

Strategic analysis: a scientific art

Inaugural lecture

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Wolverhampton Business School

Wolverhampton Science Park

27th May 1998

Occasional paper series May 1998

Number **OP 001/98**

ISSN Number **ISSN 1464-1747**

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Strategic Analysis: a scientific art

Introduction

I am not aware of any other academic who has chosen the title “Professor of Strategic Analysis”.

This is not to say that the work I have been conducting over the last twenty years is unique but having been educated as an urban and regional planner, my research has always been at the interface of academia and practice.

I will attempt a definition of strategic analysis.

The word “analysis” is relatively uncontroversial and involves the decomposition of complex phenomena into their component parts as a first step in the better understanding of issues and problems - it requires an essentially reductionist stance.

While defining analysis is relatively easy, it is somewhat more difficult to define the concept of strategy as there are many interpretations and misinterpretations which pervade the academic literature.

However, the phrase which best encapsulates my own view of the word strategy is “the deployment of resources to achieve organisational objectives”.

If we were to put these two components together - with some additional embellishments - my definition of the term “strategic analysis” would be:

“developing a theoretically informed understanding of the environment in which an organisation is operating, together with an understanding of the organisation’s interaction with its environment in order to improve organisational efficiency and effectiveness by increasing the organisation’s capacity to deploy and redeploy its resources intelligently”.

Initially, my research focused on developing methods and approaches for conducting, what is known in the public policy domain as environmental scanning.

More recently the work I have been doing has focused on organisational analysis and trying to develop a better understanding of how organisations enact strategic management.

In my definition of strategic analysis, I used the word “intelligent”. As all psychologists will tell you, “intelligence” assumes a capacity to learn.

Consequently, strategic analysis must be seen as a recursive and adaptive process concerned with closing learning loops in organisations.

Thus, strategic analysis is an essential component of the knowledge creation processes of organisations and must be embedded within the organisations core management processes.

It is in the domain of analysis where the **science** of strategic analysis lies and it is in embedding research and analysis into organisation where the **art** lies - hence the title of my lecture.

While the science element has often proved difficult, it is usually tractable and solvable by the application of sufficient computer and statistical power.

But embedding critical and intelligent strategic analysis into the management processes, the power structures and the culture of organisations is not a problem that is amenable to solution by raw computer power or by a technocratic or a mechanistic approach.

I have often wished that it was.

Over the last few years, academic researchers have focused increasing attention on the concept of managing organisational knowledge.

A fundamental problem in many organisations is that those who have the knowledge do not have the power and that those who have the power do not have the knowledge.

Strategic analysis has a major role to play in making the powerful more knowledgeable.

At this point, it is useful to differentiate between strategic analysis **for** policy and strategic analysis **of** policy.

In the first instance, strategic analysis for policy, is primarily concerned with analysing the environment external to the organisation through the collection and analysis of structured data in a coherent, theoretically-based framework.

It is this theory testing orientation that distinguishes research - that is knowledge creation - from simple fact collecting.

In the second instance, the strategic analysis **of** policy, is the process by which the organisation, through a structured programme of research, evaluates the impact of its actions in its operating environment in the context of its stated policies and intentions.

It is through this process that an organisation learns what policies, programmes and interventions work, what does not work and why things do or do not work.

The hoped for outcome of these two aspects of strategic analysis is that the organisation continually augments its knowledge base and becomes more intelligent in the way in which it deploys its resources to achieve its objectives.

This then is my interpretation of the construct “strategic analysis”.

It is my view that an effective strategic management process in an organisation will depend on how well the organisation can conduct strategic analysis for policy development and also how well the organisation can conduct the strategic analysis of policy and programme implementation.

The development of a career in strategic analysis

Over the last twenty years, I have been conducting research in the field of strategic analysis.

Much of this has been within or about local government or in other public sector organisations.

A common element of most inaugural lectures is to demonstrate how one’s academic activity in one’s chosen field has developed, and, hopefully will continue to develop.

Perhaps what is more important is that the task of constructing a lecture like this requires one to do three things.

- First, to reflect and to try to identify some coherence in the substance of one’s research;
- Second, to seek to demonstrate some progression in the development of methodology and technique; and,
- Third, to demonstrate a contribution to creation of knowledge and understanding in a particular domain.

Without wishing to appear to have engaged in too much post hoc rationalisation in terms of the substantive coherence of my research, much of what I have been working on in the last twenty years has focused on:

- trying to make organisations more aware of the needs and issues they should address,
- assisting them to become more reflective and critical of the impact of their actions and, hopefully
- assisting organisations to become more strategic.

Methodologically, my contribution has been in the domain of information management as much of my research activity has focused on the design of very large scale information systems and surveys and on the integration of information drawn from disparate sources into coherent frameworks which are amenable to rigorous analysis.

The third aspect, of demonstrating a contribution to knowledge, is something I will try to achieve in the rest of this lecture.

In the rest of this lecture I will try to do three things.

- First, to describe some of the information systems I have developed based on my work in local government;
- Second, I will describe some of the detailed research projects I have conducted; and,
- Third, I will discuss some of my more recent research on the nature of strategic management processes in local government.

Strategic analysis and public sector organisations

Local authorities are very complex organisations that play a major part in all our lives.

Over the last twenty years, many, but not all, local authorities have become far more sophisticated in the way they are managed in response to political

pressure to confront issues such as unemployment, poverty and inequalities in health, education and welfare.

