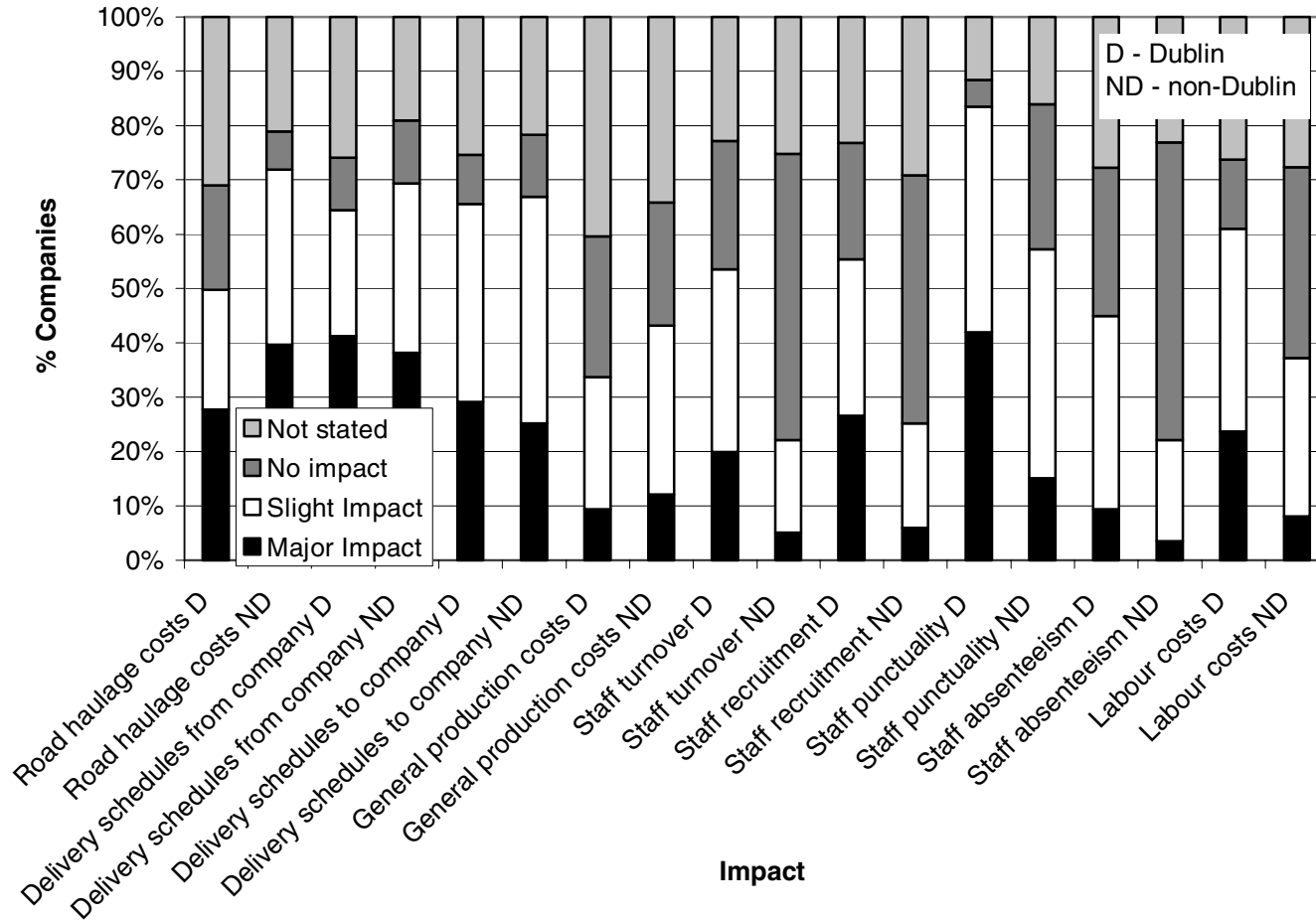
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