Multiple Centrality Assessment: Computer-Operated Procedure for Interpretation and Modification of Urban Streets Network and Spaces. A Case Analysis of Govan Town, Glasgow, United Kingdom.

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ABSTRACT

Govan is a riverside district, shipbuilding industry. The area is also known for its traditional pubs and red sandstone Victorian buildings, as well as The Ibrox Stadium that serve as a home ground for The Glasgow Rangers FC. On the other sides, the area long had a reputation of deprivation and poverty partly due to the unemployment, street gangs and crime in community area, and the shipbuilding industries in Govan will face serious pressures to decline. Within the Glasgow network, Govan is clearly isolated from central areas due to a lack of connections and poor centrality due to large blocks and cul-de-sacs urban design in western areas. Now, it has been planned for a comprehensive programme of five and ten years' physical regeneration programme designed to make Central Govan attractive, vibrant and prosperous, a place where people wish to live, work, visit and invest with special focus on accessibility and the quality of spaces. The objectives of this paper are to use the new 'tools' that an Urban Designer may apply to the interpretation and modification of urban streets network and spaces. To map the structural potential of each urban space in Govan to sustain a thriving and diverse local life, as expressed by its density of centrality with respect to all other places in the system and also to test alternative scenarios of development of the street system in order to understand the impacts of local decisions on possibly remote spaces. As part of the problem setting phase, the Multiple Centrality Assessment (MCA) was applied. MCA is a process of network analysis based on primal graphs, a set of different centrality indices and the metric computation of distances (S.Porta et al, 2008) - in order to solve problem phase turning out to offer a relevant contribution to the comparative evaluation of three alternative proposed scenarios, leading to the identification of one final solution of urban design.

Keywords: multiple centrality, street network, urban space, centrality

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INTRODUCTION

"No matter how good its offering, merchandising, or customer service, every retail company still has to contend with three critical elements of success: location, location and location: (Taneja, 1999, p.123). What is location? Why does it matter? A simple and intuitive answer is: centrality. (S.Porta, 2009)

A central place has one special feature to offer to those who live or work in a city: easy accessibility from immediate surroundings and more distant places. A more central location commands a higher real estate values and is occupied by a more intensive land use.

Central locations in an urban area have the potential to sustain higher densities of retail and services, and are a key factor for supporting the formation and vitality of urban nodes (Newman and Kenworthy, 1999). Centrality emerges as one of the most powerful determinants for urban planners and designers to understand how a city works and to decide where renovation and redevelopment need to be place.

In centrality assessment, the Multiple Centrality Assessment (MCA) was implemented. It works on the forefront of the growing wave of interest for Geographic Information research to interpret the structural interpretation of urban spaces for urban planning and design while offering a new and deeply alternative technical perspective (Porta et al, 2006).

In this research, we will illustrate how Multiple Centrality Assesstment (MCA) was applied over a network of two systems of vehicular (accessible by motor vehicles) and non-vehicular (limited to pedestrian and cycles paths) by tracing the crossings as *nodes* and connections as *edges* to represent the connectivity of the streets in case study area. From these reports, it will represent

1) The existing network
2) The potential street network
3) The real network according to the scenarios created.

Why Govan is a Spatial Focus?

Govan is one of the district part of Glasgow which located in United Kingdom. It is a riverside district, famous for its 20thcentury shipbuilding industry. The area is also known for its traditional pubs and red sandstone Victorian buildings, as well as The Ibrox Stadium that serve as a home ground for The Glasgow Rangers FC. The area contains a significant cluster of institutions, employment areas, town centers, public transport infrastructure, strategic road connections, opportunity sites and buildings for investment, as well as established, dense urban communities. These conditions provide a strong foundation to deliver on the City's ambitions for inclusive economic growth.