Many local authorities have developed elaborate strategic management processes - sometimes based on programmes of applied research sometimes not - with the objectives of better understanding the issues they are required to confront and reallocating their resources often with the explicit objective of improving the quality of life of the most disadvantaged members of the community.

When I joined local government, it was in a chief executive's department and I was simultaneously involved with the design and development of a strategic planning process for the organisation as a whole as well as the design of large scale information systems.

Hence the need jointly to think about the purely analytical aspects of my role and the need to ensure that the outcomes of the analysis actually contributed to the effectiveness of the organisation.

Integrating the outcomes of research into the strategic process of the whole organisation may appear easy at first sight but in reality it proved far more difficult than the conduct of the research itself.

This was particularly so when the outcomes of the research did not confirm the expectations and prejudices of the leading political group or they were seen to threaten the balance departmental power in the organisation.

My first realisation was that while the organisation had a massive commitment to large scale interventions in the local community, it did **not** have the information resources necessary to support these political and managerial intentions effectively.

While often misunderstood, number-crunchers are sometimes useful people to have around as one of the first tasks of my first tasks in local government was to produce an economic, social and demographic audit of a locality as a basis for the informed development of policy.

Initially, this was a massive fact gathering exercise that got much more refined as time progressed.

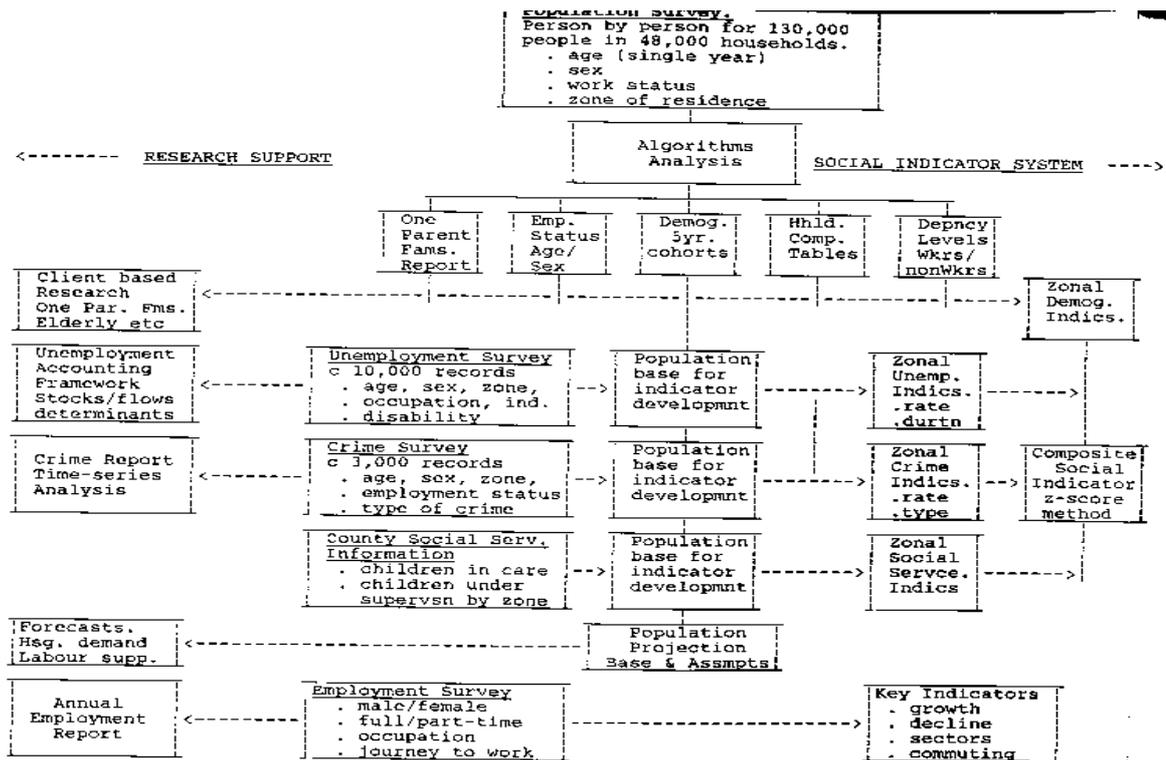
Over the next few years, I spent considerable effort developing and refining the information systems into a comprehensive and integrated urban information system.

The system provided the basis for the annual monitoring of change in Telford and for the conduct of some sophisticated social and economic research exercises.

Before describing the uses to which the information systems were put, I would like to describe the component systems which comprised, what became known as, the Telford Model.

Figure 1: The Telford Model

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The main elements of the Telford Model, each of which were updated on an annual basis, were:

- a population information system developed by enhancing the Electoral Register - by 1990, this was generating data on about 40,000 households annually;
- an employment information system collecting data on every local firm - numbering around 3,500 establishments annually;
- an unemployment information system which captured data on every locally unemployed person - in one survey over 10,000 people were enumerated;
- a crime information system based on prosecution data derived from the magistrates service; and,
- a host of other inputs derived from operational systems within the local authority and the County Council - on, for example, children in care and levels of educational attainment.

While the overall Telford Model appears quite simplistic, an urban information system of this complexity was unique in the UK.

The implementation of a system this complex required that several key problems had to be overcome in its development.

