

Space Syntax

TAIYUAN XISHAN DISTRICT SUSTANABLE DEVELOPMENT FORUM

9th July 2009

The spatial components of sustainability

Introduction

Slide 1

Good afternoon, Vice-mayor Wang and distinguished guests. It is an honour to have been invited to speak at this important conference.

My presentation is about the spatial network of the city – how it can be described; how its properties can be analysed; how its effects on patterns of movement, land use and density can be measured; and how to capture its enormous value when planning and designing the future of our cities. In doing so, I will develop the discussion about the importance of spatial configuration that Mr Kai Wang introduced in his presentation this morning.

My company, Space Syntax Limited, has developed a unique urban modeling system that we use to advise municipalities, property developers and investors about the spatial aspects of their urban planning proposals. We work alongside other urban planners, offering expert advice during the urban planning process.

I will show you some practical experience and will share with you the lessons that my colleagues and I have learned about the spatial network of the city. This experience has been gained over the last twenty years, working on urban planning projects in China and throughout the world, including some of the most prestigious projects in the United Kingdom.

Twenty years seems like a long time to me but of course it is a short period in the lifetime of Xishan and Taiyuan. Our visit yesterday to the Jinci Temple showed me the long history of architecture and spatial planning in Xishan. My impression was reinforced by Party Secretary Shen in his speech this earier today. When we toured the city yesterday afternoon we saw the modern history of Xishan: the rapid growth that economic progress has created and the environmental challenges that have accompanied this growth.

Tim Stonor

Sustainability

The theme of my presentation is sustainability and here I should pause briefly to define what I mean by sustainability, which is, I believe, the most important issue in urban planning. Sustainability has many aspects. One aspect is architectural: the environmental performance of a building – the thermal efficiency of its façade, the effectiveness of its heating and cooling systems and the energy embodied in the materials from which the building is constructed. Another aspect of sustainability is the cleanliness of industry, which we have seen is a major issue in Xishan. We have learned today how great efforts are being made here in Xishan to improve industrial processes and reduce the polluting effects of industrial emissions.

But there is a third, significant, aspect of sustainability which relates to the way that people move around cities. Over the last fifty years, people in cities throughout the world have increasingly travelled greater distances between their places of work and their places of living. Our cities have seen the construction of road networks, rail networks and air networks that have facilitated faster travel across a larger scale. While this progress has opened up new opportunities for people it has also come at a cost. People are becoming less healthy as they take less exercise. Congestion is a feature of most urban centres. The costs on time, on the environment and on the healthcare needed to treat unhealthy people are large and are increasing.

The role of spatial accessibility

One of the most striking characteristics of the “global city” has been the reduction of local accessibility. Existing communities have been literally divided by new major roads. New communities are often provided with low levels of local accessibility because they are separated from each other by highways. One of the greatest risks therefore in the development of cities relates to social harmony. I hope to show how this risk has a spatial component and how, by understanding spatial networks, we can rebalance the planning of our cities to achieve a better harmony between global and local accessibility.

Slide 2

The spatial layout of the city is the largest object of human creation – it should therefore be planned as an object in its own right.

Slide 3

The space of the city is the theatre of **everyday activity**. The purpose of this activity is **trade** - social & economic. Any urban place is therefore a **trading engine** – a hugely valuable asset for both social harmony and economic prosperity.

Measuring spatial accessibility

Slide 4

My company, Space Syntax Limited, has developed models that measure the spatial accessibility of individual streets within the overall spatial network. We display the results of the calculation graphically, using colours to represent accessibility values with highly accessible routes in red, then orange and yellow to less accessible routes in green and then blue. Here is the spatial accessibility analysis of London, showing the distinctive radial pattern of highly accessible routes from the centre to the edge. This pattern is created by the geometry of London's street network. Our computer model analyses each segment of space between street intersections and calculates how accessible that segment is from all other segments.

Although we do not feed actual vehicle movement flows into the model, the remarkable fact is that the spatial accessibility pattern corresponds closely to the actual pattern of vehicle movement in London. Not only this, the pattern of spatial accessibility also corresponds to the historic location of land uses, with land uses that need more movement, such as popular retail, locating on more accessible streets and land uses that require less movement, such as housing, on less accessible streets.

Slide 5

Movement is the lifeblood of cities – the spatial model provides a powerful tool to understand and, as I will show you, manage the movement of the city.

We have also discovered that the pattern of land value in London corresponds with the pattern of spatial accessibility, as well as the pattern of certain crimes such as house burglary and street attacks. These correlations are written up in the extensive academic literature that underpins these models and gives our urban planning practice an essential research foundation.

Spatial accessibility and urban identity

Slide 6

Each city has a unique spatial profile.

