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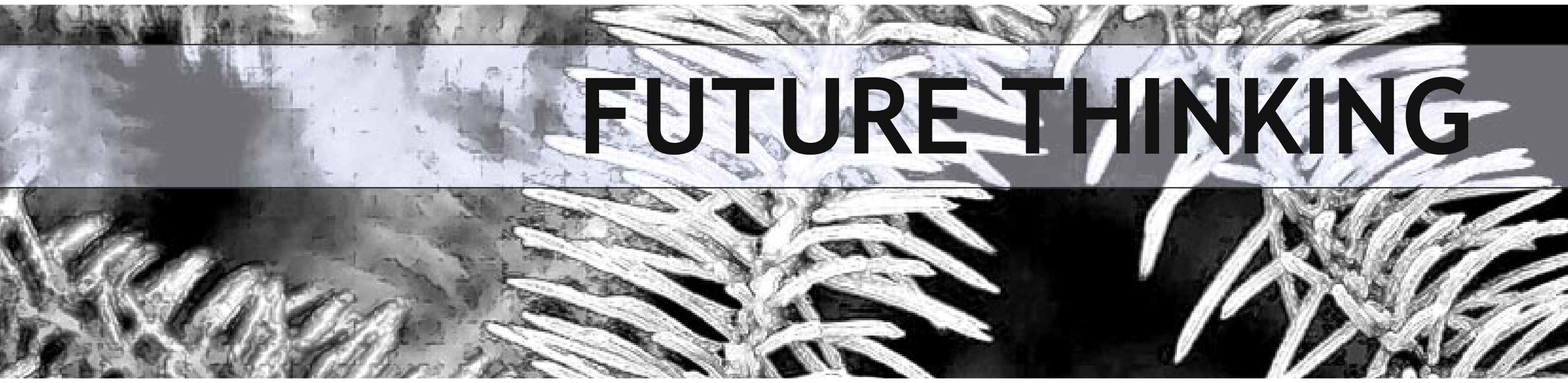

FUTURE THINKING

HARRY BRUHNS

THE ROLE OF INFORMATION IN A SUSTAINABLE PROPERTY MARKET

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by Harry Bruhns, University College London, UK

Property is a complex phenomenon, non-domestic property particularly so. A nation's building stock is determined and influenced by numerous social, economic and physical factors and it impacts on the environment in many ways. A huge array of market processes are involved. A great deal of information is required to document and manage all these factors, impacts and processes.

And what precisely is sustainable development? Sustainable what, to whom, for whom? There are many participants in the property market and its formation of the built environment. Whose decision-making is to be supported by information gathered?

This paper examines these issues with a view to informing a research agenda that can accurately address the needs of property professionals.

What is information, where does it come from, what information do we need and what does information need to do to assist the development of a more sustainable built environment (however sustainability is defined)?

Something that appears to be trivial becomes increasingly complex the closer we examine it. Starting with, 'what is information', one might define information in a very crude sense as any data sets combining some form of enumeration and matched descriptions. This is simple enough, but the matter becomes rapidly more complex if we ask what make up the constituents of useful information?

One can identify three forms of information, each of which is vital to quality of the built environment. These are data, information and knowledge. The term 'information' is used interchangeably in the following pages, to refer to that which lies between data and knowledge (avoiding the sticky task of defining these precisely) and to refer to all three phenomena together.

We can carve up information on buildings in various ways. For instance, information may be defined as internal – ranging from a householders awareness of their own dwellings energy costs and what they might do about them – to a corporation with large holdings maintaining a comprehensive property management information system to guide their own resource allocation. Alternatively it may be external, including floorspace statistics, climate and the prospect of climate change, employment and economic trends.

One might then ask, where do the various types of information come from? The short answer is they come from nearly all human activities and many physical phenomenon. A great deal of information is needed to understand the built environment, but only a little of it is directly and solely related to sustainability. That leads into the final question, what does information need to do? Some argue that information is available but not used; others draw attention to important things we do not know. Is the problem lack of information or lack of use, or is it both?

One of purposes of this paper is to bring clarity to discourse about information in its many forms. Further attention will be given to the peculiar nature of information as compared with other resources and the need for knowledge as well as information.

