Are landmarks essential to the city – its development?

Anthony Clerici, Izabela Mironowicz

(Arch. Anthony Clerici, Clerici Design, 1 Townsend Street Worcester WR1 3JQ, ant@clericidesign.com)
(Dr. Izabela Mironowicz, Wrocław University of Technology, Faculty of Architecture, ul. B. Prusa 53/55 Wrocław,
izabela.mironowicz@pwr.wroc.pl)

1 ABSTRACT

Across Europe there has been considerable debate over factors affecting successful urban transformation. Many regeneration plans are developed and implemented. Compared to even ten years ago the mainsprings of success are now quite well recognized and understood. Most of them refer to economic, social and environmental issues.

Our research will focus on spatial and even architectural aspects of cities. We claim that one of the most important and influential components of successful urban transformation is the quality of landmarks which express not only sense of place but also essential values basic both in economic development and in public involvement. In consequence landmarks might be considered as a key factor the quality of urban life.

In the first part of the paper we will examine fundamental role of landmarks in the cities concerning historical and cultural context; we will also discuss the definition and meaning of landmarks and explore the sense of urban transformation. In the second part of the paper we will suggest the essential relationships between quality of landmarks and successful urban transformation considering a few case studies particularly from Europe including Poland and UK.

2 MEANING OF CITY

2.1 What is essential in cities?

When analyzing widely known definitions of the city one can find key words associated with this kind of settlement. The most evident is concentration. Cities are 'magnets' aggregating people and activities within an urban form.

The city has always differed from other settlements because of its diversity and hierarchy. A few millennia of rural settlements created only the homogenous spatial structure whereas the city appeared as a completed, complex spatial solution with its machinery of power and control. In other words cities cannot exist where everything has equal value. This difference (variety) and hierarchy appeared in the oldest Sumerian cities as the enclosed form of a 'citadel' containing palace, temple and warehouse. They were the symbols of power – political, ideological and economic. The only buildings surviving from such times are those representing these values. The same can be said about the oldest Egyptian cities, where the power of ideology is expressed by both temples and pyramids.

The city core is invariably composed of buildings expressing values and having meaning.

2.2 Urban change or City transformation

Cities are ever changing; they are 'alive', they respond to ever changing need. The most constant feature of cities is change. They represent a process of evolution by changing all the time but not always with a great evolutionary success.

Cities change because life changes. Urban form adapts to changes in civilisation reflecting their social structures.

Urban transformation is often considered as a 'modern' feature of the city. We are inclined to regard current changes as something unusual particularly in scale and depth of their transformation. Looking back in the Mediterranean basin there have been no less that three great urban transformation leading to a completely different form of the city (Mumford, 1961; Le Goff, 1964).

The first urban transformation in the middle of the 4th millennium BC saw the city as a new type of settlement. Two thousands years later the second metamorphosis shaped the ancient Greek city. Finally, the third urban revolution brought a city model based on medieval order that still existing today. All of these transformations weren't 'small changes', they led to completely different city structures and, as a consequence, to new city forms.

Since the first half of 19th century we have been experiencing the fourth urban transformation which can be considered as so far incomplete. This process of shaping a new pattern of the city has two aspects.

First is enormous city growth in area, population and influence on the global economy. Considering only one but significant example of the City of London, the transformation from nodal city into its new form which has yet to be labelled: an agglomeration; a city-region: an urbanized area; a metropolitan area ('metro') is clearly noticeable (Calthrope & Fulton, 2001; Garreau, 1991; Lang, 2003; Prosperi, 2007). London's population increased from the beginning of the 18th century when it rose from 4th in the world with 550.000 residents to 1st in 1850 with 2.320.000 inhabitants. It then almost doubled in next 25 years (4.241.000), tripled in 50 years (7.742.000) and quadrupled to 8.860.000 in 1950. It lost its leading position in 1925 (Chandler, 1989). By 2006 it had sunk to 21st position with 12 million residents (http://www.citypopulation.de). Population figures are an indication that present cities cannot be like the past. The new form of the city is not simply an 'up scaling' the old into a new larger one. We observe the emergence of a new model of the city: the fourth urban transformation.

