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Spatial Conditions For Sustainable Communities :

The Case of Informal Settlements in GCR

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كلية الهندسة

قسم التخطيط العمراني

فهم الملاحة الحضرية: إيجاد الطريق داخل المدينة

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كجزء من متطلبات الحصول على درجة الماجستير في التخطيط العمراني

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ملخص الرسالة

مقدمة

- إن عملية العثور على الطريق عملية طبيعية يتعلمها الناس منذ الطفولة وتزداد قدرتهم تدريجيا في مراحل النمو المختلفة. إن الملاحة الحضرية تعتمد على الخبرة وفهم البيئة المحيطة بنا. يكتسب الناس معرفتهم بالطريق خلال ترجلهم في المدينة والقيادة عبر طرقاتها . وهم لا يحتاجون في عثورهم على الطريق إلى أن يحفظوا جميع معرفتهم بالبيئة المحيطة في رؤسهم. ويمكن تمثيل معرفتنا بالبيئة في ثلاثة أجزاء: احدها في الرأس والثاني في البيئة المحيطة والثالث في العوائق البيئية المحيطة. إن الآثار الناجمة عن صعوبة العثور على الطريق ربما تكون قاصرة على المشكلات الشخصية كتتضيع الوقت والقلق والإحباط وربما تتعدى الآثار الشخصية لتمثل كارثة كأن تفشل عملية إخلاء مبنى به حريق نتيجة للارتباك في عملية العثور على الطريق.

مشكلة البحث:

- يواجه العديد من الناس صعوبة في العثور على طريقهم خلال بيئة معينه كما يجدون صعوبة في أن يكون لديهم تنبؤات للحركة خلالها.
- كما انه بالرغم من تواجد بعضهم في بيئات ذات طابع متميز وشخصية قوية فإن الناس يعجزون عن تحديد موقعهم من الأماكن المحيطة وعن توجيه أنفسهم داخل الفراغ .

أسئلة البحث:

- لماذا يفقد الناس طريقهم ويجدون أنفسهم تائهين في بيئة معينه؟
- كيف يمكن وصف الطريق للآخرين اعتمادا على الذاكرة ومن خلال العناصر الموجودة بالمدينة؟
- كيف يمكن تقييم بدائل المسارات المختلفة للوصول إلى مكان ما؟

أهمية البحث:

- ناقشت العديد من الأبحاث مشكلة إيجاد الطريق داخل المدينة وأرجع بعضها ذلك إلى العلاقة بين المدينة وهيكلها العمراني والنسيج العمراني بها كما أرجعت أبحاث أخرى ذلك إلى وجود علاقة بين إيجاد الطريق بالمدينة والتكوين البصري لها إلا أن الأبحاث التي تناولت علاقة هذه المتغيرات الثلاثة ببعهضا مازالت قليلة وتمثل فجوة ينبغي العمل على دراستها.

أهداف البحث:

- يهدف البحث إلى:
- استكشاف العلاقة بين إيجاد الطريق داخل المدينة وهيكلها المكاني والتكوين البصري بها.
- يناقش كيفية تعرف الناس على المدينة وإيجاد طريقهم بها وقدرتهم على اتخاذ القرار المكاني من مكان إلى آخر في هذه المدينة.

مفاهيم أساسية :

- **إيجاد الطريق** (Way-finding)

هو عملية تعريف مسار في بيئة معينة باستخدام واكتساب المعرفة المكانية وبمساعدة مفاتيح المدينة.

- **الاستقراء** (Legibility):

تتعلق بالطريقة التي بها يستطيع الناس قراءة بيئة معينة ومن ثم القيام بمهام إيجاد الطريق وفي كتابه " الصورة الذهنية للمدينة " فقد عرف كيفن لينش وضوح معالم مدينة ما بـ" سهولة التعرف على أجزاء المدينة وتنظيمها في شكل متجانس" ويشير لينش هنا إلى تشكيل خريطة ذهنية داخل عقول الأشخاص وهي هيكل عبارة عن تمثيل داخلي لبيئة معينة يستخدمها قاطنيها كمرجع عند توجههم إلى مكان معين داخلها.

- **التكوين البصري للمدينة:**

وهو يشير إلى عناصر الخريطة الذهنية للمدينة(المسارات والحدود والعقد والأحياء والعلامات المميزة)

أ- المسارات : وهي قنوات الحركة الرئيسية التي تدرك من خلالها المدينة وقد تكون طرق رئيسية أو ممرات مشاة أو مجاري مياه .....الخ.

ب- الحدود : وهي تزود الأحياء بحدود تميزها وتفصلها عن غيرها وتكتسب تلك الحدود تأكيدا وقوة حينما يسهل تمييزها أو رؤيتها عن بعد.

جـ - العقد :

وهي نقاط هامة بطول المسار مثل تقاطعات الطرق والميادين ونقط تجمع الأنشطة.

د- الأحياء :

والحي هو منطقة ذات طابع متجانس والتي يمكن تمييزها من خلال التجانس والاستمرارية وقراءة الأجزاء جميعا وكأنها شيء واحد متكامل.

هـ - العلامات المميزة :

هي العناصر الساكنة التي يمكن تمييزها والتعرف عليها والتي تستخدم لإعطاء إحساس بالمكان والتعرف عليه من خلالها.

- **نظرية صيغة التركيب الفراغي(Space Syntax) :**

هي طريقة لوصف وتحليل أنسجة الفراغ المعماري على الصعيدين المعماري والعمراني فهي تندرج تحت المنهج المورفولوجي في البحث المعماري والعمراني، الفكرة أنه باستخدام طريقة موضوعية ومحددة للوصف نستطيع أن نستكشف مدى ترابط منطقة ما ببعضها وقياس مدى إمكانية الوصول من مكان إلى آخر داخل التنظيم الفراغي. ويرى أصحاب تلك النظرية أن المعلومات الثقافية والاجتماعية موجودة في الشكل الفيزيائي وفي هيكله ، وأنه من خلال التنظيم الفراغي للتجمعات العمرانية نستطيع أن نتمثل طبيعة الحقائق الاجتماعية.

المفهومية : Intelligibility

هي محاولة فهم التنظيم الفضائي بتبيان العلاقة بين البعد المحلي (Local) الذي يتمثل في الأماكن العامة والأحياز العمرانية والساحات ، والبعد الشامل (Global) الذي يشمل التجمع العمراني بأكمله كالحي أو المدينة فالبعد المحلي يجعلنا في علاقة مع محيطنا القريب والبعد الشامل يجعلنا في علاقة مع التجمع الأكبر حجما وكلما تقاربت العلاقة بين البعدين المحلي والعام كلما زادت إمكانية فهم المدينة والعثور على الطريق بها.

محددات البحث

- تنحصر دراستنا في هذا المبحث على :

١- تعريف عام بمفهوم الإدراك ونظريات الإدراك

٢- تعريف عام بالصورة الذهنية للمدينة وعناصرها

٣- تعريف عام بمفهوم الاستقراء من ناحية التركيب الفراغي للمدينة

٤- مناقشة الفرق بين الصورة الذهنية للمدينة والتركيب الفراغي لها من خلال حالات الدراسة بالبحث

- يتناول البحث عملية العثور على الطريق في البيئة الحضرية اعتماد على التصميم الجيد وبالتالي فإن هناك العديد من المسائل التي لا يستهدفها هذا المبحث كالعثور على الطريق في البيئات الخيالية كالإبحار خلال الانترنت ، الاعتماد على الخرائط ، واللافتات.

- يتناول البحث دراسة ثلاثة احياء مصرية وهم وسط البلد و مصر الجديدة والمعادي.

فرضية البحث:

- إن القدرة على إيجاد المكان داخل المدينة مرتبط بصلة وثيقة بالتكامل بين الهيكل المكاني لهذه لمدينة و التكوين البصري بها.

منهجية البحث :

وتنقسم إلى جزئين

الجزء النظري :

- يتناول هذا الجزء الأبحاث والدراسات السابقة عن القدرة على إيجاد الطريق داخل المدينة ويناقش المفاهيم الأساسية بالبحث ويحاول استكشاف العلاقة بين إيجاد الطريق (wayfinding) والتكوين الطبيعي لها وهنا يطرح البحث العديد من الأسئلة ما هي طبيعة العلاقة بين متغيرات البحث؟ ما هي الأساليب السابقة المستخدمة في تقييم وتحسين وضوح معالم المدينة ؟ كيف يمكن لهذه الطرق أن تكون فعالة في الإجابة على مشكلة إيجاد الطريق داخل المدينة(wayfinding) وصنع القرار المكاني بها؟ كيف يستطيع الناس توجيه أنفسهم في المدينة؟ كيفه يمكنهم تذكر الطرق بين الأماكن المختلفة؟ كيف يتم تقدير الاتجاه والمسافة بين هذه الأماكن؟

الجزء العملي:

- في هذا الجزء يتم اختيار ثلاث مناطق وهم المعادي بمحافظة حلوان ومصر الجديدة ووسط البلد بمحافظة القاهرة ولتقييم وضوح معالم تلك المناطق نستخدم طريقتين مختلفتين في عملية التقييم هما:
- طريقة كيفن لينش لتقييم الصورة البصرية لحالات الدراسة
- طريقة بيل هيلير لتحليل النسيج العمراني لها

١- **طريقة كيفن لينش** : في هذه الطريقة يتم دراسة عناصر التكوين البصري لحالات الدراسة (cognitive map elements) ومن خلال ذلك نحصل على خريطتين لكل منطقة هما:

أ- الخريطة الطبيعية : وهي ناتجة من ملاحظة الباحث ودراسته للمنطقة وتوضح الخصائص العامة للمدينة

ب- الخريطة الذهنية : وهي ناتجة من الاستبيان والمقابلات وأن يرسم الفرد خريطة للمكان الذي يعيش فيه.

- المقابلات الشخصية والاستبيان :

- يتم عمل مقابلة شخصية مع ثلاث مجموعات من الناس :

أ- الذين يعيشون بالمنطقة أو يعملون بها وبالتالي فهم مرتبطين بها بصفة يومية

ب- الذين يزورون المنطقة لأغراض مختلفة غير يومية

جـ- الذين يزورون المنطقة على فترات متباعدة كأغراض السياحة وغيرها.

- يتم مقابلة الأشخاص الذين تتراوح أعمارهم بين ٢٠- ٤٠ سنة حيث وجد أن الأفراد عند تلك الفئة العمرية يكون لديهم القدرة على رسم خرائط تصل إلى مستوى جيد من الدقة.

- يتم اختيار هؤلاء الأشخاص بالتساوي بين الرجال والنساء ويتم استبعاد الرسامين والمتخصصين من الاستبيان.

- يطلب من كل شخص أن يرسم خريطة تقريبية للمنطقة مبينا عليها أكثر الأماكن جذبا لانتباهه وأكثر المعالم أهمية بالنسبة له كأنه يرسمها لشخص غريب موضحا عليها أكبر قدر من التفاصيل التي يتذكرها والتي يسهل للغريب من خلالها التعرف على المنطقة .

- يطلب منه أن يرسم مسار تخيلي لرحلة معينة من خلال المنطقة بداية من نقطة هامة على المسار شارحا عليها كل الأحداث والمشاهدات التي يمر بها على أن يكون المسار المختار شاملا وواصفا لأجزاء كثيرة من المنطقة .

- يطلب منه أن يكتب قائمة تحوي الأجزاء التي يشعر بأنها أكثر تميزا عن غيرها.

- يطلب منه الإجابة على عدة أسئلة مثل أين تقع..... في المدينة؟ وماذا يجاورها؟ وكيف تميزها أثناء رحلتك؟

– يتم بعد ذلك تحليل المعلومات السابقة وفقا لتكرار ذكر العنصر وعلاقة العناصر ببعضها وكذلك تحليل تتابع العناصر في الخريطة ودقة الخريطة واكتمالها مقارنة بالخريطة الطبيعية للمنطقة.

٢- طريقة بيل هيلير :

- يتم إجراء الخطوات التالية:

– رسم الخريطة المحورية لحالات الدراسة (axial map) عن طريق رسم أطول وأقصر الخطوط بشكل قطري في قنوات شبكة الطرق بالمنطقتين وبذلك نحصل على نموذج أو مودل لكل منطقة

- إدخال هذه الخرائط المحورية إلى الكمبيوتر وعن طريق استخدام برنامج متخصص في تحليل النسيج العمراني (UCL Depthmap) نستطيع تحليل هذه الخرائط المحورية والحصول على قيمة الإدماج الشامل(global integration) والعمق (depth) والإدماج على المستوى المحلي (local integration)
- ندرس العلاقة بين الإدماج على المستوى الشامل والمحلي (global& local integration) للحصول على (scattergram) والذي يوضح درجة مفهومية المدينة (intelligibility).

– الخطوة التالية هي اختبار إذا ما كانت المناطق التي تتمتع بصورة بصرية قوية طبقا لمعايير كيفن لينش تتمتع بقيمة تكامل مرتفعة طبقا لمعايير بيل هيلير ؟

- بمقارنة نتائج طريقتي كيفن لينش وبيل هيلير نستطيع استكشاف العلاقة بين الصورة البصرية للمدينة وهيكلها ونسيجها العمراني وعلاقة هذين المتغيرين بإيجاد الطريق داخل المدينة.

هيكل البحث

خطة البحث :

وتتناول مقدمة عن موضوع البحث وأهدافه وحدوده وفرضية البحث والمنهجية التي يتبعها البحث في الدراسة.

الفصل الأول: فهم إيجاد الطريق

يعرض هذا الفضل مفهوم العثور على الطريق ويعطي خلفية عن مفهوم الإدراك ونظرياته كما يناقش مفهوم الخريطة الذهنية وكيفية صنع القرار المكاني وتنفيذه.

الفصل الثاني: منهجية كيفن لينش

يشرح هذا الفصل أفكار كيفن لينش عن الشكل الجيد للمدينة و الصورة الذهنية للمدينة وعناصرها وكيفية تكوينها ثم يتناول كيفية تطبيق أفكار كيفن لينش في دراسة المدينة عمليا ، وأخيرا يقدم الفصل أهم الانتقادات التي وجهت إلى طريقة كيفن لينش في حصوله على الصورة الذهنية للمدينة.

الفصل الثالث: منهجية بيل هيلير

يشرح هذا الفصل طريقة بيل هيلير في تحليله للنسيج العمراني للمدينة وكيفية تحليل النسيج بطريقة موضوعيه يمكن من خلالها حساب درجة الترابط بين عناصر شبكة النسيج ويشرح المفاهيم الأساسية التي استخدمها بيل هيلير في بناء نظريته عن النسيج العمراني ، وأخيرا يعرض الفصل أهم الانتقادات التي وجهت إلى بيل هيلير في طريقة تحليله للنسيج العمراني للمدينة وخاصة ما يتعلق بمسألة العثور على الطريق.

الفصل الرابع: تطبيق منهجية كيفن لينش

يتناول هذا الفصل أسباب اختيار حالات الدراسة ثم يتناول تحليل لحالات الدراسة طبقا لأفكار كيفن لينش عن الصورة الذهنية للمدينة ثم يتناول مقارنة حالات الدراسة ببعضها وقياس درجة الاستقراء والوضوح لكل منطقة في ذهن المشاهد .

الفصل الخامس: تطبيق منهجية بيل هيلير

يتناول هذا الفصل تحليل النسيج العمراني لحالات الدراسة طبقا لأفكار بيل هيلير في تحليله للنسيج العمراني وباستخدام برنامج UCL Depthmap وحساب الإدماج الشامل والمحلي ودرجة الاستقراء لكل حالة من حالات الدراسة ويقارن نتائج التحليل لكل حاله ببعضها البعض.

الفصل السادس: المناقشة والتوصيات والخلاصة

ويتناول مقارنة نتائج الفصلين الرابع والخامس ببعضهما ومناقشة تلك النتائج بطريقة موضوعية وأخيرا يتم استخلاص النتائج والتوصيات الخاصة بكل حاله من حالات الدراسة والنتائج والتوصيات بشكل عام ثم يعطي الباحث لمحة عن اتجاهات البحث المستقبلية.

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ABSTRACT

This thesis discusses the issue of Wayfinding, depending on both of spatial configuration and spatial cognition of the city. It presents two different theories: First, the concept of imageability / legibility by professor Kevin Lynch (1960) which claims that way-finding is related to the process of forming mental maps of our environmental surroundings based on sensation and memory. Second, the concept of intelligibility by professor Bill Hillier, the father of Space Syntax theory, which claims that urban environment can be better understood through its spatial configuration. The thesis explores the relationship between the two concepts in a crucial trying to bridge the gap between them. Methodological procedures consisted of interviews, questionnaires, cognitive maps, researcher observation of physical environment, and spatial configuration analysis measuring global and local integration values using UCL Depthmap software. The results of previous analysis showed that spatial configuration and spatial cognition are closely related. Hence, Cities should be legible visually and structurally.

INTRODUCTION

Wayfinding is a natural and vital process that people learn in childhood (Piaget and Inhelder 1967) and develop gradually as they grow up. Urban navigation depend upon experience and understanding the environmental surroundings (Johnson 1987). people acquire their knowledge through strolling, driving across the city roads (Gluck 1991). People do not need to store all environmental knowledge in their heads in order to navigate and orient themselves easily (Norman, 1988). Knowledge can be presented in three parts: one in the head, one in the world, and one in the constraints of the world. Wayfinding difficulties may be confined to personal problems like loss of time, stress, and frustration or their impacts exceed this limit causing crisis such as evacuation process failure in building fire as a result of wayfinding confusion.

RESEARCH PROBLEM

-Human beings find it difficult to navigate through an environment, and to make predictions for movement through it.

- Despite its seemingly strong character and dominance, people find themselves lost and unable to determine where they are and to orient themselves in that environment.

UNDERSTANDING THE PROBLEM

- Many researches have tackled the relationship between wayfinding in the city and its spatial structure, and others tackled the relationship between wayfinding and visual form, but those dealt with the three variables together are few, and this represents a gap that should be studied.

RESEARCH OBJECTIVES

The research concerns with :

- Exploring the relation between wayfinding and (spatial configuration & visual form) of the city.

- Discusses how well people recognize the physical form of the city. Particularly in response to the "Way finding problem issue.

MAIN CONCEPTS

Way finding, Legibility, visual form, spatial configuration, space syntax, **intelligibility**.

Way finding:

Is the process of defining a path through an Environment, using and acquiring spatial knowledge, helped by (artificial) cues.

Legibility:

Legibility in the context of navigation and way finding, is a term which has been used for many years in the discipline of city planning. Work on legibility in this area has been concerned with the way in which people are able to read an environment and hence perform way finding tasks. In his book "The Image of the city"(Lynch, 1960) Kevin Lynch defines the Legibility of a city as: "… The ease with which its parts may be recognized and can be organized into a coherent pattern……".

Visual form: Stands for cognitive map elements(paths, Edges, Nodes , Districts, Landmarks)

Paths:

Major avenues of travel through the environment such as major roads or footpaths.

Edges:

Structures or features providing borders to districts or linear obstacles.

Nodes:

Important points of interest along paths, e.g. road junctions or town squares.

Districts:

Sections of the environment which have a distinct character which provides coherence, allowing the whole to be viewed as a single entity.

Landmarks:

Static and recognizable objects which can be used to give a sense of location and bearing.

Spatial configuration: It is the use of spatial relationships and rules for product configuration. Spatial configuration allows the layout and assembly of multiple products to arrive at integrated solutions.

Space syntax:

Is a method to describe and analyse patterns of architectural space both at the building and urban level. The idea is that with an objective and precise method of description, we can investigate how well environments work, rigorously relating social variables to architectural forms.

Intelligibility:

Is defined as the correlation between global integration and local control (hillier,1983).

RESEARCH SCOPE AND LIMITATIONS

- The research paper is limited to a discussion to urban design concepts with particular focus on the following:

1. A generic overview on the concept of perception and cognition.
2. A generic overview on the imageability of the city and its elements.
3. A generic overview on the intelligibility of the city relating to spatial configuration.
4. A discussion on the imageability and intelligibility in relation to case studies.

- The research is mainly concerned with studying way-finding in urban environment depending on good design. Hence, way-finding in virtual environments, wayfinding depending on maps, verbal instruments, and signs system are all excluded.
- Research methods are applied on three Egyptian case studies (Heliopolis, Maadi, Downtown Cairo)

RESEARCH HYPOTHESIS

-Wayfinding is closely linked with the interaction between both sides: structure of spatial system and cognitive map elements.

RESEARCH METHODOLOGY

The thesis consists of the following:

Theoretical Part:

This part is a literature review that will discuss the basic terms of the research Legibility, Physical form, Way finding, Space syntax, Intelligibility and try to explore the relation between Wayfinding and physical form of the city and here the research raises a number of questions: what's the nature of relation between research variables ?; what are the previous techniques used

in evaluating and improving the legibility of the city?; how can these techniques be helpful in response to the“ way- finding” and spatial decision making issue?; how can people find orientation?; how are routes between two locations remembered?; how are distance and direction estimates made?; how are relative locations between places learned?;

Empirical Part:

Three Egyptian case studies were used to advance the analysis: Heliopolis, Maadi and Downtown Cairo. In order to evaluate the legibility of these two Districts two methods were used:

1- Kevin Lynch’s mapping methods “PENDL”.

2- Bill Hillier’s mapping method “space syntax”.

1- **Kevin Lynch’s mapping methods**:

PENDL elements of both case studies were defined and integrated into two kinds of maps:

a- **The physical form maps**: They were the productions from the researcher's site observation and indicate the generalized physical expressions of the city.

b- **Mental maps**: They were created from the results of interviews and asking peoples to draw a sketch map.

- Interviews and questionnaires:

- Three groups of people were interviewed:

1- Those who are vitally depend on the studied spaces (live or work there)

2- Those who are not necessary in daily interaction with studied spaces but use them frequently for different reasons.
3- Occasional visitors (tourists and alike) to uncover which are the most important elements of the case study.

