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GIS for business and service planning

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Within the realm of business and service planning, traditional GIS are weak so far as predictive modelling is concerned, notably because they have no means of coping with competition. This chapter outlines a framework within which GIS can be linked with other analytical tools in such a way as to offer commercial organisations support in constructing strategic development plans. We have consistently argued that the integration of modelling tools within a GIS environment creates a whole that is substantially more than the sum of the parts. In fact, it leads to the creation of 'decision support systems' for managers that can address a much wider range of operational and strategic issues than 'desktop mapping'. The approach is illustrated by examples drawn from the authors' work for major retailing corporations in both Europe and the USA in terms of optimal siting of outlets and improved distribution mechanisms.

1 INTRODUCTION

Since the first edition of this volume was published in 1991, a significant amount of change has occurred in the area of 'business geographics'. It can be argued (with some important exceptions) that GIS in business has moved from a peripheral, technical role to a mainstream management role. With GIS products such as MapInfo being incorporated into Microsoft Office, the ubiquity of GIS in business is impressive (see Elshaw Thrall and Thrall, Chapter 23). Most, if not all, large commercial and government organisations have access to GIS technology in one form or another. This maturity, following a common life-cycle pattern in IT applications, has naturally led to observers asking 'where do we go from here?' Has GIS become another widely accepted technology that can exist alongside spreadsheets, data warehouses, and other business IT applications – or is there something distinctive about GIS and its relationship with business application that remains untapped and offers significant potential for exploitation? In this chapter we offer, in a pragmatic manner, an approach and an argument that supports the latter rather than the former view.

Viewed from within the GIS industry, business geographics is seen as a tremendous success and we applaud the efforts of the 'GIS in business' community to promote the application of GIS in the commercial area. The number of conferences and the range of participants demonstrates an effective collaboration of developers and appliers. However, viewed from a different perspective (that of contributing to the strategic planning of business organisations), the position is less clear cut. It often appears to be the case that GIS in business is used simply to map out or represent spatially referenced data. At one level this is reasonable and should be supported. At another level, it falls somewhat short of what we have termed 'intelligent GIS' (Birkin et al 1996). We have consistently argued that the integration of modelling tools within a GIS environment creates a whole that is substantially more than the sum of the parts. In fact, it leads to the creation of decision support systems that can address a much wider range of operational and strategic issues than desktop mapping. We would thus like to see GIS move from the mainstream to the strategic (see also Gatrell and Senior, Chapter 66; Sugarbaker, Chapter 43).

Given this background, the aim of this chapter is to outline a framework within which GIS can be linked with other analytical tools in such a way as to offer commercial organisations support in constructing strategic development plans. Such a framework is likely to be built upon the following sequence: data ⇒ information ⇒ intelligence ⇒ action. The chapter will review the role of GIS in business and marketing, and outline its contribution in each of the above categories. Examples will be drawn from the fields of high street retailing, financial services, and automotive retailing. An argument will be made that GIS is excellent for examining 'what is' issues, but poorer at making 'what if' forecasts and predictions. The advantages of GIS for data storage and handling, mapping, and the provision of basic levels of information will be discussed first. Then we shall review the kinds of spatial analysis tools that are currently available or recommended to retail analysts. These include buffer and overlay techniques and network analysis for store location research and customer targeting. A key argument here will be that many of these techniques are now somewhat dated in terms of methods available outside GIS (both in theoretical terms as purveyed through the literature and in applied terms through specialist software and consultancy operations).

In terms of forecasting and predicting the impacts of changes in distribution patterns we then argue that current proprietary GIS are less useful. This has now been recognised by many GIS vendors and 'solved' by introducing suites of location models, particularly location–allocation models and spatial interaction models (see Church, Chapter 20; Getis, Chapter 16). This recognises the usefulness of these tools for forecasting and 'what if' style predictions. However it is our belief that making simple (often one parameter) models available for *applied* problems can be as dangerous as not having such modelling power in the first place, mainly because it is unlikely that such simple models will be able to reproduce accurately the complex consumer behaviour patterns seen in modern retail markets. The alternative is to customise GIS so that the modelling tools become the main analysis tools, supported by good graphics and data processing. We will demonstrate how such (disaggregated) models can help add intelligence in the schema described above through examples of a variety of business situations that require action plans.

2 THE CORPORATE GROWTH MODEL

The geographical development of most retail and business organisations has taken place in a haphazard way. Few organisations can point to a systematic plan for network development which has involved prioritising potential target locations. That is not to say that there has not been an overall 'grand plan'. Indeed, many companies will have decided historically on either contagious diffusion strategies (expansion from a headquarters location: see the example of the UK Kwiksave grocery chain in Sparks 1990) or hierarchical diffusion strategies (involving location in the largest cities first). Some may also have gone as far as publishing lists of target sites (Kwiksave again is a good example – see Langston et al 1997). However, it would seem fair to say that such lists are often merely rankings of shopping centre by size, rather than the result of any proactive spatial analysis of competitive retail markets. This lack of investment in locational analysis does not surprise those who have dealings with senior management in retail organisations. The majority of these managers (if not all) will be accountants, lawyers, or business managers not accustomed or trained to acknowledge the importance of the branch location network in other than a superficial fashion (hence the importance of, and interest in, the arguments in section 3 below). In a fascinating recent appraisal of the importance of dealer networks in the Caterpillar organisation (Fites 1996) there is discussion on the value of dealers in terms of customer care and help in shaping new technical developments. Discussion of the relationship between sales and dealer location is less prominent although Fites does recognise the value of local marketing and knowledge of local customer needs. The only reference to the location of dealers in respect to sales in his publication comes with reference to Mexico where sales dropped during a recession and many competitor dealers were closed:

'When the good times returned, we were the only ones with a viable dealer organisation in Mexico, and we got the vast majority of the business.' (Fites 1996: 92)

Such recognition of national dealer locations needs to be mirrored at the regional and local levels. Part of the problem lies with the fact that many organisations believe few new opportunities exist.