The second aspect is transformation of internal city structures. Urban patterns respond to social needs and technical development. The city can be described as a physical representation of civilisation (Baeujeu-Garnier & Chabot, 1963). There is no doubt that the form of the city should follow the level of civilisation reached by particular society. Places change their importance and meaning within city structure. It is a kind of natural process where places are transformed in response to new needs. What is important in this evolution is the stage of decline or even degradation. Places become 'useless' loosing their utility and meaning, and probably as a consequence, their importance within the city structure. These places may be or even should be adapted to new needs and therefore create new elements of the city structure.

In our paper we will focus only on this second aspect of city transformation.

3 WHAT IS LANDMARK?

3.1 Importance/necessity of landmarks – why do we need landmarks?

Landmarks are usually considered when answering the question: 'Where am I?'. They are essential when determining how do I find directions to…(wherever)?; and to provide a vocabulary for direction givers (Klippel & Winter, 2005; Weissensteiner & Winter, 2005). However, these are landmarks acting as markers. They might be substituted by signs, graphics or indicators but we are interested in understanding their profound significance within the urban form.

When one thinks of 'Paris' one sees the Eiffel Tower, 'Sydney' its Opera House, 'San Francisco' – the Golden Gate. But why? They represent their city as a mark, a badge, a brand sending ripples beyond the city boundary. Before identifying crucial essential features of these iconic structures we need to consider the basics. Humans need to understand their place, where they are going and their relationships with their surroundings. To be well informed enables us to use our environment, to live, to find food, to travel, to stay safe. These basic needs were found before cities, even before settlements. Primeval landmarks were at first natural features and then modified natural features. At first they provided important survival information – 'turn left', 'cross here', 'this is a safe place' but also embodied important associations: cemeteries (cultural); shrines (religious); resources to be protected (economic); signal territory or borders (power) (Mumford, 1961).

Landmarks are important symbols associated with place which increased in significance with time through use. They represented a quality of place, depth of tradition and culture that is true of today's landmarks.

But why it's important to be recognisable?

Even natural landmarks have essential characteristics – height, distinctiveness, form, visibility, views: and they define 'place', signpost routes, modify 'space' and have as we have noted developed cultural, economic or religious meaning.

The physical manifestation of landmarks reflects fundamental human psychology and relies on contrast to enable visibility.

The value and meaning expressed through landmarks in embryonic city structures were directly translated from the 'pre-settlement' world (Mumford, 1961).

Although nature doesn't have a 'quality' issue; it is only human interpretation. Man changed the natural order by modifying natural features (eg. cairns) to enrich their vocabulary and to express distinctive value through landmarks.

In summary, we need landmarks for knowing where we are (static), orientation when moving (dynamic), expressing values (communication), understanding meanings (relationship with culture) and defining place (design).