- Interviewee were between 20-45 years old. It has been that between this range of age the ability of people in drawing maps reaches its optimum level. They were selected equally between men and women. Professional draftsmen were avoided.

- The participants were asked to draw a map of Heliopolis, Maadi, and Downtown with characteristical elements of the three case studies.
- There was no limit on the time for drawing maps. On average, drawing each map took 15-20 minutes.
- After gathering the data, maps were evaluated to verify which urban layouts would show the highest legibility.

- The maps were scored according to their complexity, completeness and accuracy.

- The difference between the physical form map and the mental map indicated the gap between actual visual form and the form in people's mind.

2- **Bill Hillier's mapping method "space syntax"**:

The procedures have concluded these steps:

a- Taking the map of the three case studies, drawing the longest and fewest axial lines to obtain the axial map.

b- Analyzing the maps for spatial structure by using UCL Depthmap software, calculating the integration values, and checking if the top integration lines are related to the other lines in the system.

c- Checking the correlations between local and global integration to predict intelligibility.

d- Checking if the most significant areas in Lynch's study are also have strong position in the axial map.

- Comparing the results of Lynch’s and Hillier’s methods has indicated the relation between visual image and spatial structure of the city.

عنوان الرسالة: فهم الملاحة الحضرية : إيجاد الطريق داخل المدينة

مستخلص الرسالة

هذه الرسالة تناقش مسألة العثور على الطريق اعتمادا على كلا من الهيكل المكاني والبصري للمدينة. وتقدم الرسالة نظريتين مختلفتين لإيجاد الطريق الأولى: هي الاستقراء لكيفن ليـنش (١٩٦٠) والتي يشير فيها إلى أن إيجاد الطريق مرتبط بتكوين خـرائط ذهنيـة للعناصـر البصرية للبيئة المحيطة اعتمادا على الذاكرة. والثانية هي نظرية صيغة التركيب الفراغـي لبيل هيلير والتي يشير فيها إلى أن فهم البيئة المحيطة يعتمد على علاقة الفراغات المكونـه لهيكلها ببعضها البعض. هذه الرسالة تسكتشف العلاقة بين هاتين النظـريتين فـي محاولـة لربطهما ببعضهما البعض. وقد تم اختيار مصر الجديدة والمعادي ووسـط البلـد كحـالات للدراسة، وتقوم منهجية الدراسة على الأسلوب الوصفي والتحليلي للمعلومات المستخلصة من خلال المقابلات الشخصية والمسح الميداني ورسم خرائط ذهنية لحالات الدراسة وملاحظـة الباحث واستكشافه الحقلي لها، وتحليل النسيج العمراني لحالات الدراسة وحساب قيم الإدماج الكلي والمحلي لكل حالة من حالات الدراسة باستخدام برنامج *UCL Depthmap* ومقارنـة نتائج تلك الدراسات ببعضها البعض. وقد أظهرت النتائج أن هناك علاقة بين إدراك المكـان والتنظيم الفضائي له وان صيغة التركيب الفراغي يمكنها أن تتنبأ بشكل جيد مدى القدرة على إيجاد الطريق في المدينة فيما عدا حالات معينة عندما تكون الطرق الرئيسية والفرعية لهـا نفس العروض حينئذ ستكون نتائج التحليل باستخدام صيغة التركيب الفراغي غير صـحيحة وبعيدة عن الواقع. كما أظهرت نتائج الدراسة أيضا أن القدرة على إيجاد الطريـق داخـل المدينة مرتبط بصلة وثيقة بالتكامل بين التنظيم الفضائي لهذه المدينة و التكوين البصري بها.

الكلمات المفتاحية:

ايجاد الطريق، الاستقراء، التكوين البصري، التنظيم الفضائي ، صيغة التركيـب الفراغـي، المفهومية.

CHAPTER ONE
UNDERSTANDING WAY-FINDING:
Perception & Cognitive Mapping

1.1. INTRODUCTION

Way-finding is a vital and intuitive process within which the observer can perceive and organize his environment. Successful way-finding system increases satisfaction, safety, and productivity; and reduces time cost. Nevertheless, the investment in wayfinding systems is less than that devoted to other categories of planning. Thanks to three writers the term way-finding was widely used. In 1960, urban planner Kevin Lynch[1] used the term in his influential book, *the image of the city*. Lynch claimed that way-finding is about forming mental images of our environmental surroundings based on sensation and memory. He tried to evaluate city form based on the concept of *imageability* and to offer principles for city design. Twenty years later (in the mid-1970s) University of Montreal architect and environmental psychologist Romedi Passini extended Lynch's theory to architectural spaces, signage and other graphic communications. In his doctoral dissertation in man-environment relation, Passini made the first empirical study of wayfinding process[2]. He made his book *Wayfinding in architecture* and tackled the subject in greater depth. In 1992, he coauthored *Wayfinding: people, signs, and architecture* with Paul Arthur, a Canadian professor-cum-designer (Gibson, 2009). In parallel trend, researchers like Christopher Alexander were searching the influence of the layout of built structures on human emotions and movement. He coauthored two books in the late 1970s

[1] Lynch (1918-1984) has been called the ′ leading environmental design theorist′

[2] Tatarka, A., Larsen, D., Olson, T., and Kress, N., 2006, Wayfinding in the library: usability testing of physical spaces, ARL Library Assessment Conference, University of Chicago.

with his collaborators. The two books are *A Pattern Language*, 1977, and *The Timeless Way of Building*, 1979.

"Wayfinding is the adaptive function that allows us move through an environment efficiently to locate valuable items like food, shelter, or meeting places within the environment (Downs& Stea, 1977; Evans, 1980)" (Bell et al., 2005: 69). According to Golledge (1999), way-finding is the process of determining and following a path or route between a specified origin and a specified destination. Way-finding refers to one's ability, both cognitive and behavior, to find his / her way. One could do his journey to work blindfolded or do it with his eyes shut habitually relying on his memory. Way-finding may take place in virtual environments such as navigation through web sites / maps, so navigator or way-finder is larger than objects. We pay attention here that our thesis focuses on real world or large-scale spaces, so objects are larger than way-finder, thus we can learn about environment. There are way-finding aids that person can rely on to reach a destination such as portable maps, posted maps, GPS, GIS, electronic signs, bus placards, etc. Maps can give you much information about an environment. But how to find your way if these maps were torn to pieces or left in home or the information presented on it is incomprehensible? How to locate yourself if the instrument you rely on has broken down? How would you act if you are in a foreign country and can not read a sign or you can read it but do not understand what it means?. In fact, in the absence of, or facing difficulties with way-finding aids, humans must rely on internal representations or stored memories of experienced environments which we may call cognitive maps. Other scientists defined way-finding as a process of problem solving and spatial decision making. Arthur and Passini claimed that way-finding is a dynamic process and it is more than generating a static mental map of an area. They postulated that wayfinders are in a sequential process of decision making

through their trips. We pay attention here that Urban navigation is " a sequential process of decision making concerning route choice" (Golledge, 1999: 4). Eventually, to navigate easily in an environment, it is essential to read and recognize its components easily. Kevin lynch called that degree to which an environment facilitates cognitive mapping "*Legibility* ". Legibility influences the rate at which an environment can be learned. On the other hand, Bill hillier set it as "*Intelligibility*". Legibility and Intelligibility will be discussed in more detail in the following chapters of this thesis.

Figure1.1. Basic components of way-finding consisting of three parts: Origin (starting point), Destination(end point), and a route segments (connection) in between.

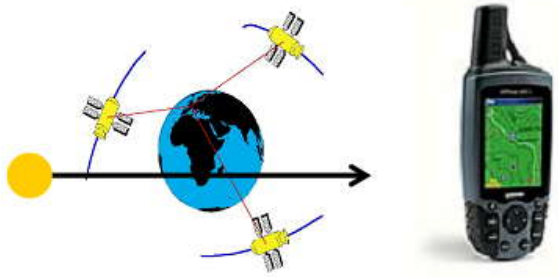

Figure1.2. Global Position System.

1.2. WAY-FINDING AND MOBILITY DISTINCTION

Passini and Langlois (1986) argue that " spatial orientation and way-finding are the foundation of mobility". The term mobility seems to be a synonym for way-finding, but they are partly different. Mobility stands for the ability to move physically. This movement ability may be restricted by an ailment or totally prevented by a paralysis, whereas way-finding is generally stands for a cognitive skill rather than physical ability. Nevertheless, the term mobility may be used in a different way. For instance, Strelow (1985) used

the term mobility to describe way-finding skills. He urged that it is a characteristic of both human and animal behavior. He then generalized the term to stand for the overall process of guidance by which wayfarers move through environment. Strelow claimed that way-finding in the absence of vision depends upon path-following strategy, on the nature of the task facing wayfarer, and on the type of information available along the route (Portugali, 1996). Finally, we should differentiate between spatial orientation and way-finding, since the term spatial orientation stands for a person's ability to understand the space around him and to locate him self, while way-finding stands for a person's ability to reach a destination.

1.3. THE IMPACT OF DISORIENTATION

> "Easy information benefits business, transport, culture, tourism and, most importantly, the people of the city. Making connections can also help achieve wider social, economic and cultural benefits and promote civic pride." (Kelly, 2001: 15)

People may have different feelings toward environmental surroundings. While some of them are happy, others may feel confused, bewildered and distressed. They may avoid unfamiliar natural settings because of fearing of getting lost. It is really annoying and terrifying to be lost in a city, wasting your time and energy in a fruitless attempt to reach a destination. It is said that time is money and the time of a trip is an essential factor in determining an alternative for a spatial decision making, so wasting your time attempting to find your orientation may cost you a lot; patients may die because ambulance drivers could not find their way to an address in time; you may miss your appointment or train because you do not know how to get there easily. In fact, person will actually get fed up from the frustration and stress of getting lost (Arthur & Passini, 1992). Way-finding difficulties may also be on building scale. For example, if there is a fire in a building, then the

issue of emergency evacuation becomes an urgent task, and way-finding becomes a matter of life and death (Arthur & Passini, 1992). Moreover, disorientation may cause functional inefficiency which may lead people to vandalism expressing their anger. In hospital, Doctors and nurses may lost time trying to find their way about, particularly when they are new on the job. We actually need to be able to build up effective mental map of an area, so assessment and planning of journeys will be easy, and the ability of specifying safest and shortest routes between origins and destinations will be possible.

1.4. PERCEPTION AND COGNITION

According to Lang 1994 perception is the active and purposeful process of obtaining information from the environment through observation, while cognition is the process of thinking that involves learning and remembering (or forgetting), generalizing, feeling, and attitude information, liking and disliking. There is an ambiguity by psychologists and other social scientists in distinction between perception and cognition, since it difficult to determine whether the word concerns the perception process itself or the product of it. According to experimental psychologists, perception "…involves the awareness of stimuli through the physiological excitation of sensory receptors" (Downs & Stea, 2005: 13). According to geographers, it is a comprehensive term that includes all psychological factors that needed for the formation of environmental cognition (Downs & Stea, 2005).

Perception is closely connected with events, it is "…the process that occurs because of the presence of an object" (Downs & Stea, 2005: 14), so it is a direct sensory, whereas cognition is indirect sensory, thus it may be connected with the past or the future.

In fact, cognition is an umbrella term that includes perception, thinking, problem solving and the organization of information and ideas. Stea (1969) differentiated between perception and cognition from a spatial point of view. According to him, cognition occurs when the perceived objects and events are larger than the field of view, so they must be organized mentally (Downs & Stea, 2005).

1.5. THEORIES OF PERCEPTION

1.5.1. Empiricism

Learning and memory studies began with speculations by the Ancient Greek philosophers. The British philosopher John Locke (1632- 1704) wrote on Empiricism. He described the mind at birth as a "tabula rasa[3]". According to Locke, humans are born without knowledge (like a white paper) and gradually experience acquired through empirical observation and associations; association means linking ideas together, so complex notions are built up by associating simpler ideas (Bornstein& Lamb, 1999; Howard,1995; Sternberg,2008). Empiricist urged that a stimulus stimulates bodily sensation. William James (1842-1910) created the phase "blooming, buzzing confusion " to describe the perceptual world of the newborn infant. He postulated that babies live in a confusing world which gradually turns more ordered through learning. Empiricism transits human beings from naïve to mature perception.

1.5.2. Nativism / Rationalism

Nativists urged that knowledge can not be achieved by learning alone, there must be inbuilt one in our minds. French rationalist Rene Discartes (1596-1650) postulated that fundamental concepts such as time and space are too complex to be learned, so humans are granted with ideas and categories

[3] Tabula rasa means blank slate or empty headed in Latin.

which present at birth and emerge through maturation (Bornstein& Lamb, 1999; Howard,1995). Rationalists believe that the key to understanding human mind is through logical analysis. German philosopher Immanuel Kant (1724-1804) urged that both Rationalism and Empiricism must work together and never be isolated from each other. Today, many psychologists accepts Kant's thoughts (Sternberg,2008). In fact, There was a sterile and absurd controversy between Empiricism and Nativism. For example when considering the evolution of using the vocal apparatus, we born able to use it (the baby's first cry) natively spontaneously. But no child able to speak in cradle; it is acquired skill. Consequently, innate and acquired factors must be considered (Gordon,2004). The problem is ambiguous and complicated by the relationship between genes and the world.

1.5.3 Structuralism

Structuralism aims to understanding the structure of the mind and its perceptions (Sternberg, 2008). It emerged in 1690 as the first school of thought and reached its peak between1870 and 1910 thanks to the work of Wilhelm Wundt in Germany and Edward Titchener in America. Wundt and Titchener tried to explore the mind in a method similar to chemical analysis of complex substances (Gordon,2004). They believed that complex perceptions can be decomposed into elementary sensations (Gordon, 2004; Mather, 2006). For example, the perception of a flower in the view of structuralism will be analyised in terms of colors, forms, size relations, etc. Researchers tried to understand the basic elements of consciousness using a method known as introspection. "**Introspection** is a looking inward at pieces of information passing through consciousness"(Sternberg, 2008: 6). Introspection involves an observer describing what went on in his mind through a particular reaction to a stimulus (Howard, 1995). According to structuralism the perceived world is a mosaic. This reduction to sensations

leads to the "stimulus error" in which there is a confusion between the source of sensation and the sense itself. Structuralism was criticized for the subjectivity of the experimental methods that used to study the structures of the mind (observers usually differ in their introspections) and a lack of reliability in results because of the use of introspection method, as "introspective data are inherently qualitative rather than quantitative" (Mather, 2006: 32). Other critics argue that structuralism has focused on internal behavior, which can not be directly perceived and cannot be accurately measured[4].

1.5.4. Functionalism

Functionalism formed as a reaction to the structuralism and was heavily influenced by the work of William James (1842- 1910) and the evolutionary theory of Charles Darwin. Functionalism explains the mental process rather than configurational elements (structure). In other words, it focuses on the purpose of consciousness and behavior: understanding human behavior and its justifications, so functionalism is in contrast to that of structuralism. Functionalism had led to pragmatism which asserted the validity of knowledge according to its degree of usefulness: how to exploit our knowledge?. Pragmatists believe in the importance of the psychology of learning and memory as they can be helpful in improving the performance of children in school and enhance the people's ability of learning how to remember names (Sternberg, 2008). Functionalism was criticized by Wilhelm Wundt: "It is literature. It is beautiful, but it is not psychology" (Blumenthal, 1970: 238; Reisman, 1991: 21; Hergenhahn, 2009: 340).

1.5.5. Associationism

[4] http://psychology.about.com/od/historyofpsychology/a/structuralism.htm

Associationism explores the relationship between events or ideas: how events can be associated with each other in the mind through contiguity, similarity or contrast, thus leading to learning. Associationist believes that behavior, whether simple or complex, is a mechanical process based on memory. Hermann Ebinnghaus (1850- 1909) was the first experimental who was influenced by associationism. He studied how people learn and remember material through the conscious repetition. He made an inference that frequent repetition can be helpful in learning. Thorndike (1874- 1949) claimed that satisfaction is the key to forming associations calling this principle the law of effect: "A stimulus will tend to produce a certain response over time if an organism is rewarded for that response" (Sternberg, 2008: 8). The work of Thorndike led to the metatheory of behaviorism.

1.5.6. Behaviorism

John Watson (1878-1958), the father of Behaviorism, was influenced by Empiricism and associationism. He urged that introspection method was subjective; and behavior can be studied scientifically, rather than thinking which exists only in human, thus Behaviorism shifted the emphasis of experimental research from human to animal participants. Although conducting with laboratory animals such as rats allows for much greater behavioral control of relationships between the environment and behavior, generalizing the research to humans may not be valid (Sternberg, 2008). According to Watson, the mind does not affect behavior. Ivan Pavlov (1849-1936) studied the salivation at dogs. First, he claimed that dogs salivate automatically, when their tongues touch food calling the response the salivation reflex. After that, he introduced another stimulus unrelated to feeding by ringing a bell before the arrival of meat, and after a few repetitions, the dogs salivated upon hearing the bell before the arrival of the meat. Pavlove called this new response the conditioned reflex. Some

psychologists rejected radical behaviorism. For example, Tolman 1932 urged that understanding behavior requires a certain knowledge of the purpose of and the plan for, the behavior, so behavior is related to what's known as cognitive psychology. Behaviorism limited learning to be merely as a result of direct rewards for behavior ignoring social aspect which may also lead to learning.

1.5.7. Gestalt Theory

Gestalt psychology, founded In 1912 by German theorists Max Wertheimer, Wolfgang Köhler, and Kurt Koffka, was to some extent a revolt against the molecularism (structuralism) of Wundt's program for psychology, in sympathy with many others at the time, including William James. The German term Gestalt is often translated as form, figure, pattern or configuration in psychology[5] (Mather, 2006). The gestalt theory refers to how we see things in general. "We can not fully understand behavior when we only break phenomena down into smaller parts" (Sternberg, 2008:10). According to Gestalt psychology, the whole is greater than the sum of it's parts because dealing with the parts will mean that vital properties of the whole will be meaningless. For instance, a sentence has a Gestalt because it has a characteristic of its meaning which none of the individual words or letters have.[6] Gestalt psychologists developed a set of principles to explain perceptual organization, or how smaller objects are grouped to form larger ones. These principles are often referred to as the "laws of perceptual organization"[7].

1.5.7.1. Laws of Perceptual Organization:

1.5.7.1.a. Law of Similarity

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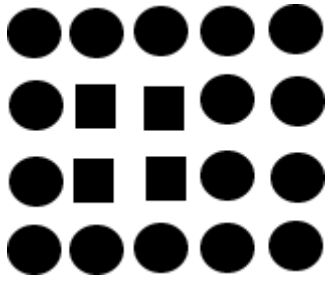
[5] http://www.answers.com/topic/gestalt-psychology

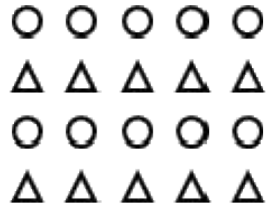
6 http://atheism.about.com/library/glossary/general/bldef_gestalt.htm.

[7]http://psychology.about.com/od/sensationandperception/ss/gestaltlaws.htm

Similar shapes tend to be grouped together constituting some type of meaning. For instance, if we see a row of triangles, we tend to group them as a row or line. We are less inclined to view them as separate triangles, but we tend to perceive them as a line of triangles[8].



(source: www.mikegreen.info)



(source:www.interaction-design.org)

Figure 1.3. Law of Similarity.

1.5.7.1.b. Law of Goodness or Pragnanz

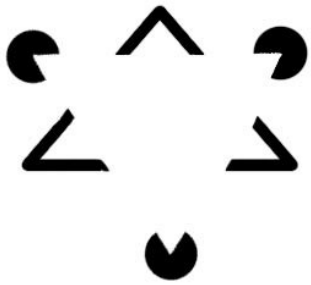
Pragnanz means good figure in German terms. "Koffka (1935,p138) describes the law: "of several geometrically possible organizations that one will actually occur which possesses the best, simplest and most stable shape" (Bruce et al.,2003: 127). The law states that figures are perceived in away that make them as simple as possible (Bell et al., 2005). For instance, irregular and complex figures appear to the eye as simple geometric shapes, like circles, squares or triangles although they are actually different. In fact, good figure can mean several things such as regular, simplistic, symmetrical, etc.

[8]http://ezinearticles.com/?Gestalt:-Law-of-Similarity

Figure 1.4. Law of Pragnanz: The figure appears to the eye as a square overlapping a triangle, not as a combination of several complicated shapes.(source: www.ethnomusic.ucla.edu)

1.5.7.1.c. Law of Closure

It states that objects are grouped together if they tend to complete some entity. Our minds tend to ignore gaps and complete missing information. A circle, for example, with a small parts of its circumference missing, will still be seen as a circle, as the gaps will be closed.



(source:http://3.bp.blogspot.com)

(source:www.mikegreen.info)

Figure1.5. Law of closure: we tend to complete missing information and ignore gaps.

1.5.7.1.d. Law of Figure-Ground

This law states that we have a tendency to perceive one aspect of a composition as the figure or foreground and the other as the ground or background. “The figure-ground distinction is highly important evidence for the dynamic character of perception” (Gordon,2004:15). There is ambiguous relation between figure in a field of view and the ground against which it is seen. For instance, figure 1.6. shows an ambiguity between figure and ground as the white circle can be perceived as a disc or a hole.

Figure1.6. Ambiguous figure-ground relationship. Is the white disc superimposed on the triangle, or is it a hole through which the underlying ground can be seen? (source: Gordon,2004: 15)

In other words, with many images that use this law, the way in which we see two images is to just change our attitude and to look at another aspect of it. For example, the tow images below can be seen as a vase or as two faces, if we change our attitude towards them[9].