THE IMPORTANCE OF THE BUILT ENVIRONMENT

The built environment is a major and vital part of our infrastructure. Most of the world's people spend the greater proportion of their lives in buildings. We work, learn, eat, play, sleep and are healed in various kinds of non-domestic buildings. The quality of those buildings, and of the shelter and spaces they provide, is a major determinant of the quality of our lives.

Buildings are also important consumers of environmental resources, particularly energy. Typically, in developed nations, the operation of the built environment accounts for 40% to 50% of total energy use. Adding to this, the mining, manufacture and transport of building materials substantially increases the total. Vale (1994) estimates the built environment thus accounts for as much as 66% of energy use in UK.

Though the construction and maintenance of buildings contributes relatively little to energy use, typically 1-3% (Uher), it accounts for 10-15% of the total GDP and about half of gross capital investment. It is a very substantial part of both the real economy and the money economy (Cox 1999). Through rents and property prices the product of

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"THE INFORMATION AVAILABLE FOR NON-DOMESTIC BUILDINGS IS LIMITED"

the construction industry, the building stock itself, affects the financial status of virtually all people and commercial organisations.

With continuing urbanisation, transport crises and climate change, Britain has an increasing need, perhaps already critical, for comprehensive information and a powerful knowledge base on which to develop informed policies applicable to the domestic and non-domestic built stock.

Lack of information on the built environment

The information available for non-domestic buildings is limited in relation to that needed for sustainability. Britain has, for example, moderate information on the regional distribution of economic activity, but very poor information on how that distribution influences the nature of the building stock, or is influenced by the building stock. This has been noted for some time. For example Fothergill and Gudgin, in Fielding and Harford (1990) stated:

> *"We do not have accurate information on the intra-urban, urban or regional changes in land uses, nor can we learn what changes have taken place in the stock of buildings by age, type or use. ...For whatever reason we seem to be remarkably ignorant about the physical structure of the cities within which we live out our lives. This is something which should be addressed in the planning of the Government's statistical activities and in deciding future research priorities."*

This situation has improved to some extent since 1990. The ODPM has reinstated floorspace statistics (DETR 1995, DTLR 2001, ODPM 2003) and is developing several initiatives to do with land information. There have been some changes in corporate property management practice as a result of 1990s property price shocks (Chaplin 1997). Nevertheless, we are some way off being well supplied with information that is sufficient for both public and private sectors to develop and implement effective policies on sustainability. This is particularly so for the non-domestic stock. Some of the directions that we might pursue in this regard are mentioned later in this paper.

The use of information on the built environment

Several authors have discussed the idea that sustainability is being hindered by a failure to use information. Bordass, for example, argued: (retaining his emphasis):

> *"We have the technical and management skills to slash their energy demands and to lessen their dependence on supply-side measures including nuclear power. But these skills are not yet focused: few can tell you how their buildings are performing, even in the simplest terms. Many would have you believe that performance is far better than the actual, real world situation. Even if they would like to, the supply side of the building industry does not always serve its customers well; as it does not know enough about how its products perform and what really needs to be improved. In short, many are* ***flying blind."***

In my view, the problems are both a lack of information and a lack of effective use of the information that we do have.

What is a sustainable built environment?

What is a sustainable building? Consider for example a low energy building on a greenfield site. If that building caused increased use of car transport for the employees to get to work, is that a sustainable building? How about a building that has a very efficient air-conditioning system that was not needed, or could have been avoided if more thought had been given to the design of the shell, glazing and lighting (Bordass 2001)?

The meaning and definition of sustainability are vitally important to the role of information and there is a great deal of literature that may be referred to. Cox (1999), for example, provides a good overview and numerous further references.

Edwards (2003) groups sustainability into three types *economic, social* and *environmental* (the latter referring to the natural environment). For now it suffices to note two observations. First, there is a high level of interaction between the sustainability of economic, social and environmental resources. Second, in each of these areas sustainability requires different forms of information to evaluate whether or not current activities are supporting it, and whether proposed activities might support or limit it.

MODEL OF BUILT ENVIRONMENT SYSTEMS AND INFORMATION

Performance of buildings

Performance may be defined in a very general way as *behaviour in use*. The following framework summarises and organises the determinants of physical building performance. It makes explicit the way in which participants in the production of buildings make a series of decisions, *each of which constrains later decisions*.