3.2 Landmark attributes

3.2.1 Analytical method

We need to understand landmark attributes and therefore had to find an appropriate method for exploring and defining them. This analysis was required to inform our understanding of the form and quality of landmarks. Landmarks at their simplest level are 'signs'; therefore we have to study 'signs' using semiology - the study of signs - as an appropriate method for our analysis of landmark attributes.
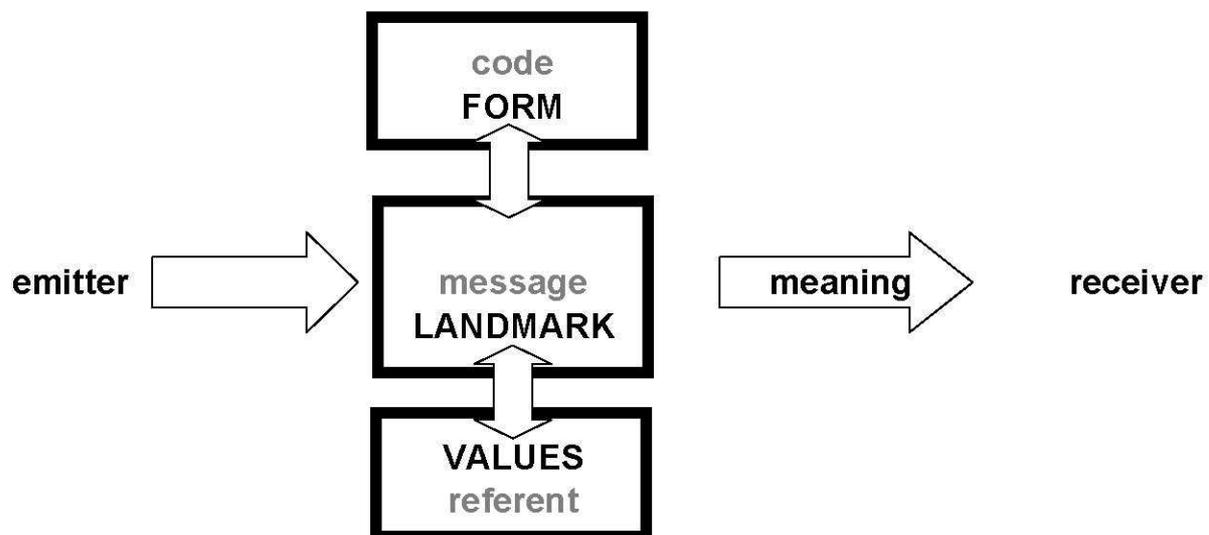
Figure 1. Landmark within a communication diagram

Landmarks express meaning by giving a visible message that relies on a relationship between the emitter and the receiver. And because cities and urban design is complex this involves a myriad of stakeholders, decision makers and just people; emitters include client, landowner, planning authority, funder whose requirements have to be interpreted by the designer; and receivers who are all users after transformation both those directly envisaged by the emitter and, because its an urban area, all those who will experience the city. The referent is the value and the code is the language of communication which for landmarks is its form. Visibility is the landmark's principle attribute. The meaning arises from the relationship between value expressed by landmark and receiver.

3.2.2 Value

We have already seen that values relate to power be it – political, economic, ideological but there are others that arose as human settlement and government took on new complexities and broader activities. For example, Versailles and the White House represent different forms of rule.

These main categories express variations in their value:

political includes:

- territorial control (boundaries and gateways),
- their sphere of influence National Government (Houses of Parliament), City Authorities (Town Halls),

- the system of governance (democratic parliaments, autocratic palaces),

economic includes:

- private wealth (banks, insurance offices),
- national wealth (treasuries),
- exchange (stock markets),

ideological includes:

- religious (cathedrals, mosques),
- civic (monuments).

Increased value through combination of these essential values:

- political/economic (castles),
- political/ideological (triumphal arches, monument, war memorials),
- economic/ideological (monasteries),
- economic/ideological/political ('citadels', inner cities).

As society became more complex other values required their own expression, and because landmarks provide basic human need (currency) they too were expressed as landmarks.

We have identified some examples:

- education and science (university spires, science parks, telescopes),
- culture and the arts (museums, galleries, opera houses, theatres, media buildings),
- sport and leisure (Olympic stadia, roller coasters),
- communications (telecom towers, ports, stations).

3.2.3 Meaning

Using the semiology model shows that meaning is the relationship between the landmark and the receiver. This depends upon a common language so that although one can superficially appreciate the meaning of the Inca temples without education, and with further knowledge greater understanding, the full meaning is lost as it can only be comprehensively experienced through participation in the ceremonies of the time. Some might forgo this painful experience and rely on books. Cities contain many places with meaning, not all are landmarks but crucially all landmarks must, through meaning, communicate to the receiver. On a personal level the same building may have very different values and meaning, a tourist visiting a religious icon does not necessarily involve worship.

If cities are in constant change the meaning of landmarks must also respond that process. If those changes are small or slow then it is easy to understand adaptability within the meaning. Where changes are significant, for example where there is transformation, then meaning can be severely affected or even lost. A redundant church might be demolished, or transformed from 'religious' to 'cultural'.