Figure 1.7. Ambiguous figure-ground relationships: Images can be seen as a vase or as two faces (source: www.mikegreen. info/ portfolio/ websites/ visCom)

But it is impossible to maintain simultaneously of both the faces and the vase. Relying on this principle of interference between figure and ground, the artist M.C. Escher produced etchings reflecting ambiguity between figure and ground (Bruce et al., 1996). This interference between figure and ground

[9] http://www.mikegreen.info/portfolio/websites/visCom

can be exploit to construct pictures with ambiguity in their internal organization. For instance, Jastrow's duck-rabbit picture may be seen as a duck (beak at the left, or as a rabbit (ears at the left).

Figure1.8. Escher's "circle limit IV" (source: Bruce et al., 1996)

Figure1.9. Duck or rabbit.[10] (source: Bruce et al.,1996)

1.5.7.1.e. Law of Proximity

It concerns a tendency of the mind to group objects that are close together not as separate parts, but rather as one coherent whole.

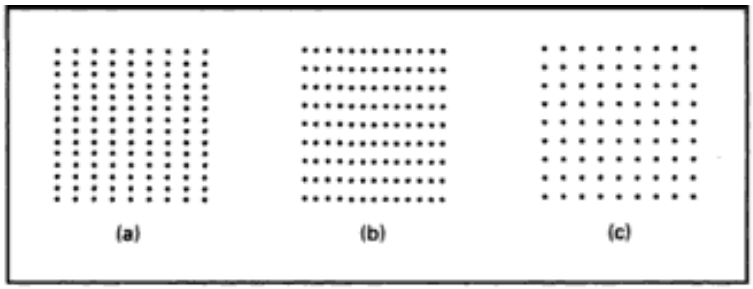


Figure1.10. Law of proximity :The dots in **(a)** form column because they are nearer vertically than horizontally. At **(b)** we see rows, the dots here are nearer horizontally.;**(c)** is ambiguous, the dots are equally spaced in both directions. (source: Bruce et al., 2003)

1.5.7.1.f. Law of Continuity

[10] this ambiguous picture was introduced to psychologists by J. jastrow in 1900.

The law of continuity states that points or shapes that are joined by straight or curving lines are seen in a way that follows the smoothest path[11]. We are less inclined to view them as separate lines and angles, but we are more inclined to view them as belonging together. Figure 1.11. shows that one tend to perceive two smooth curves that cross at point X, rather than perceiving two irregular V-shaped forms touching at X.

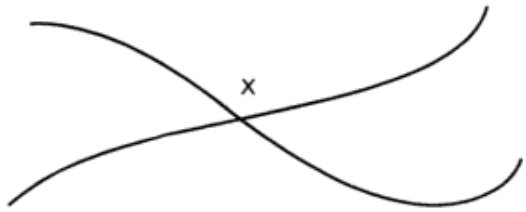


Figure 1.11. Law of continuity: This is seen as two smooth lines crossing at X, rather than as two V-shapes touching at X. (source: Bruce et al., 1996)

Similarly, dissimilar shapes may also tend to be grouped together if they are closer from each other.

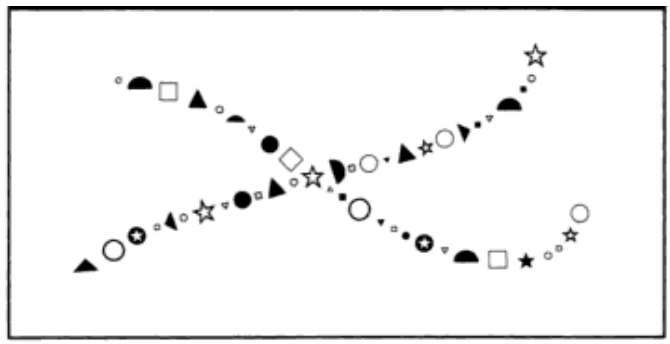
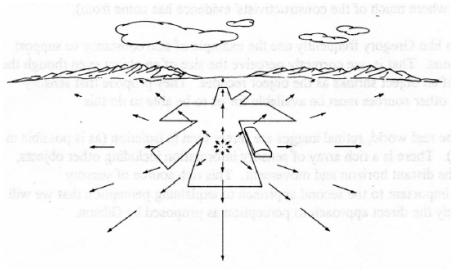


Figure 1.12. Continuity of dissimilar shapes: Quite dissimilar shapes tend to be grouped together through a combination of proximity and good continuation. (source: Bruce et al., 1996)

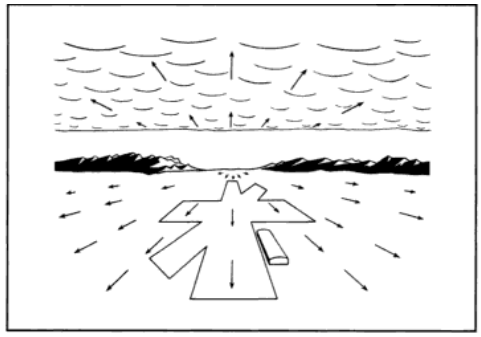
1.5. 8. The Ecological Theory of Perception (Direct Perception)

[11] http://psychology.about.com/od/sensationandperception/ss/gestaltlaws_5.htm.

The ecological approach to visual space perception was developed by the American psychologist J. J. Gibson since 1950. Gibson worked during World War Π on the problems of pilot training and selection. The most difficult problem was how to land successfully, this requires knowledge of location relating to the air strip; the angle of approach and how to modify this approach. This issue of aviation led Gibson to discover what he called *optic flow patterns* which provide pilots with information about direction, speed and altitude (Bruce et al., ١٩٩٦). Directions of flow of the optic array determine the type of movement. For instance, if there is any flow of optical array then the perceiver is moving. If a flow seems to be getting out from a particular point, this means that the perceiver is moving towards that point; but if the flow looks to be towards that point, then the perceiver is moving away[12] (Gibson, 1979; Hayes, 2000).



(source: http:// cranepsych. com/ Psych.)



(source: Bruce et al., 1996)

Figure 1.13. The optic flow pattern for a pilot landing an aeroplane.

[١٢] http://cranepsych.com/Psych/Theories_of_Perception.pdf

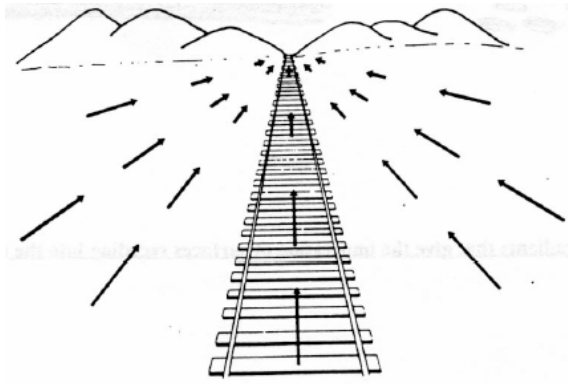


Figure 1.14. The optic flow pattern for a person looking out of the back of a train. (source: http://cranepsych.com/Psych.)

The starting point of Gibsonian is not retinal image which states that information for visual perception is obtained through provoking of the light on the retinal, but it is the ambient optic array which stands for "a bundle of visual solid angles at a point of observation" (Schwartz, 2004:162). The ambient optic array emphasises that the structure in the light extended over space and time that furnishes direct information about the media, surfaces, substances, and events for an observer.

> "Gibson's model sometimes is referred to as an ecological model (turvey,2003). This is because of Gibson's concern with perception as it occurs in the everyday world (the ecological environment) rather than in laboratory situations, where less contextual information is available"(Sternberg,2008:101).

Ecological approach emphasizes that the initial function of perception is to ease interaction between observer and environment (Eysenck, & Keane, 2000). Gibson's Ecological approach is a direct realist, as there are *affordance*s between environment and organism which emphasis that environment and organism are inseparable; "The affordances of the environment are what it offers animals, what it provides or furnishes, either

for good or ill." (Gibson,1986:127; Lang, 1994: 30). It is "the possibilities for action which are offered by an object" (Hayes, 2000: 60), so perception and action are interwoven and closely related (Bruce et al., 1996). Gibson claimed that all the information that the perceiver needs to perceive objects is provided by the entire pattern of proximal stimulation with no need for any learning or any experience, as all information is picked up straight from the optic array and not processed mentally because there is no need for memory in explaining perception (Hayes, 2000). He also urged that there is much information existing in sensory stimulation than what generally realized calling this phenomena process of *resonance* which is analogy to the workings of radio. For instance, There are many channels available in the electromagnetic radiation, but receiving them requires resonating the radio with the information contained in the electromagnetic radiation (Eysenck, & Keane, 2000; Mather, 2006). One argument against the Gibsonian view is that the stimulus information is sometimes misleading and not sufficient for perception, as the stimulus does not provide you with what you need. For Bruner, perception is intelligent process and requires the perceiver to make various kinds of judgments and inferences to engage and reason problem solving. If the perception is a mechanism process, how can we interpret ambiguous pictures, as the stimulus is constant while the perception changes according to how we look at the object. This definitely confirms that the perception is a mental process.

1.5.9. Brunswik's Probabilism

This theory is the work of Egon Brunswike (1903-1955). He made a model known as the *lens model* paying all the attention in interpreting perception to environmental stimuli. He differentiated between two types of stimuli: one is the distal stimulus that coming from the environment; the other is the proximal stimulus that represents the pattern of light on the retina of an

observer's eye, so the proximal stimulus is complicated and subjective. Environmental stimuli vary in their usefulness in perception process, as some of information may be insufficient or superfluous. This degree of usefulness is called *ecological validity*. Likewise, Individuals differ in personality and experience, so they might differ in interpretation of a particular situation as a result of differences in weighting environments stimuli. This degree of weighting environments stimuli is called *cue utilization* (Bell et al., 2005). The fundamentals of Brunswik's model may be illustrated in the following example: suppose that you and a friend are studying. Suddenly, you hear noise behind your desk! Your perception becomes focused on gathering information from environment to decide your response against this stimulus. The noise behind the disk represents the environmental stimulus, it is useful but insufficient (*ecological validity*) − as you can not specify what actually caused the noise, −; You may make guess that a mouse caused this noise, while your friend may differ in interpretation of the cause of this noise or perhaps he did not hear it at all. These differences in interpretation is the *cue utilization*.

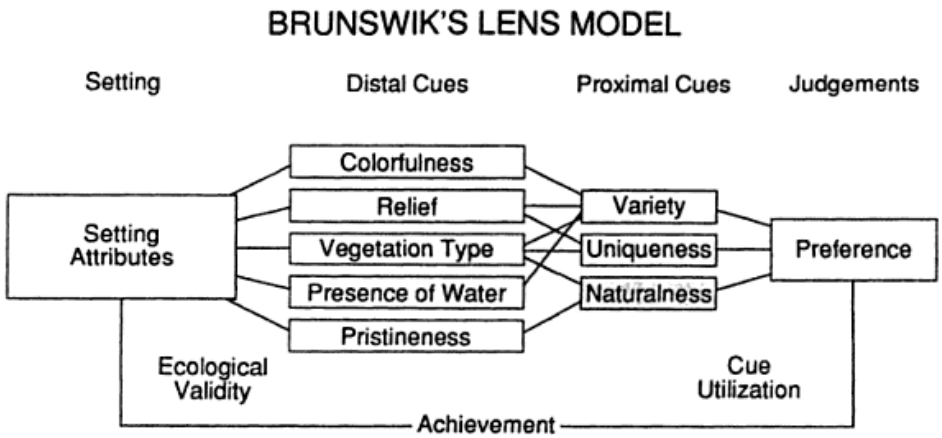


Figure 1.15. Brunswik's Lens Model (source: Bell et al., 2005).

1.5.10. Cognitivism

There are several approaches and theories within this framework. According to cognitivism, human behavior can be understood in terms of thinking (Sternberg,2008). Cognitivism emphasizes internal mental processes using precise quantative analysis for studying the way of thinking and learning. Kail and Bisanz (1992) and Massaro and Cowan (1993) urged that[13]:

1- Psychology concerns studying the mind which responsible for representing environmental surroundings internally and coding them as a set of symbols for things in the real world. In such a way, the mind is a program that runs on hardware (neurons).
2- A cognitive phenomenon is the process that interprets and reflects the relation between two variables: stimulus and response.
3- A small number of elementary processes underlie all cognitive activity.
4- Processes are closely linked. Executing a particular task may require combining several processes, so performance is a result of integrated system.
5- Processing occurs in stages preventing overlapping.
6- Cognitive theory describes the way within which representations and process interact together to produce performance.
7- Humans pick up information and act on rules.
8- Learning is establishing new internal representations or modifying existing ones.
9- Cognitive process changes through self-modifications; for instance, through maturation and learning. This may encourage us to make an

[13] Howard, R., 1995, Learning and memory: major ideas, principles, issues and applications, Greenwood Publishing Group.

inference that a cognitive product could be influenced by many factors such as age and gender differences, and social aspects.

1.6. COGNITIVE MAPPING

1.6.1. Historical Background

The term cognitive map was first used by Tolman (1948) who used it to study the behavior of rats in a maze. His experiment was first to train rats to reach a food using a particular path. It was thought that rats move according to turns of right and left through the maze and their behavior is just a simple matter of stimulus and response. But when the path was blocked, Tolman noticed that the rats were able to switch to another unused path. Furthermore, the rats ran across the top directly to the food source. Tolman made an inference that the rats learned the route and that they could make navigational decisions based on knowledge of the environment, rather than their directional choices.

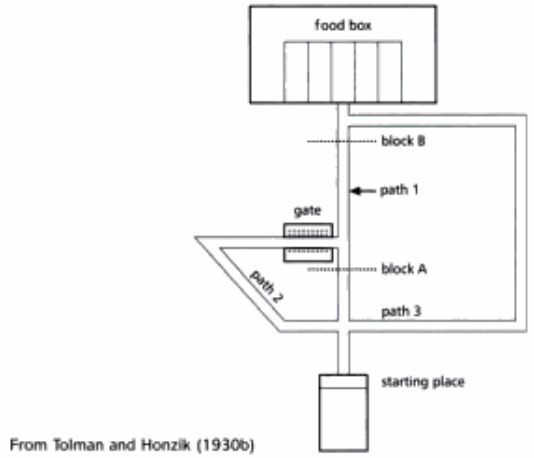


Figure 1.16. Tolman and Honzik maze: initially, rats learned their way from to the start to the food box without obstructions and reliably used route 1, the shortest. When their path was blocked at A, the rats selected route 2 to avoid the obstruction and reached the food on 92 percent of the trails. When the path was obstructed at B, 93 percent of the rats chose route 3 on the first test trail (source: Russell & Roberts, 2002: 177)

Since Tolman's experiment, many studies on the nature of cognitive representations have been carried out. Two publications were really

influential in paying attention to cognitive mapping studies, the first is *the image* by Boulding in 1958, the second is *The Image of the City* by Kevin Lynch in 1960. Boulding emphasized that understanding what people do requires understanding what they know and that understanding the image in peoples minds is essential in understanding humans behavior. Kepes urged that we create symbols and images to understand environmental surroundings, individually in our personal images, and socially in images we share with others. Lynch tried to explore the relation between an observer and his environment and how the image is built up. He aimed to investigate people's feelings and knowledge about their environment. He identified five elements people tend to pick up from the environment to build their images. He urged that these elements are the design criteria for a highly legible and imageable environment. Lynch's work is still used widely, it is the classic reference in cognitive mapping. In it, Lynch constructed a methodology for studying cognitive maps depending on questionnaire and field reconnaissance analysis (Bell et al., 2005).

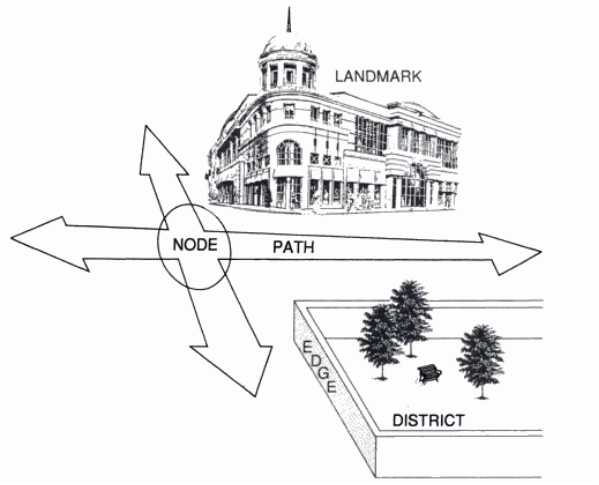


Figure1.17. A diagram illustrating all five of Lynch's elements in a cognitive map (source: Bell et al., 2005)

1.6.2. What Is a Cognitive Map?

Cognitive mapping is:

> "…a process composed of a series of psychological transformation by which an individual acquires, codes, stores, recalls and decodes information about the relative locations and attributes of phenomena in his everyday spatial environment." (Downs & Stea, 2005: 9)

It concerns a spatial cognition: how we think about space; and how people learn and use spatial information about environment. We notice that our memory has to integrate spatial information with non-spatial information (Garling & Evans, 1984). Cognitive mapping has been used in three different ways (Kitchin& Freundschuh, 2000):

1- A descriptive title for studying how people learn and remember spatial information about an environment.
2- A descriptive phrase for the process of thinking about spatial relations.
3- A descriptive name for understanding cognition in general.

Cognitive maps or mental maps constitute a part of our everyday life. They are internal representations or models of the world in which we live (Portugali,1996). " The stronger a mental map we have, the more confident we are about walking to our destination and exploring new areas on foot" (Transport for London, 2007:15). Kitchin has produced a collection of phrases in literature review related to spatial representations including abstract maps (Hernandez 1991); cognitive images (Lloyd 1982); cognitive maps (Tolman, 1948); cognitive representations (Downs& Stea, 2005); cognitive schemata (Lee 1968); environmental images (Lynch 1960); mental maps (Gould 1966; Gould & White 1974); topological representation

(shemyakin 1962). This diversity of synonymous terms stands for internal spatial representation of environmental information.

Figure 1.18. Cognitive map. (source: Bentley et al., 1985)

1.6.3. Cognitive Mapping Signature and Cognitive Representation[14]

Cognitive mapping signature is "the way in which spatial information encoded (map making) and decoded (map reading or interpreting)" (Downs & Stea, 2005: p11). There are three steps to represent real world on a cartographic map:

1- Rotation of point of view to a vertical perspective.
2- Drawing the map in appropriate scale to fit paper size.
3- Coding map information using symbols (for example, green color for lines, blue lines for channels).

Cognitive maps may be presented in a way similar to that used in cartographic maps signatures, but they differ in the degree of abstraction employed and in the type of symbols chosen to represent information (Downs & Stea, 2005). Davis (1999) pointed out two main differences between cognitive and cartographic maps: a cognitive map may have different knowledge structures and may be incomplete, imprecise, distorted

[14] Downs, R. & Stea, D., eds., 2005, Image and Environment, Aldine Transaction.

and subjective, whereas cartographic maps are rationally complete and accurate[15]. Cognitive maps consists of points (such as landmarks and reference points); lines including routes and paths, areas (for example regions and neighborhoods) and surfaces.

1.6.4.Characteristics of Cognitive Map

Cognitive maps are rough approximations rather than perfect presentations of the real world. In fact, a spatial product may not accurately reflect a stored knowledge structure. All Cognitive maps contain errors because most people are not expert mapmakers. "Errors incurred during the encoding phase of knowledge phase of knowledge acquisition can produce distortions in the material stored" (Golledge, 1999: 23). Errors in cognitive maps are most often metrical and rarely topological (Lynch, 1960). Errors can be summarized in the following items :

1.6.4.1. Incompleteness or Leaving Something Out

It is the most common error. Cognitive maps tend to be incomplete, we often omit minor paths and details (Bell et al., 2005). Cognitive map is discontinuous. For instance, The surface of the earth is nearly continuous curvature, but we see it flat because our field of view is limited (Downs& Stea, 2005). We sometimes omit prominent features of the city because they may play no significant or valued role in our behavior, thus they never noticed or learned. On the other hand, we always depict things that are known and familiar to us. Eventually, accuracy and clarity of a cognitive map depends up on either its familiarity, and its conformity to stereotype, or because of uniqueness and strength of the image itself.

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[15] Tokarczyk, P., 2008, Automatization of data acquisition and processing for pedestrian navigation system purposes, M.Sc. thesis, institute for Geoinformation and Cartography, Geoinformation Research Group, Technical University of Vienna.

1.6.4.2. Distortion

It is also very common error, it means the degree of cognitive transformation deviation of both distance and direction. When a cognitive image is depicted in a sketch map, distortion of transformation process occurs. This distortion may be in size or distance, etc. For instance, a thing may be placed too close together, too far apart, or aligned improperly. Peoples sometimes misestimate the size of streets intersections angles. "Acute intersection angles are often overestimated, and obtuse angles are underestimated" (Bell et al., 2005: 78). Likewise, places well known to people are seen as more important in size(Passini, 1992).

1.6.4.3. Abstraction or Schematization

schematization means "the use of cognitive categories into which we code environmental information and by which we interpret such information" (Downs& Stea, 2005: 19).

1.6.4.4. Augmentation

It is the least common and most puzzling of the errors. We may augment our maps by adding non-existent features to them as embroidery. For example, ancient cartographers detested vacant areas and filled them with spurious elements. We may also put in a set of traffic lights at a junction we know to be dangerous, even though there are none there (Russell & Roberts, 2002; Downs& Stea, 2005). Augmentation often happen when there is ambiguity between two places, then the depicted cognitive map may includes elements of both (Bechtel, 1997).

1.6.5.How to Study Cognitive Maps?

Cognitive maps are externalized as a variety of spatial products. Cognitive maps can be depicted through verbal, sketching, estimation or modeling techniques.