Along the Clyde corridor the SEC, Pacific Quay, the Riverside Museum and Glasgow Harbour have all become landmark symbols of the River's regeneration. On the other side, the city-district of Govan is also characterized by negative factors which mitigate against the unlocking of the area's potential. The area long had a reputation of deprivation and poverty partly due to the unemployment, street gangs and crime in community area, and the shipbuilding industries in Govan will face serious pressures to decline Around the River corridor and in Govan large areas of vacant and derelict land remain. Within the Glasgow network, Govan is clearly isolated from central areas due to a lack of connections and poor centrality due to large blocks and cul-de-sacs urban design in western areas.

There is a challenge to ensure that economic development translates into inclusive economic growth which can benefit those currently marginalized both spatially and economically. The urban structure left over from the era of de-industrialization too often divides communities instead of connecting them. The result is that some of the City's best social and economic assets are isolated from each other, failing to generate the added value associated with dense urban economies.
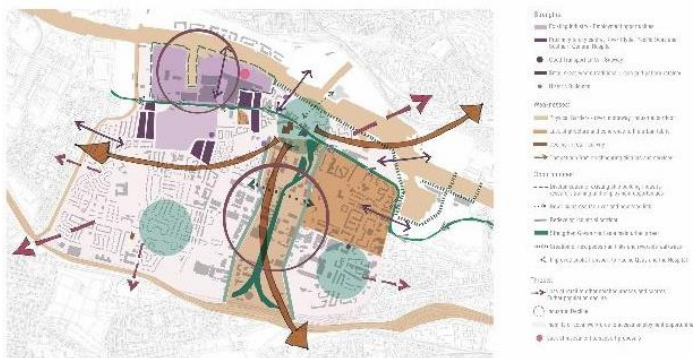
Issues on Govan Development
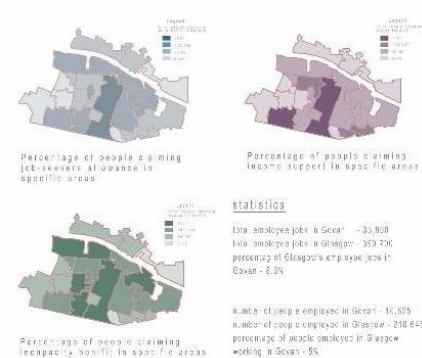

Figure 1: SWOT Analysis

Figure 2: Socio-economic Diagram

According to Strategic Development Framework by Glagow City Council 2020, there are some key stages on Govan development:

Stage 1: The area develops slowly over hundreds of years, an important location in relation to the Clyde River fording point.

Stage 2: Period of imperial expansion of trade, industrial development and intensive urbanisation. River widened and deepened.

Stage 3: Industrial heyday. The area becomes one of the most important shipbuilding centres globally.

Stage 4: Deindustrialization and extensive demolition of residential and industrial structures. Port function all but gone. Significant urban expressway interventions. Massive population decline in Govan. River becomes a barrier.

Stage 5: Period of post-industrial regeneration. Some locations see very intensive re-use, whilst large swathes of land and the River itself remain largely unused. River remains a barrier.

The strategy is to reconnect two historic City districts (Govan – Partick) which have become distinct in spatial and social terms in recent decades. According to Strategic Development Framework by Glasgow City Council 2020, a new phase of development, where the River Clyde will be re-established as the linking heart of the urban area and where the place will be recognized as a leading location for economic activity at a national level. This approach will unlock the area's potential by responding to the current urban conditions, which too often limit rather than celebrate the opportunities for local communities, visitors and investors by doing a research on street network analysis from Multiple Centrality Assessment method.

Now, it has been planned for a comprehensive programme of five and ten years' physical regeneration programme designed to make Central Govan attractive, vibrant and prosperous, a place where people wish to live, work, visit and invest with special focus on accessibility and the quality of spaces. As part of the problem setting phase, the Multiple Centrality Assessment (MCA) was applied. MCA is a process of network analysis based on primal graphs, a set of different centrality indices and the metric computation of distances (S.Porta et al, 2008) - in order to solve problem phase turning out to offer a relevant contribution to the comparative evaluation of three alternative proposed scenarios, leading to the identification of one final solution of urban design.