Location

The first decision about a building is where it is to be located (for now we will take size and function as preset, though there are important sustainability issues around these decisions. A number of parameters are fixed by the location. The size and shape of the site constrain the shell. Heating and cooling requirements are determined in part by the local climate, as are lighting requirements. The latter are also determined by the sky horizon created by surrounding buildings. The location impacts on local transport requirements in various ways. Most of the employees within new non-domestic buildings will either place additional pressure on public transport or require car parking, depending on number of employees, work patterns and the distance from employees' dwellings.

Structure

Structure includes the size and shape of the building and the materials from which it is constructed: the 'bricks and mortar'. Glazing and other long lasting passive components are also included. All must be designed within the constraints of location, including access to daylight and availability of materials. In turn they largely fix the thermal performance of the building, including heat loss, daylighting and solar heat gains.

Services

Services include the full range of active services installed in a building, such as internal environment control, transport services and communications. Environmental control is mediated by HVAC systems, ranging from plug-in heaters to sophisticated automated and centrally maintained systems, and lighting systems. Of the internal services, environmental control has the greatest impact on environmental sustainability, but what these services can do, and the resources they require to do it, are severely constrained by the location and structure.

Operation

When location, structure and services are given, there is relatively little that can be achieved by the operators and users within a building. Domestic buildings are more amenable to conservative activities by users. In non-domestic buildings users can turn lights off when unused only if they are suitably switched and arranged and switches accessible and labelled. They may be able to exert some local control of temperature. In either case, unless poverty demands otherwise, energy consumption is a low priority compared to comfort and completing work loads (despite the risks posed by natural environmental deterioration).

Performance of the built environment

I will now make explicit the distinction between buildings and the built environment. The difference is important to all study of the built environment. Though the latter is comprised of buildings, the problems of understanding the built environment are quite different from understanding buildings. The essential difference is that the former requires knowledge of what has been built. For instance, it is a reasonably simple matter to calculate the energy savings from the installation of loft insulation in a building. Calculating the energy savings from installation of loft installation in all non-domestic built stock requires one to know how much floorspace is immediately under a roof (i.e. on the top floors of buildings), how much of it has lofts rather than flat roofs, how many such roofs already have loft insulation, and something about heating patterns under those roofs.

Some of the information required to understand the built stock, why it is as it is, and how it might develop in the future is listed below:

- *economic environment, its structure and growth*
- *total population and other demographic changes*
- *availability of materials and technologies*
- *availability of architectural, engineering and low energy expertise*
- *regulatory environment*
- *climate and fuel costs*
- *spatial and vertical distribution of stock floorspace*
- *patterns of materials used*
- *types and sizes of glazing*
- *installed services*
- *occupancy patterns*

Information on the built environment

Table 1 shows the participants or decision-making agents in the built environment and some of their information requirements. It illustrates the large variety of information of interest to those managing buildings and the built environment. Indeed, there is a myriad of topics about which we may collect information, and information can be collected for many different locations, at various levels of spatial and typological aggregation, with various degrees of accuracy and resolution. It may be about the economy, the property market, the built environment generally, or be particularly concerned with sustainability.

Other institutions also play important roles but do not fit into any one of the categories above. Insurance companies (looking at their insurance of property rather than investment in it) play a role in provision and maintenance, often paid

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for by the user. Outside all of the categories in Table 1, educational bodies provide the expertise required by various participants and financial regulatory authorities, interest rates *et al* impact on how these parties operate.

The information requirements listed cross participant groups categories, and are indicative of the wide range rather than exhaustive. The participant categories in this table are adapted from Nutt (1997).

An overview of information

The bewildering variety of information in Table 1 is organised by participant. To make the information more manageable it may also be organised by other means, such as whether it is concerned with buildings or the built stock, internal or external to an organisation, by topic, spatial aggregation and resolution, its source and its uses. Tables 2, 3 and 4 show some of these information frameworks.

Information does not guarantee sustainability. Table 4 shows the steps, all of which must be satisfied, before something useful results from information.

The extent to which these steps occur depends on the expertise and knowledge capital of a nation, the existence of a range of businesses using this capital, the educational system, numerous elements of the financial and regulatory environment, and the dominant value systems and ethics.

Sustainability information

In the context of the wide variety of information required by the participants in the generation and use of the built environment, what kinds of information are most important to sustainability? The right-hand column of Table 1 lists some specific examples.