1.6.5.1. Drawing Sketch Maps

This method, employed by Lynch (1960), provides researchers with information about internal spatial representation of environment in people's mind. It is to ask individuals to draw sketch maps of their city, thus providing a rich source of data. Sketch maps are flawed because of individuals differences in abilities of drawing sketch maps; variations in the perspective from which the map has been drawn; the scale of the map (city, neighborhood, campus) and the type of map (spatial or sequential) (Russell & Roberts, 2002; Bell et al., 2005). The quality of sketch maps is a good indicator of way-finding ability, that is, the better sketch map, the more likely individuals to find their way. In order to overcome sketch maps problem of individuals differences, Gold and white (1982) used a method called Goldian maps by which participants can be asked with reference to an accurate base map for information about their reactions (Bell et al., 2005).

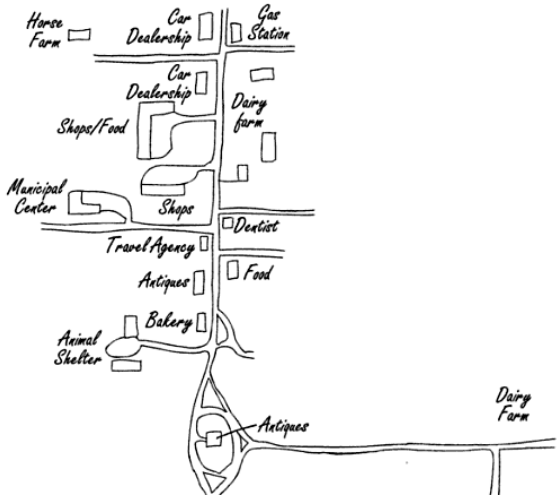


Figure 1.19. A student's sketch map of her hometown (source: Bell et al., 2005).

1.6.6. Gender Differences

Males and females differ in their cognitive mapping abilities, females tend to have less spatial confidence than males (Lawton, 2001; Lawton & Kallai, 2002; Bechtel et al., 2002). Males have been found to draw complete, extensive, and accurate cognitive maps. Women seem to focus on landmarks and districts, whereas men are more likely to emphasis path directions and distance estimates. Women may know more information about a district than they include on their sketch maps (Kitchin & Freundschuh, 2000). They are also more accurate in the recall of landmarks. These sex differences may be due to differences in familiarity with a city, differences in experience, or the socialization process, but a biological component can not yet be entirely eliminated (Bell et al., 2005; Russell & Roberts, 2002). In her studies of psychology, Lawton (2001) made an inference that men prefer using global or cardinal references (such as compass points or the position of the sun) in orientation strategies. On the contrary, women rely on local references such as left and right turns when navigating within an area.

1.6.7. Spatial Updating

Spatial updating is a significant process for successful way-finding ability. One must constantly know his location in relation to places in the environment. In fact, cognitive map itself need to be updated periodically. Spatial updating can be undertaking in a variety of ways such as[16]:

1- Recognizing reference points such as landmarks for identifying current location and a destination.
2- Coding our locomotion along path segments, so the path can be mentally retraced and current location can be inferred.
3- The codes used in motion mental representation should be related to environmental knowledge.
4- Establishing spatial configuration using nodes and polar victors.

[16] Portugali, J., 1996, The construction of cognitive maps, GeoJournal Library, Springer.

1.7. HOW TO FIND MY WAY?

1.7.1. An Informal Model of Spatial Cognition

Any journey should be preceded by a strategy of movement which we can call action plan. Action plan needs information about relative locations of places. In absence of this information, we navigate haphazardly, thus missing our way. We can get information from printed maps, instructions from other humans, and memories of past travel to form an action plan for a proposed journey (Bell et al., 2005).

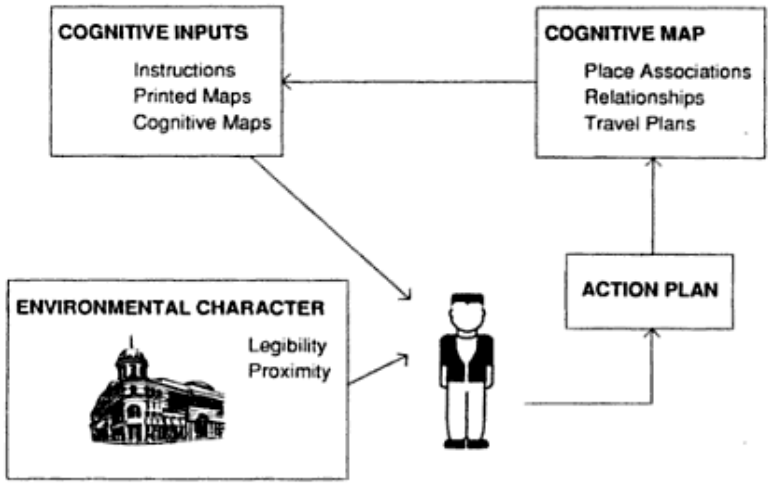


Figure 1.20. An informal model of spatial cognition
(source: Bell et al., 2005)

Way-finding then, is a process of decision making including a four steps of action plan:

- Determining the location
- Localizing the destination
- Selecting a route
- Deciding how to travel

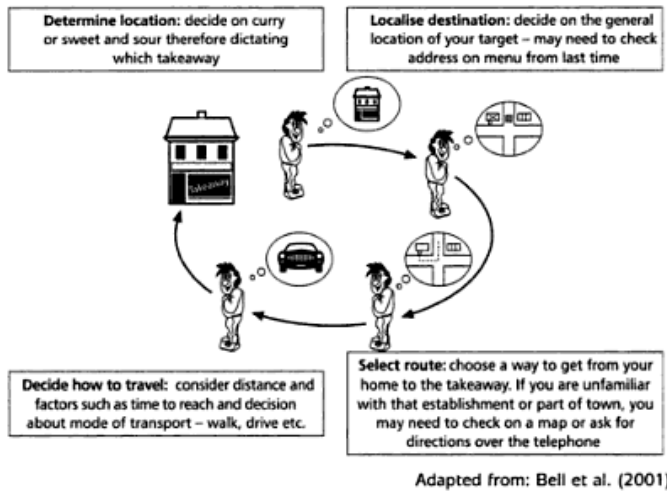


Figure 1.21. Steps of constructing an action plan
(source: Russell & Roberts, 2002)

1.7.2.Way-Finding as a Problem Solving Process

According to Passini (1984), way-finding is a sequential process of spatial problem solving. This process includes three distinct abilities[17]:

- Information processing (cognitive mapping ability). It is perception and cognition, furnishing the essential information for making and executing decisions.
- Decision making or planning ability and the development of an action plan to reach a destination.
- Decision execution that results in behavior at the appropriate places along route.

1.7.2.1. Decision Plans Components

Way-finding process is broken down to many tasks which generally contain many decisions that differ in number according to complexity of the task.

[17] Bechtel, R., 1997, Environment & behavior: an introduction, SAGE.

For instance, a task that does not last longer than 20 minutes may requires more than 100 decisions to be completed. the original complex task is broken down into subtasks in order to be more manageable problems. Any subtask involves a reasonable number of decisions that range frequently from three to four and never exceed half a dozen. developing Decision plans lead to developing a solution for way-finding.

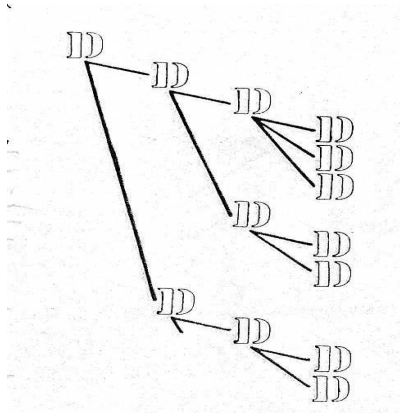


Figure 1.22. Breaking up of a complex task into subtasks.
(source: Passini, 1992)

1.7.2.2. Decision Making Flexibility

It is completely away from reality to think that a person puts a total plan for an unfamiliar task and then executes it. In fact, people first have only a global and enigmatic initial plans including a few general decisions that help at the initial steps. After that, way-finding problems are tackled as they present themselves, since the person will pick up new information that helps focusing and clarifying the problem.

Global initial plans and inability to assess problem is a logical start as there are many environmental factors unknown or unpredictable. New plan is formulated after executing previous one. This formulation occurs sequentially avoiding overlapping that definitely leads to many failures. This indicates that we deal with just one problem or subproblem and never solve many problems at the same time. When a person fails to solve a way-finding

problem, he has two alternatives: The first is to contrive a new plan to execute the same task for instance, if one can not go up to his flat by the elevator, he may choose to use the stairs. The second alternative is to change the task itself (Passini, 1992).

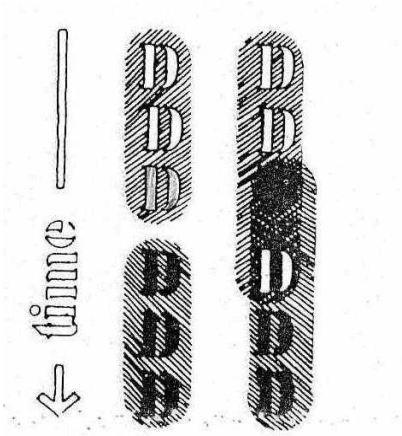


Figure 1.23. Sequential and overlapping plans.
(source: Passini, 1992)

1.7.2.3. Executing Decision Plans

Any decision is composed of many parts determining the way of its execution. Way-finding decisions contain an action part and an object part. The action part is what we intend to do (the event), while the object one is the recipient of the action. The object part provides an expected mental image which may be more or less clear (Passini, 1992). This image creates an expectancy of finding at the appropriate time. If there is congruence between the image expected and the image perceived in the physical environment at the appropriate time, then the decision can be executed. If no congruence existing at the appropriate time, the decision can not be executed. This means that in case of matching between the expected object image and the perceived object, then the action part of the decision is in motion and vise versa.

The person may have to develop a new plan for a decision that has become a task, as it is assumed that the person continuously matches expected decision image with perceived images.

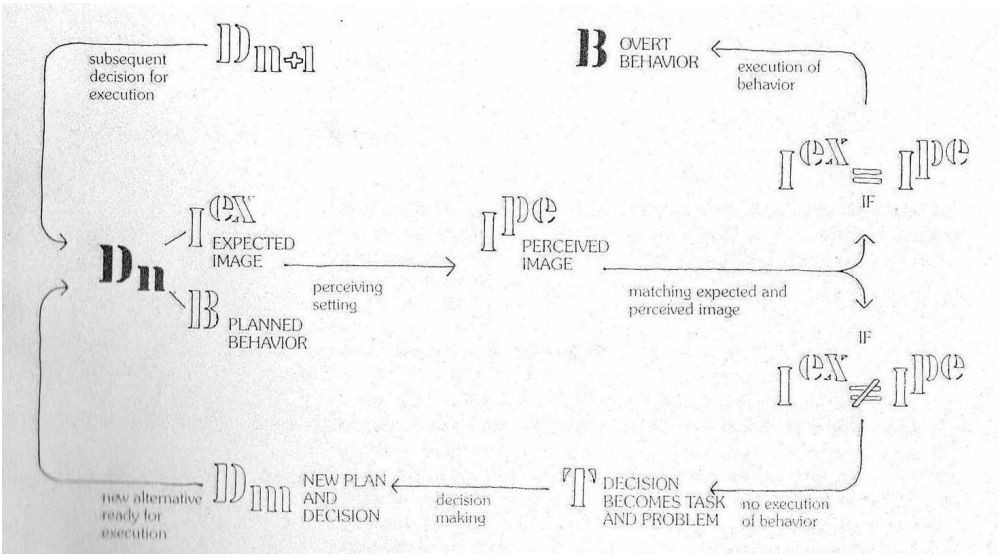


Figure 1.24. Decision execution as a matching feedback process. (source: Passini, 1992)

1.7.2.4. Decision Making Alternatives

People may take the longest path between to points in an environment. The reasons that might prevent them from following the shortest one can be theorized. For instance, they may not be aware of the shortest path. Another, there may be constrains that prevent or guide people's movement. In fact, a choice between number of places requires retrieving information about environment, then probable alternatives are set up. These alternatives need to be evaluated, thus choosing one of them to be implemented. Choice of a place leads to choice of a path, and finally implementing the decision. Both spatial and non-spatial attributes influence spatial decision. Spatial attributes include direction or location of the decision alternatives. Non-spatial attributes may constitute a disutility when they are correlated to travel

distance, time, danger or threats, and energy cost of travel whereas the attractiveness of place/ activities constitutes a utility. Utilities and disutilities should be compared when alternatives are evaluated, for instance whether attractiveness of the place offsets the cost of moving to it. There are also other factors affect choices of decision such as limited working memory, mode state, time pressure, and lack of knowledge. It is worth mentioning that it is not necessary to go from an origin to a particular destination and back, then to the same origin to go to another destination, as places are frequently linked, so one can go from an origin to a destination considering this destination as an origin to a new task and so on until he achieve his mission and then back to home origin or starting point a gain.

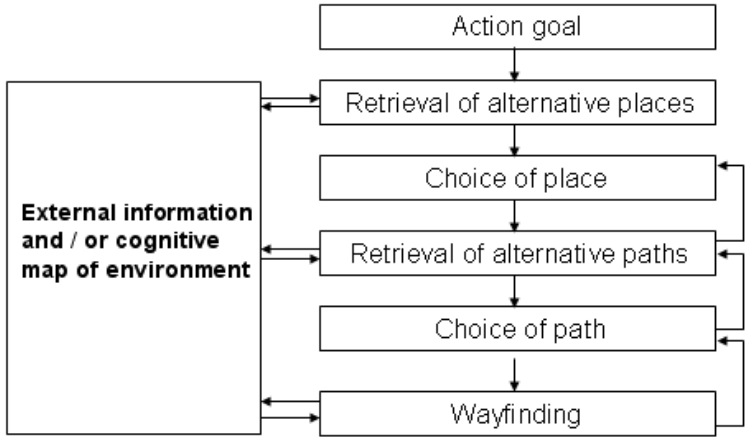


Figure1.25. Stages of spatial decision making (source: Kitchin & Freundschuh, 2000)

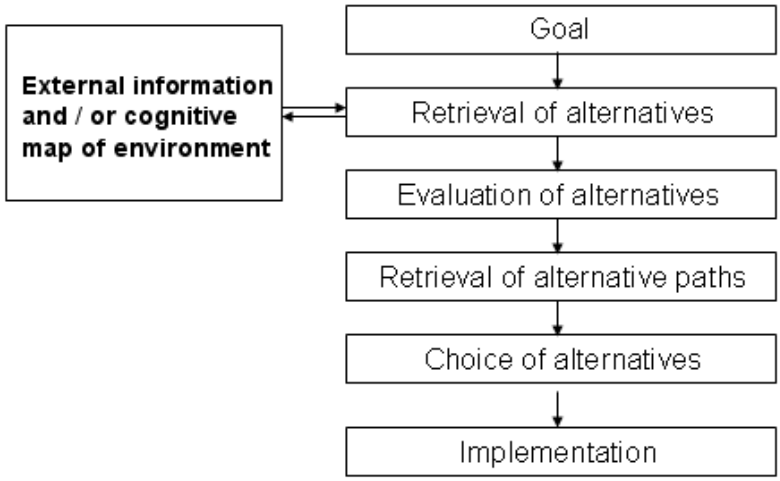


Figure 1.26. A hierarchy of spatial decisions
(source: Kitchin & Freundschuh, 2000)

1.8. CONCLUSION

This chapter discussed many important definitions and tackled many related issues.

First, we explained way-finding definition declaring distinction between it and mobility. After that we mentioned psychological and social impacts of being lost on an observer and how that can get him frustrated and stressed, thus leading him to mental agony.

In the next part of the chapter we discussed theories of perception and criticisms confronted to them. Environmental perception emphasizes ecological theory of perception that much more dynamic and absolutely differs from reductionism formerly practiced in psychology.

In the last section, we explained an important part of our notion related to human experience in remembering routes, it is cognitive mapping; its definition; characteristics and errors of it; ways of studying it; and gender differences.

Finally, we discussed the notion of way-finding from a different point of view as a sequential process of problem solving. In this part, we presented Romedi Passini thoughts about way-finding and how it influences spatial decision making.

CHAPTER TWO
KEVIN LYNCH MAPPING METHOD: Physical & Spatial Characteristic Of Environment

2.1. INTRODUCTION

Years of research into city form and spatial cognition have shown that finding one's way through an environment can be a difficult task. The initial questions that need to be considered are: what are the criteria of good city form? What is the relationship between observer and environment? How the visual quality of a city can contribute to the urban legibility? This introduction addresses the basic material of this section. The task of this section is to give an overview of Kevin Lynch's theory of urban form, as set out in his book *The Image of the City*. City image is important because the ability to recognize objects in our environment is critical to our ability to act and function in places effectively (Lynch, 1981). Thus, the ability of a city is somewhat depends on its ability to be easily found and identified. Kevin Lynch made a connection between psychology and environment, at a time when many psychologists preferred laboratory experiments to the wondering variables of the complicated, real world (Banerjee & Southworth,1990). It's worth mentioning that lynchian thoughts were the solid foundation for many other theories of good urban design.

2.2. PERFORMANCE OF THE CITY

The degree of good city performance is determined by its ability of providing biological, psychological, social and cultural requirements to its inhabitants. Once these requirements have been specified, then an estimation could be made offering to which degree the city is good. Kevin Lynch in his

book *good city form* summarized these requirements in five points, they are called performance dimension:

2.2.1.Vitality

The degree to which the city sustains the essential, biological performance of human beings: this is the supports of our bodies needs such as water, air, energy and food, there should be sufficient supply of them to sustain life, moreover good settlement should be free of danger, poisons and disasters, then it supports safety for its inhabitants.

2.2.2. Sense

It is the degree of fit between the physical city (form) and the way people recognize and organize it in their minds. In other words, it is the degree of homogeneity between environment and observer. Sense then, reflects the clarity with which people perceive the space. Sense depends upon spatial structure, quality, the culture and the current purpose of the observer (Lynch, 1981). This dimension will be tackled in more detail later.

2.2.3. Fit

It is the match between the action (function) and the physical city (form), this is the requirements of our culture. It is " how well the spatial and temporal pattern of a settlement matches the customary behavior of its inhabitants" (Lynch, 1981: 151). When there is congruence between form and patterns of behaviors, people feel comfortable; conversely, absence or lack of fit could make it uncomfortable and difficult to behave through an area.

2.2.4. Accessibility

That is not means the ability to reach transportation only, but to access to all things such as services, information, other places and to other peoples also, then an interaction is established between these variables. Access offers the degree of choice and diversity presented to us. A place should provide people with information about physical ways of reaching it.

2.2.5. Control

It the degree to which the environment is under the control of the people who actually use it or reside in it. According to Hall, control gives people feelings of power and stability. People feel in control when there is enough social and physical space to do as they need.

2.3. ANALYZING THE SENSITIVITY OF THE CITY

It is clearly believed that building the image of an environment is a two way process, it is the result of an interaction between the observer and the environment in which he lives. The process is not just how we see things and others, but also how others see us as a part of environment. Consequently, it reflects the influence of observer and environment on each other. " nothing is experienced by itself, but in relation to its surroundings, the sequences of events leading up to it" (Lynch,1960: 1). Sense of the city as mentioned above represents the relationship between physical environment and cognition, since its components are the observer and his environment, this sense can be broken into six elements :

2.3.1. Identity

" Identity is the characteristic that allow us to differentiate one space from another" (Arthur & Passini, 1992: 87). It is the character and spatial attributes of an object or a place that enhance the ability of recognizing and

identifying an environment, those attributes of the object make it distinct, ultimately unique and easily separable, then it stands for individuality or oneness (Lawson, 2001). Place identity is closely linked to personal identity,“ I am here supports I am”(Lynch, 1981: 132). There is not only an identity of place, but also an identity of events which differs naturally from the first as it gives peoples a means to remember events that happened, thus helps them to structure their life.

2.3.2. Structure

It is how the object is placed in the space considering its relation to the observer and to other objects, as the object is not seen isolated from surroundings but as a part of all environmental components. “The architect has to realise that the forms of his buildings react on adjacent forms” (Moughtin, 2003: 28). Aldo Rossi considered the city as a man-made object, a work of architecture and engineering that grows through time. He said “ this is one of the most substantial hypothesis from which to work” (Rossi, et al.,1982: 34). Norberg-Schulz and lynch refer to **organization** when they talk about structure.

2.3.3.The Meaning

Meaning is that which the place stands for or represent (Lawson, 2001). It is a hidden character of the object and the deepen sense that reflects the importance of the object, this sense may be practical or emotional. For instance, the meaning of the door may be as a hole for getting out. The meaning is a complicated notion, its sides are difficult to be specified, but can be separated from the form in the early stages of analysis. A particular city may stands for enjoyment, power, vitality, mystery or something else presented in mental image of its inhabitants. Lynch says that “ the visual environment should be meaningful; that is, its visible character should relate

to other aspects of life"[1]. Steinitz (1968) made an inference that the city becomes more meaningful and known to its inhabitants when there is a congruence between its physical form and activity (Broadbent et al., 1980). People select and filter information that is meaningful to them and build their choices on it.

2.3.4. Congruence

It is the relationship of the form to its function. In other words, how is the environmental structure congruent with nonspatial structure. For instance, what degree of congruence between a residential building and family size?. Congruence can be tested by comparing abstraction of place with abstraction of function.

2.3.5. Transparency (Immediacy)

It stands for the degree of visibility of process occurring in the place to users. In other words, it is the degree to which one can actually see what's going. There are many events occur in the city such as selling, buying and movement, how many of them we can see actually. Definitely, we see less of what actually happening.