OBJECTIVES

The main objectives of this research are to use the new 'tools' known as Multiple Centrality Assessment (MCA) applying with ARCGis software where an Urban Designer may apply to the interpretation and modification of urban streets network and spaces to strengthen the work on urban analysis. As part of the problem setting phase, the Multiple Centrality Assessment (MCA) was applied.

The research focus on centrality of Govan district area located in Glasgow, United Kingdom. To get the result of centrality in Govan, the network analysis of street was done by using ARCGis software. This research is unique one where it blends operational tools with community involvement, theory with hands-on approaches in order to:

1) To map the structural potential of each urban space in Govan to sustain a thriving and diverse local life, as expressed by its density of centrality with respect to all other places in the system.

2) Also, to test alternative scenarios of development of the street system in order to understand the impacts of local decisions on possibly remote spaces.

Perhaps this research will be applied to prospective private and public body such as local authority and developer especially for Port Dickson local council (MPPD) to understanding the impacts of local decisions on urban planning in Port Dickson since there are many interest and potential places in Port Dickson that are not connecting each other due to of lack connections and poor centrality. Thus, it will impact on key-dynamics of the districts such as real estate values, land use and crimes where it will be a primal factor in development of the city.

METHODOLOGY

This research method is formulated based on the analysis that has been named "Modelling the existent city" and "Modelling scenarios". These two analysis was addressed in parallel in order to complete the research findings.

1) **Modelling the existent city**

- Build the graphs by using ArchGIS

First, map of the study area was printed out at appropriate scale and have drawn with different colors of pen to show the two systems of vehicular (accessible by motor vehicles) and non-vehicular (limited to pedestrian and cycles) paths by tracing the crossings as *nodes* and connections as *edges*. Then, the map drawn by hands printed on OS maps was transferred in a GIS Environment (ArcVIEW). This was done directly on ArcVIEW.
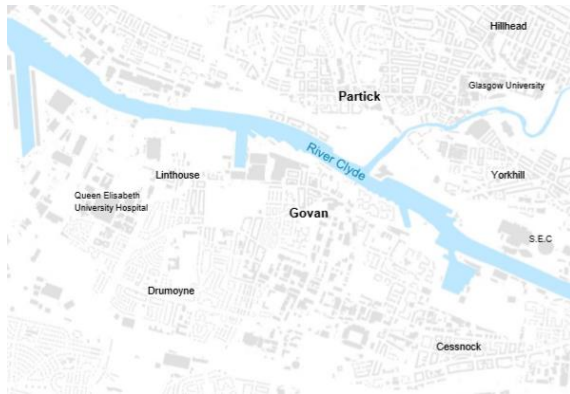