- The first of these was the need to develop common conventions to facilitate the integration of data.
- Second, and more problematic, was the need to design a common approach to geographical referencing which would enable the spatial integration of the data sets as this was essential for the development of GIS applications.

The approach to spatial referencing became increasingly sophisticated with the arrival of GIS moving from a common zoning system in the early 1980s to the use of unit postcodes in the early 1990s.

The Telford Model in its totality provided a fertile ground for research.

Each of the constituent data sets, which as time progressed became increasingly longitudinal, also provided major opportunities to explore issues of major academic and political concern.

I will give an overview of research based on the Telford Model which explored three particular issues.

- first, explaining the dynamics of unemployment through the medium of social accounting frameworks, logistic regression and log-linear modelling;
- second, exploring and explaining changes in the distribution of employment and unemployment among households; and,
- third, the use of simple Galtonian regression to measure the changing degree of spatial polarisation in Telford - and, following on from this, a linked research programme into the operation of housing allocation policies which this macro-level research triggered.

Modelling the dynamics of unemployment

The first area I will discuss is the use of social accounting frameworks and statistical modelling to explain the dynamics - or stocks and flows - of unemployment.

The early and mid 1980s were characterised by a massive increase in unemployment nationally and in particular in Telford.

Telford became stigmatised at the unemployment centre of the West Midlands as its traditional employment base was decimated by the recession.

In parts of Telford, male unemployment reached 45%.

While local agents sought to respond with the design of palliative responses, they were effectively powerless in overcoming a nation-wide macro-economic problem.

However, while emotional responses are often seen as necessary - because of the local political need to be seen to be doing something, however useless - the design of more effective policy requires a deep understanding of the nature of the problem that the policy is being designed to confront.

A consistent theme that has run through much of my research has been a concern with equity and with the notion of equitable distributions of social goods and social ills.

Consequently, it seemed appropriate to develop a more insightful view of the nature of unemployment focusing on unemployment as a distributional issue rather than as an emotional one.

In particular, it is wrong to see unemployment simply as a stock phenomenon but to see it as the outcome of a dynamic process of differentials in inflows and outflows.

More simply if inflow is greater than outflow then the stock increases.

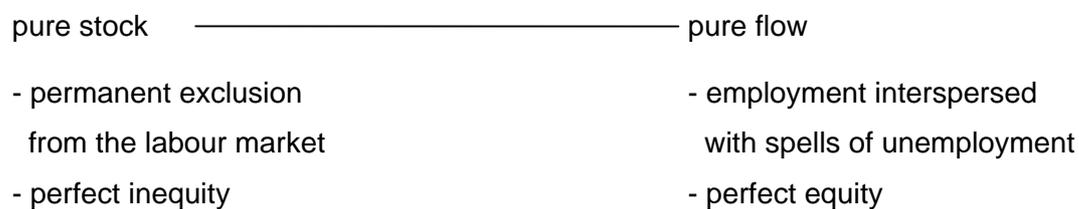
Here lies the link with equity and distribution and this can be demonstrated by considering what an unemployment rate of 40% actually means.

Does it mean that the same 40% of the workforce is permanently unemployed?

Or does it mean that everyone can be expected to be unemployed for 40% of the time.

These contrasting definitions together with their relationships with the flow differential view of the dynamic of unemployment and the concept of distributional equity can be seen in **my next slide**.

Figure 2: Unemployment dynamics and equity



Obviously, the two definitions of an unemployment rate fall at either end of a continuum between pure inequity where 40% of the workforce is permanently excluded and pure equity where everyone can expect their fair share of unemployment.

Being able to measure where an urban system is on this continuum – or indeed where different neighbourhoods or social groups are on this continuum - is clearly a valuable input to the framing of social policy.