Slide 7

Here is the spatial accessibility pattern of Taiyuan's twin city, Newcastle upon Tyne in England – my home city. We are using this to help the city plan its pedestrian and vehicle movement infrastructure.

Slide 8

Here is the spatial accessibility pattern of Beijing which, unlike London or Newcastle, has strong orbital connections.

Slide 9

Here is Tokyo, with strong radial connections and strong orbitals. Tokyo is famous for its polycentric structure with several major subcentres. Its spatial accessibility pattern makes Tokyo's economic and cultural identity possible.

Slide 10

It is possible to measure accessibility at any scale: for example, at a local scale of 400 metres or at a global scale of 20 kilometres or more. These different scales relate to the different kinds of trips that people make: for example, short walking or cycling trip or larger-scale commuting trips, and everything in between. This local accessibility analysis of part of London identifies the many small commercial centres that have built up as London has grown. Not all, perhaps not any, of these were planned. Instead they have evolved.

Slide 11

Even in highly planned cities such as Brasilia, we find that unplanned centres have emerged alongside planned ones. Sometimes the planned ones are not located in spatially effective places and they fail. The long-term success of planned centres is a key component of urban sustainability.

Balanced accessibility and risks in modern planning

In our experience, sustainability is achieved through a balance between local and global spatial accessibility.

Slide 12

One of the greatest risks to this balance is the design of the major street network. One hundred years ago, as in Paris on the left, we were able to create streets that mixed different modes of transport: pedestrians and vehicles. Today, many of our cities – such as in Jeddah, Saudi Arabia, on the right – are dominated by high-speed vehicle traffic. Such highways increase global accessibility but reduce local accessibility.

Slide 13

A second risk concerns land use planning. In the historic city on the left, land uses were mixed and so local accessibility was higher and journeys were shorter. In modern city planning, we often separate and zone land uses. This reduces local accessibility and makes journeys longer.

Case studies

I would now like to show two case studies from the cities of Sao Paulo and Jeddah that demonstrate how Space Syntax modeling is being used to balance the accessibility patterns of rapidly growing cities. I will then present an initial spatial network analysis of Xishan district and make some comments on both the existing spatial layout of the city and the future opportunities for its sustainable growth.

Sao Paulo

Slide 14

In Sao Paulo, Space Syntax Limited was asked to prepare a strategic plan to transform a former industrial area in the heart of the city.

Slide 15

We constructed a spatial model of the city to understand its accessibility patterns and to test strategic design ideas.

Slide 16

The site sits between major residential areas...

Slide 17

...and is dominated by the former Ford vehicle manufacturing factory with a railway line running north-south.

Slide 18

Here is the global accessibility pattern of the site, showing poor east-west connections. The motorway is strongly connected.

Slide 19

Here is the local accessibility pattern, highlighting one large centre and one small one.

Slide 20

We tested one strategic option that created new, direct east-west routes.

Slide 21

Our analysis showed that these were in fact too strong – they would have reduced the importance of the motorway and possibly made local routes more attractive for unwanted, large-scale through traffic.

Slide 22

So we curved the routes, changed the connections...

Slide 23

...and created a better global pattern that preserved the importance of the motorway for long-distance movement while improving east-west connections over the railway.

Slide 24

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Our next job was to create a local movement network. Again, we tried different options. First, a simple, rectilinear grid of secondary connections...

Slide 25

...second a grid of shorter, less continuous secondary connections...

Slide 26

...and third an “organic” grid that created secondary connections that were either longer and continuous or shorter and more secluded.

Slide 27

The first, rectilinear grid option achieved strong global connections...

Slide 28

...but a weak local accessibility pattern.

Slide 29

Similarly, the less continuous grid achieved a strong global pattern...

Slide 30

...but very weak local accessibility.

Slide 31

The organic layout, however, achieved strong global accessibility...

Slide 32

...and strong local accessibility.

Slide 33

We selected this option and designed a linear park through the masterplan to create a unique character for the development.

Slide 34

We arranged the heights of the buildings so that they were taller at the places where local and global accessibility were highest.

Slide 35

We similarly organised land uses so that greater densities of commercial and retail uses were located at the focuses of accessibility.

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Slide 36

We referred to the local...

Slide 37

...and the global patterns of spatial accessibility to guide the masterplan design.

Slide 38

The result is a plan that is both globally connected and locally distinct.

Jeddah

Slide 39

In Jeddah, Saudi Arabia, Space Syntax urban modeling has been used to guide the replanning of the entire city.

Slide 40

60 years ago, Jeddah was a much smaller city, approximately 1km in diameter.

Slide 41

Since then, the city has grown rapidly to the north and east.