Figure 3: Existing City

Figure 4: Build the graphs by using ArcGIS

- Run Multiple Centrality Assessment

Second step the map drawn in ArcVIEW was run in Multiple Centrality Assessment to compute *Centrality*.
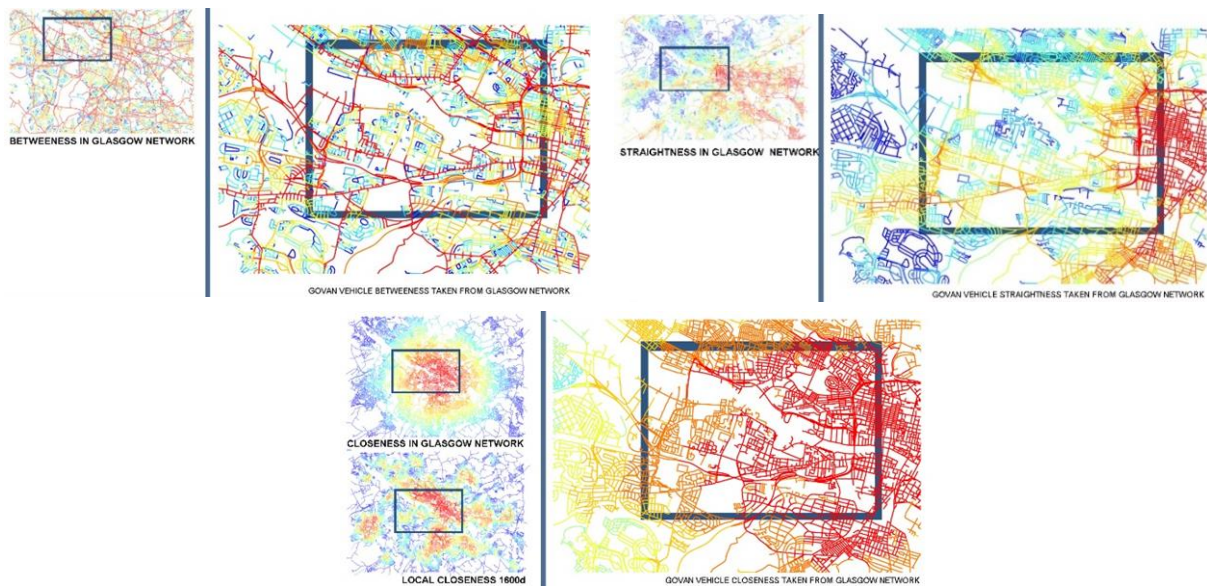

Figure 5: Betweeness, Straightness and Closeness of street network analysis run by Multiple Centrality Assessment

Workout MCA Report

MCA Report was produced after the process of calculating and visualizing centrality for both vehicular and the non-vehicular graphs. Researcher was requested to run the process 4 times, once for every centrality measure that choose to analyze. To summarize that, the complete list of maps was produced in these analysis works which are *Betweeness, Closeness* and *Straightness*.

Figure 6: Workout on MCA report on Betweeness, Straightness and Closeness of Govan vehicle network.

2) Modelling Scenarios

- Identify scenarios

    Scenarios of future developments for the street network of Govan and its immediate territorial context are identified in this phase. Such scenarios could be, for example, a new bridge across River Clyde, a new road, or the cancellation of an existents vehicular road that is therefore transformed into a pedestrian space.

    Once 2 to 4 alternatives of street network reforms have been discussed and sketched on paper, they will then have translated into ArcMAP graphs to create scenarios graphs. That can be done easily by modifying the two vehicular and non-vehicular graphs of the existent.

- Analyze the scenarios by compute centrality and map centrality

    The *Compute Centrality* and *Map Centrality* was analyzing by Multiple Centrality Assessment.

- Workout MCA report

    MCA Report was produce after the process of analyzing the scenarios for both vehicular and the non-vehicular graphs compute on MCA.

FINDINGS & DISCUSSIONS

The discussions on findings are discussed according to the analysis scenarios attributes of network analysis done in Govan area. The strategic plan for New Working Govan is proposed through long, medium and short-term initiatives categorized by the following themes:

1) Social and Cultural.

Figure 7: Existing closeness network analysis

According to the findings on closeness centrality MCA report, the existing closeness network (as figure 7) shows greater centrality in eastern/ central portion of area due to density and scale of blocks (red lines to show more central). Larger blocks and cul-de-sacs in western portion account (yellowish line to show less central) for poor performance. Also, the diagram shows areas of greater density perform well due to permeability.

Figure 8: Proposed closeness network analysis

When a link over the railway track was created as the 1st scenario, existing situation of closeness network analysis show an improvement by increasing the area of centrality within the core area. It can be the best solution for expansion, through reduces overall centrality of Govan Road. Plus, a link connecting Govan to the new Museum of Transport on the southern part as a second scenario was created. It shows improvement and focuses within central core of the Govan area. It was proved by the yellowish lines was change to red in the simulation report to show the area changed to more centrality.