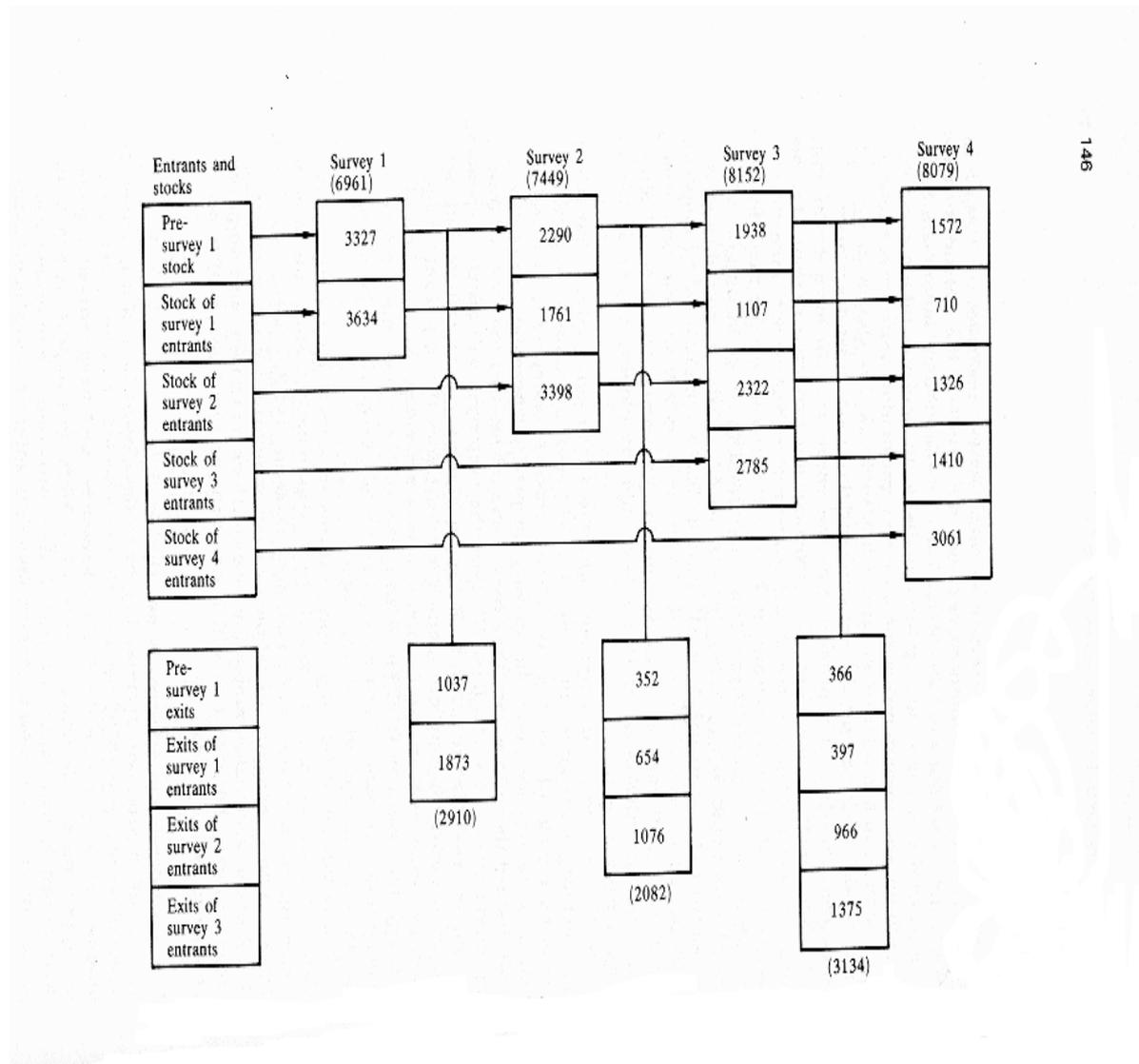
Being able to assess whether the whole area or neighbourhoods or social groups are moving to a more or less equitable positions is also an important input to the design of more targeted policy and programme interventions.

Consequently, the unemployment information systems were built into a social accounting framework which allowed the measurement of changing inequality at the whole town, social group and neighbourhood levels.

These accounting frameworks also provided a medium for explaining the selectivity of the unemployment dynamics in terms of the characteristics of those people flowing onto the register, those flowing off the register and those staying on the register as a basis for assessing the relative stickiness of some social groups to the register.

The accounting framework is shown in its simplest form in my next slide.

Figure 3: The basic unemployment social accounting framework



From Worrall, 1987 in Gordon I (ed).

The figure shows that unemployment is highly dynamic with a high ratio of flows to stocks even in a period when there was significant job loss.

For example:

- of the 6,961 males unemployed in Survey 1, 4,051 were still unemployed by Survey 2 reducing to 2,282 by Survey 4; and,
- within Survey 2, 4,051 unemployed had stayed on the register from Survey 1 while 2,910 people had left the register to be replaced by an inflow of 3,398.

The information systems were designed so that it was possible to search for differences in the social, demographic and economic characteristics of differing subgroups of the unemployed in terms of their accession to, exit from and duration on the unemployment register.

Using logistic regression and hierarchical loglinear modelling, attempts were made to explain statistically the probability that certain groups would flow off or stay on the register.

The sub-groups of the unemployed were categorised on several attributes including:

- age;
- area of residence;
- occupation;
- previous industrial sector; and,
- accumulated unemployment duration.

Perhaps more importantly - from a statistical perspective - an objective was to identify significant interaction effects between these variables to identify where the joint effects of variables were multiplicative rather than additive.

The outputs from research had substantial policy implications:

- First, an analysis of mean unemployment durations showed the extent to which unemployment was worsening differentially for different subgroups;
- Second, the regression equations showed the existence of clear area externalities – more specifically, unemployment got worse quicker in areas already characterised by high levels of unemployment;
- Third, systematic changes in the parameter estimates for unemployment duration revealed that as duration increased its effect on the probability of re-employment became more severe; and,

- Finally, significant interaction effects were found between low skill, age, duration and area of residence.

The research demonstrated quite clearly, that processes were at work in the labour market which tended to impose a clearly defined structure of the composition of the unemployed.

This resulted in unemployment becoming increasingly concentrated among an increasingly residualised section of the community.

I turn now to the second area of research I wish to discuss - The changing household distribution of unemployment and employment

It was very interesting to note that prior to the 1997 General Election the Labour Party made several references to the massive increase there had been in the percentage of households which were totally excluded from the labour force and how employment had become increasingly concentrated in multi-worker households.

This they explained by reference to a concept called the replacement ratio which relates family income derived from state transfer payments to that which can be reasonably expected from paid work net of journey to work and other costs.

Essentially, the present government has drawn attention to the fact that unemployment has become increasingly concentrated in certain households while employment has become increasingly concentrated in other households.