2.3.6. Legibility

It is the term that has been used for along time in urban planning defined as " the ease with which its parts can be recognized and organized into a coherent pattern" (Lynch, 1960:2). This definition estates that degree of legibility depends upon the formation of cognitive maps within wayfarers mind (Arthur & Passini, 1992). Legibility is "the degree of distinctiveness that enables the viewer to understand or categorize the contents of a scene- the greater the legibility the greater the preference" (Bell et al., 2005: 45). It

[1] Norberg-Schulz, Genius Loci, p.5.

is the quality which makes an area understandable. Lynch considers Legibility as a physical and spatial characteristic of the environment, so visual sensations of color, motion, smell, touch and sound…etc. are all cues of orientation that reinforce legibility. This view postulates that environmental surroundings influence immediately spatial cognition, and spatial representation is isomorphic to the physical structure (Kosslyn, 1975). According to Lynch definition, legibility can enhance the identity, structure and the meaning of environmental surroundings. The city may has strong identity and character but still confusing and unclear because of confusion of its path system. Wiseman (1981) defines legibility as the degree of facility with which finding one's way is possible in a given built environment. It worth mentioning that Lynch's initial interest was of legibility, but soon the focus adjusted to the issue of the city's mental representation. This led Lynch to the concept of imageability and the identification of the city elements (paths, edges, nodes, landmarks, and districts). The sketch map drawn by city's dweller is more accurate and legible than that drawn by a visitor because image clarity is improved by familiarity and its conformity with stereotype.

Identity and structure are the formal components which help us to perceive and organize both of space and time in themselves, while congruence, transparency and legibility are the informal ones which create interaction between environment and other sides of our lives (Lynch, 1981).

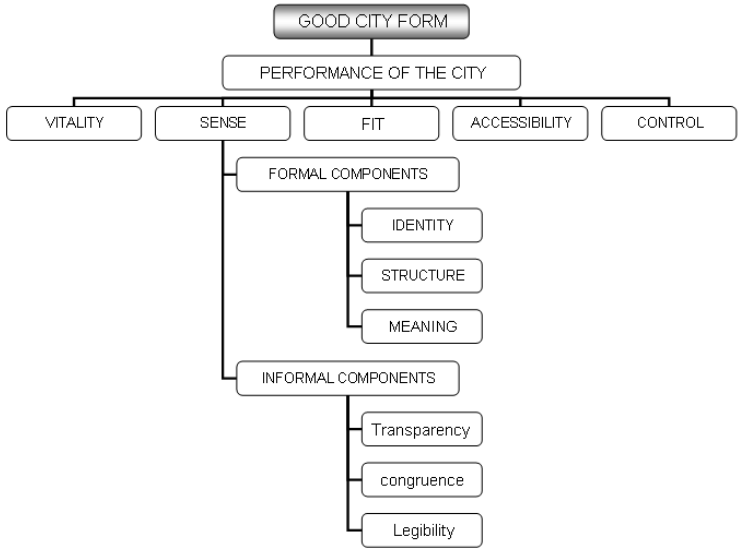


Figure 2.1. Lynch's theory of good city form.

2.4. BUILDING THE IMAGE[٢]

As mentioned before, environmental image is a two- way process. It is a complex process results from an interaction between observer and environment, so the image is built by association (Lynch, 1960).“ City order is related to the way in which people perceive or read and understand the environment” (Moughtin, 2003: 26). Lynch describes observer as a citizen who “ has had long associations with some part of his city, and his image is soaked in memories and meanings” (Lynch, 1960: 1). He divides environmental elements into moving elements(such as peoples, their activities) and stationary physical parts. Way-finding in his theory is related to two things: physical elements and a map drawn in peoples mind, this map is what Lynch named mental map or cognitive map.

[٢] Lynch, the image of the city, p.6.

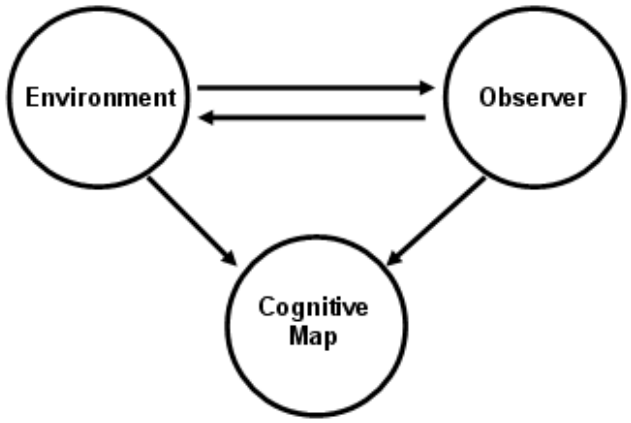


Figure2.2. The interaction between observer, and environment leads to cognitive map.

Lynch classified physical elements into natural elements and man-made ones. Natural elements are all elements that man did not make, but exist naturally like sun and rivers, whereas man-made elements are all elements that man makes such as buildings, bridges, vehicles, etc. Characteristics of environmental elements, whether they are natural or man-made, determine the visual quality of the built environment, these characteristics are what Lynch named *Imageability*, " It is that quality in a physical object which gives it a higher probability of evoking a strong image in any given observer" (Lynch, 1960: 9). The quality of an object depends upon its shape, color, and arrangement. This quality determines the degree of legibility. Imageability has physical and cultural components; the first one defines two attributes: location (a real location, spatial relationship, prominence and scope) and appearance (shape, color, age, size, construction materials…etc.), the second component has two sides also: meaning (economical, political, social, historical, religious, functional….etc.) and association (familiarity, atmosphere and affinity) (Broadbent, et al., 1980). A highly imageable environment would have a good form, a strong identity, and would be recognizable to the common dweller. Lynch analyzed the effects of physical

and perceptible objects, and from this he was able to isolate distinct features of a city, and see what specifically is making it so vibrant and attractive to people. Peoples first create a mental map that constitutes a mental representation of what the city contains, this mental representation, along with the actual city, contains many unique elements (Lynchian elements).

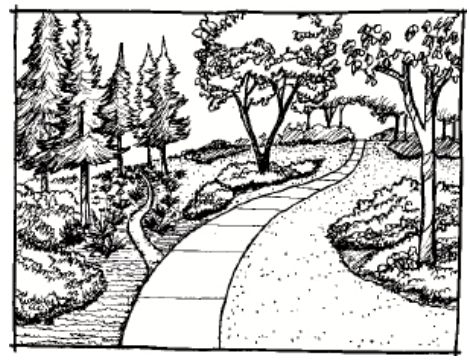
2.4.1. Lynchian Elements

2.4.1.1.Paths

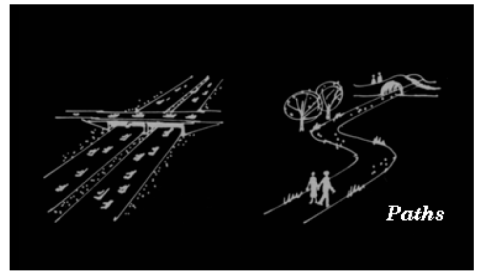
They are the channels of movement within which the city can be conceived such as alleys, streets, railroads, motorways, canals and the like. Any path has three characteristics that enhance its prominence, they are identity, continuity and directional quality. The path may have continuity, if there is a concentration and variation of activities along it, then people will be oriented by following the main stream of traffic. The similarity of names may also give the path its continuity. The building facades can strengthen the importance of the path and give it explicit identity, if they are distinctive and have the same characteristics. There are other special features that increase the importance of the path such as planting and pavement textures. Spatial qualities of width or narrowness can attract attention and strengthen the image of particular paths. In fact, there are many factors that may cause break of path continuity. For example, sudden change in the use building, branching of the path, and the more wider junctions along the path are all causes of breaking continuity. Consequently, peoples fail to find their way. The path is not an isolated element, it is a part of an integrated environment, so the sharp separation of a path from surroundings may causes way-finding difficulties. Any path has origin that represents the start point of the trip and destination that represents the end one, these two points if well-known and clear enough, the path will have strong identity that helps linking the city parts together. In fact, strong entrances and leaves are all together have an

important value in creating identifiable paths. Moreover, clear hierarchy along a particular path improves directional quality as well. For instance, a gradient of use intensity and steady changes in direction of movement are all essential characteristics of strong path properties (Lynch, 1960). “When we consider more than one path, then the path intersection becomes vital, since it is the point of decision” (Lynch, 1960: 57). Lynch mentioned that perpendicular angle of an intersection is the easiest to handle, as this right angle reinforce the simplicity of the shape of that intersection. Indeed, there are two structural factors that seem to control the ability of recognizing a particular intersection, they are number of points and types of angles that tie these points. In other words, crossing of more than four points and different types of angles always cause locational difficulties. But this is not all the story, as there may be clear perpendicular, three-pointed crossing with confusion of intersection, this may refer to the shapelessness of that intersection, thus failing to communicate its structure (Lynch, 1960).

(source: Bentley, et al., 1985)



(source: Kaplan, et al., 1998)



(source: www. faculty.ksu. edu.sa /DrMohsen/ Selected Readings)

Figure2.3. Paths.

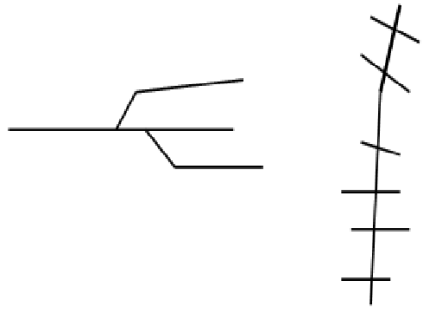
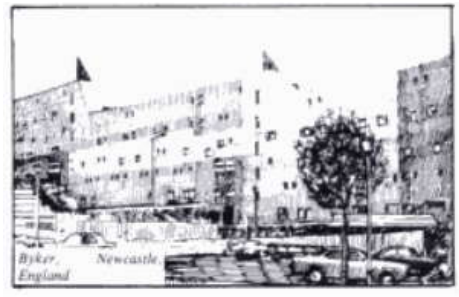


Figure 2.4. Weak paths: Branching and number of small changes along the path cause orientation problems (source: the researcher from Lynch, 1960)

2.4.1.2.Edges

"Edges are the linear elements not used or considered as paths by the observer. They are the boundaries between two phases, linear breaks in

continuity: shores, railroad cuts, edges of development, walls" (Lynch, 1960: 47). Edge is that line which separates two areas having different features from each other, this line may be natural boundary like rivers, viaducts and topography or artificial form such as greenbelt, waterfront, highway, elevated motorways or something else, as it may be just the degree of differentiation between two districts through their distinct characteristics, these characteristics may result from using different architectural vocabularies in facades, particular types of landscape elements, property of concavity, height of buildings, different types of housing, classification of activities, social classes…..etc. But separation never conditionally means isolation, as it may just stands for division. A particular edge may not be barrier at the ground level, when it is elevated such as bridges and elevated railways, these types of edges seen from below are called overhead edges. Strong edge should be visually prominent, continuous in form and impenetrable to cross movement, as unpleasant edges seem to be mentally omitted (Lynch, 1960).



(source: www. faculty.ksu. edu.sa /DrMohsen/Selected Readings)

(source: Bentley, et al., 1985)

Figure2.5. Edges.

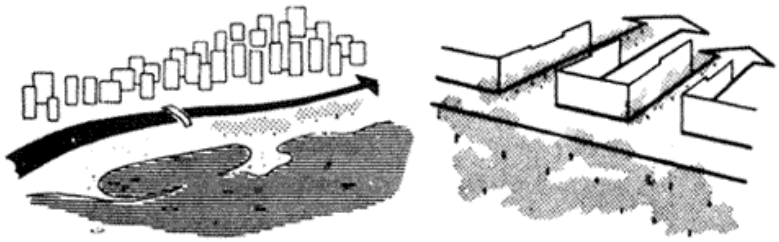


Figure 2.6. Boston water front edge (source: Lynch,1960)

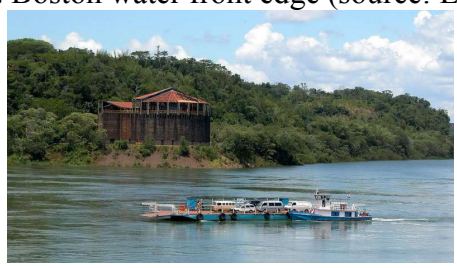


Figure2.7. Natural edge:The river as a natural edge.
(source: www. k43.pbase.com)

2.4.1.3. Districts

Districts are character areas perceived to have common characteristics, a separate visual identity from the rest of environment. These areas can be recognized as a thematic unit. Good physical characteristics of districts are determined by continuities and homogeneities of facades materials, textures, spaces, forms, details, symbols, building type, uses, Activities, inhabitants, colors, skyline topography, …etc.(Lynch,1960). All these features give a district its identity, create intimacy between its parts, and identify the basic clues of the city. Districts names also play an important role in giving identity to districts. Districts may have various kinds of boundaries that offer different characters, as some may be soft, hard, certain or uncertain, thus they may reinforce or limit district identity. Districts may be in relation with each other, well-connected together, then they are in an extrovert character. On the contrary, they may stand alone to their zone, in other words they are not linked together, then they are in an introvert character (Lynch, 1960).

Figure 2.8. Districts (source: www. Faculty .ksu.edu.sa /DrMohsen/ Selected Readings)

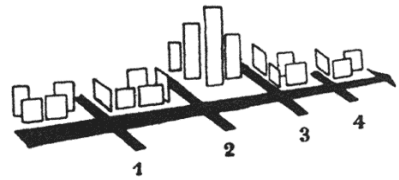


Figure2.9. District events (source: Lynch,1960)

2.4.1.4. Nodes

According to Lynch "Nodes are the strategic foci into which the observer can enter, typically either junctions of paths, or concentrations of some characteristic" (Lynch, 1960: 72). They are the gathering points such as squares, railroad stations, plazas and junctions even ordinary street intersections are nodes. Nodes may be junctions, then they are related to paths, as being the convergence of these paths such as squares; or thematic concentration such as a concentration of shopping; or both of junctions and concentration. In fact, the city itself can be imaged as a node with respect to a large enough level. Nodes can be recognized even when they are shapeless, but when supported by a strong physical form, then they become memorable (Lynch,1960). Good recognizable node should has its identity through singularity and continuity of walls, floor, planting, lighting, topography, silhouette, function, clarity of shape and intensity of use. Location determines nodes utilization, as locating nodes on main routes make movement economy more efficient than those located away from.

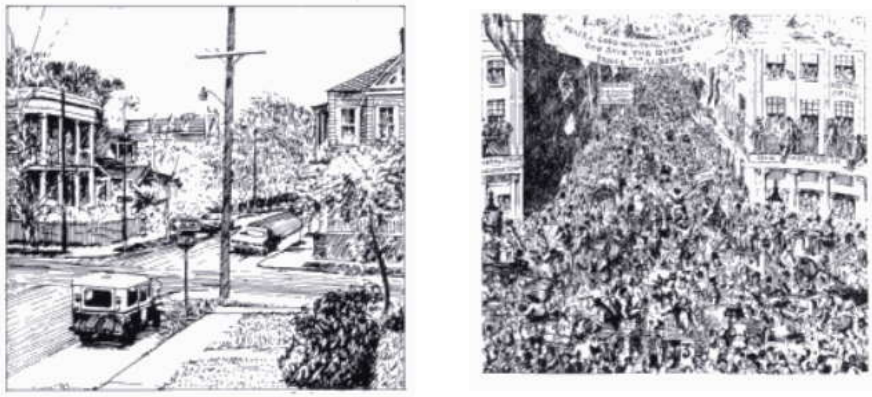


Figure 2.10. Nodes(source: Bentley, et al., 1985)

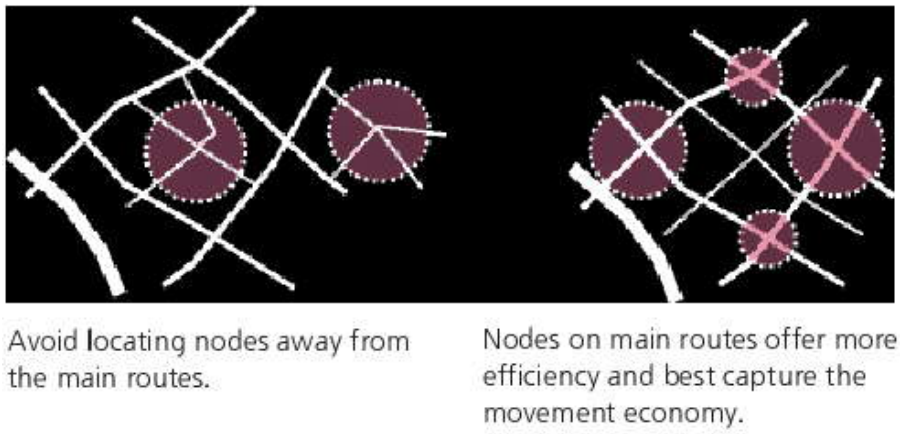


Figure 2.11. Best place for nodes (source: http:/ /www.mfe.govt.nz/ publications/ rma/people-places-spaces-mar02/people-places-spaces-mar02.pdf.)

2.4.1.5. Landmarks (Points Of Interest POI)

In contrast to nodes, which can be entered, landmarks are external features to the individual that act as reference points (Lynch, 1960). Landmarks vary with an individual's personal experience. They are usually static (they also can be mobile objects such as the sun) and unique objects (physical structures or geographic features) which can be singled out from a host of possibilities. Landmarks are very important cues in way-finding process when they are distinctive and not too many (Kaplan, et al., 1998). Many

peoples with different types of cognitive abilities as well as those cannot read at all or who cannot read the native language rely on landmarks to mark and remember a path (Salmi, 2002). Landmarks are distinguished by their dominance and singularity of shape, color, size, height, location, visibility and finally, their sharp contrast with background. Landmarks should be in a tune with their surroundings and not too many, as too many landmarks can undermine their helpfulness (Kaplan, et al., 1998). Landmark may be a modern building among classic ones or it may be remarkable for its cleanness in a dirty place and may also be memorable for its prominent position as seen from far and near distance; and as a place of spatial decision making when it is located at a focal point along a route.

Figure2.12. Jarring distinctiveness: lack of harmony with environmental surroundings can detract from the natural experience (source: Kaplan, et al., 1998).

Characteristics of good landmarks may be visual, semantic or structural attractions[٣]:

2.4.1.5.a. Visual Attraction

It is concerned with the physical characteristics of an object which strengthen it as a landmark these characteristics are:

- Façade Area: It reflects the degree of contrast between the object and surroundings.

- Shape: It is measured by considering its shape factor and also the deviation of its shape from that of a rectangle. Shape factor stands for width to height ratio. For instance, high buildings have a high shape factor and vise versa.

-Color: Object color may single out it as an unmistakable landmark for example, a red building in the midst of a set of white ones is easily to be memorable.

-Visibility: If an object is located in a prominent position, then it has a high visibility, as it can be seen from near and far, by day and night.

There are other visual properties of an object such as its texture but it has been excluded because of its subjectivity and lack of formality.

2.4.1.5.b. Semantic Attraction

It is concerned with the meaning, as the object may be not distinct in itself, but represents a great value for observers, this value may be derived from its cultural or historical importance.

2.4.1.5.c. Structural Attraction

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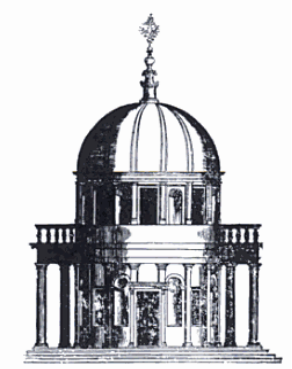
[٣] Raubal, M., & Winter, S., 2002,"Enriching Wayfinding Instructions with Local Landmarks", unpublished paper, University of Munster, Germany.

The origin of this principle is the major role that an object plays if it is located in an area of spatial decision making such as intersections.



(source: Moughtin, 2003)

(source:www.informedesign.umn.edu)

(source: Bentley, et al., 1985)

Figure2.13. Landmarks: Distinctive landmarks provide wayfinding cues.

Eventually, different circumstances can shift a particular city element type, since a highway may be a path when considering a vehicular movement, and an edge when considering a pedestrian movement. Likewise, downtown is also considered as a district regarding to city scale and as a nodal point with respect to larger level. Remarkably, all city elements are not isolated from each other, but in a series of integrated link.

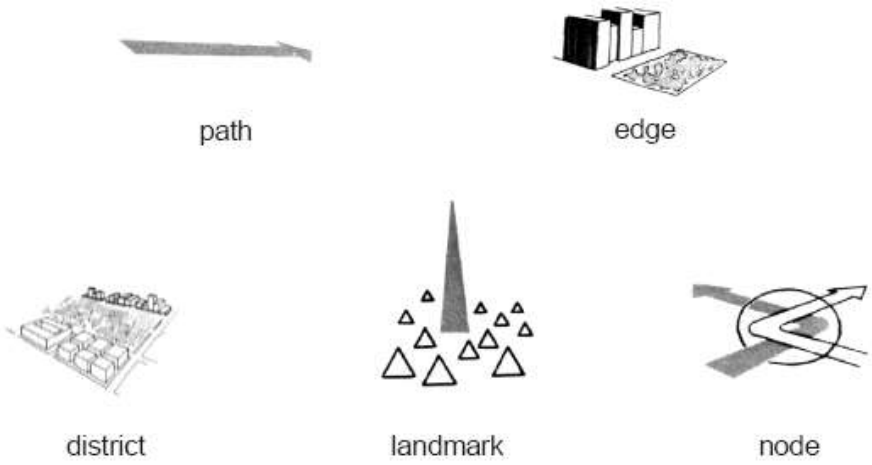


Figure 2.14. Lynchian elements (source: Klippel, 2003).

Clues of visual quality can be summarized as following:

a- Clues Related to Identity: these clues aim to single out the element through its character.