Their networks probably developed in piecemeal fashion over the years, especially where mergers and acquisitions have also added to the uneven nature of spatial corporate growth. In addition, many organisations believe their network is complete in the sense that they no longer concentrate serious resources on location research, often believing home markets to be saturated. When we began to work with W H Smith (the largest bookshop and stationery chain store in the UK; see Birkin and Foulger 1992) they expressed surprise at the opportunities which were revealed through the appraisal of local markets simply because they had got used to the belief that their network of branches was complete and UK shopping opportunities were saturated. This attitude is common amongst retailers despite the fact that, in most retail sectors, company market shares vary significantly from region to region and substantially within regions themselves and that there is widespread regional variation in provision indicators such as floorspace per head of population (Langston et al 1997: see Figure 1). The lack of investment in location research is even more surprising in relation to opportunities provided by overseas markets (Wrigley 1993).

It is good news for those involved with spatial analysis that the situation is slowly changing. This must partly be attributed to the success of GIS vendors faithfully spreading the message at an increasing number of business conferences, through site visits, and through magazine articles. It is also a reflection of an increasing number of academics getting involved with consultancy (see Clarke et al 1995). Before we assess the contribution of GIS to business applications, it is useful briefly to rehearse the arguments concerning the importance of geography in the distribution and targeting of goods and services.

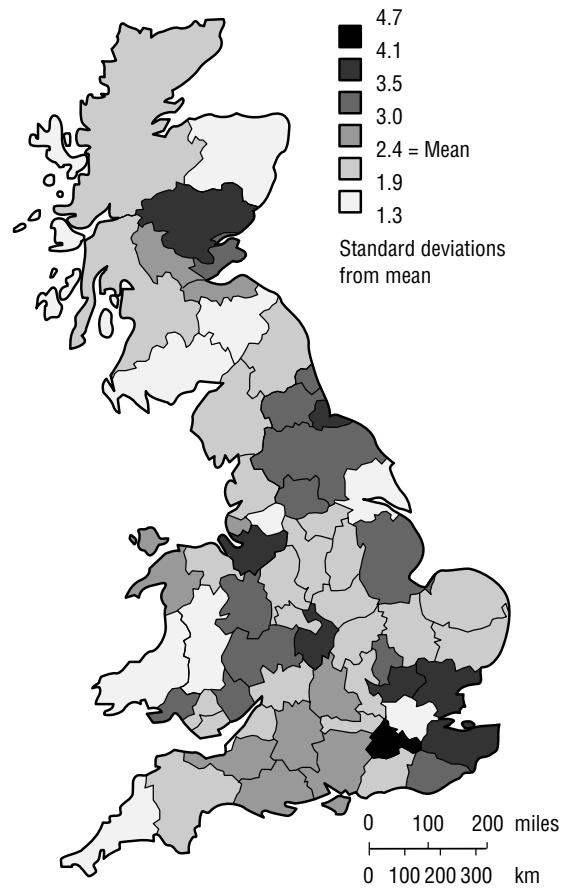

Fig 1. Spatial variations in retail provision: multiple grocer floorspace per household in Britain.
Source: Langston et al (1997)

3 THE GEOGRAPHY OF SERVICE PROVISION

Ask any UK retail company about their current market share for different products in the UK and the vast majority will provide the correct answer. There is good market information at this coarse level of spatial resolution. However, ask the same companies for a regional breakdown and they may begin to struggle. This is often more interesting since national figures usually mask very large regional variations. Figures 2 and 3 show the variations in regional market shares for LADA and BMW cars respectively in the early 1990s. The variations in regional performance are clear to see. Such variations even occur in the business-to-business sectors where historically many companies monopolise markets in traditional strongholds but are very weak in other geographical areas. For example, Shell Chemicals has very strong market shares in northwest England and around Greater London. Referring back to the Fites (1996) article cited above, Caterpillar are equally likely to have uneven international *and* national market shares given the location of its global network of dealers.

Although these regional variations are often striking, the actual variations within regions are normally even greater. The vast majority of service organisations will struggle to provide market share estimates for major cities within regions, let alone for

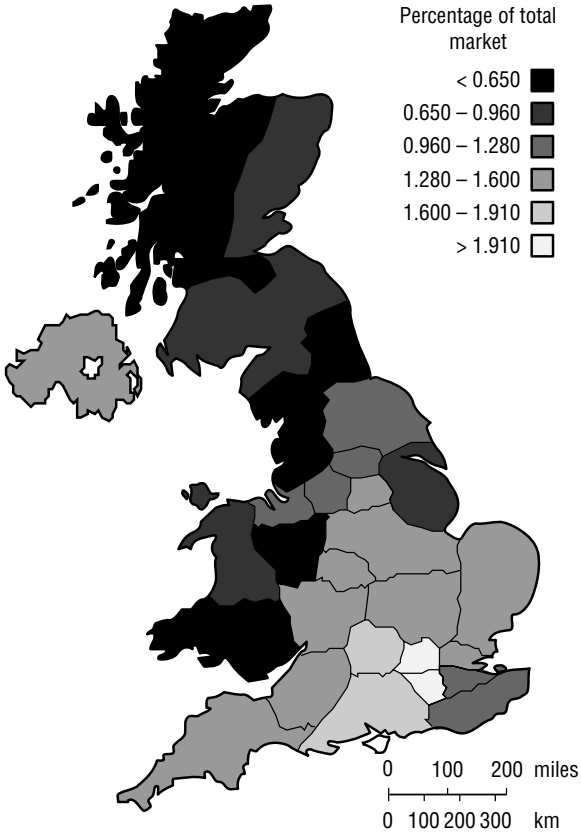

Fig 2. Regional market shares for Lada cars in the UK.

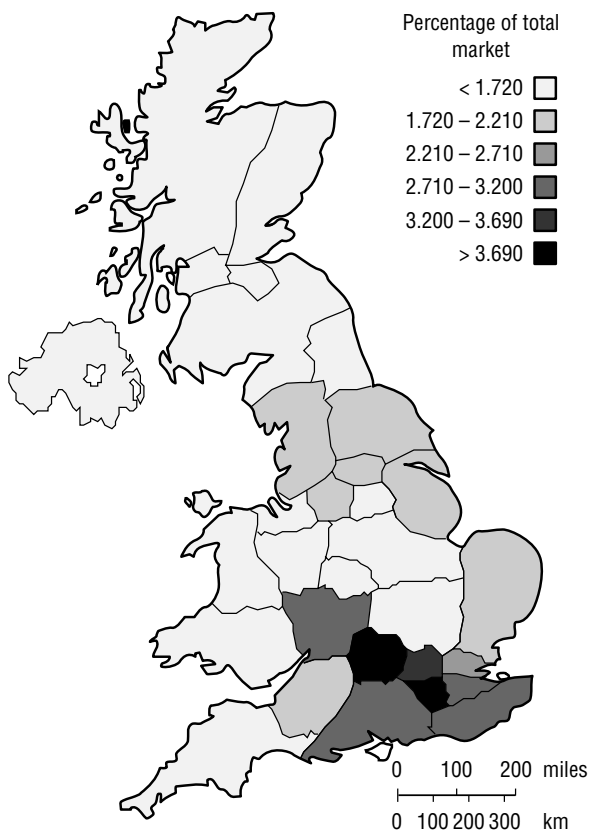

Fig 3. Regional market shares for BMW cars in the UK.