This has subsequently been used as an excuse for leveraging down the worth of state transfer payment for particular social groups seen as being prone to exclusion from the labour market as it is easier to do this than to set a national minimum wage.

While unemployment is usually analysed using the individual as the unit of analysis – as in the case I have reviewed above – it is often more insightful for the crafting of social policy - to examine the changing distribution of unemployment using the household as the unit of analysis.

This is particularly so if we are looking specifically at issues related to social and economic exclusion.

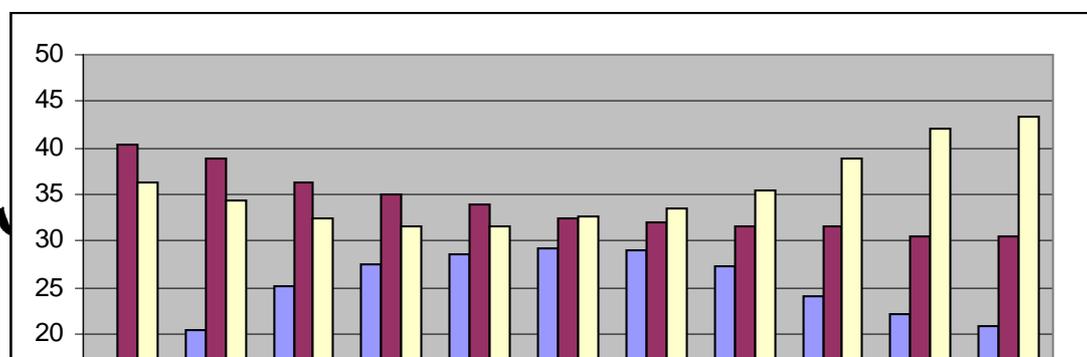
Essentially, theory advises us that the labour market decisions of individual households members are related to those of other people in the household particularly through their impact on the replacement ratio.

Research I conducted in Telford in the mid-1980s drew attention to this issue by analysing the changing household distribution of unemployment and employment at the whole town and small area level.

These distributions showed large variations over time as prevailing macro-economic conditions changed.

In my next figure, I show how the distribution of unemployment and employment among households changed in Telford in the period from 1980 to 1990.

Figure 4: The changing household distribution of employment and unemployment: Telford 1980 to 1990



The figure reveals that up until 1985 that the one worker household was the norm but that this declined consistently throughout the period.

Two things are particularly noticeable:

- First, that the percentage of households in which all members were unemployed increased from 17% in 1980 to peak at almost 30% in 1985 – the height of the recession – before falling back to 21% by 1990; and,
- Second, the percentage of multi-worker households had risen from 32% in 1985 to over 43% in 1990.

While the figure reveals that generally 20-30% of households were totally excluded from the labour force in Telford as a whole, an analysis of the data at the small area level revealed massive variations between neighbourhoods.

In some areas, in 1985, over 60% of non-pensioner households had no workers present while in others it was under 5%.

This particular piece of research revealed two key issues of fundamental importance to the design of urban social policy:

- First, that the structure of the labour market had changed in which unemployment had become increasingly concentrated in residualised households which were totally excluded from the labour market; and,

- Second, that there were massive intra-urban variations in social and economic conditions within Telford at the neighbourhood level.

The issue of intra-urban variations in social and economic conditions and their dynamics is a topic I will turn to next in describing the third area of research -

Measuring and explaining spatial polarisation

Research into the changing household distribution of employment clearly revealed the extent of intra-urban variations in the socio-economic standing of neighbourhoods in Telford.

However, this form of static analysis is far from path breaking and is, in fact, the norm in many local authorities.

The great opportunity provided by the existence of a large, well structured, time-series, small area data base on Telford was that this basic form of static analysis could be augmented to include a temporal element to measure and subsequently to explain the dynamics of differential urban change.

The hypothesis tested in this particular piece of research was that as social and economic conditions deteriorated generally, they deteriorated unevenly with those areas already displaying the most adverse social and economic conditions tending to deteriorate faster than areas with a higher socio-economic standing.

The availability of year on year data for each of 110 spatial units provided an information rich environment in which this hypothesis could be tested.

Four indicators were selected as the basis for testing the hypothesis that spatial polarisation was occurring in Telford.

These were:

- The percentage of under 16s living in one parent families;

- The percentage of non-pensioner households without any workers present;
- The adult male crime rate (measured as the number of prosecutions per 100 males aged 16-64); and,
- The male unemployment rate.

In this analysis, the variables for 110 zones for one year were regressed against the same panel of variables for subsequent years.

An analysis of the regression parameters - each of which was significantly above one - supported the spatial polarisation hypothesis.

This meant that as conditions deteriorated generally, the relative deterioration in already deprived areas tended to pull them further away from the mean indicating increasing disparities in social and economic conditions at the small area level.

An analysis of the residuals derived from the regression equation also allowed the identification of those areas which had deteriorated more than had been predicted by the model - in the main these were predominantly public rented areas.

While this research was useful in identifying that the degree of polarisation was increasing, it did not explain the social processes which were contributing to the observed widening between the best off and worst off areas.

The earlier research I described revealed that area externalities were operating in the labour market – that is people with certain addresses were relatively disadvantaged in gaining access to employment.

Consequently, a research project was constructed to analyse whether certain social groups - perhaps the same ones - were experiencing forms of discrimination in the housing allocation system.