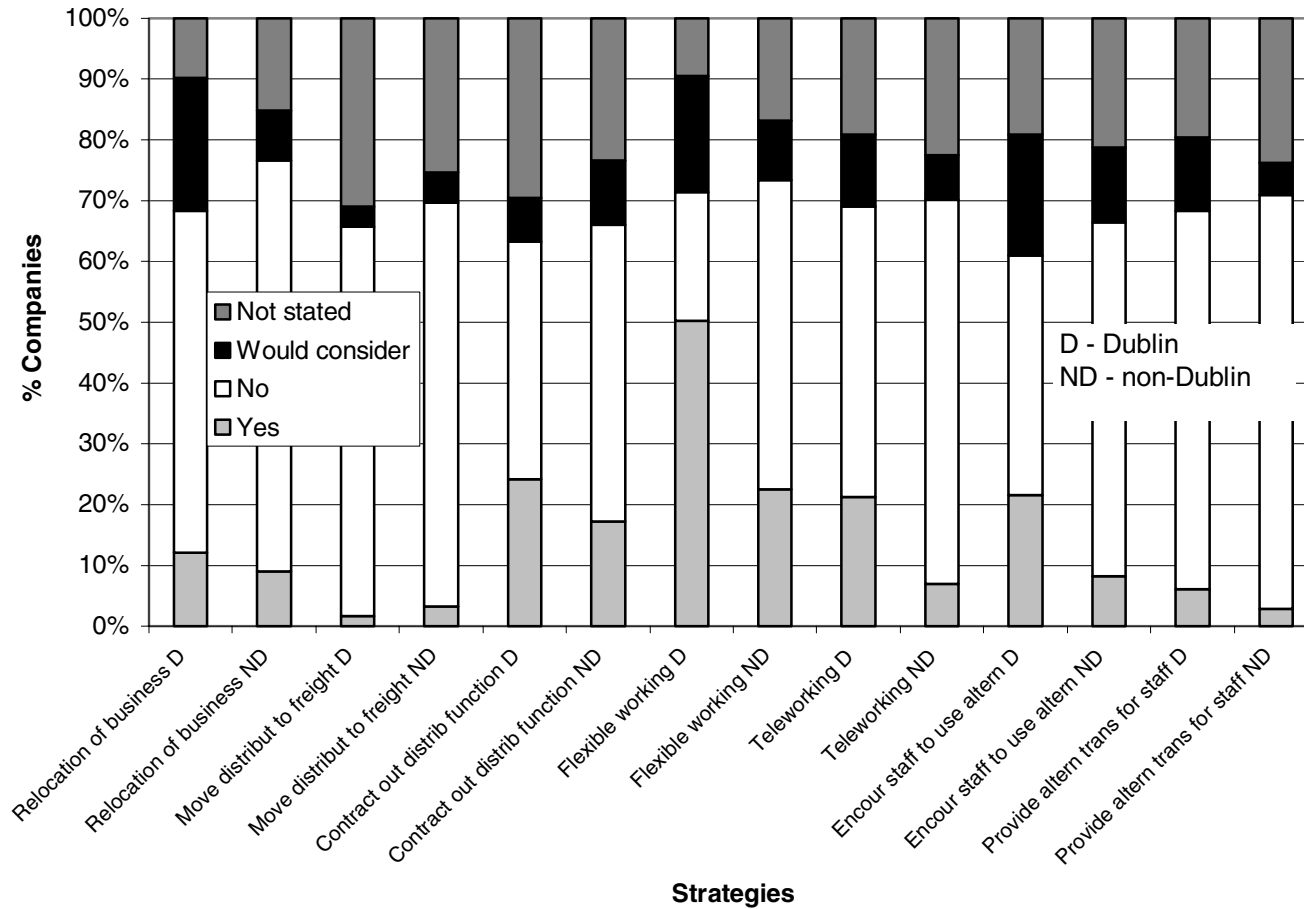
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