smaller geographical areas such as postal districts. As we mentioned above, this is partly because senior managers are not geographically aware and do not typically think in this way. Figure 4 shows the actual market penetrations for a major car retailer in the two UK counties of Hampshire and Dorset by postal district. This particular manufacturer has a national share of roughly 2.5 per cent. As Figure 4 shows, the postcode district averages within Hampshire and Dorset range between less than half and more than twice this average. The distance decay effect around each dealer is also evident. If geography (or dealer location) were unimportant, then local market penetrations for individual manufacturers would be much flatter and nearer to national figures (even allowing for random variations). This phenomenon is not peculiar to the UK. Figure 5 shows the same relationship between market share and dealer location for a leading motor company in Puerto Rico.

A second obvious factor which influences local geographical performance is the location of customer 'types'. Kwiksave have a target market of UK social groups D and E, traditionally low- or unskilled workers more interested in cheaper prices than store layout or store choice ('no frills retailing'). Similarly, Toyota are more likely to sell 'top of the range' cars in areas of high affluence and their two-seater MR2 sports car in areas containing both wealthy and typically young professional workers. Hence customer targeting is very important in strategic planning, and the geodemographics industry aims to supply information to companies on geographical variations in such customer types. Clearly the geographical balancing act is to combine distribution and sales points with the greatest concentration of potential customers.

We have long argued (Birkin et al 1987) that, to understand the geography of service provision, we need to understand the relationships between customers, sales, and markets. For some service sectors these data are readily available but currently remain greatly underused. Financial institutions, for

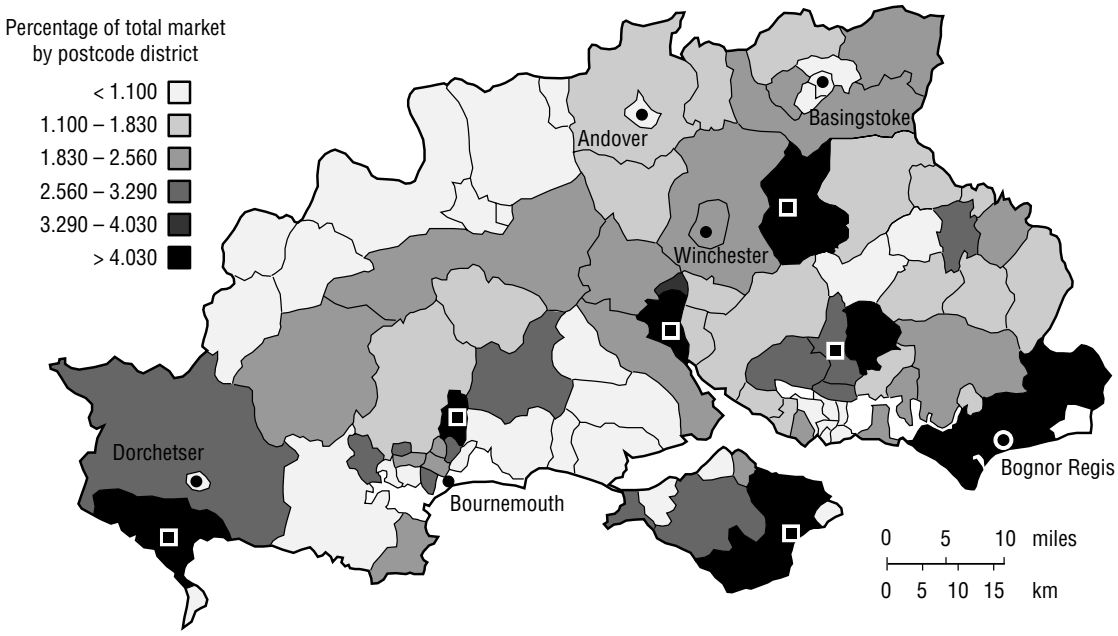

Fig 4. Market penetration for a leading motor distributor by postcode district, with dealer locations shown as squares.

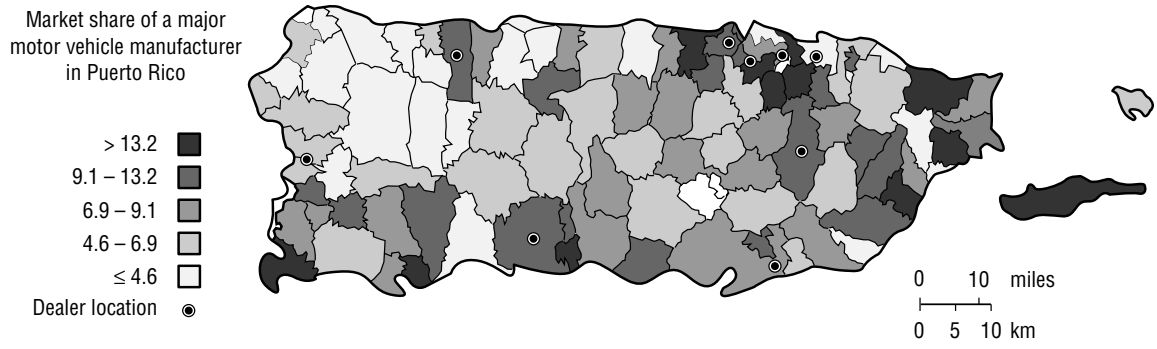

Fig 5. Market share of a major motor manufacturer in Puerto Rico. Dealer locations are shown by dots.

example, have superb data on their customers and their place of residence. In Britain, the motor industry can purchase sales information for their company and all the competition from the Society of Motor Manufacturers and Traders (SMMT), including customer postcode addresses by manufacturer and model type. In these two instances, companies are likely to be in the commonly stated position of being 'data rich but information poor' in that there is so much raw data that processing and analysis without computer-based technology is virtually impossible (or at best extremely time-consuming). Even if data are provided on computer (or by computer tape), it is our experience that it is often simply printed out on reams of computer paper and analysed by traditional eyeballing methods.