Data on housing allocations was analysed to see if certain types of applicant were being allocated housing in certain types of area.

The research showed conclusively that households categorised as disadvantaged were 12 times more likely to be allocated housing in areas categorised as acutely disadvantaged than households headed by a person in employment.

The research also revealed that one parent families were over 8 times more likely to be allocated housing in acutely disadvantaged areas than “more traditionally structured” families.

The research showed a number of things very clearly:

- First, the sensitivity of the information systems that had been designed to monitor the changing social, economic and demographic conditions of Telford;
- Second, that the methods derived for the analysis of that massive volume of data were effective in deriving meaning and policy relevant intelligence from that data; and,
- Third, that the same organisation which was concerned about the increase in social polarisation at the corporate level was actually instrumental in creating and maintaining that inequality at the operational level.

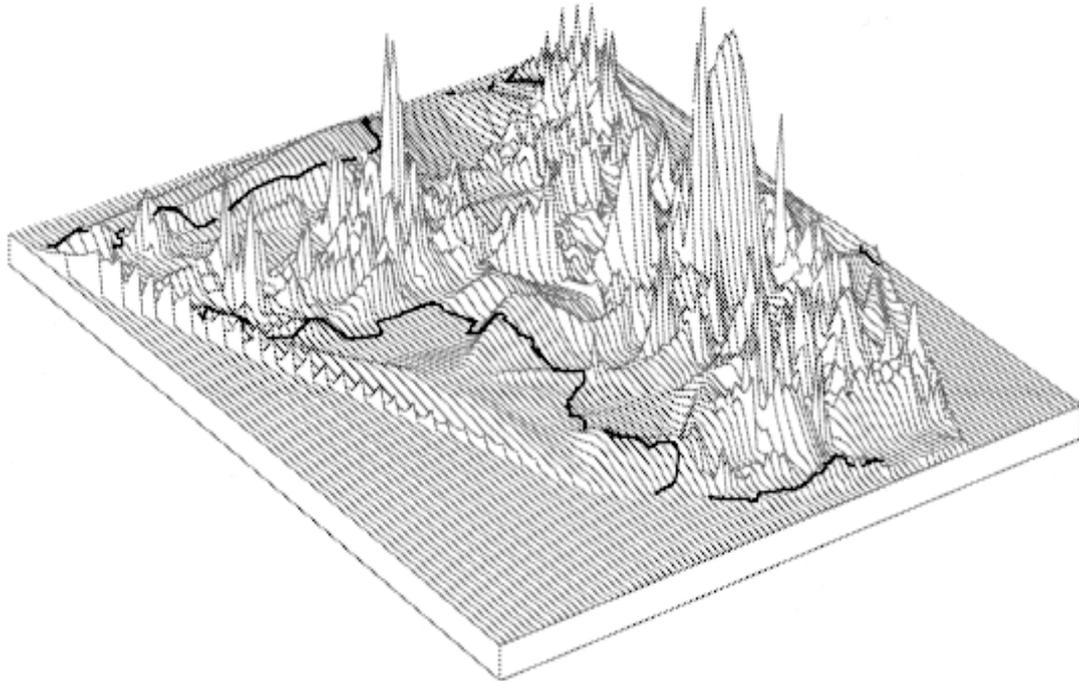
During the early 1990s, research became focused on developing computing front ends to the integrated sets of data using powerful statistical tools integrated with sophisticated GIS software packages - this was conducted at Liverpool University in conjunction with Dr. Rao Liang.

This integrated analysis engine was used to exploit further the research and policy potential of the data and to provide the mechanisms for the more effective support of decision makers – at least from an academic perspective if not from a practitioner perspective.

The use of advanced mapping techniques to construct what we labelled “policy surface models” is shown in my next figure.

This reveals the spatial distribution of poverty in Telford based on an analysis of anonymised data on welfare benefit eligibility derived from unit postcoded data from within the local authority housing rebate section.

Figure 5: Policy surface modelling - poverty and welfare dependence in Telford 1991



The research shows:

- First, that many organisations are sitting on a mine of operational data that can be used strategically; and,
- Second, that this analysis could be rerun at intervals to assess the impact that the local authority is having on the problem.

The map, which is analogous to a contour map, reveals, not only the location of poverty in Telford, but also the extent of intra-urban variations in poverty and welfare dependence in the area.

The subsequent use of GIS to drape ward boundaries over this surface gave added local political relevance to the analysis from the few elected members who saw it.

Perhaps I can summarise the messages from the “scientific phase” of my lecture.

It is clear that over the years that the research incrementally generated a mass of intelligence directly useful to - but not always used by - local government.

It also reveals that the methods for analysing the data and delivering intelligence from that data became significantly more sophisticated and increasingly visual as technology improved.

Hopefully, I have shown the benefits that can be derived from the design of effective information systems architectures and their rigorous analysis.

However, while conducting this research, it became very clear that the outcomes of this research were not automatically being embedded into or absorbed by the strategic consciousness of the organisation in which that research was being conducted.

Perhaps, with hindsight, it was naïve of me to have this rather osmotic view of the relationship between applied urban research and strategic management in a highly politicised environment.

Increasingly, my research interests have turned to explore the complex relationships between strategic analysis and the development of public policy.

In a recent paper published in 1997 with Derek Bond of the University of Ulster, we expressed a concern that there appeared to be a dissonance between the mindset of the analyst and the mindset of most politicians and many senior managers.