However, the energy use of buildings, and the built environment, in the short term, and even more so in the long term, is determined by most aspects of the economic, technical, cultural and physical structure of a society, along with environmental factors such as climate and geology and as expressed in fuel costs. To understand current consumption and to even begin to make reliable predictions about future energy use and its impact on the natural environment, information on all these factors is required. Indeed, much the same information is needed for monitoring, managing and predicting sustainability as is required for monitoring, managing and predicting most other aspects of the built environment.

The primary impact of the built environment on sustainability is due to its size, and future impacts will be consequences of its growth (or decline in certain conceivable circumstances) and its changing nature, in turn due to population and economic growth (or decline).

The macro level of the built environment is typically less well understood than the micro level and is in greater need of research. For example, one might model or monitor the detailed thermal properties of a secondary glazing system on a specific building. However the benefits of this system to the sustainability of the built environment require one to know the numbers of windows to which that system can be fitted, the operating temperatures of those buildings and the range of climatic and microclimatic situations in which they can be fitted. This is the *technical potential* of an energy conservation measure. The importance of a particular factor to sustainability of the built environment depends on how common that factor is.

That said, two examples of micro level research that I believe would be worthwhile are listed.

Comfort determinants

The complex interaction between physiology, work patterns and work place psychology, air movement, humidity, location of thermostats and heating and cooling systems, thermal mass, radiative temperatures that together determine users demands of HVAC systems.

Why is energy efficient technology not more widely used

This matter also involved complex interactions, between lease structures, fuel costs, business priorities, technological knowledge and fashions, producer education and economic parameters.

In general I suspect that the problems of sustainability are more a result of a lack of a systems understanding of the built environment and the way it is used, than they are due to a lack of technical means by which to implement energy efficiency and other changes important to sustainability.

THE NON-DOMESTIC BUILDING STOCK

In this section I will focus on the non-domestic building stock. Firstly the provision of macro information on the non-domestic stock is my field of work, secondly the complexity of this stock well illustrates some important information problems that need to be dealt with to bring about a more sustainable built environment.

We don't have a very good picture of the basic parameters that describe the non-domestic stock at this moment in time, let alone over the time period during which the bulk of the current stock was built. We do not even have reliable data on total floorspace, we know only lettable floorspace and that for only the major commercial and industrial classes. There is little precise information on the relationship between

Role	Function	Description	Information requirements	Sustainability goals
Official agencies	Economic policy makers	Set economic and taxation environment, including inflation and interest rates, business rates	Economic inputs and outputs and trends thereof Policy impacts	Sustainability of the environment, economy and social fabric of the nation
	Regulators	Planning and building regulatory authorities (central and local govern-ment) set rules on function, location, size, height, safety, materials, thermal properties and so forth	National and local aspirations Spatial distribution of various building types and activities Properties of materials and components	As above, with particular emphasis on safety, local environmental impact and resource consumption
Providers	Investors	Those who make investment decisions, to arrange capital to purchase buildings and fund refurbishment	Economic trends, socio-economic data Built stock location, quality, value Future capital value and rental yields	Economic sustainability
	Producers	Those who design, specify cost and execute building construction and refurbishment, and the components for these activities	Properties, costs of systems, components materials Performance indicators and benchmarks Sales and market predictions for components	Quality of internal environment Energy performance of systems, components and materials, embodied energy.
	Marketers	Those who find users for buildings and buildings for users	Lists of individual buildings and features Supply and demand statistics	Rental structure Operating costs
	Developers	Developers combine some or all the functions of providers		
Users	Owners	Those owning and using premises	Demand, rentals etc, corporate indicators, income	Lease structures
	Facility managers	Building and premise managers ranging from property management companies and maintenance contractors to services operators	Use patterns Physical condition	Set points (heating, cooling, lighting) Consumption
	Occupants	Those renting and using premises	Operating costs	Fuel costs and consumption
	Suppliers	Those who provide the components and resources for use	Generating costs, supply stability	Network current and predicted loads

Table 1: Participants and their information requirements

Level of built environment	Relationship to cost centre	Internal *Information from within buildings, or the organisation using them*	External *The operating environment, financial, climatic, energy costs*
Micro	*Information about a single building*	Location, structure, services, operation	Microclimate, fuel costs, sky horizon
Macro	*Information about many buildings (eg. corporate holdings, a council's housing stock)*	Average energy consumption for corporate holdings	Stock data, Floorspace statistics, degree-days, economy