Other service organisations (e.g. high street retailers) may not be as fortunate as the ones mentioned above: for them, data may be poorer and less easily accessible. However, it is likely that through a mixture of internal data (invoices, credit card information, transaction data), public domain information (in the UK the Census of Population,

Census of Employment, Family Expenditure Survey, etc.) and agency information (market reports from Euromonitor, the Economic Intelligence Unit, Audits of Great Britain, and more specialist sources such as SMMT for the motor industry and AMI for the chemical industry) it is possible to piece together a large volume of market information; similar market information can be assembled in other countries. Indeed, the first major benefit from developing a computer-based information strategy is often the 'data audit' associated with piecing together relevant material on markets and customers.

The most immediate benefit of GIS itself lies in the ability to store large volumes of such data within a framework which allows quick and efficient retrieval (see Goodchild and Longley, Chapter 40). In geographical terms, this obviously relates to information pertaining to different spatial areas (and possibly spatial scales) as well as the medium of display through modern computer graphics. We have seen in the examples shown above that spatial data and information can be 'brought to life' and hence more easily understood if displayed in map as well as tabular form. It is at this stage of the information system that simple arithmetic operations can greatly add to the information base. Data retrieved can be filtered (or sorted by some key category), ranked, and added together. For example, if the datasets include census variables on characteristics of either the population or the household, then these are likely to be available for small geographical regions. They can then be combined with household information sets available only at the national level to produce new estimates for small geographical regions. Marrying the Census variables on household social class with expenditure on products (in the UK from the annual Family Expenditure Survey) can produce demand estimates by product groups not normally published (see an example of this approach for the estimation of demand for books in Germany shown in Figure 6).

GIS can also provide useful methods of data linkage through polygon overlay where different layers of data can be superimposed (see Martin, Chapter 6). The ability to link data together turns data into information. In the financial services industry, data on different types of account holders could be linked to provide customer profiles of the sorts of persons most likely to have a basic current account, a mortgage, or to be financially active holding many accounts. Targeting new deposit accounts could thus be made more sophisticated through this data overlay procedure – but see Curry, Chapter 55, for an appraisal of the privacy issues that this sort of operation raises. Whilst many organisations are getting better at producing information, there is still a shortfall in good spatial analysis: we argue that it is the ability to analyse this type of information which provides market intelligence and the ingredients for action. Thus, to continue the financial services example, we could go on to assess the role that different types of customers play in adding to profit levels and trying to work out a strategy for optimising profits. Once we understand the profit implications of new clients, then the search is on to find other cases of these and similar customer types for added value products.

4 GIS AND MODELS IN RETAIL ANALYSIS

We will now illustrate the advantages of combining GIS and models ('intelligent GIS') using four examples of issues or problems which can arise in the retail industry. The first explores the day-to-day activities of marketing and branch network planning. The last two are examples of activities which take place more infrequently but which present obvious geographical problems to solve. We will demonstrate that intelligent GIS can offer solutions which lead to effective action plans.

4.1 Marketing and store revenue predictions

Most organisations are interested in analysing regional or local markets to understand both existing performance ('what is?' analysis) and to predict the impacts of changing the distribution network in some way ('what if?' analysis). Having used simple overlay procedures to identify target sites, the GIS literature often suggests a combination of buffer and overlay analysis to calculate store revenues for existing and new (potential) stores (see Elshaw Thrall and Thrall, Chapter 23; Waters, Chapter 59; Beaumont 1991a, 1991b; Elliott 1991; Howe 1991; Ireland 1994; Reid 1993; Reynolds 1991). This works by first estimating how far consumers are willing to travel to a store (existing or potential). The result of this exercise will be either a travel time (say 20 minutes) or a distance (say no more than three miles). The second stage is then to delimit an area around that store (a buffer) that marks the limit of that time or distance factor in

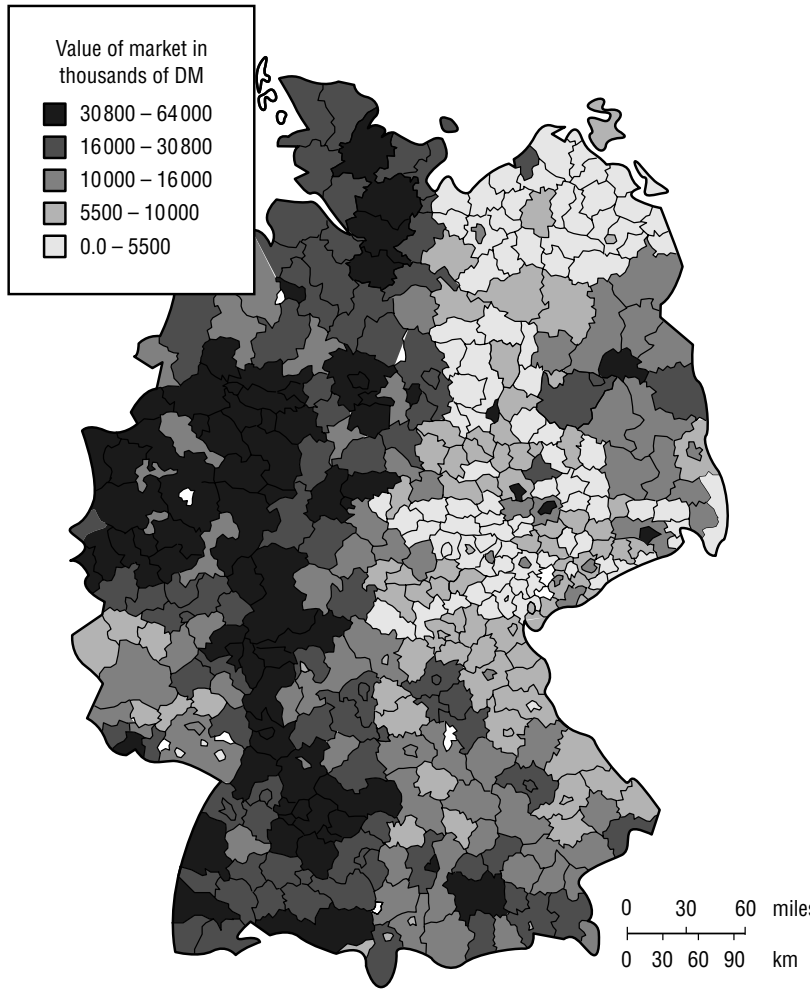

Fig 6. Estimated demand for books in former West Germany.