Slide 42

This growth has occurred without proper water supply, sewage and public transport; likewise, without protection of many important historic buildings. As a result the city suffers from sprawl, decay and pollution.

Slide 43

Much movement in the city is only possible by private vehicle.

Slide 44

Our spatial analysis revealed how the city had developed an imbalanced spatial accessibility pattern that only worked because of the motorways.

Slide 45

The authorities in the city had a strategic choice to either build more motorways or to stop building such fast streets and start building a local infrastructure based on shorter journeys, mixed land uses and public transport.

Slide 46

Using the spatial model we showed how the city would suffer if more motorways were built. As a result of our contribution, the authorities have decided to follow the alternative strategy.

Slide 47

A key element of the new spatial plan is the transformation of the many unplanned settlements – or urban villages – that surround the Historic Core.

Slide 48

Our strategy is to connect the strong local movement patterns of the urban villages with the global movement that surrounds them, making the connection with new development that allows trade to occur at their edges.

Slide 49

The Space Syntax spatial model has been used to plan the new land use pattern with retail streets formed along new boulevards, in the historic tradition of street-based trade.

Slide 50

We have identified the location for a major new street, the “Jeddah Boulevard”, which will serve as a new focus for commercial business in Jeddah.

Slide 51

As in Sao Paulo, the spatial accessibility model has been used to create guidance on building heights...

Slide 52

...and on urban design features, such as tree shading, that will ensure that the strategic spatial planning principles are translated into fine-scale design.

Slide 53

We have helped to create a new public transport network in which routes and stations have been aligned with key accessibility corridors and nodes.

Slide 54

We have created area action plans for several parts of the city, including the Jeddah Waterfront...

Slide 55

...illustrating these for potential developers and investors.

Slide 56

We are using intelligent spatial models to understand the implications of real estate development requirements...

Slide 57

...on spatial and physical form. Such “parametric urban modeling” is, we believe, the future for city planning.

Taiyuan

Slide 58

I would like to close my presentation by turning to Xishan District in the city of Taiyuan.

It has been a pleasure for my company to collaborate with Mr Kai Wang and his colleagues at the China Academy of Urban Planning and Design in preparing an initial analysis of Xishan District, which I would like to present to you.

Slide 59

The first point I would like to make is that, in order to study the spatial layout of Xishan District, we need to gain an understanding of the entire city of Taiyuan. We can begin by first acknowledging the powerful role of the mountains in defining the boundaries of the city and in creating a key element of its character.

Slide 60

Next, the Fen river, as an important communications route and supply of water.

Slide 61

Between them, the mountains and the river define the built up area of the city.

Slide 62

The railways and the airport provide the key large-scale transport connections for the city.

Slide 63

The ring motorway facilitates movement to, from and around the city.

Slide 64

The six central bridges across the Fen river provide important connections between the Taiyuan side of the city and the Xishan side in the west.

Slide 65

Tim Stonor

The streets that lead up to the six bridges then become the principal east-west alignments in the overall city.

Slide 66

The east-west routes are complemented by key north-south roads, two each on either side of the river.

Slide 67

Together, the east-west and north-south routes create the “supergrid” of movement connections for the city.

Slide 68

Within the supergrid are located a secondary network of important streets.

Slide 69

The various layers, when presented as a composite image, create an initial spatial mapping of Taiyuan.

Slide 70

In order to produce a finer-grain understanding of the city’s spatial layout network, we have constructed a Space Syntax model of Taiyuan.

Slide 71

First, we can view the local accessibility analysis of the street network where we see higher levels of spatial accessibility to the east of the river and lower levels on the west, Xishan side. This suggest to us that the spatial planning of Xishan should aim to create a stronger local movement network. As we saw in Sao Paulo, the layout geometry of the street network is a critical factor in any city’s urban performance, so the local qualities of the spatial layout – and especially the way in which the local and global patterns overlap - is something that deserves special attention in Xishan.

Slide 72

When we analyse the global spatial pattern, we see strong levels of accessibility on each side of the river. This suggests that Xishan already benefits from good global accessibility. New, major road projects will strengthen the global pattern even further. Based on our experience, we believe that the way in which the local pattern integrates with the global pattern will be very important to the sustainability of the future Xishan.

We have proposed to use this model, as we have done in Jeddah, Sao Paulo, Newcastle and London, to help develop the strategic spatial plan, the land use plan and the transport plan. We look forward to the opportunity to do so.

Tim Stonor

Slide 73

And so, in conclusion, I hope that I have shown you how, by understanding space, we can facilitate the planning process and help to achieve the systematic coordination between planning, urban economics, transport and architecture that is the objective here in Xishan District and is, in my opinion, the final component of sustainable development.

Thank you.

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