It can be said, to strengthen the existing social and cultural in the area of Govan and reinstate the Clyde as working river, a new bridge link will be the clearest symbol of this reconnection, and the economic and social opportunities it can offer are significant. The bridge will create more than a mere physical connection; it will improve access to wider economic, social and cultural opportunities, north and south of the River Clyde in this part of the City (Govan - Partick SDF 2020, 2019).

2) Employment and Education.

Figure 9: Existing betweeness network analysis

Existing network from street analysis shows two structural routes running along the northern and southern boundaries perform best due to their centrality within the network. Large blocks and cul-de-sacs account for poor centrality in western areas. Within the Glasgow network, Govan is clearly isolated from central areas due to a lack of connections. It can give a bad impact on employment and education sector due to connectivity.

Figure 10: Proposed betweeness network analysis

By creating two scenarios (new bridge and link across industrial areas) in analysis of street, it shows improvement on betweenness. Centrality improved in Govan area, more likely that Govan will be transverse by people and goods who do not originate from the area. It improves betweeness around the historic center means that Govan has the potential to attract and develop a successful urban center. Regeneration of Govan cross into a densified block structure will attract investment in retail and hospitality, thus creating job opportunities. Moreover, Heritage Park, Transport Museum on the north and the tall ship link on the east all require implementation, regulation and maintenance. These three areas when have a clear accessibility will be resulting in employment.
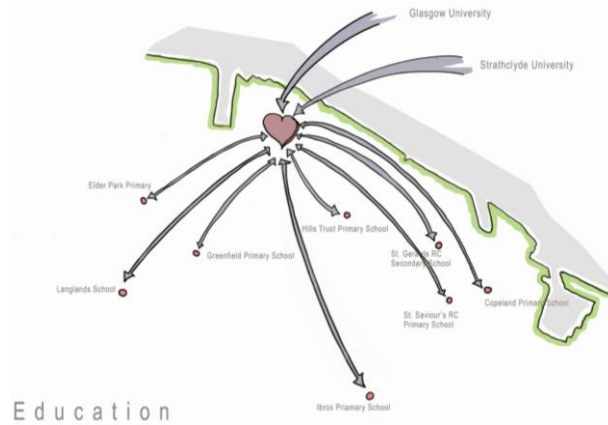
Figure 11: Proposed Govan centre as the heart of educational area

By redevelopment of Govan centre through improvement of accessibility at the northern part allowing Govan to be thriving as a centre of educational area that gives opportunities for all age group including formal qualifications, evening or weekend classes including employment skills and specialist social groups such as pensioners.
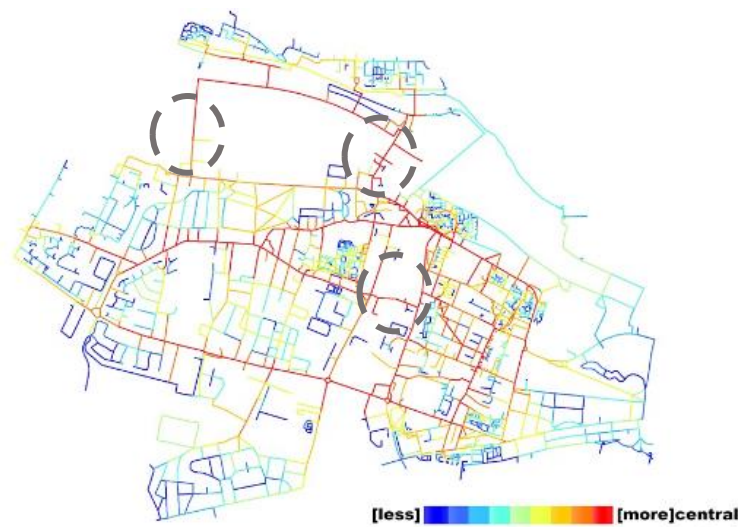
3. Connectivity.