3.2.4 Visibilty

Landmarks cannot exist without being seen. We have already shown that visibility relies on contrast. But what do we see? A tree on its own can be a landmark. Equally a group of trees. A clearing in a forest can be a landmark. A rock in a flat desert can be a landmark. A rock or group of rocks in a forest can be a landmark

We see the individual tree on a plain but cannot differentiate between trees in a forest. Manhattan is a landmark composed of many towers, an ever changing skyline but is only one single landmark. If you transplant one of the towers to a low rise city like Wroclaw then that tower takes on a totally different visibility. We see – something different.

Distance with changing perspective is crucial. If you are low – high looks higher. Landmarks have varying significance with respect to distance form it and possible views. From the sea Manhattan is a single landmark, even when close but outside it remains as a single landmark but it is only from inside Manhattan

that individual buildings, particularly the small scale churches become landmarks because from that perspective they offer contrast and the office blocks can only frame the views or act as a backdrop.

Visibility is generally appreciated in daylight but we need to note in passing that other factors can have influence: night (artificial lighting), the sound of clocks (chimes), fog horns are substitute landmarks.

3.3 Landmark Form

Landmark form must be visible, express values and give meaning. We have investigated how the qualitative assessment of landmarks can be analysed. It is how the landmarks' features are expressed and how the landmark itself sits within the city.

Our basic forms for describing how landmarks work are the point, the line and enclosure. And we recognise that landmarks are:

- points in their own right (towers),

- a point on a line (bridge),

or

- a point on the perimeter of an enclosure (gateway).

Contrast, as already defined, enables landmark visibility and the most obvious expression of this is height.

Everything that is 'UP', an abstract concept, has positive associations – angels, pleasure, success – it is embodied in language: sky is a limit, cloud 9, on a high, top of the world, top class, summit of success, etc and, conversely, everything that is 'DOWN' is linked with negative things – demons, pain, failure and its language: feeling low, the gutter press, hellish feeling.

Landmark form is best expressed through both pure and relative height giving the potential to express eternity, the Gods, dominance, control, aspirations, dreams, prestige.

In addition to height, other expressions of contrast that manifest themselves as differing forms are:

- shape (unique),

- colour (specific),

- texture (contrast compared to surroundings),

- spatial relationships (distinguished).

Finding appropriate form of landmarks lies with the designer to express the relevant codes (solution) by interpreting the values with respect to meaning and 'place'.

3.4 Quality and utility of landmarks

Having discussed value, meaning and visibility, and then the form of landmarks, there remains the issue of quality. We define quality very basically – as high grade, superiority, perfection, excellence. The value and meaning need to be clearly expressed and understood. This is tested by peoples understanding of its codes, their understanding of meaning. This cannot be achieved without visibility.

What's the affect of good or poor quality? Landmarks are embedded in urban grain they are symbolic of the culture, power, wealth etc of the city and need quality in order to be legible and fulfil their meaning. A poor quality landmark is counterproductive – how can a bank's customers have confidence in their bank if the HQ is falling apart? The code we all understand is that quality is symbiotic with the meaning and values. Clearly seen, appreciated and eventually loved as part of the whole city and its civilisation, people will vote resources to maintain landmarks and protect them against threats.

There can be different relationships between functionality, as a development, and its quality as a landmark. However it is not essential for landmarks to have utility which is clearly seen if landmarks change their function during their lifetime but remain as key landmarks (Musee d'Orsay, Covent Garden).

A high quality landmark has value in its own right – it will have appropriate form and spatial relationships.