each direction outwards from the store. The revenue accruing to that store can then be estimated by overlaying the consumer spending power that resides within the postal sectors (or parts of sectors) or zipcodes that lie within that buffer. Unfortunately, the assumption is often made that customers close to the store are as likely to travel to the store as are those at the edge of the buffer. When there are competitor stores within the catchment area buffer, then revenue prediction becomes even more problematic. Normally, the so-called 'fair share' method is used (see Beaumont 1991a, 1991b) where the total amount of revenue generated by all stores in the buffer is divided simply by that number of stores. This could be made more sophisticated by basing 'fair share' on store size and perhaps store ownership. However, even with these refinements, the revenue predictions made are likely to be fraught with danger. When the supermarket catchments overlap one another, the GIS software merges them into one polygon along with all the spatial attributes associated with that buffer. Clearly, the problem is greater when there are two or more stores which are located close together and thus effectively have very similar catchment areas. Although some of these issues have been addressed in relation to catchment area analysis (see Davies and Rogers 1984), the solutions do not yet appear in many GIS packages.

On the other hand, spatial interaction modelling is ideally suited to the problems of defining realistic

catchment areas and estimating store revenues. A study area is divided into a set of residential zones, say postal sectors or zipcodes, and all centres and outlets are identified. The models thus attempt to quantify exactly how many customers in each demand zone will patronise each and every store in the region. Since customers to different stores will come from a variety of demand zones, overlapping catchment areas are expected and explicitly handled. The model is calibrated on existing flow data, after which a new outlet can be introduced and its impact assessed. Although these models have been around for 25 years, only recently has their full potential been realised as better spatial data and computer hardware/software became available (Birkin 1996; Clarke and Wilson 1987). Examples of these models and their use is provided by Birkin et al (1996).

It should be acknowledged that these types of model are increasingly to be found in proprietary GIS (see Maguire 1995 for developments in ARC/INFO). Although this should provide a more sophisticated level of analysis, there remains the general problem of the lack of flexibility in model design and outputs as well as a number of practical problems. The argument concerning the lack of flexibility which is often needed to handle a variety of often unique business questions has been provided by Birkin (1996). The practical problems have been explored by Benoit and Clarke (1997). They found model selection a major problem for the uninitiated. An analysis for a local health care facility will typically require a different model to that for an automotive dealer. A reasonable question from the new investor who has recently purchased the GIS package might be: 'Which model should I use?' Second, there is typically not a useful or related calibration method imparted to the potential user, so it becomes necessary to devise one's own method. This particular problem makes it eminently difficult for a retail manager initially to comprehend what to do for his or her own store location analysis unless he or she has access to extensive knowledge on retail modelling.

The arguments for integrating specialist modelling software (where highly disaggregated models can often be constructed) and GIS have been made elsewhere and the term 'intelligent GIS' (Birkin 1996; Birkin et al 1996) is broadly synonymous with 'spatial decision support systems' (Shiffer, Chapter 52; Densham 1991; Densham and Rushton 1988). However, it is important here to emphasise the benefits. Since the models deal with spatial interactions, we can not only predict accurate revenues but also analyse resultant flow patterns. This, in turn, facilitates the calculation of a wide range of residence-based and facility-based performance indicators as a matter of routine (see Bertuglia et al 1994; Birkin 1994; Clarke and Wilson 1994) and also allows the analyst to construct area or regional 'typologies'. Examples of these typologies are given in Table 1. In this case, basic data on market performance have been turned into useful information. Having identified appropriate regional strategies, the resulting action plans can then be tested using the models in a 'what if?' fashion. The most common of these is the testing of new store openings. Again, the power of the models over traditional GIS comes with the accurate prediction of new catchment areas which are always likely to be skewed in some way (again because of the location of the competition) rather than the simple, common assumption of circular travel times or distance buffers.

Table 1 Four typologies of regional performance and management actions.

Sales per branch	Market share: *Low*	Market share: *High*
High	**Type 2** Low market share High sales per branch *Extend branch network*	**Type 1** High market share High sales per branch *Maintain status quo*
Low	**Type 3** Low market share Low sales per branch *Reconfigure branch network*	**Type 4** High market share Low sales per branch *Rationalise branch network*

4.2 Launch of a new product

A special type of 'what if?' analysis concerns the distribution of a new market product. If this is a new type of chocolate bar, then an organisation would probably be safe retailing this from all newsagents and confectionery stores. However, what about a new £30 000+ ($48 000+) motor vehicle? GIS could highlight areas containing the most affluent consumer groups as a useful starting point. Existing dealer locations could then be overlaid to see which dealers might be in the most appropriate locations to sell cars valued at over £30 000. How many cars each dealer would actually sell is a much harder question to address with proprietary GIS. If the company has over 1000 dealers and hopes to sell 10 000 vehicles then it works out at ten per dealer. Realistically, however, some dealers are likely to sell 50, others fewer than five. This suggests we need a selective distribution policy which involves accurately estimating how many each dealer is likely to sell and hence which dealers should take priority. Figure 7 shows the results of a model-based appraisal of the likely sales of a new luxury car for company X from its dealers in the southeast of England and hence the dealers most likely to be able to sell 50 or more.