Figure 12: Full scenarios implemented in centrality network analysis

According from centrality MCA analysis when full scenarios were created, development of three structural routes has improved overall centrality. Noticeable improvement can be seen in north-western portion of network as north and southern boundaries are linked. But the Science Centre on the eastern part loses importance within the network.
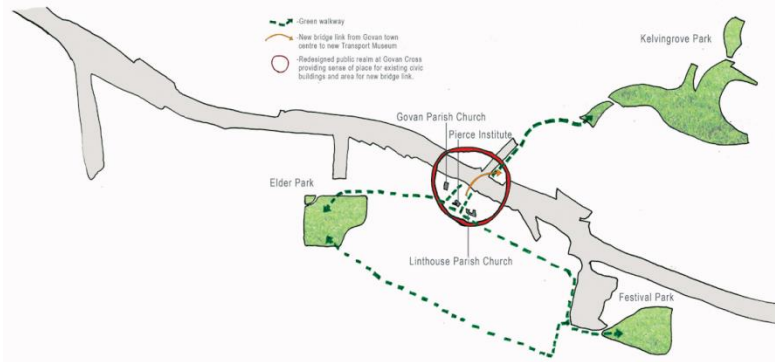
4. Environmental

Figure 13: Ecological connections

With having an improvement of connectivity, Govan center to become more accessible by use of shared surfaces, encouraging pedestrian activity on riverfront walkway and reduced reliance on cars, improving health and Govan's carbon burden. Cultivating and preserving environment in Govan for residents and natural environment by recognition and preservation of existing natural resources and areas of environmental quality including parks and churchyard by creating good accessibility.

Comprehensive of future physical regeneration programmes.

Comprehensive programme of five and ten years' physical regeneration programme designed to make Central Govan attractive, vibrant and prosperous, a place where people wish to live, work, visit and invest with special focus on accessibility and the quality of spaces.

Figure 14: Future physical regeneration

Social and Cultural

By 2025 Govan will be a vibrant place with a growing economy recognised nationally and internationally as a vibrant place with a growing economy. It will be a key element of the City's economic development strategy, and a genuine addition to the existing spatiale conomic framework of the City.

Employment and Education

For a long term strategic Govan will be recognised as a thriving and sustainable place to live and work in Scotland. Culture, vibrancy and quality of place will combine to provide the inner-urban lifestyle which will attract key industry sectors in the knowledge economy.

Connectivity

In ten years' physical regeneration programme Govan will be one of the best-connected low -carbon places in which to move around and do business in Scotland. The area will offer a very high level of quality and connectedness for

walking, cycling and public transport. This will contribute to the target of building a Carbon Neutral Glasgow by 2030.

Environmental

By 2025 the Govan area, as part of the wider Clyde corridor, will define best practice in the transition of landscape from an industrial port area to a well-functioning ecology, supportive of human wellbeing and biodiversity. It will be a green place with an urban structure which promotes wellbeing among Govanian and Scottish.

CONCLUSIONS

This research suggests that by using MCA analysis of urban street and spaces has demonstrated a high capacity to capture the potential of area to develop into mixed use urban environments. The study was initiated based on the fact that the Govan area and its surrounding development were under-utilized, perhaps due to the river barrier and the indirect bottleneck bridges have made it worse.

Using this MCA will analyze the current scenarios of the network, which will seamlessly provide the best possible approach for local planning authorities or the related bodies. On the other hand, the MCA will assist in concluding whether or not their designs and purpose are feasible and realistic for future development. According to S.Porta in Urban Design Group Journal (2013), MCA confirmed and justified a series of design choices by creating the scenarios regarding the generation and character of streets and enabled the urban design team to select the most desirable option from several alternatives.

This research also includes the suggestion of applying MCA looking at the best methods for presenting it to prospective private and public body such as local authority and developer. MCA's potential lies in how it combines with other more established types of analysis, and how to easily explain its benefits to commissioning bodies, without the recourse to technical language (S.Porta et al, 2013)

ACKNOWLEDGEMENT

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