Table 2: Macro and micro information

"THOUGH WE KNOW FROM BUSINESS RATES THE APPROXIMATE NUMBER OF PREMISES, WE DO NOT KNOW THE NUMBER OF BUILDINGS, OR EVEN HOW THEY SHOULD BE DEFINED"

"THE NATURE OF INFORMATION IS CRUCIAL TO ITS OPTIMISED USE FOR SUSTAINABILITY"

Source	Description	Common outputs
Collation and analysis of operational data	Collection, classification and organisation of administrative data, frequently associated with financial transactions	Data and information
Research initiatives	Data collection, surveys, experiments, modelling and so forth of a project nature	Data, information and knowledge
Discourse and synergy	Sharing of ideas, brain storming	Information and knowledge

Table 3: Sources of data, information and knowledge

Step	Description
Generation	Generation of information and knowledge
Distribution	Distribution to potential users
Comprehension	The information must be understood…..
Acceptance	…..and its truth must be accepted
Options	If the information suggests or mandates that some action is required, it must be possible, and within the resources of a participant
Motivation	There must also be some incentive, whether financial, social or simply self-preservation
Action	Only then will action occur

Table 4: Steps from information to action

Bulk class	Floorspace peak (mode) (m^2)	Average floorspace (m^2)	Comment
Shops	100	149	The difference between mode and average is much smaller for shops than other bulk classes, indicating a relative lack of very small premises
Offices	45	252	There are many small office premises. Some may be associated of larger premises but valued as separate hereditaments because of physical separation
Warehouses	40	670	As for offices, there are many small storage units valued as separate hereditaments, perhaps associated with larger premises
Factories	100	698	As with shops, the relatively larger mode suggests that very small factories are not functionally viable. As with warehouses, factories may be very large

Table 5: Statistics of hereditament size for bulk classes

the different types of floorspace and Standard Industrial Classifications (SIC). Vacancy rates are largely unknown outside limited ranges of buildings.

Size distribution in the non-domestic stock

It is natural and understandable when thinking about, say, energy conservation in offices, to think of large purpose-built office buildings. However the reality is somewhat more complex. Firstly, much of that office space is split up into premises under individual business' control. Whether or not they are metered separately or control their own HVAC, they certainly control use patterns. Further, the separation of users from central services is an important factor in energy consumption. Second, there is a great deal of office space in floors above shops, in small premises in old back street buildings, converted houses and so forth. Table 5 shows just how small premises are typically. Floorspace peak, statistically termed the *mode* is the most common size. That is, there are more office premises around 45 m² than there are of any size larger or smaller.

The statistics in Table 5 are derived from Valuation Office Agency data for England and Wales for December 1994. At that time, figures for the floor area of a few very large industrial units was unavailable, so the average floorspace in reality will be somewhat larger than shown here. The following points may be noted:

- *The separation of parts of premises into separate hereditaments in certain circumstances is required by Rating Law. It is likely to correlate with separation of building services.*
- *On the other hand many hereditaments are premises within larger buildings thus reducing the number of units of separate fuel consumption and thermal control.*
- *Both the modes and average sizes for buildings will be significantly larger than for premises, but it is not possible currently to aggregate data for hereditaments into buildings.*
- *Different participants disagree on average sizes. An inspection of planning applications suggested buildings were mostly small, estate agents disagreed and said the majority of the stock was large (Joshua 2003).*
- *In many instances there is an arbitrary element in defining the boundaries of a particular building - it is not clear where one building ends and another begins - some may see one building, others two or more depending on their degree of connectedness and structural uniformity.*

The size of buildings has obvious implications to the evaluation of policies concerned with thermal properties and energy consumption. Some impacts are strongly related to building characteristics, e.g. a building will typically contain a single central heating and air conditioning system servicing numerous occupants. Other impacts are more closely related to the attributes of premises, e.g. installed lighting and small power loads. Though we know from business rates the approximate number of premises, we do not know the number of buildings, or even how they should be defined. Obtaining better information on *buildings* rather than *premises* is important for developing sustainability.

The National Land and Property Gazetteer (see below) holds some promise of being able to provide a means of aggregating hereditaments into buildings, thus giving better information on the services and thermal units of which the non-domestic stock is comprised.