3.5 Hierarchy

Not all landmarks have the same value, meaning or visibility. They exist with varying degrees of these attributes and their quality is also relevant to this. At a basic level landmarks have influence across a spectrum of distances and therefore can be described as having relevance to:

- city – as a symbol of the city (Eiffel Tower in Paris, Brandenburg Gate in Berlin, Guggenheim's Museum in Bilbao);
- district – as a symbol of the district in the city/important place (Olympic Stadium in Munich, Place Omnisport Bercy in Paris, Credit Lyonnaise Bank 'Crayon' in Lyon);

and finally,

- neighbourhood – as a local symbol of neighbourhoods/quarters/functional groupings (Icon Gallery in Brindley Place, Birmingham).

But the complexities within metropolitain areas are reflected in their landmarks which exist within their built environment exhibiting a myriad of values and meanings to the people that are able to navigate using their physical and symbolic attributes. Their hierarchy necessarily becomes more diverse. This aspect of hierarchy of landmarks requires its own focussed research, leaving us to establish our premise that landmarks are necessarily more than simple signposts and are essential components in a successful urban development.

However, relationship to place can be very specific or not. We tend to assume that landmarks are invariably rooted to a single place, a site, an orientation within the site. Classical design offers clear examples with symmetry, balance and being a focal point that means any element loses its value if moved by even a small distance. This is particularly true if the object sits at a crossing point of two or more lines (axis).

On the other hand the Telecom Towers of Vilnius, Shanghai, Birmingham etc which are tall towers that landmark their cities from huge distances can be relocated within the city centre because they have little or no relationship to their immediate surroundings.

Inter-relationships of landmarks within the city add value to their constituent parts. Arc de Triomphe du Carroussel is strengthened through its relationship to the Arc de Triomphe and they were both linked and given increased status to the city by Grande Arche – 'their sum is more than the total of their parts' particularly as this conversation is augmented through additional perpendicular axis.

There is an interesting game to be played: imagine the removal or relocation of a landmark. It is a quality test

Let's imagine Paris without the Eiffel Tower…Mais non! C'est impossible!

It represents the essence of Paris and indeed France; there is no other landmark that can take its place.

But Berlin without the tall office building that closes an important vista from the Reichstag (former exhibition centre at Planckstrasse) or the TV tower on Alexanderplatz?

Sometimes landmarks are removed by other means – Great Fire of London, war, terrorism and this precipitates frenetic activity to 'replace' them if, and only if, they are valued. New York's Twin Towers are being replaced but their value and meaning have changed as the city itself has changed.

4 TRANSFORMATION WITHIN CITIES

We have already noticed that change is an essential feature of the city and have identified two avenues for this change: the first, through internal transformation which we discuss in this paper and, second, expansion which merits its own specific research.

We have observed that the structure of cities is in constant flux and constant change: this process is inevitable, essential and naturally reflects human society. This change can be both positive and negative, it does not necessarily mean decline. However urban transformation of a part of a city arises within areas that have experienced reduction of value and meaning and a consequent decline. Our discussion about the relevance of landmarks has little bearing on the reasons for this decline but focuses on how they are essential in the regeneration process.

The model of transformation commences with a recognised loss of value and meaning. Such as a loss of a key industry to other markets, population migration, the knock on effect of other development within the city

that moves the 'centre of gravity' away. Regeneration takes place when sufficient motivation attracts resources and investment that, in turn, requires new meaning and new value to create a new sense of place.

Landmarks are needed to express this change in order that development provides essential urban features. Without these features 'transformed areas' have undifferentiated equal value, they cannot retain their urban substance. They revert to places where people cannot orientate themselves and the effects are: reliance on signing, lack of coherence and no real value and meaning, in short unsuccessful transformation. Their lack of landmarks spells failure. Without landmarks there is no other medium to express the new values. It cannot be done by advertising! This can be seen in large housing neighbourhoods, a sort of 'mono-culture', where a lack of diversity, no sense of place or distinctiveness and lack of hierarchy means these developments are short lived. However, the aim of transformation is to achieve a long term, sustainable result. Poor quality transformations reduce quality. How can we 'manage' landmarks in this process because they provide both diversity and hierarchy?

There can be both existing landmarks, that expressed the now redundant values and meaning, and newly created landmarks, that aim to embody the new ethos and character. More often than not it is a combination of both.