I also became increasingly aware that this gap could never be closed by ever more sophisticated statistical techniques nor by the application of more computer power.

It could only be narrowed by the analyst developing a better understanding of the nature and idiosyncrasies of the strategic process that he or she was trying to inform and support.

So much then for the science of strategic analysis – what about the art of strategic analysis - that is getting the outcomes of strategic analysis into the strategic consciousness of the organisation.

The art of strategic analysis

I have identified that strategic analysis runs the risk of being perceived of as a highly specialised, stand alone, technocratic activity conducted by a lone number-cruncher in a back room somewhere.

However, it is clear that in a highly politicised environment, the effectiveness of strategic analysis depends on how well the analysis is integrated within the broader strategic management processes of an organisation.

As I have indicated earlier, building this degree of integration and asking questions which can undermine conventional wisdoms and threaten existing power structures within organisations is far from easy.

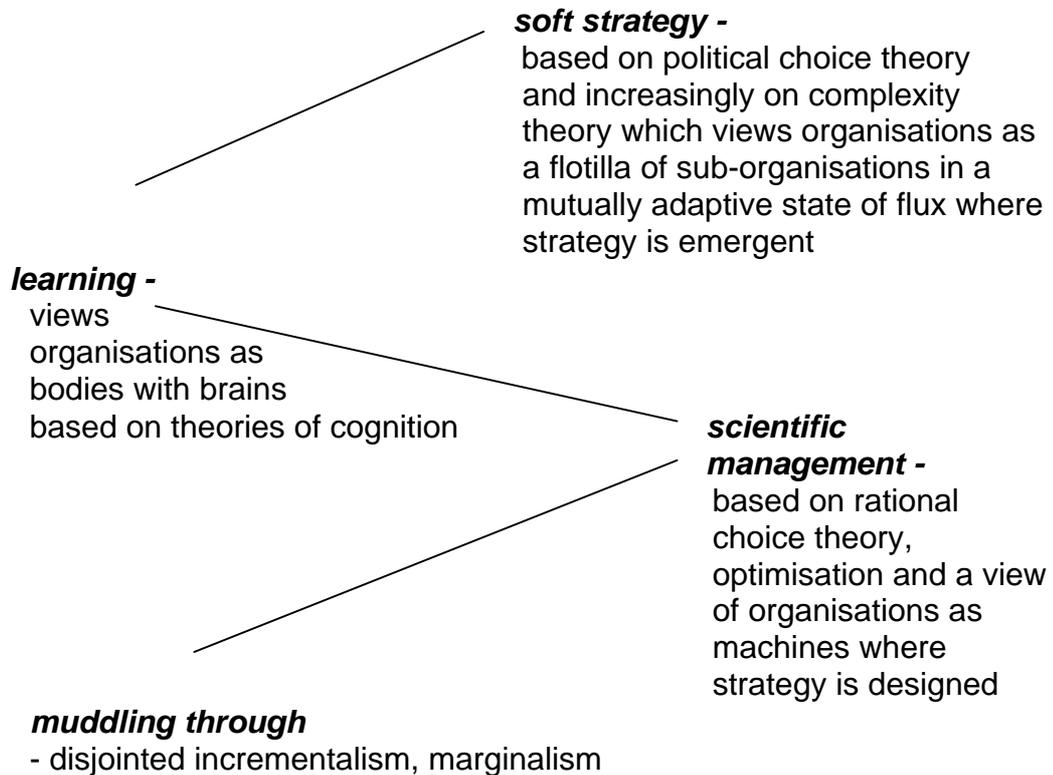
It is here where strategic analysis loses its technocratic innocence and moves into the world of organisational power, organisational culture and organisational politics.

This realisation has, in recent years, after I moved out of local government, caused me to develop a research agenda to explore the nature of what I have termed the strategic process in local government.

This research has sought to build a better understanding of how the strategic process in local government is constructed.

The emergence of thought on the nature of strategic planning and strategic management is insightful here and can be categorised into four broad stages.

Figure 6: The evolution of thought on strategic management



What is clear from the figure is that conceptions of strategic management have changed radically in the recent past.

In particular, most organisations have move away from scientific approaches based on the rational choice theory so loved by the economist.

Many have moved to softer forms of strategy based on political choice theory and more recently on chaos theory and complexity theory.

This latter stage actually admits that despite management, organisations tend to have a capacity for self-organisation.

These changes in how strategic management has been conceptualised have also meant that the way that the analyst/ researcher perceives him or herself has also had to change.

Researchers in organisations are clearly not neutral observers doing objective research leading to policy which is enacted as a programme of detached social engineering.

In applied research in a political environment facts are not value neutral and research programmes and strategies are constructed in the context of complex organisational power structures which can either legitimise or summarily discard the outcomes of the research process.

In addition to conceptions of strategic management changing, so too has thinking about the nature of organisations.

Early conceptions of organisation were often based on a militaristic metaphor in which organisations were seen as chains of command and control where unity of purpose could be imposed from the top.