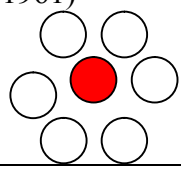
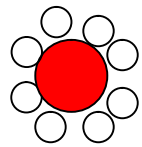
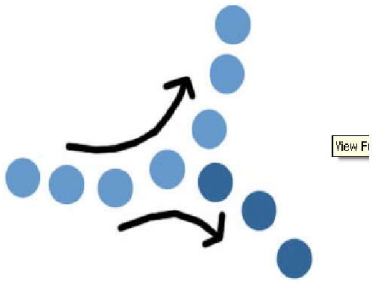
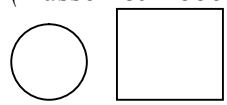
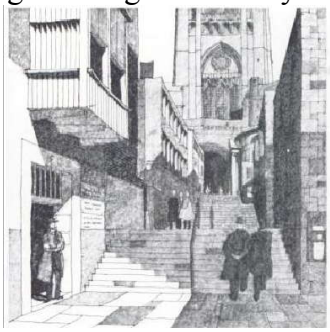
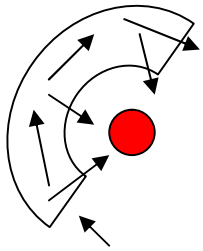
Singularity or Differentiation: distinctiveness giving places there identity is a major requirement of wayfinding(Arthur & Passini, 1992). Element can be singled out if it is unique in shape, color, proportion, surface and in contrast with its surroundings, then it is recognizable. Uniqueness is very important factor in producing high degree of imageability (Dichter, 1961) 	**Dominance**: dominance of an object over others through its size, height and other physical characteristics improves image quality, since it allows simplification of an environment. 

Table 2.1. Clues of Identity.

b- Clues Related to Structure

Continuity: It can be achieved by similarity, nearness of objects, harmony and sequence of events along paths and edges. 	**Unity or Equivalence**: "It is the characteristic to group space into zones along some common traits" (Arthur & Passini, 1992: 87). Elements should be in relation to each other, since scattered elements with no relation to each other cause confusion and disorientation. Alberti said "I shall define beauty to be a harmony of all the parts, in whatever subject it appears, fitted together with such proportion and connection, that nothing could be added, diminished or altered, but for the worse" (Beardsley,1975:125; Moughtin, 2003: 31).
Clarity of Joint: Clear relation between joints make them highly perceptible.	**Simplicity**: Simple forms such as dome, rectangle or any regular form in general, are easily recognizable. "Way-finding is hampered in environments with a very complicated spatial layouts" (Russell & Roberts, 2002: 197). 
Table 2.2. Clues of Structure.	

c- Visual Scope: It stands for the extent within which the element can be seen for a long period and by many observers from near and far. Table 2.3. shows qualities that increase degree of exposure.

Closed Vista: by creating visual scope through closing the vista by a mass  **Figure2.15.** Closed vista: The vista is closed by the mass of the tower (source: Cullen, 1995)	**Panorama or High Degree of Visual Access**: It means that the element is visible from different perspective, this may occurs if it is placed on a curve, then the element will be seen as long as we move around this curve. 
Surprise: It is the arrangement of elements in a particular way within which the element appears and disappear in a sequential method. Surprisingness leads to high imageability (Wohlwill, 1966).	**View Overlapping**: It can be achieved by mixing various elements together, thus creating overlapped layers.
Table 2.3. Clues of Visual Scope.	

d- Names and Meaning[ٔ] : They are non-physical characteristics that may refer to historical, social, religious or functional significance. Names, as mentioned before, play an important role in forming the sense of a place.

[ٔ] Lynch, the image of the city.

2.5. POST LYNCHIAN THOUGHTS

There are many thoughts emerged later representing Lynch's thoughts from different dimensions, some of them are related to philosophy and imagination, whereas the others are more realistic:

2.5.1. Appleyard[5]

Donald Appleyard has attempted to extract factors that influence the degree of imageability while walking through the central core of a city. He found that many subjects referred to attributes of physical design such as size and shape (Appleyard, 1969). Appleyard estates that the city is a product of different group perceptions. He divides these groups into two main categories: (1) The ordinary planners (2) The planner-citizens. He has demonstrated that this distinction of the two groups is a perfect example of the different perceptions individuals elicit of the city[6]. He emphasized that people should change the way they perceive an environment according to changes that happen in this environment, as mental maps need to be updated or reconstructed according to these changes. For instance, if certain landmarks change or disappear, then people's mental maps become more vague and primitive, thus they loose details of stored spatial knowledge that have been built through time. According to distinction of people's perceptions, there are three characteristic types of urban perception (Appleyard, 1976):

a. Operational

It is attributed by personal movement and visibility; when a person perform an action he uses particular environmental elements for carrying out it, we can then say that these environmental elements have an operational role such

[5] Donald Appleyard‘s work in the 1960s, with Kevin Lynch at MIT and with the Ciudad Guayana project in Venezuela, explores physical form as reflected in human understanding.

[6] Tzinis, A., 2005, The Egocentric City, M.Sc. thesis, Bartlett School of Graduate Studies, University College London.

as traffic circles, islands, intersections, signs, entrances etc. Environment should be in a harmony with the performance of tasks, otherwise it will probably be frustrating. It should be operationally satisfying, since interesting toys may be extremely dull when children try to play with them (Downs & Stea, 2005).

b. Responsive to The Configuration of The Environment

when a person perceive an environment, there are imageable elements catch his eye; these distinctive and unique elements are not necessarily visual; they can be distinctive sounds or smells (Appleyard, 1975).

c. Inferential and Probabilistic in Nature

It is attributed by socio-functional significant; when we encounter an environment, we construct a model of likely events including significant places and screening trivial ones out. Yet, trivial places may be noticed as a sort of curiosity, so it is difficult to understand our environment without knowledge of its categories which can be acquired by wider urban experience (Downs& Stea, 2005).

2.5.2. Bentley -Responsive Environment-

Bentley l. et al.(1985) formulated a set of guidelines to make the built environment more responsive –maximizing degree of choice to users–. These guidelines include but not limited to the following:

a. Permeability: It is the number of choices/ alternatives that environment offers to people, where people can go and where they can not, so responsive places are the accessible to people. The greater the number of alternative routes, the greater people's freedom of movement and, therefore, the greater the responsiveness of that environment. Permeability should not only be in

physical properties but in visual appearance too, since paths which are not visually obvious may remain unused. Nature of spaces also influences degree of permeability.

b. Variety: It means the range of activities that environment provides to people. For example, a particular place can be used as a market where people buy and sell goods, talk to each others and perhaps visit a café. So, the environment may be not confined to housing only, but provide wide mix of uses like shopping, employment, recreation, and so forth. Variety supports permeability, as easily accessible environments are irrelevant unless they offer a choice of experiences.

c. Legibility: It means the ease with which the environment can be grasped, since the degree of choices offered by environment depends upon how legible it is. The main features that impact on legibility are paths, edges, nodes, landmarks, and districts.

d. Robustness: It describes environments that can be put up to multiple uses and thus offer their users more choice than whose design limits them to a single use. For example, changing the configuration of the furniture of a particular room may turn it to a lecture room, dinning room or place for birthday party.

e. Visual appropriateness: It describes environments which are interpreted as having meanings that help people aware of offered choices in approaches of permeability and robustness. In other words, it affects whether the detailed appearance of the place makes aware of the offered choices.

f. Richness: It is a quality that increases the choice of sensory experiences that a user can enjoy (experiences of touch, motion, sound, smell, light, and so forth). At this stage, the details of buildings and open spacesare considered.

g. Personalisation: It is the ability of people to personalize the environment. In other words, it is the ability of them to put their won mark/ stamp on their own environment. Participation is highly desirable; and personalisation quality has been necessitated by the fact that most people live and work in environments designed by others.

Permeability, variety, and legibilityare all related to larger-scale environments, whereas visual appropriateness, richness, and personalisation are related to the scale of individual buildings and groups of buildings[7]. Bentley's approach of responsive environment was evolved and developed by McGlynn and Murrain (1994) who reduced the seven original guidelines to four fundamental qualities: permeability, variety (vitality, proximity and concentration), legibility, and robustness (resilience). Recently, resource efficiency, cleanliness, and biotic support were suggested by Ian Bentely (1990) and Ian Lyne at the JCUD (the Joint Center for Urban Design) to be added, to include the ecological impact of urban forms and activity patterns (Carmona, 2003; Carmona & Tiesdell, 2007).

[7] http://www.arch.ksu.edu/seamon/ResponsiveEnvts.htm.

Figure 2.16. Responsive environment qualities.
(source: Bentley, et al., 1985)

2.5.3. John Cato[8]:

Cato divided city image into three components :

a. City Image

He postulated that the ability of recognizing our environment depends upon reshaping our environmental surroundings through Lynchian five elements considering exclusion of elements that cause confusion and misleading.

b. Narrative & Story Telling

According to Cato, the city is like a story, since its sequence of events can be narrated and described by presentation, believability, color, attraction, familiarity, surprise, and so on[9].

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[8] John Cato is a practicing designer, looking for practical ideas that may help with design strategies of an interactive system. He worked in this field since 1989. this text was first presented at a workshop on narrative and hypermedia in Brighton, 1997.

[9] http://www.softdesign.co.uk/cityimg.htm

c. Interaction Design

We should attempt to create an involving, attractive and enjoyable interactive environment, one which encourages us to use and delight in our use. Space should be multi-dimensional and rich in artifacts, yet at the same time some essential underlying simplicity that communicates and draws us in[10].

2.5.4. Jonathan[11]

Jonathan Raban (1975) divides the city into soft and hard parts. The soft city is created by the minds of its inhabitants, so it is individualized interpretation, whereas the hard city is the concrete ideas such as alleys and architectures. In other words, the soft city is concerned with the mental side which need to be exercised by the imagination of city dwellers, but the hard one resorts to the material level observed by the sense of dwellers. The two parts are interactive and closely related. According to Raban, the city visitor first encounters the hard city, but gradually he will feel it and then he encounters the soft one.

> "…the city goes soft; it awaits the imprint of an identity. For better or worse, it invites you to remake it, to consolidate it into a shape you can live in. You, too. Decide who you are, and the city will again assume a fixed form round you. Decide what it is, and your own identity will be revealed, like a position on a map fixed by triangulations. Cities, unlike villages and small towns, are plastic by nature. We mould them in our images; they, in their turn, shape us by resistance they offer when we try to impose our own personal form on them." (Raban, 1975: 3-4)

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[10] http://www.softdesign.co.uk/cityimg.htm.

[11] Jonahthan Raban (b. 14 June 1942, Hempton, Norfolk, UK) is a British travel writer and novelist.

Raban imaged the city as a living object, it interacts with its dwellers and calls for its own identity. Both of the city and its dwellers seek to impose their images on each other. Furthermore, Raban claimed that all cities are theaters; Every city has its own story and every citizen plays his own part at that story. He discussed the way people remember their cities whether through memories of the streets they have actually visited or streets they imagine. He goes on to describe mind construction as a kind of stage set that we create and in which we play out our part; some of us succeed at this game but many of us suffer from a sense of dislocation and lack of community.

Raban has emphasized that individuals interact with environment not through its physical elements, but in relation to the quantity of information that they receive and store along their daily life, since various space events help an observer to interpret the inner meaning of all constructed shots within that space.

2.6. HOW TO USE LYNCHIAN METHOD EMPIRICALLY?

Lynch carried out an analysis of three American cities (Boston, Massachusetts; Jersey city, New Jersey; and Los Angeles, California) in order to evaluate the components of perception at the group level. He choosed small samples of interviewees for his study: thirty persons of Boston and fifteen each in Jersey and Los Angeles. Interviewees were from professionals and managerial classes. There were two basic types of analysis:

2.6.1. A Systematic Field Reconnaissance

It starts by finding out the existing potential by the site and its surroundings. It is made on foot by a trained observer who maps the area and explores the visibility of it defining its elements and recording any existing activities and forms which could be used to make the place more legible, dividing them

into major and minor categories according significance and strong visibility. The map resulted from this analysis is an a bstraction of true physical map, since the mapping process itself is subjective and done independently from the interview analysis. Automobile survey can also predict the probable composite image, as there are some minor elements could be neglected in foot survey.

Lynch's checklists of elements are helpful here for stimulating the analysis[12]:

paths:

Recording routes that adjoin or cross the area; classifying them according to their significance in the area.

Edges :

Recording any strong linear barriers and any distinct limits to areas with different patterns of use or visual character.

Landmarks:

Recording any distinct elements wither in shape, meaning or location.

Nodes:

Recording focal points like squares, intersections, and plazas; recording buildings that attract people and create movement like cinemas and shopping malls.

Districts:

Recording areas that differ from each other in character and use specifying factors that outline these differences like material and form.

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[12] Bentley, I.(Ed.), McGlynn, S. and Smith, G., 1985, Responsive environments: a manual for designers, Architectural Press.

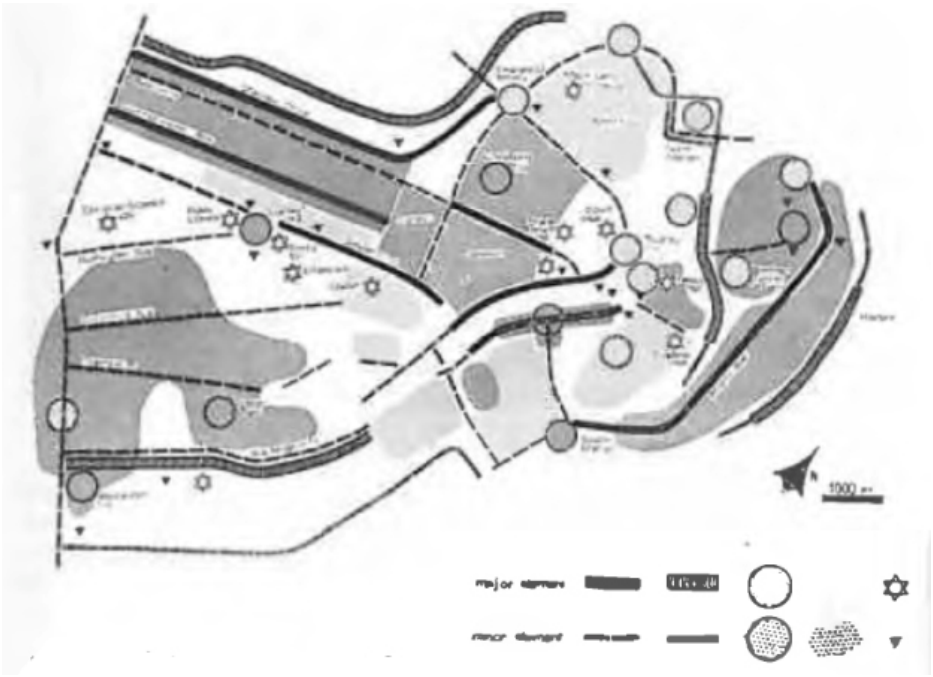


Figure2.17. The visual form of Boston as seen in the field.
(source: Lynch, 1960)

2.6.2. Interviews and Questionnaire

Questionnaires provide a means of gathering a snapshot on the views of observers, thus extracting cognitive map of an environment. The people interviewed are carefully selected:

- Choosing people who frequently use the site, or its immediate surroundings.
- There should be a balance in sexes, and ages in the sample.
- The number of people interviewed is about 20-30 for every area.

An interview can be held with the sample of a city in order to elicit their own image of the environment within which they live. The interview made by Lynch and his team contained many points (Lynch, 1960):

- Interviewees were asked about their first impression about the area: what first comes to their mind about it?

- Interviewees were asked to draw a sketch map of the area showing the location of most important features, and placing map details as if they describe it to a stranger.
- They were asked to draw an imaginary daily trip illustrating the sequence of events would they see, hear or smell. The path chosen for this trip should be rich in its components giving a general description of physical features of a case study.
- Subjects were asked to select the most distinctive elements listing and describing them; explaining why they had included them on their maps. These distinctive elements might be streets, buildings, sections or any physical features which are meaningful for a person, thus worth to be mentioned (Downs & Stea, 2005).
- Subjects were asked what they like and dislike about the area and how much they like it?; what they like to change in it?
- There are informal questions about the goals of the work; importance of orientation and recognition of a city to people and the degree of satisfaction when subjects find their way and able to locate themselves in a city.
- Interviews were recorded on tapes; and several photographs of a city and several cities where arranged randomly, then subjects were asked to classify them according to their familiarity, and placing them on a large table as if photographs were placed on a large map of a city (Lynch, 1960).
- Sketch maps can be classified according to their accuracy and completeness, thus excluding weaker ones.
- Maps obtained from interviews and questionnaires can be synthesized into a single citizen map, since there were repeated elements in subjects sketch maps.

- The above interviews and questionnaires are subjective, so they need to be compared with an objective description of a physical map that can be supported by air photos and diagrams density and use.

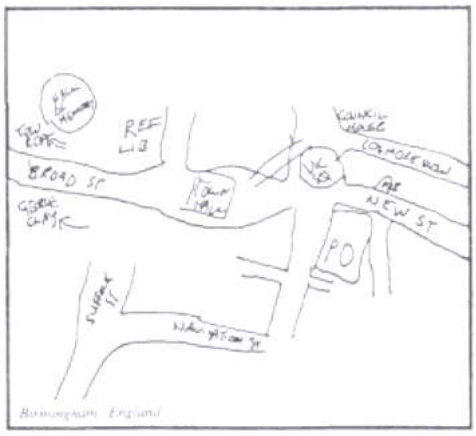


Figure2.18. A sketch map drawn by an interviewee.
(source: Bentley, et al., 1985)

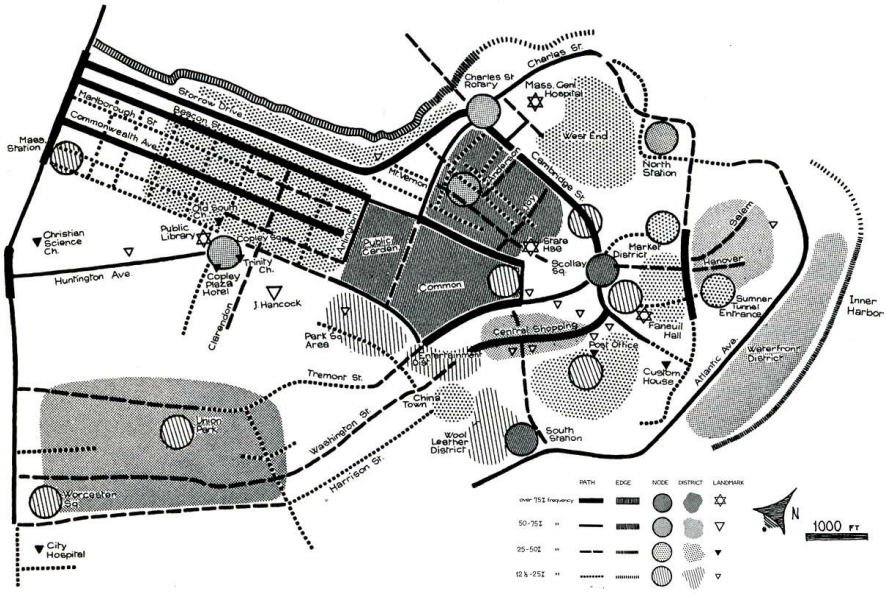


Figure 2.19. The Boston image as derived from verbal interviews (source: Lynch, 1960)

2.6.2.1. Techniques of Inquiry

2.6.2.1.a. Local Work Places and Cafes

By asking people a set of questions during a break. This is the most common way to get people drawing their own images. Providing standard sheets is helpful. What we try to investigate is how people see the area, not how it is.

Figure2.20. Local work places interviews (source: Bentley, et al., 1985)

2.6.2.1.b. Doorstep Interviews

Doorstep surveys are done by going to people's homes (usually chosen random) and asking them a set of questions. These techniques are little used, although they are useful for tapping the view of local residents and their memories about events happened in the area. Through interviews, we do not lead the answers, but people are the experts.

Figure2.21. Doorstep interviews (source: Bentley, et al., 1985)

2.6.2.1.c. Street Corners Interviews

It is done by stopping peoples and asking them a set of questions about the place, with one or two photographs to stimulate conversation. It will be a good result to get answers from more than one in ten people.

Figure2.22. Street corners interviews (source: Bentley, et al., 1985)

2.6.3. Getting A Cognitive Map

Analyses of interviews reveal a considerable overlap between different people's images of a given environment, enabling a shared image to be mapped. Maps are analysed according to frequency of elements; after that, the results are compared. Legible layout is that people are able to form clear and accurate images of it.