Existing landmarks have to be considered for their new purpose by asking the question 'will they contribute value to the transformation?' Liverpool's dockside warehouses were important landmarks, dominating the water front with an iconic presence but they fell into decline with Liverpool's loss of sea trade, eventually the Tate Gallery with other mixed uses have transformed them into an integral part of the city's rebirth. Values shifted from 'economic' to 'cultural' but externally the buildings remained the same.

We have said new landmarks have to achieve the same result. They need the attributes described above. They also need to reflect the new context. Existing landmarks have established relationships, a former context, an influence built up through time, they have associated history, memory, echoes of past transformations but new landmarks can only respond to their place and wider context.

The both have different objectives and challenges: existing landmarks need to change their meaning and clearly express new values, whereas new landmarks need to respond to their spatial context. When both are present there are further opportunities related to their interaction.

These ideas are evident in the following two examples: La Defence's Grande Arche is a new landmark within a Parisienne context expressing new values for the area, organised to respond to the existing landmark net: whereas the Brandenburg Gate is also physically unchanged has been subject to a series of symbolic transformations, each time it has retained a city wide importance from monarch's gateway, to a symbol of imperial power, to symbol of freedom.

There is also a conversation, a reciprocal affect of landmarks within the area of transformation out into the city. This phenomenon can also be described with respect to point, line and enclosure.
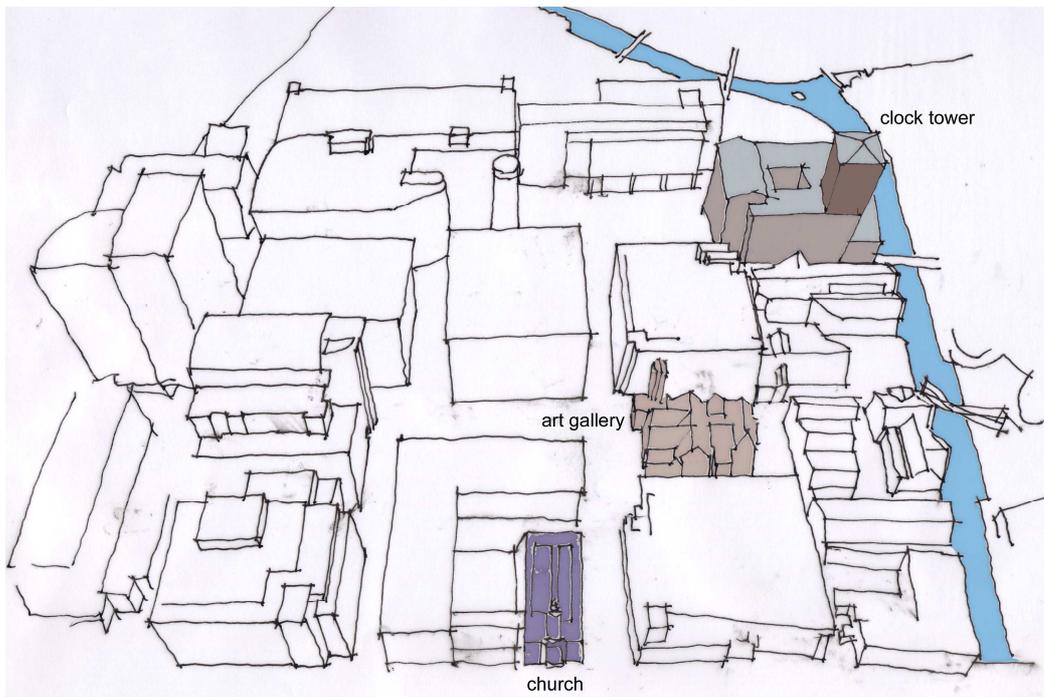
Figure 1. Brindley Place, Birmingham. Existing and new landmarks

Brindley Place is an inner city regeneration area that contains both existing and new landmarks. There are three landmarks that illustrate how successful transformation can be achieved. The three landmarks are:

- a church on the boundary of the site that acts as a gateway (point on a line) and relates to other existing landmarks on Broad Street,

- a Victorian school building that was converted with great skill into a modern art gallery – a contemporary cultural landmark (point) that has no direct relationship beyond its immediate surroundings because of its scale in relation to adjacent new buildings that separate it from the city, and finally

- a tower with clock on one of the new offices (point and gateway) that can be seen from outside the site and is a landmark of Brindley Place itself.