Diversity of classification

The activity classification of non-domestic buildings raises particularly difficult problems of definition and interpretation, and some of the existing classifications mask the complexity that exists within their named categories. The non-domestic stock is extremely heterogeneous in size, function and form. It ranges from tiny kiosks through converted houses, multi-storey office buildings with shopping on the ground floor, small workshops, enormous factories, to large mixed-commercial complexes containing offices, shops, cinemas, gymnasiums and doctors' surgeries.

Such variety makes if difficult to classify buildings in a rigorous and consistent manner; hence data on non-domestic buildings collected by different organisations frequently disagree, because data sets with similar titles include different buildings. Hotels serve to illustrate the magnitude of discrepancies that may be found here. Different data sources contain the following values for numbers of hotels over 10 rooms in England and Wales:

Keynote (1989)	*9,392*
BRECSU (1991)	*13,420*
Census (1991)	*14,336*
Tourist Board (1992)	*9,516*
Valuation Offic…e (hotels)	*10,086*
Valuation Office (guest houses)	*9,817*

"WE DON'T HAVE A VERY GOOD PICTURE OF THE BASIC PARAMETERS THAT DESCRIBE THE NON-DOMESTIC STOCK AT THIS MOMENT IN TIME"

Perhaps each of the first four sources is in its own way accurate but has applied different criteria to the definition of a 'hotel over 10 rooms'. The Valuation Office has probably distinguished hotels from guesthouses by number of rooms, and it would seem that the criterion was somewhere in the region of 10 rooms. If a user requires trends, the problems are compounded as a small shift in the rules by which an organisation classifies buildings, or in the balance of multiple data sources, could overwhelm or reverse a real world trend.

The problem of classification is compounded by confusion between groups of buildings, individual buildings and premises. Possibly some of the data sources for hotels cited above have clustered adjacent or nearby hotels with a common owner into single premises. Multi-storey office buildings and mixed-use complexes may be described as single buildings, but they contain numerous occupiers and different activities.

Comparing the Standard Industrial Classification (SIC) to functional classifications provides another example of definitional problems. The SIC is an *economic* classification. Nevertheless buildings are frequently grouped by SIC without any consideration given to the difference between the SIC and the character of buildings. For instance, problems arose in one project because ONS data quite correctly classified the headquarters of a national supermarket chain as a retail enterprise. The Valuation Office quite correctly classified the same building as an office. The building in question had a retail premises on the ground floor and several floors of offices above that. Even if it had not had the retail ground floor, its economic purpose was still retail.

In conclusion, the non-domestic stock is complex and tremendously heterogeneous. Much of it is small (as in Table 5). Most of it is old (Fact file). Its relationship to economic activities is much more complex than implied by the provision of major developments in response to economic cycles. The impact on the natural environment is equally complex. We are not well informed about these matters, but there are ways in which the situation can be improved.

"THE VAST MAJORITY OF USEFUL INFORMATION ALREADY EXISTS, HAVING BEEN COLLECTED FOR OTHER PURPOSES"

IMPROVING THE SITUATION

Though information is sometimes collected specifically for sustainability matters (e.g. additional metering, energy management systems, insulation surveys and so forth) the vast majority of useful information already exists, having been collected for other purposes. *Reuse of data* should be central to built environment management. These data can then underpin the development of the systematic knowledge of built environment needed for an efficient and effective sustainability strategy.

Importance of an information infrastructure

The *data - information - knowledge* chain needs itself to be developed and maintained, involving education and training, socio-economic and technical research, and effective research funding decisions at senior levels in the public and private sectors. That is, UK needs a fully functioning data, information and knowledge <u>infrastructure</u> for optimised operation of the property market, and for sustainability.

People, institutions, expertise, innovations and recorded material (books, papers, databases, libraries, web sites) are vital components of a knowledge infrastructure, as is research policy that maintains and develops knowledge in a timely fashion. It takes years to convert data and information into sound knowledge, and the likelihood of a crisis in the medium term is sufficient in my view to warrant more serious investment. It is important to devote resources to problems likely in the future, now, not when an emergency arises, when is too late for really effective responses. Effective research requires long horizons, ten years or more, and a regime that balances the resources required for collaboration with those required for carrying out effective research. Often the topics on which research is most needed are relatively mundane, but provide important parts of the jigsaw of knowledge.