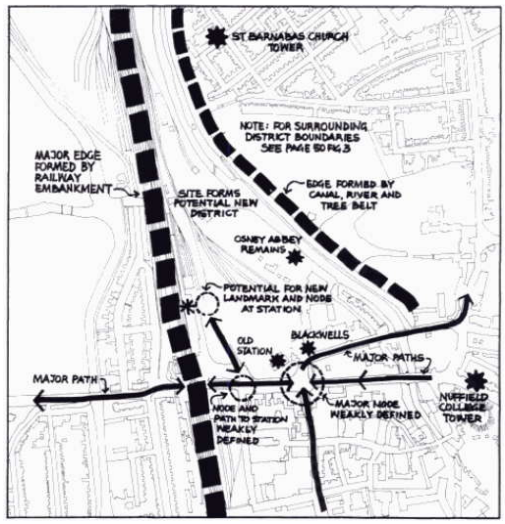


Figure 2.23. Analyzing a map by using Lynchian method.
(source: Bentley, et al., 1985)

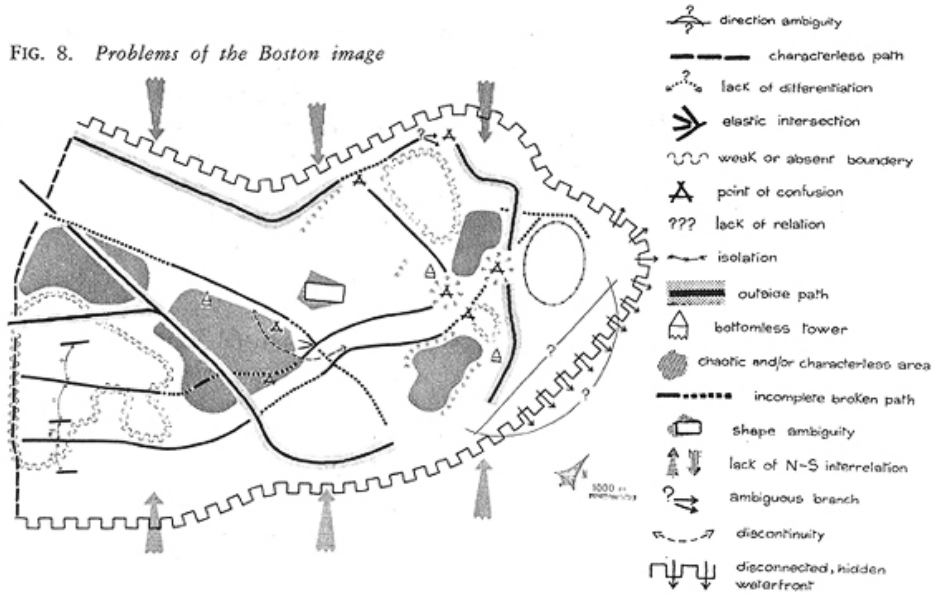


Figure2.24. Problems of Boston image (source: Lynch, 1960)

2.7. CRITICISM ON LYNCHIAN METHOD

a. " A major criticism of Lynch's original study centered on the nature and selection of the sample of respondents" (Downs & Stea, 2005: 80). The sample size that Lynch and his team interviewed was too small and biased, since interviewees were thirty in Boston, and fifteen each in Jersey and Los Angeles. They also were all young, middle-class people, and most of them were professionals (Banerjee & Southworth,1990), while there are several factors control sketch maps such as class, gender, age, culture and familiarity. In other words, Lynch neglected the observer variation in his study, so the validity of aggregating the mental images of subjects with different experiences and backgrounds has been questioned. But it was astonishing that the basic ideas of the city image have held when they have been applied in different places with different cultures, so Lynch's team were lucky.

b. Using interviews and questionnaire for getting true mental image is inadequate method. Furthermore, map drawing is too difficult for most

people. Although the comment is just, as entering the charming realm of psychology is a difficult mission because what in the mind is an elusive matter, Lynch has claimed that sufficient array of investigations can produce more realistic image that tend to be the true one, moreover environmental image is enjoyable for most people, since they like to talk about it (Banerjee & Southworth,1990). Although talking is more familiar than drawing for most people, drawing should not be neglected, since it is a valuable means of expression conveying the inner feelings of interviewees.

c. Design usurpation: researchers worried that Lynchian method may control designers creativity, thus leading them to repeated templates. Lynch refuted this attack claiming that perception studies could support and enrich design.

d. In *good city form* Lynch reduced the emphasis on legibility considering it as one kind of sense. Furthermore, he downplayed its significance in reconsidering *the image of the city* (Carmona, 2003). Lynch's studies have focused on way-finding issue, although he accepted it as a secondary problem for most people, since individual can find his way by asking peoples or using a map. Although Lynch assumed the importance of wayfinding issue and analyzed its nature accurately enough, he did not demonstrate it. In other words, he just questioned the value of legible environment and proved it indirectly. For instance, it may be argued creating legible environment obscures the hidden value of mystification that beckons one to explore further, but Lynch refuted this criticism indirectly claiming that getting lost is intolerable strain assuring that "…self-identity is reinforced by a strong identity of place and time" (Banerjee and Southworth,1990: 250), moreover there is a satisifaction and pleasure of identification with a distinctive home place.

e. Lynchian method has focused on objective and physical aspects of urban environment with less attention given to cultural and social aspects.[13]

f. Lynch defined three formal components for the sense of perceiving an environment: Identity, structure and the meaning, but he confined his study to Identity and structure excluding the meaning (Crane, 1961), although meaning plays an important role in improving the imageability of the city (Broadbent, et al., 1980: 164). In other words, cognitive mapping techniques tend to neglect issues of people's feeling toward their environment and what actually it means to them. Lynch also confined the visual perception to forming the image of a city obscuring other significant factors associating in image formation such as sound, smell and tactile (Southworth, 1969). Lynch emphasized the seeing aspect of the imagery, while cognitive image is a product of an integrated multimodal representation that involves visual aspect and many other inputs (Downs & Stea, 2005).

2.8. CONCLUSION

[13] Salheen, M., 2001, A comprehensive analysis of pedestrian environment: The case study of Cairo city center, Ph.D. thesis, Heriot-Watt University, Edinburgh College of Art, Faculty of Environmental Studies, School of Architecture.

This chapter briefly described Lynch's theory about urban form and some other relations.

First, we explained Lynch's thoughts about good city form by measuring the degree of city performance which expresses the environmental requirements of the city through its vitality, fit, sensitivity, accessibility and control. We then briefly focused on sense of the city dividing it into six elements, these elements are identity, structure, meaning, congruence, transparency and legibility.

In the next part of the chapter, we explained the five elements of the urban environment: paths, edges, districts, nodes, landmarks. After that, we mentioned some new theories related to Lenchian thoughts.

In the last section, we explained how to use Lynchian method in analyzing city image illustrating how to get a mental map of an area.

The final part was a criticism on Lynch’s method and his thoughts about urban Legibility. The criticism was basically confronted to the basic relevance of lynch's studies and vivid obscuring of many aspects like culture and social aspects and the meaning.

CHAPTER THREE
BILL HILLIER MAPPING METHOD: Basis Of Space Syntax Technique

3.1. INTRODUCTION

How to describe space? How to analyse urban fabric according to objective way? How to predict movement and usage from a spatial structure? How to evaluate the design of an area ? How to measure the connection of spaces? How to investigate society-space relation?

These questions will be tackled by extending a coherent family of ideas and analytical techniques: Space syntax.

Space syntax, originated and developed in the 1970s at the Bartlett Unit for Architectural studies, University College, London (Hillier,1988;Hillier & Hanson; Hillier et al., 1983; 1989a;1989b;), is a robust technique that can be used to describe and analyse patterns of architectural space both at the building and urban level. It's how to establish an objective way to evaluate and investigate the relationships between the morphological structure of man-made environments and social structures or events. "Space syntax is a set of techniques for the analysis of spatial configurations of all kinds, especially where spatial configuration seems to be a significant aspect of human affairs, as it is in buildings and cities."[1] Space syntax is also defined as "a family of technique for representing and analysing spatial layout of all kinds"(Hillier 1999: 165).It attempts to explain human behaviors and social activities from a spatial configuration point of view (Hillier,1997).

[1] space syntax laboratory ,retrieve on 7th may 2008," http://www.spacesyntax.org /introduction/ index. asp"

- Space syntax has been used in a wide range of research projects. Hillier et al (1987a) made an analysis of house genotypes. Peponis et al (1990) looked at the function of morphological structure of buildings in the way finding process. Hanson (1989) described the sociocultural implications of different plans for the rebuilding of London after the great fire. Miller (1989) used space syntax as a tool in the process of urban renewal in a Swedish town. Hillier et al (1989b) attempted to predict spatial patterns of crime in urban areas, and De Holanda (1989) was concerned with social implications of different ways of structuring city-form in the third world. Mills (1989) showed how the spatial structure of townships acts as a mechanism of control in the apartheid ideology. Last and most important, the relationship between the morphological structure of urban areas and (mostly pedestrian) movement patterns has been researched frequently (Hillier 1988; Hillier and Hanson, 1984; Hillier et al., 1983; 1987b; 1989a; 1990; Peponis et al., 1989)2.

3.2. THE IMPORTANCE OF ANALYZING THE SPACE

Space is the unit within which all human activities occur. It reflects the social and cultural aspects of the city. The effect of space on people, how they use it and interact with each other within it are all need to be grasped. It is necessary to understand space from a functional perspective in terms of what people do in it. We should think of space not as the background to human activity, as we think of it as a background to objects, but as intrinsic aspect of human beings do (Vaughan, 2007). Space can be described in three geometric ideas: linearly when people move in it, convex space(in which every point can see each other) when they interact within it and finally isovist which from any point of space can be seen as a variably shaped, often

[2] Environment and Planning B; planning and design,1993“ Space syntax: standardised integration measures and some simulations”

spiky visual field (Benedikt, 1979). All these geometric ideas will be defined in more detail in this chapter.

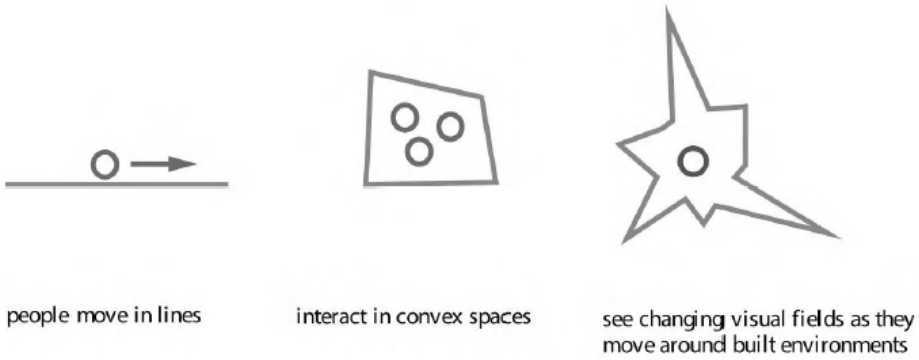


Figure 3.1. Relation between space and activity: Space is not a background of activity but an intrinsic aspect of it. (source: Vaughan, 2007)

3.3. WHAT IS SPATIAL CONFIGURATION?

It is clearly accepted that city is the container of activities, in its spaces many human behaviors like eating, gathering, interacting and dwelling occur, having their spatial form. There is an expected relation between space and its use lies in the relation between configuration of people and configuration of space. Configuration as defined in Hillier's book *space is the machine* is "a set of interdependent relations in which each is determined by its relation to all the others" (Hillier, 1996: 24). The arrangement of spaces in such a way influences the use of them according to how we relate these spaces to each other. For example, figures 3.2.a and 3.2.b show two different types of spatial configuration, although they seem similar in adjacency and number of cells, they are totally different in underneath topology(Hillier, 1996).

Regarding to the principle of permeability, it is clear that the position of doors in the two figures is quite different, therefore has its influence on the privacy of spaces, that eventually determine the use of space, so spatial configuration needs to be analyzed and understood (Hillier, 1996).

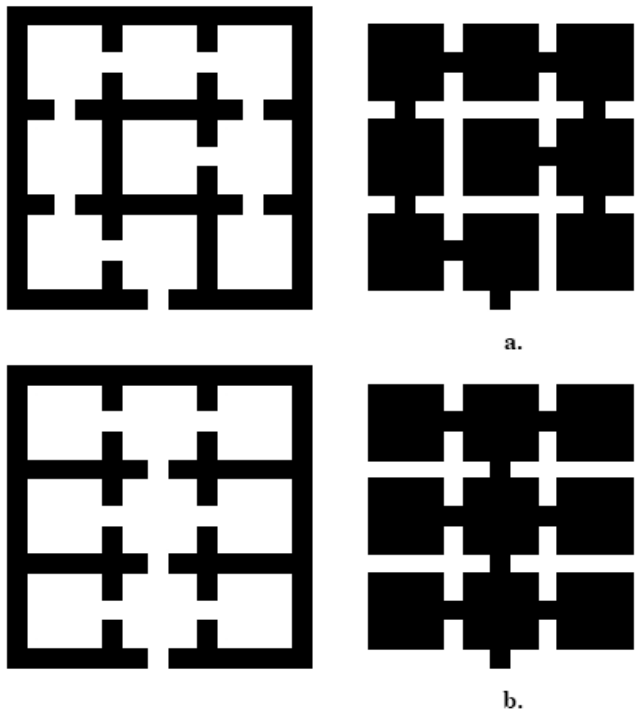


Figure 3.2. Spatial configuration. (source: Hillier, 1996)

3.4. UNIT OF SPACE SYNTAX TECHNIQUE

Every point in the space has one and two dimensional aspects, the one dimensional is called axiality; the other is called convexity :

3.4.1 Axiality

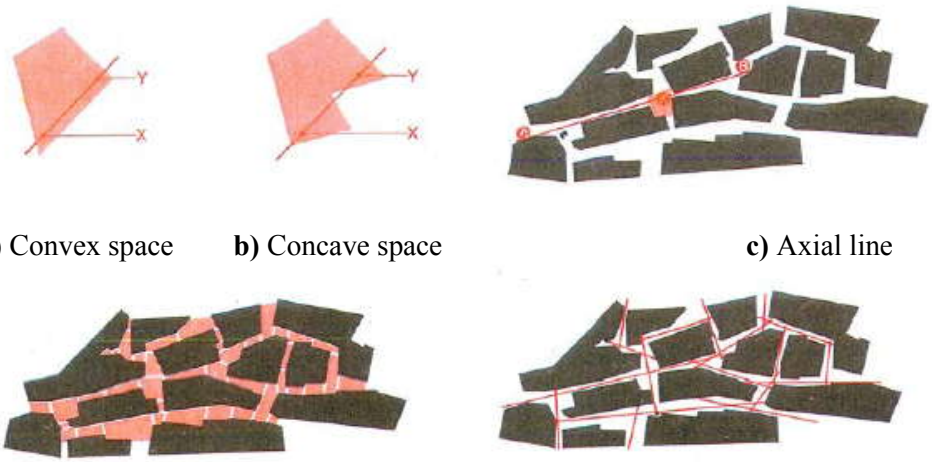
It is to draw the longest and fewest lines that covers the system, the product is called axial map. It offers the most globalizing perspective, as an axial line will extend as long as at least one point is visible and directly accessible (Hillier et al.,1983). Axial lines are used when studying movement.

3.4.2 Convexity

A convex space is defined as " a space that will not contain concave parts" (Hillier et al., 1983). It is an area outlined by a border of straight lines, any

two points in this convex space can be joined by a straight line which doesn't go outside the space.

Convex map consists of the largest and fattest convex spaces that cover the area (Hillier et al., 1983; Szalapaj, 2001). The convex space offers the most localized perspective because any selected point taken within it appearing visible and directly accessible to all other points within that same space (Hillier et al., 1983). Convex spaces are used when studying interaction.



a) Convex space **b)** Concave space **c)** Axial line

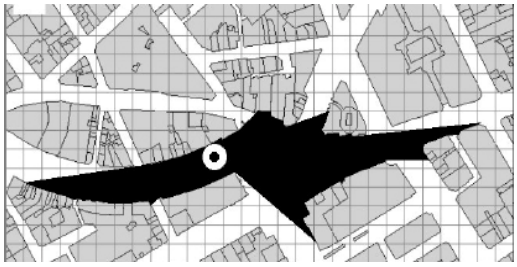
d) Convex map **e)** Axial map

Figure 3.3. Space syntax tools (source: Hillier et al., 1983)

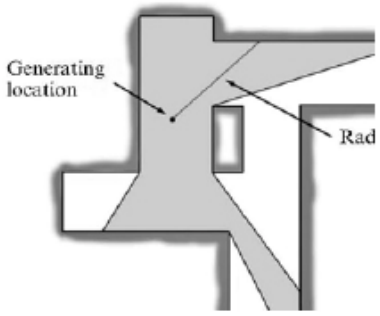
3.4.3. Isovist

The key criterion in defining isovist is how far can one see or move from every point in the space. Isovist analysis has been developed in landscape studies and is integral to GIS (Rana,2002). Benedikt (1979) adopted the term isovist from Tandy (1967) who had used it to describe landscapes. Isovist field is in itself a measure of the morphology of the system, it can be generated automatically by using a software such as **Depthmap** from Turner, **Omnivista** from Dalton. Isovist is defined as "the set of all points visible from a given vantage point in space and with respect to an

environment"(Benedikt, 1979: 47). It is the field of view within which the entire space boundaries can be defined through the transportation of observer's eye around 360˚ without geometric obstacle. The boundary-shape of an isovist is sensitive to location of point of seeing when the space is non-convex, as there would be many isovists with different shapes. It is used when examining complex patterns of behavior.



(source: Batty& Rana, 2002)



(source: http://wiki. uelceca. net/ 2007/2008/files/ doc+essay.pdf)

Figure 3.4. Isovist.

3.5. THE CONCEPT OF DEPTH

The main interest in space syntax has not been in creating axial lines or maps, but in examining and interpreting relationships between lines that cover such map (Batty & Rana, 2002). Space syntax measures distance between spaces topologically, this topological distance is called depth. Depth means number of intervening lines that must be crossed to get from space to another, the minimum number of steps means shallowness (integration), whereas the maximum number of ones means segregation.

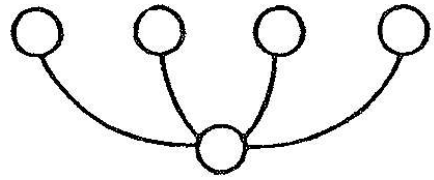
3.6. INTEGRATION

3.6.1. The Correlation Between Integration and Depth

Integration is the fewer intervening lines which need to be passed through to go from a line to every other line. It's in contrast with mean depth (obtained

by dividing the total depth by k, the number of spaces in the system), the most integrated lines means minimum depth. In other words, integration α 1/mean Depth so The more segregated spaces means higher depth.

Maximum depth(least integrated)



Minimum depth(most integrated)

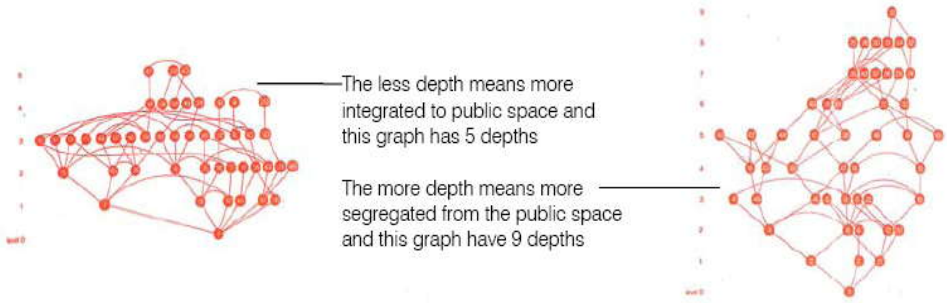


Figure3.5. Relation between integration and depth (source: Hillier et al., 1983).

3.6.2. Measuring Integration

If the axial lines of an area have been drawn, it is possible to choose any line and place all lines that join directly with it on a separate level until we cover the whole system, then the number of levels required to join up all lines in the system can be specified and values of integration, and depth can be calculated (Hillier et al., 1983). As shown in figure 3.6., by starting at line 7, we can see that it is only connected to line 5. then line 5 is connected to line 6 and 4. By placing each direct connection on a separate level, we find that

for line 7 we need four levels to join up the system. Similarly, for line 4 we can see that it's directly connected to lines 2,3 and 5. then line 5 is connected to line 6 and 7, moreover line 2 is connected to line 1. Continuing as before we see that we need 3 levels to join up all the system, so line 4 is more integrated than line 7 because it needs fewer number of levels(3). To calculate the mean depth of a certain line multiply the number of the lines on a level by the level number, sum across levels and divide by the number of lines(Hillier et al., 1983). An integration value can then be calculated as actual integration value = 1/ mean depth.

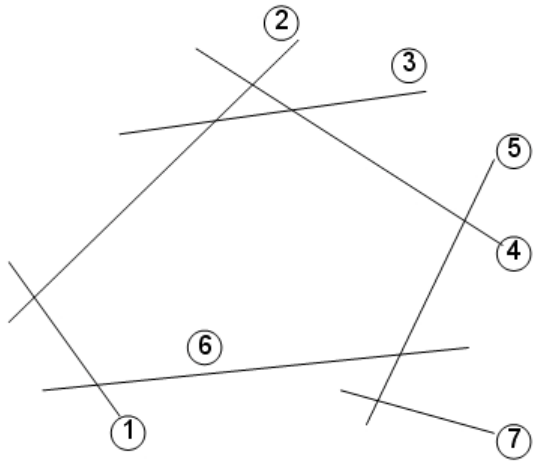
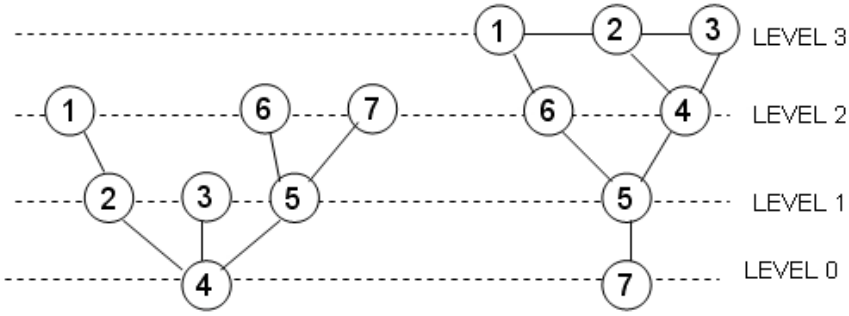


Figure 3.6. Simple model of axial lines(source: Hillier et al., 1983)



Space 4 mean depth = ((3x1) + (3x2)) / 6 = 1.5
Space 7 mean depth = ((1x1) + (2x2) + (3x3)) / 6 = 2.3
Integration value α 1 / mean depth

Figure 3.7. Simple justified graphs. (source: Hillier et al., 1983)

3.6.3. The Integration Core

Every axial line in the axial map has an integration value that differs from line to another, this integration value reflects its importance and how it relates to all other spaces. If the integration values of lines be sorted and ranked from the highest to the lowest, the lines of highest (25% of high integration lines is recommended for small settlements of less than 100 lines. 10% is the recommended value for the integration core of larger settlement) integration values can then be specified and presented on the map. These most integrated values (10%) is called integration core and can be distinguished on the map by a heavy black lines as shown in figure 3.8. In good systems, the integration core relates to all other areas. This means where ever you are in the system, you are never away from a high integration line (Hillier et al., 1983). The most integrated lines in an urban plan will represent the skeleton of the mental map because those lines are the most familiar to people.