The crucial factor is their relationship to each other in structuring Brindley Place but also with respect to landmarks in the adjacent city centre: the ICC, NIA, Hyatt Hotel and Five Ways. The links with the central city core has been carefully arranged with a clear sequence from Chamberlain Square, through the library, across a new bridge that traverses a difficult road barrier, through Centenary Square and the ICC's internal street to a canal bridge and Brindley Place itself.
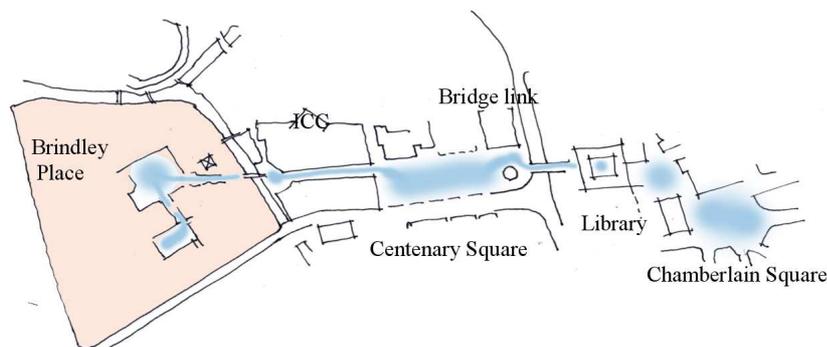

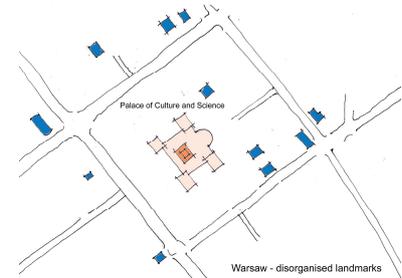Figure 2. Brindley Place: connections to the city centre

Brindley Place is held as an exemplar whereas central Warsaw has had less success. The Marriott Hotel and adjacent towers have no relation to the Palace of Science and Culture – these new landmarks have no dialogue, they lack contrast and are without spatial context. They are separated and do not form a cluster as a single landmark, nor do they relate to existing street patterns or the formal setting of the Palace of Science and Culture. There is no sense of place and as a consequence there is no development. This area is in a state of transformation where new development has not taken the opportunity to add value, but the opposite, contributing to its decline.

Focal point and established context

Individual chaos

Figure 3. Warsaw – chaotic towers around the 'classic' setting of the Palace of Science and Culture

Therefore in addition to analysing the relationships of site landmarks there should be equal importance attached to the analysis of the relationships with landmarks outside of the site with respect to the whole city as a complex structure.

However there is also a need to understand density of landmarks. High quality places could be described as those with 'landmark emphasised design' leading to urban order within diversity of the urban structure – creating order out of (apparent) chaos.

How do the 'points' relate to citywide points? Referring back to telecom towers:

- Berlin's tower has a sense of place - it fits into all levels of our criteria: the city, the district and on its site at the centre of Alexanderplatz.
- Birmingham's works on two levels: as a city centre reference to the central core and as a district landmark.
- Vilnius' tower is in the suburbs and far removed from the city centre and therefore can only indicate a citywide reference.

In this context, hierarchy of landmarks has greater or lesser relationship with existing landmark net.

In urban design there are choices: to respond to existing landmarks inside and outside of the site as part of transformation by being sensitive to the city structure and act on evidence of change for the future.

5 CONCLUSIONS

Urban transformations are often considered as merely a solution to particular issues such as to reverse economic decline, provide new employment, enable new retail development, provide new homes. We have seen that without value these endeavours fail to provide solutions of appropriate quality.