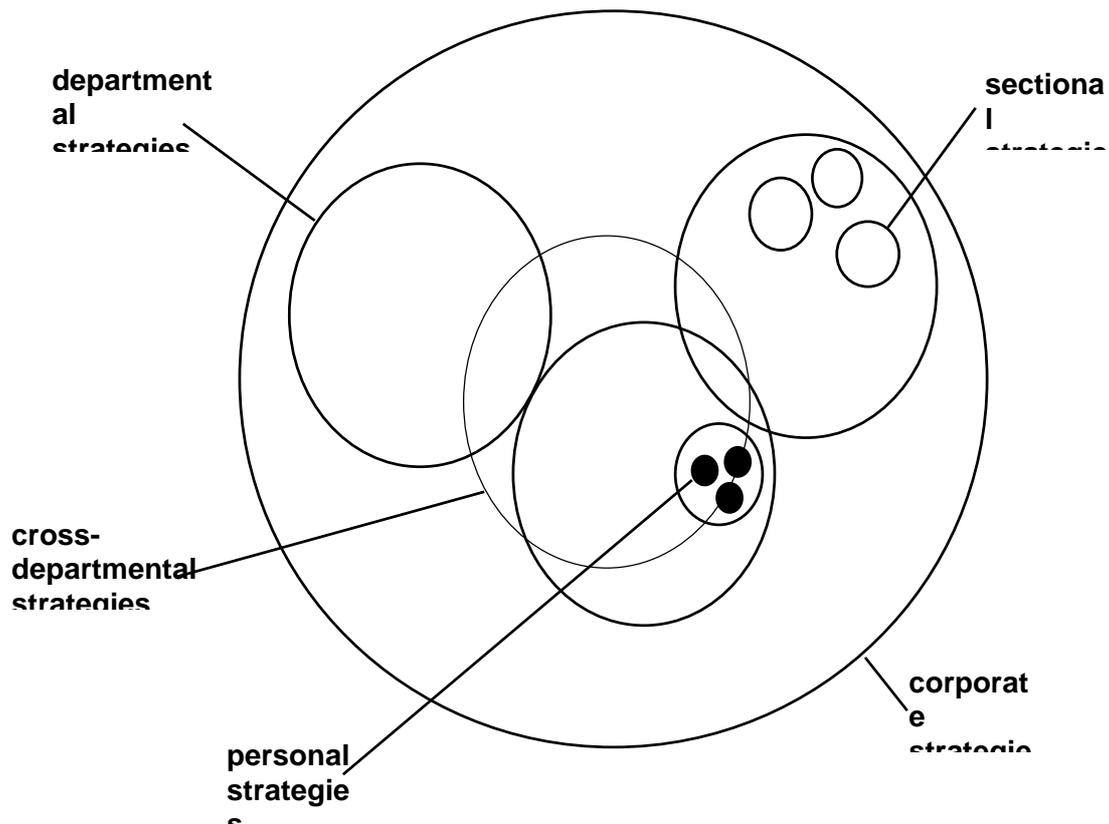
Despite the obvious redundancy and inappropriateness of this view of organisations it is amazing how many organisations are still structured using this hierarchic model.

In many local authorities, the so-called baronial fiefdom still prevails.

In recent research, with Chris Collinge from Birmingham and Tony Bill from the MRC we have developed what we consider to be a more appropriate conceptualisation of the reality of organisational life in the public sector which we have termed the spheres within spheres model.

This is shown in my next slide.

Figure 7. Spheres within spheres



Our model shows that corporate strategy needs to be embracing and provide the framework in which the internal structures, process and resources of the organisation are aligned and made sensitive to the organisation's evolving external environment.

It also shows that there is a massive task of aligning departmental, cross-departmental, sectional and personal strategies within that broad framework.

Achieving a high level of alignment has proved to be very difficult in many organisations with frustrations in not achieving a high level of alignment often encouraging managers to retreat to a form of management redolent of the more dictatorial forms of the command and control approach.

Our spheres within spheres model demonstrates the complexity of strategic management in public sector organisations and raises questions about how and where strategic analysis can be most successfully conducted.

Within this view of the strategic process, I have identified a number of areas in which strategic analysis can make a contribution to improving the effectiveness of strategic management in local government.

- First, in supporting the scanning of the environment external to the organisation to identify emerging issues and tensions that the local authority should address;
- Second, assisting in evaluating between policies and programmes by exposing the distributional and political consequences of action or inaction;
- Third, by supporting the knowledge creation process within the organisation which in turn improves the conduct of strategic management; and,
- Fourth, by assessing and evaluating the impact of the organisation's impact in its operating environment.

However, none of these actions can be supported without high quality information, robust analysis and well structured research.

A future agenda

In this lecture I have tried to describe some of the advantages that well crafted research and carefully designed information systems can have on organisational effectiveness.

I have also tried to allude to some of the difficulties of embedding strategic analysis within the broader strategic management process of organisations.

In concluding, I will try to outline a research agenda to carry forward some of the issues I have raised.

The unifying theme to this future research agenda can be encapsulated in the term “building intelligent local governance” as I think that this is a way forward that many local authorities should seek to adopt.

This theme will comprise the following key components:

- first, the need to understand the nature of the strategic process in local government as a basis for the better integration of analysis within this overall process;
- second, to develop the concept of intelligent local governance as a medium for communicating the ideas I have outlined above;
- third, to continue to develop analytical techniques and visualisation tools are sensitive to the cognitive abilities of decision makers; and,
- finally, to better understand the role of strategic analysis in encouraging the development of a more evidence-based, reflective and critical approach to strategic management.

Thank you for listening.

Works on which this lecture has been based

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