4.3 Mergers and acquisitions

Historically, mergers and acquisitions have been a key method of generating corporate growth. Most retail organisations have developed their networks and their market shares through acquiring regional players in this way (see Guy 1994; Kay 1987). There are several explicitly geographical issues involved with such action. The first is relevant when deciding on which organisations may be ripe for merger or take over. Different organisations have different regional and local market shares. By considering these variations prior to action, it may be possible to grow rapidly by achieving high market shares in regions where previously market share was very low. It was largely for these reasons that Kwiksave bought out Shoprite and Tesco bought out William Low in Scotland (see Sparks 1996a, 1996b). Once such action is complete, a second set of issues emerges. Does the combined network of stores now give that organisation the best or at least a good distribution network? In the case of the two examples mentioned above, the answer is likely to be 'yes'. However, with many mergers or buy-outs the combined organisation is left with many competing outlets in the same locations (a good recent UK example is the Leeds and Halifax building society

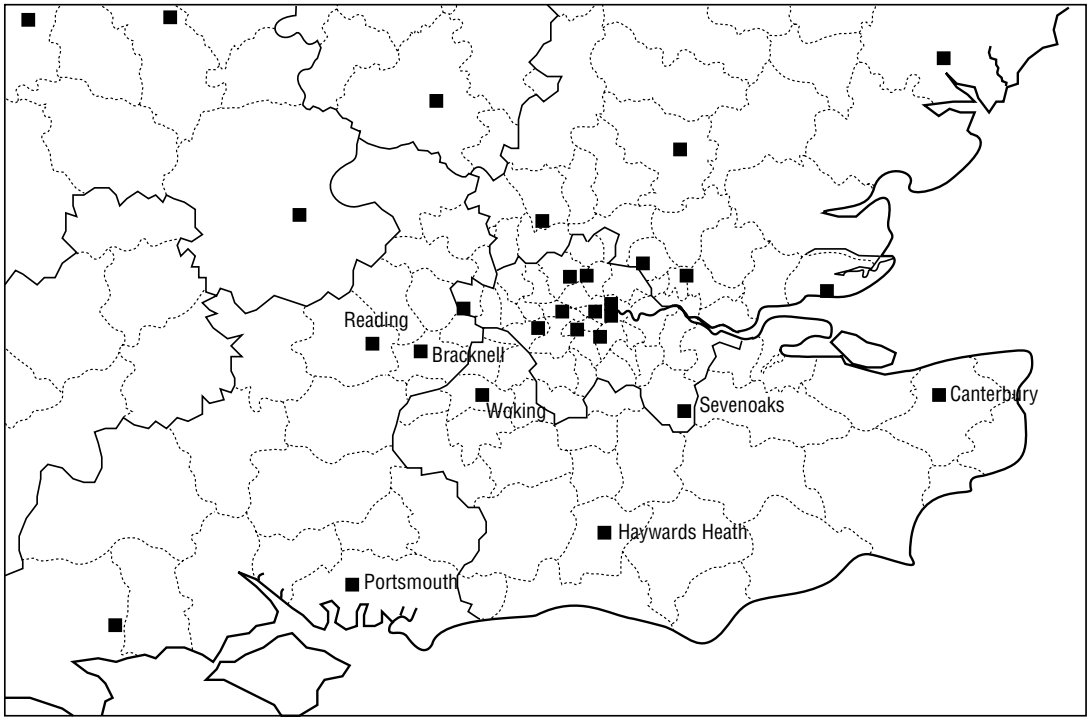

Fig 7. 'Optimal' dealers to sell new luxury cars in southeast England.

(Savings and Loan) merger where both had a high presence in the Yorkshire region as well as similar networks nationally).

If spatial duplication is the case, then the organisation is likely to want to rationalise its network through branch closure. The key questions are then which branches to close and where should transferred accounts be located, whilst at the same time considering the impacts of such closures on the desire to maintain market share. Although the intelligent GIS could be used to evaluate such store closures, a more effective action plan would also include refurbishments, change of fascias, and new branch openings – in other words, a systematic appraisal of all opportunities for the combined organisation. Tables 2 and 3 show an example of recent work we have undertaken for a new financial organisation in the UK following merger. Its main problem is to combine the former branch networks of the two organisations into one network for the new organisation. Table 2 shows a nationwide action plan which has resulted from a set of detailed modelling scenarios based on closures, reconfigurations (changing fascia name from one of the poorer performing branches of one of the old organisations to the name of the new organisation), refurbishments, and new branch openings. The action plan is clearly very different for each major UK geographical region. If we consider the southeast of the UK, we can see the more detailed action plan in Table 3. Plate 41 shows the combined impacts of these changes on market share. The pressure on the new organisation is to rationalise by closing branches (in order to reduce costs). However, it is also important to minimise the impacts of closure programmes. From our action plan, the closures inevitably result in a loss of market share in the south and east of the region but we believe the impact is minimised with closures in these areas and more than offset by new openings in far more lucrative markets to the north and west. Refurbishment of those branches which are left in the south and the east of the region may well bring back market shares to their previous levels. Swann (Chapter 63) describes analogous problems in the realm of rationalising military operations.

4.4 Optimising retail networks

We saw in section 3 that one of the uses commonly made of a GIS is to overlay different data layers to produce new information. Often this procedure takes place in conjunction with a set of rules governing site locations, such as finding sites where several criteria are met – for example, flat land, proximity to a motorway access point, and areas with a catchment population greater than 100 000. Whilst this is useful in dealing with many environmental problems, it is less useful in business. Again this is mainly because of the problems of dealing adequately with the competition (i.e.

Table 2 National action plans for the amalgamation of two building societies: number of stores affected.

Action	*East Anglia*	*Inner London*	*Midlands*	*Yorks and northwest*	*North*
New entry	18	29	25	1	3
Removal	1	4	3	10	5
Rationalise	1	8	0	2	1
Reconfigure	4	22	1	3	0

	Scotland	southeast	southwest	National totals
New entry	8	16	10	110
Removal	6	6	3	38
Rationalise	1	8	0	21
Reconfigure	5	10	1	56

where
New entry = High potential, no presence: add new stores
Removal = Poor performance, low potential: close branches of one former company
Rationalise = Poor performance, low potential: close both former company branches
Reconfigure = High potential, low market share: invest to upgrade branches