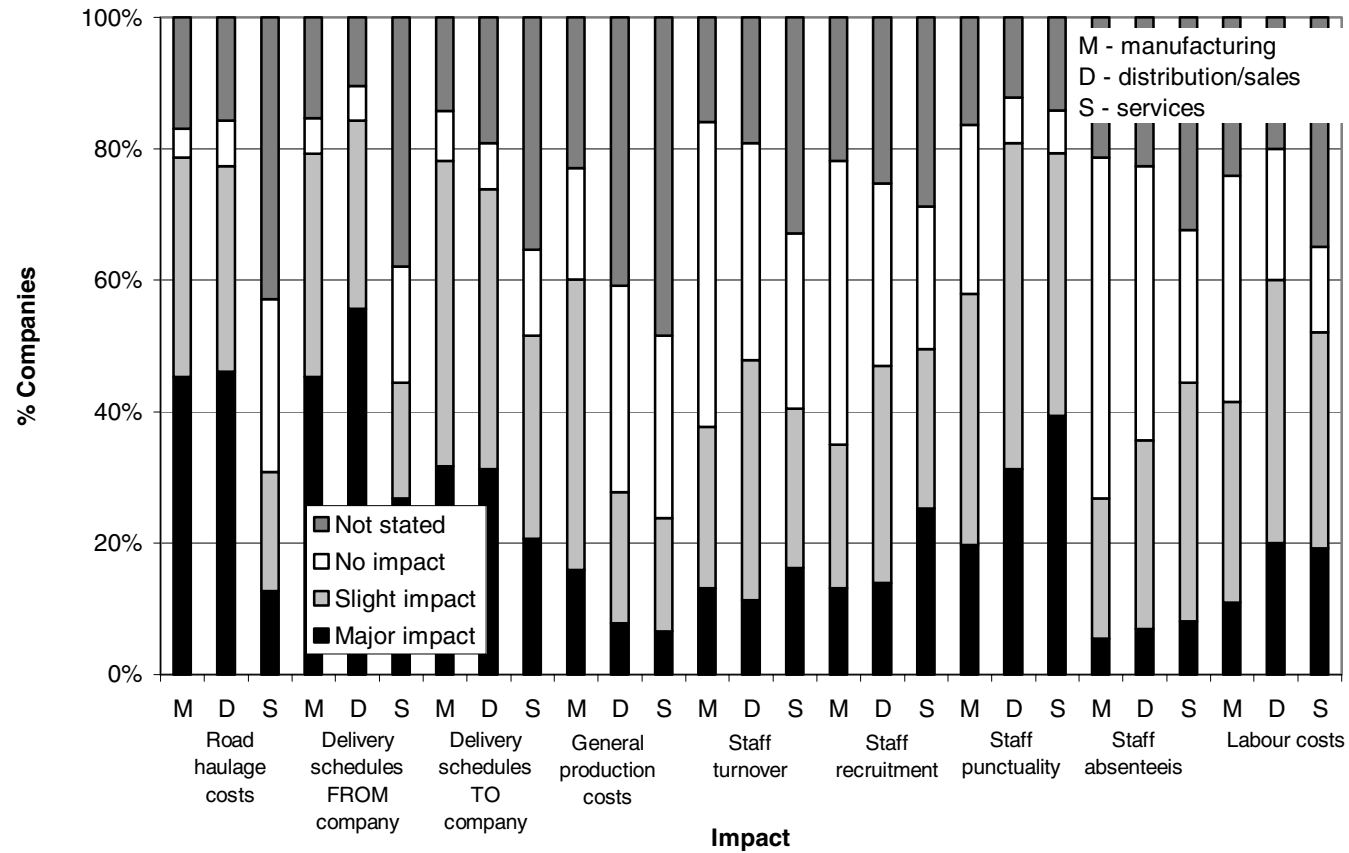
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