We have also discussed how landmarks are much more than mere reference points for orientation. They hold the key to expressing value and reveal meaning. They have particular attributes that need to be understood and recognised, able to be read within the context of urban transformation of the city and beyond. If signposts worked we wouldn't need landmarks, in suburban areas we can see less successful developmental form that is unable to create coherent urban spaces.

It is evident that there can be no successful transformation without values – and as a consequence – landmarks which represent values. It is why they're important. It is not only a building. It is expression of essential values.

It is clear to us that there is a need to better understand how landmarks function in urban transformation. Many urban design studies limit the explanation of landmarks to superficial marking of place for orientation

and physical emphasis. We have found that the meaning of landmarks has to be identified before form and location can be decided – without this deeper understanding they are only signposts. Their role and impact on development and its context is far more important than 'decoration' or 'ornament'. In transformation the process of urban design traditionally covers many factors – land use, communications, grain, transportation, links, historical background, environment, microclimate. Landmarks flavour all layers and all issues. This emphasises the importance in the quality of landmarks themselves, how they relate to their own 'place' and other landmarks.

In our analysis we have found a number of methods are required and have used traditional tools to describe our key elements.

In terms of location it is useful to adopt an elemental approach to how landmarks respond to – point, line and enclosure. With landmark form we have looked at classical Vitruvian order where contrast achieves visibility through height, texture and colour.

These are the conventional approaches to landmarks, but we have found the most important relies on understanding value. Expression of value is identified by semiology.

We have found the understanding of landmarks is incomplete, further study should be undertaken to explore how they are more influential in city transformation than mere orientation.

6 REFERENCES

BEAJEAU-GARNIER, J., CHABOT G.: Traité de géographie urbaine, Paris, 1963
CALTHROPE P., FULTON W.: The Regional City. Planning for the End of Sprawl. Washington, 2001.
CERRO SANTAMARÍA DEL G.: Bilbao: Basque Pathways To Globalization. Oxford, 2007.
CHANDLER T.: Four Thousand Years of Urban Growth. An Historical Census. London, 1989.
ECO U., A Theory of Semiotics. London, 1977.
GARREAU J.: Edge Cities. Life on the New Frontier. Cambridge, MA, 1991.
GUIRAUD P. La Sémiologie. Paris, 1971.
HALL P.: Cities in Civilisation. Culture, Innovation and Urban Order. London, 1999.
KAZEPOV Y.: Cities of Europe. Changing Context, Local Arrangements, and the Change to Urban Cohesion. Oxford, 2005.
KLIPPEL A., WINTER S.: Structural Salience of Landmarks for Route Directions. In: COHN A.G., MARK D.M. (Eds.): Spatial
        Information Theory. Lecture Notes in Computer Science, 3693. Berlin, 2005.
LANG R.: Edgeless Cities: Exploring the Elusive Metropolis. Washington, 2003.
LE GOFF J.: La Civilisation de l'Occident medieval. Paris, 1964.
LÉVI-STRAUSS C.: Anthropologie structurale. Paris, 1958.
LOIDL H., BERNARD S. Opening Spaces. Design as Landscape Architecture. Basel, 2003.
LYNCH K.: The Image of the City. Cambridge, MA, 1960.
MUMFORD L.: Cities in Civilisation. New York, 1961.
PROSPERI D.: Towards an Epistemology of Metropolitan Form. New Planning Concepts. Leuven, 2007.
SIMMIE J. (ed.): Innovative Cities. London – New York, 2001.
STEVENS Q., The Shape of Urban Experience: A Reeveluation of Lynch's Five Elements. Environment and Planning 33(6): 803-
        823, 2006.
WEISSENSTEINER E., WINTER S.: Landmarks in the Communication of Route Directions. In: EGENHOFER M., MILLER H.,
        FREKSA C. (Eds.): Geographic Information Science 2004. Lecture Notes in Computer Science. Vol. 3234. Berlin,
        2005.