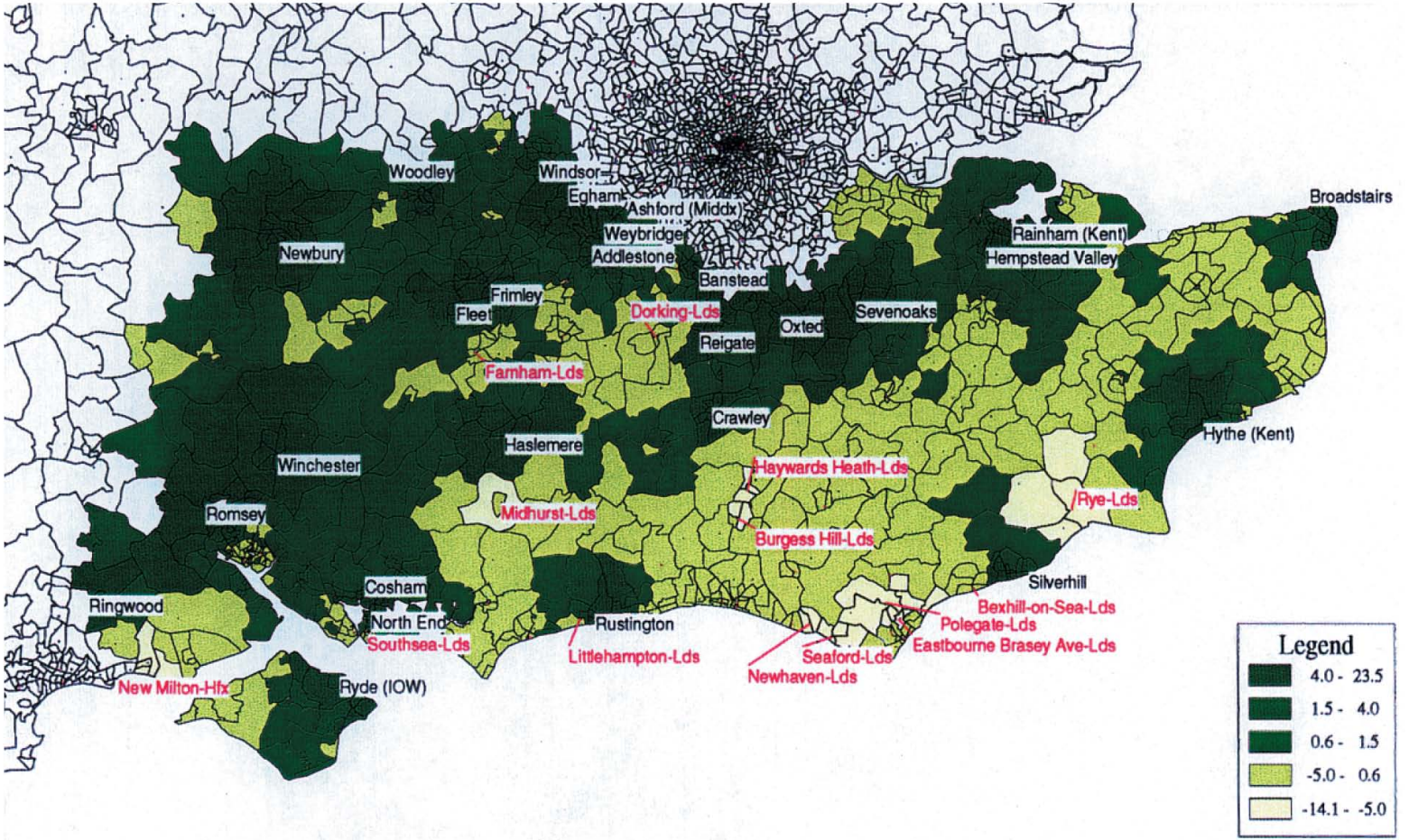

Plate 41 Change in market share of a newly merged financial institution, following the actions listed in Table 3 of Chapter 51. The legend shows the percentage change in market share, partitioned into quintiles; the branch locations of the two constituent institutions are labelled in black and red.

Table 3 Detailed strategy for development in southeast region.

New entry	Hempstead Valley	Ashford (Middlesex)
	Woodley	Romsey
	Frimley	Fleet
	Ryde (Isle of Wight)	Weybridge
	Rainham (Kent)	Ringwood
	Silverhill	Oxted
	Addlestone	Egham
	Hythe (Kent)	Broadstairs
Removal	Newhaven	Midhurst
	New Milton	Rye
	Polegate	Hampden Park
Rationalise	Farnham	Haywards Heath
	Seaford	Bexhill
	Dorking	Southsea
	Littlehampton	Burgess Hill
Reconfigure	Harley	Uckfield
	Steyning	Esher
	Shoreham	Haslemere
	Rustington	Godalming
	Lymington	Tenterden
Expansion[1]	Crawley	Winchester
	Cosham	Sevenoaks
	Newbury	Reigate
	North End	Windsor
	Banstead	Haslemere
	Rustington	

[1] where
Expansion = High potential, low market share: open additional branch

allocating population between stores). Thus, for business applications, other types of optimisation procedure may be more useful. Optimisation methods such as linear programming attempt to find the best solution to a stated problem subject to a number of constraints being satisfied (see Church, Chapter 20). They first appeared in the geographical literature to handle difficult operational research issues such as the 'travelling salesman problem'. Nowadays a much larger class of methods exists, particularly in the non-linear programming area. The great advantage of these methods over traditional GIS approaches is the way in which they can handle spatial interaction. For example, in site location problems they can consider a particular solution (say, 50 particular sites chosen from 500 possible ones) and calculate catchment populations and potential revenues very easily. Where existing GIS *can* help is possibly in identifying local sites. Certainly, a marriage of methods could well prove invaluable.

One methodology which has already been imported into GIS is the location–allocation model which finds the optimal locations for supply points given a spatially non-uniform pattern of demand (see Ghosh and Craig 1984; Ghosh and Harche 1993). The optimisation criterion is usually distance minimisation. The model can be run for any number of supply points. This kind of model is limited in its applied value since existing supply points are likely to be sub-optimally located and extremely difficult or expensive to relocate. However it does give some indication of an idealised pattern of business activity and it is particularly valuable in looking at the best locations for sales representatives or area managers. Given that the primary problem for such 'reps' or area managers is accessibility, then these models are very useful for assigning better new locations from which to serve either an existing pattern of clients to salespersons (or area managers to stores) or a new set (which themselves can be worked out in an optimal sense). Figures 8 and 9 show two examples – the optimal locations for new car dealer locations in the Seattle/Tacoma region of the USA and the Czech Republic, respectively. The optimisation objective in Seattle/Tacoma was to find sites which maximised sales for two new locations for Toyota whilst at the same time minimising the number of deflections from existing dealers. Clarke and Clarke (1995) estimated the potential financial benefits of such an optimisation procedure if this could be replicated throughout the USA: the predicted profits alone ran into many hundreds of millions of dollars! Greater details on the mechanics of optimisation appear in Birkin et al (1995) and Wilson et al (1981).