The nature of information is crucial to its optimised use for sustainability. Reuse of information costs little compared to the cost of its initial generation. The more UK optimises the use of existing information and distributes it liberally to fuel the generation of a better understanding of the forces that determine the form of the built environment (knowledge) the closer we will come to achieving a sustainable built environment. It is in all our interests to see baseline information as not solely a profitable good but one managed according to an overriding criteria of maximising the benefit of the information to the interests of the UK.

Administrative sources of non-domestic stock data

Administrative data collected by various public and private bodies is a major source of information on the built environment. Corporate initiatives are making better use of internal data (Chaplin). Utilities can and sometimes do supply detailed energy consumption data to their clients. In the UK several organisations maintain data of different types directly or indirectly describing the built environment at the macro level. Statistical data from the Office of National Statistics infers information about the built environment. Valuation Office Agency business rates and council tax data describe it more directly. Ordnance Survey maps describe the foot print of buildings and will soon produce area data for these foot prints. Addresses data from Royal Mail locates buildings and premises.

A strong case can be made that official administrative agencies are the most economic source of baseline data on the built environment. However this strategy poses significant problems of definition and classification. It is extremely difficult to ensure that a national organisation comprising thousands of people in numerous local offices throughout a nation applies definitions consistently. They need for a start definitions that can be applied consistently, this requires solving the definitional issues discussed above. Resources need to be directed to deal specifically with definitional matters, for though challenging they are amenable to research and not at all insurmountable.

In fact the UK is becoming a world leader in co-ordinating information on the infrastructure, as a result of the national land information system (NLIS), the national land and property gazetteer (NLPG) and BS7666 address standards (Parts 1 to 3). (For recent information on these initiatives see www.agi.co.uk). These initiatives provide a powerful and flexible foundation for baseline built environment information. Their potential is increased by the fact that the Valuation Office business rates database is one of the most detailed non-domestic data sets anywhere (Bruhns 2000). Though UK is some way off having truly effective and comprehensive information on built environment needed for sustainability (of itself as well as the natural environment), such initiatives offer a great deal of potential and are to be encouraged in every way.

A recent project commissioned by ODPM illustrates the power arising from processing and joining data from administrative sources. This pilot study of non-domestic vacancy matched business rates relief data to Valuation Office non-domestic floorspace data to obtain percentage vacancy in various classes, in four local authorities. In one of these authorities the planning department welcomed the project, and but added that there was virtually no vacancy in that local authority. In fact the vacancy in offices and industrial buildings had been increasing steeply for nearly a year (retail vacancy remained relatively static).

The development of knowledge

The UK initiatives will provide information that can underpin the development of knowledge on the buildings and the built stock that make up the built environment. That knowledge will assist understanding many of the issues that influence sustainability discussed earlier in this paper.

One application is worthy of particular attention. This is the development of stratified sampling frames for the non-domestic stock. Populations have reasonably well understood parameter distributions, so that if a demographic survey ensures that it has sufficient numbers of respondents in specified age, income and spatial brackets, the results of the survey may be reliably extrapolated to the population as a whole. Population parameters are usually close to statistically 'normal', such distributions as are not are nevertheless well documented (e.g. incomes). Non-domestic size distributions are highly skewed (cf. the large difference between averages and modes in Table 5). The most appropriate classifications to describe buildings and premises types have not been adequately defined (cf. the classification issues described above) though some progress has been made towards this goal (Bruhns and Steadman 1997). Robust classifications and well understood size distributions within them would allow both public and private researchers to devise survey techniques that would dramatically increase reliable information on the non-domestic building stock.

I have singled out this example since, though it is not as dramatically interesting as say, an exciting new low energy technology development, it is a step towards a more fully fledged science of the built environment, including a mathematics, statistics and theory of the built stock. It is in these areas that I think the most immediate information needs lie. Not the least important benefit of such a science is that the possibility of a successful implementation of an exciting new technology development will be enhanced by improved information on the built stock.

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Acknowledgements

The support of the RICS Foundation and the Valuation Office Agency (for provision of data to the Non-domestic Building Stock research programme are gratefully acknowledged. The views expressed in this paper are personal.

Contact the author

Harry Bruhns, Bartlett School of Planning
Email: h.bruhns@ucl.ac.uk
Phone: 020 7679 1629

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