5 CONCLUSIONS

We have argued that existing GIS for business and service planning do not provide sufficient analytical power to solve many important geographical problems which arise in areas such as sales, marketing, and advertising. We believe highly flexible information systems are required which combine database manipulation and high-quality map and graphical output with spatial modelling techniques. Although some of this can be achieved through existing proprietary GIS packages, these are too often restrictive and unable to offer the right sorts of analyses to business organisations. It is

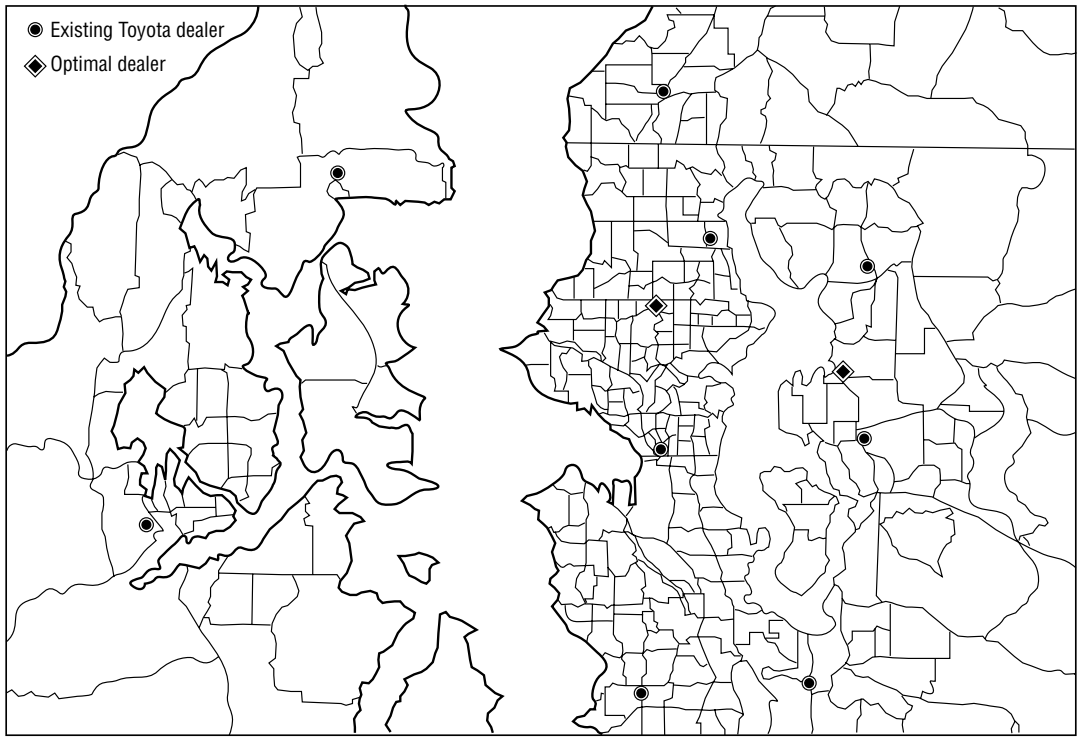

Fig 8. Two new optimal locations for Toyota dealers in Seattle/Tacoma which minimally impact on existing dealers. The land area is divided into census tract units.

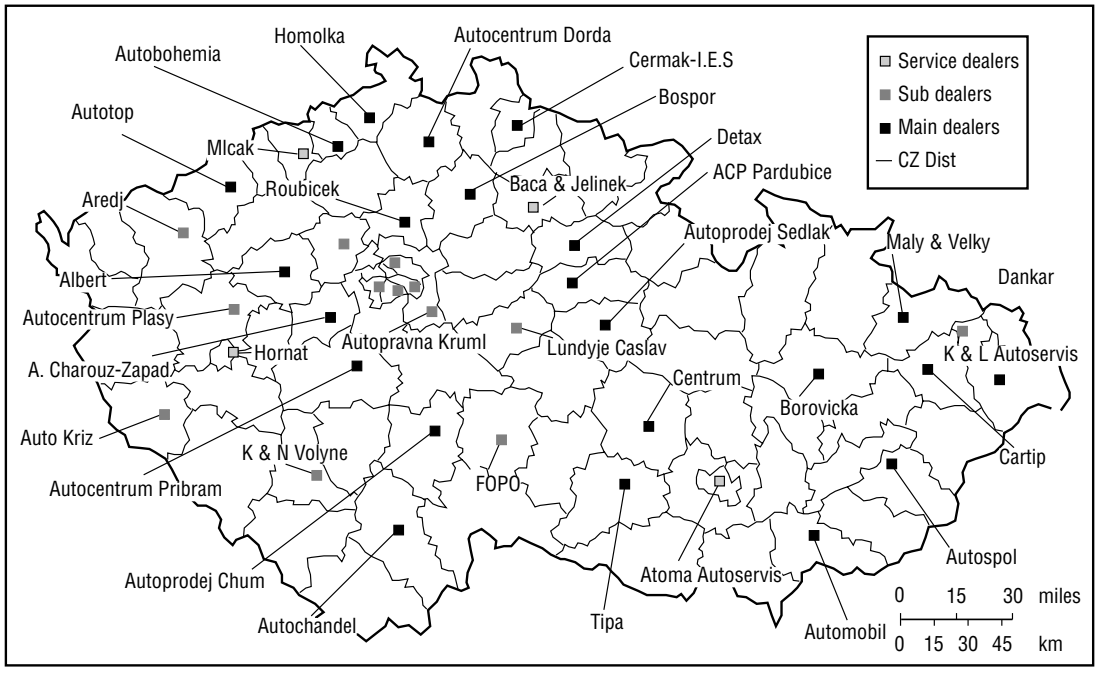

Fig 9. Optimal locations of existing dealers in the Czech Republic.

crucially important that GIS solutions can address the types of key strategic planning issue we have described above, rather than force organisations to 'shoe-horn' their problems into the analytical toolboxes available in current GIS packages. If this is not done, then we believe GIS will remain a low-order planning tool, assisting in the process of data manipulation and mapping but offering few long-term solutions or flexible action plans for distribution planning. Fortunately, the opportunities are still growing. We are convinced there are many new markets for GIS to explore. The area of telecommunications is one (see Fry, Chapter 58), offering enormous potential for good spatial analysis in distribution planning and target marketing as opposed to traditional GIS interests in physical network planning. If we can convince strategic planners in these new areas of the flexibility which is possible with GIS and spatial analysis then exciting times still lie ahead.

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