Figure3. 8. Example of axial map analysis according to space syntax technique: Darker lines is the most integrated, while light gray is segregated (source: Kim Y O, 1999).

3.6.3.1. Forms of Integration Core

Hillier (1983) postulated that:

> "The core takes a form typical of many types of town or urban area, which we call deformed wheel. A small semi-grid of lines in the heart of the settlement (the hub) is linked in several directions (the spokes) to lines on the periphery of the settlement (the rim), which also form part of the core." (Hillier et al., 1983: 69)

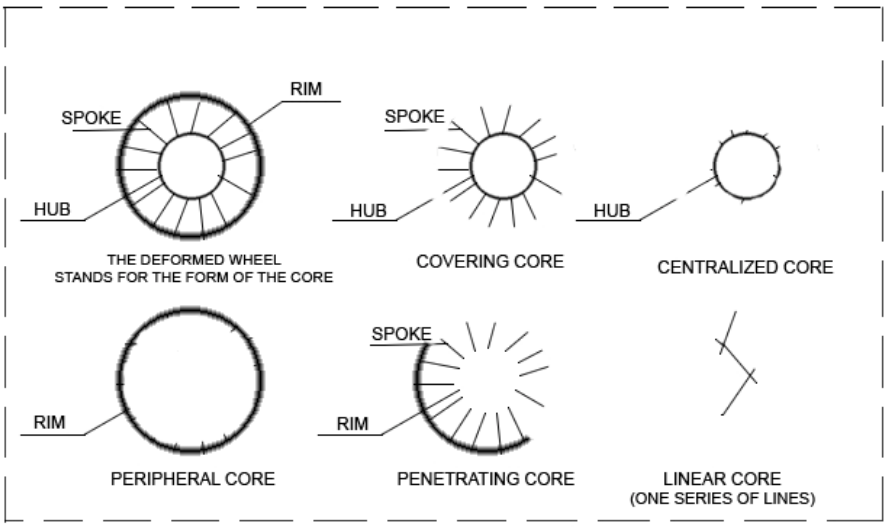


Figure3.9. Graphical forms of integration core
(source : the researcher deriving from Hillier et al., 1983)

3.6.4. Local & Global Integration

The integration value of a line changes according to the number of levels that have been considered in measure; if we count how deep or shallow each line in is from all other lines, we call this **global integration**, whereas counting how deep or shallow each line in is from all lines up to three levels away is called **radius-3 integration**, if it's only one level away from each line, then we call this **connectivity** of a line (the number of lines that are directly joined with it), so specifying the type of integration depends up on radius–n integration(Hillier, 1997). Connectivity is a property of the line that

can be seen from the line, whereas global integration couldn't be seen from the line, as it requires knowledge of the system as a whole, it considers the relationship between each line and all other lines regardless how far they go, so it's a global measure (Hillier et al., 1983).

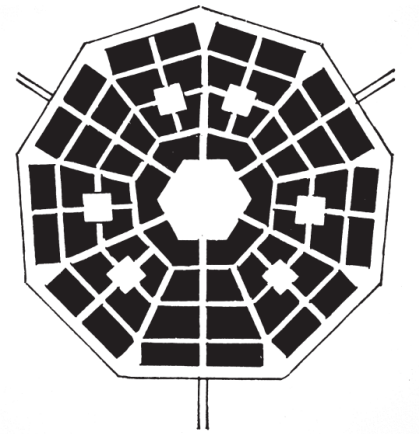
- Integration R-3 is used in investigating pedestrian movement, as it has been found out that a pedestrian movement in most predictable pedestrian trips is on average limited to three levels. On the other hand, a typical vehicular trip (vehicular movement) is often limited to ten levels(integration R-10) (Fanek, 1997).

a. Global integration. **b.** Local integration.

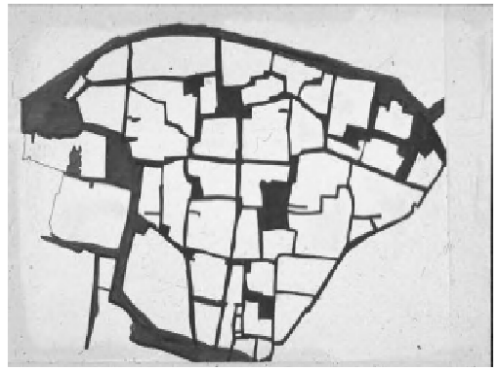
Figure 3.10. Global and Local integration of Delft, Netherlands: a (left) illustrates Global integration - It is a measurement of the relation of a line towards all other lines in the system, ranked from the most integrated (dark color) to the most segregated (light color) -, while b (right) illustrates Local integration analysis calculated up to three lines away from each line in every direction (source: Bilsen, 2006).

3.6.5. Intelligibility

Intelligibility is a key property of the spatial structure of towns. It's an indicator of the quality of an environment as being easily navigable. Figure 3.11.a. looks like an intelligible when seen from above in two dimension, but it may not be intelligible when one moves about in it, in contrast figure 3.11. b. may be intelligible (Hillier et al., 1983); so the variables affecting intelligibility need to be grasped. The intelligibility is defined as " the degree to which what can be seen and experienced locally in the system allows the large–scale system to be learnt without conscious efforts" (Hillier, 1996: 171).



a) The pattern seems Intelligible when seen from above (source: Hillier,1996)



b) The map of Apt in the south of France seems Unintelligible (source: Hillier et al., 1983)

Figure3.11. Example of intelligible and unintelligible patterns.

Intelligibility of space is "a measure of the relationship between the overall urban space and local features" (Szalapaj, 2001: 41). The definition concerns the relation between connectivity of space(local measure) and its global integration, it means how spatial configuration can be read from its parts. In other words, how the observer can be informed about his position within the spatial system as a whole from every location that he potentially occupy " The key to understanding parts and whole is understanding the relation

between the different radii of integration" (Hillier, 1996: 127).The most integrated area will be visited more, thus it will be more familiar, even though integration had no direct effect on familiarity. An intelligible system is one in which well-connected spaces also tend to be well-integrated ones and vise versa. In an intelligible world the correlation between local and global properties of space is perfect, so the whole can be read from the part. Conversely, if the correlation is poor, the product will be unintelligible environment, so the people may lose their way. Later, Hillier (1996) explains this notion using a scattergram that shows the correlation between connectivity and integration. He notes that the degree of intelligibility can be predicted by looking at the form of the scatter. If the points form a straight line rising at 45 degree from bottom left to top right, then this implies a good correlation between local and global integration. Consequently, The system would be highly intelligible (Hillier, 1996). For example, in figure 3.12.a the points form a tighter and linear scatter which indicates a perfect correlation, and therefore a greater intelligibility. On the contrary, figure 3.12.b shows that the scatter is diffused indicating that the correlation is poor. Thus, revealing unintelligible world.

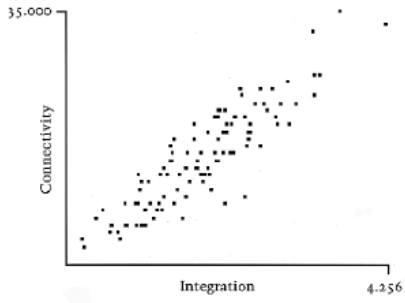


Figure 3.12.a. Intelligible spatial layout (source: Kim Y O, 1999)

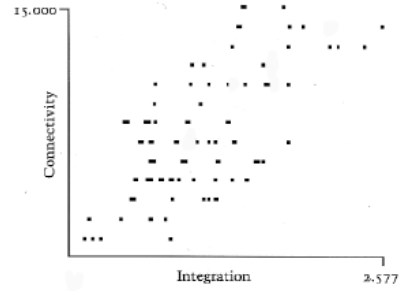


Figure 3.12.b. Unintelligible spatial layout (source: Kim Y O, 1999)

3.6.6. What Is A Synergy Value?

Synergy is simply the correlation between local (radius3) and global integrations. It is a different kind of intelligibility in so much, as it is about the relationship between the local and global structure. Radius 3 is not as local as connectivity, but it is the best correlate, for example, of pedestrian movement rates, and seems to give a good indication of the local pedestrian scale structure of urban areas. Its correlation with the global integration measure is, therefore, perhaps an indication of the relationship between the local economy of neighbourhoods and the whole city economy. Do the routes which connect the whole pass through the same spaces as those which form the heart of the neighbourhood? In the modern city one of the effects of zonal planning and traffic engineering has been to separate the global route structure from the local neighbourhood (in order to speed car traffic), and we would expect this to be shown by a reduction of synergy. We would also expect a reduction of intelligibility, but this would be shown in the scattergram as a small number of the most integrated spaces (the main traffic routes) also being poorly locally connected[3].

3.6.7. Movement Pattern

It's widely accepted that there is a relation between the spatial configuration and the likelihood of encounters, this relation is called *natural movement* (Hillier, 1996). Natural movement is " the proportion of movement on each line that is determined by the structure of the urban grid itself rather than by the presence of specific attractors or magnets." (Hillier, 1996: 120). Even though, integration of an urban plan is purely spatial analysis, it has proved a strong predictor of movement patterns, both pedestrian and vehicular (Hillier, 2004). If the integration values of an area have been measured; and

[3] From a discussion through e-mail between the researcher and both of professor Alan Penn and Dr. Ruth Conroy Dalton.

a street survey of counting the number of people who are passed when an observer walks 100m/ min. has been carried out, then the usage and pattern of movement can be predicted, as streets from which other streets can be accessed with minimum intervening lines attract more people. Thus, attract retail and other land uses that rely on the volume of pedestrian traffic, and consequently the volumes of both pedestrian and uses are multiplied, as the allocated functions then increase the importance of the location itself and attract other functions, this phenomena is what Hillier has called *Multiplier effect* (Hillier,1996). This indicates that the pattern of movement is a function of its pattern of integration (Hillier et al., 1983). This principle of predicting movement pattern and usage could be used as an evaluative tool in design and redevelopment of urban areas. Figure 3.13. shows a scattergram between encounters on the horizontal axe against integration on the vertical.

Figure 3.13. Scattergram between encounters and integration.

3.7. WHAT IS A CONTROL VALUE?

Control is defined as " the degree of choice that each space represent for its immediate neighbours as a space to move to" (Hillier et al., 1983: 237). It is the sum of the reciprocal of the connectivity of its neighbours. It has been determined that each line starts with a control value of 1. Each line will

distribute its initial value of 1 equally to lines with which it intersects. Each line will give and take control values depending on the number of lines that intersect with it, these control values reflect the influence of each line over those intersected with it. Figure 3.14. shows that line 1 intersects with two lines, it will distribute its initial control value equally to line 2 and 6 by giving each a value of 0.5. Similarly, line 3 will give line 2 a value of 0.5 and line 4 will give line 2 a value of 0.333. consequently, the control value of line 2 equals the sum of 0.5, 0.5 and 0.333, the resulting control value of 1.333 is higher than it had initially. Other lines may get control values less than their initial ones such as line 6 which has control value of 0.833.

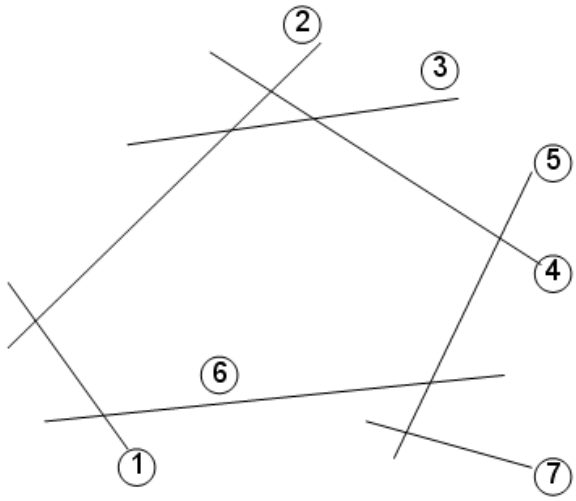


Figure 3.14. Axial lines demonstrating the control value.

3.8. AXMAN SOFTWARE

It is a computer aided design program created by Nick Dalton at University College London. By creating an axial map and inserting it into Axman software, all syntax values such as Depth, Connectivity, Integration R=n and Control can be obtained, as Axman applies space syntax methodology using programmed mathematical processes. “Axman constructs a graph of the

configuration of axial lines, interpreting the lines as the graphs nodes and connections between lines as the edge of the graph"[4]. Axman is included in the Macintosh Bundle.

3.9. UCL DEPTHMAP

Depthmap, created by Alasdair Turner at University College London, is an application used in visibility analysis of architectural and urban systems. Axial maps can be entered to the program and analyzed according to Space syntax principles. UCL Depthmap can perform many types of analyses such as the original visibility analysis, generation and analysis of axial maps as well as segment analysis. The program was first written for the Silicon Graphics IRIX operating system as a simple isovist processing program in 1998. It is designed to run on Windows 2000 and XP operating systems[5].

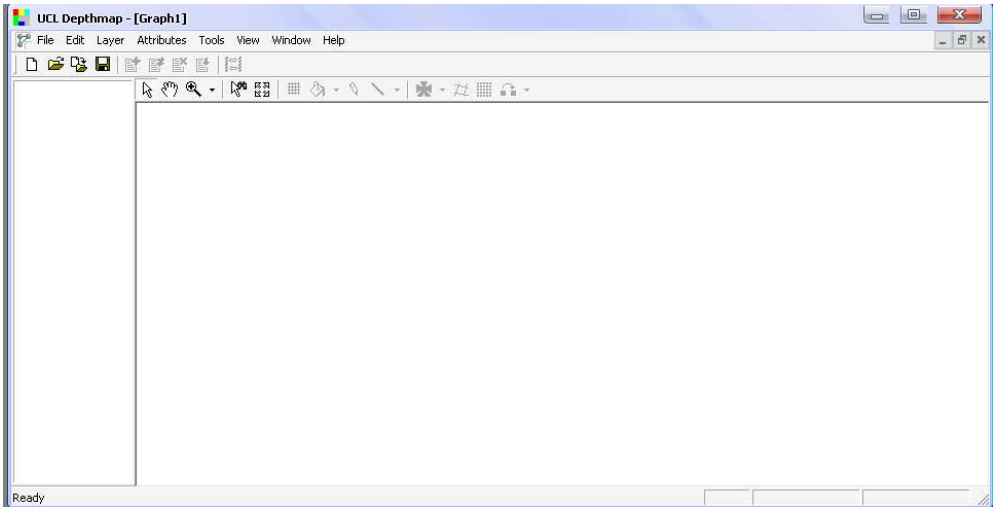


Figure 3.15. UCL Depthmap interface.

[4] http://www.spacesyntax.org/software/macbundle.asp.

[5] http://www.spacesyntax.org/software/DepthMap.asp.

3.10. CRITICISM ON SPACE SYNTAX

Although space syntax is widely used and published since few decades, the validity of technique is controversial. The limitations of space syntax can be presented in the following points:

1- Discarding of metric and 3D information: Ratti (2004) argued that space syntax measures the distance between spaces topologically neglecting metric distance and this is hard to be accepted. Hillier (2004) claimed that space syntax is not enough for social behavior interpretation, as it has noting to say about pedestrian choice make, so it need to cooperate with other suitable variables to do so. He argued that there is a conflict between the metric and topological relations, as considering metric distance instead of topological one will always presents the geometric center of the system as most integrated (because it is metrically closer to all other parts of the system) and presents the geometric edges as most segregated, this means that the boundary of the model will be affected by the choice of its position.

Some architects reject the analysis based on space syntax because it is not three dimensional and can not therefore have much to say about visual quality. Consequently, Space syntax ignores the superficial appearance of the environment, including surface colors, textures and patterns. Ratti stated that there are many factors can generate movement such as bus stop and taller building. As space syntax neglect 3D information, then it's hard to differentiate between a pedestrian pavement and an urban highway when counting on axial map.

2- Redundancy and ambiguity of terms used in space syntax: The terms used by Hillier in writing space syntax are complicated and ambiguous. Moreover, some of these terms are similar in the meaning. For instance, both of depth and integration mean the same thing. Thus, this produces redundancy.

3- Lawrence (1990) argued that space syntax technique is inadequate in projecting society's norms. Likewise, Edmund Leach (1978) argued that the generative syntax can not be inferred by just looking to the two dimensional urban pattern of a settlement, and even if we could be sure of what generative syntactic rules have been, nothing could be inferred about the society that makes the use of the resultant settlement. On the contrary, Hillier suggested that social interaction results from the spatial configuration of an urban layout. This claim is impossible to be tested, as our today urban lifestyle is totally different from that existed when Hillier built his thoughts[6].

4- "The danger of planners using space syntax without understanding of the ideologies behind it which might lead to " other equally important design issues being treated as secondary "(McLeish,1987:108)"[7].

5- Space syntax has nothing to say about many properties of urban layout such as property of shape, and the angular size of the turns. Although axial maps may speculate main and sub roads through lengths of axial lines, it has nothing to say directly about road width. In other words, pattern of axial maps may reveal existence of hierarchy of roads while it is actually not. Hierarchy of roads can not be obscured in wayfinding and orientation issue. This point will be discussed in more detail in the empirical part.

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[6] Salheen, M., 2001, A comprehensive analysis of pedestrian environment: The case study of Cairo city center, Ph.D. thesis , Heriot-Watt University, Edinburgh College of Art, Faculty of Environmental Studies, School of Architecture.

[7] ipid.

3.11. CONCLUSION

In this chapter, we have briefly introduced the basic elements of space syntax. For instance, illustrating the concept of spatial configuration, defining the tools of spaces syntax analysis (convex space and axial line), explaining the notion of depth and integration and how to measure them. We have also mentioned the difference between global and local integration and how the correlation between them can be used as an evaluative tool of good urban areas properties in the light of intelligibility principle. After that, we identified another important term used in space syntax, it is the control value of a line, illustrating its meaning and how can it be calculated manually.

In the last part of this section, the relationship between integration and pattern of movement have been discussed, illustrating how can spatial pattern predicts usage. A scattergram is presented to make better understanding of the correlation between space syntax and spatial behavior.

There are other specialized terms used in space syntax such as centrality and choice have not been mentioned in this research study, as they have little significance for it.

Finally, we have discussed the criticism against space syntax especially the abandon of metric and 3D information, the argument between Hillier and C. Ratti has been discussed in order to support or refute metric and 3D information.

CHAPTER FOUR
MAPPING CASE STUDIES ACCORDING TO LYNCHIAN METHOD

4.1.INTRODUCTION

Finding one's way depending on environmental knowledge requires first to know what internally represented about his environment. Sketch maps and interviews can give us what's coded in people's minds about their environment. The degree of completeness of sketch maps and the way people use in describing a way for strangers can predict the degree of urban legibility; and outline the actual reasons behind wayfinding problems. Wayfinding problems in general result from difficulties in coding or recalling environmental knowledge in wayfinders minds, so the question is: why particular environments are easily to be coded and therefore easily to be navigated, while others are difficult to be internally represented and therefore have locational difficulties? This question addresses what mainly we intend to do in this chapter. Three Egyptian areas were chosen for applying Lynchian method on them. These areas are: Heliopolis, Maadi, and Cairo CBD. They are unique in character among Cairo districts, and being vivid and similar in form.

4.2.CRITERIA OF CHOOSING CASE STUDIES

4.2.1 Character

The area chosen for study should be unique in character, rich of its unique buildings, squares, landmarks and nodes, and seem, on first observation, to have high order of imageabilty, thus the ability of studying Lynchian elements can be available.

4.2.2 Urban Fabric

The area chosen for study should have a form reflecting its character. What ever type of urban fabric, problems of disorientation may be emerged. This may refer to problems in urban fabric itself or to visual problems in general. Formal planning never means that a particular area is free of way-finding problems, since they may exist as a result of absence of roads hierarchy or isolation of some parts, etc.

4.2.3 Social Aspects

People differ in their cognitive maps construction according to their culture, gender, social class, age and many other factors influence their way of reading an environment.

4.2.4. Wayfinding Problems (Locational Difficulties)

The area chosen for study should seem on first observation to have wayfinding problems, then we try to find an answer to main research question: what is responsible for locational difficulties: visual image or structure of spatial system?. This question may lead us to new principles enhancing way-finding abilities.

4.2.5 Special Considerations

There may be other considerations influence choosing case study. These considerations may refer to size, history, or age of the chosen area.

Criterion	Heliopolis	Cairo CBD	Maadi
Character	It has a unique character of Islamic look in facades that were ornamented by arcades.	It has a unique western-style designed in a combination of art deco, art nouveau, baroque and, a	It was built in English countryside cottage style. Its unique villas reflects its distinct

		little later, neo-Islamic styles. It looks as a part of Europe.	character.
Urban fabric	It has a western urban layout presented in radical urban fabric with rigid grid pattern	It has a French touch in its layout like Hussman planning of Paris. It has a radical urban fabric.	It has a radical urban fabric with rigid grid pattern.
Social aspects	It is filled mostly with cosmopolitans and native aristocratic Egyptians.	It shows a variety of residential districts ranging from slum areas within which low or middle class live to distinct housing as upper class and collar bills live.	It is filled with Americans, plus an assortment of wealthy Egyptians, Gulf Arabs, and other nationalities that together comprise a distinct and broad international community.

Table 4.1. Criteria of choosing case studies.

Area	Counts	%
Heliopolis	21	30
Maadi	57	81
Cairo CBD	34	48

Table 4.2. Results of a questionnaire distributed amongst 70 subjects. They were asked at what areas they had most difficulties in wayfinding.

Analyses were made of Maadi, Heliopolis, and Cairo CBD. Maadi is unique in its character, urban fabric; green areas along its streets, as well as it is distinguished by upper-class housing. Nevertheless, it has many problems in orientation and full of locational difficulties; Heliopolis for its unique

character, its unique landmarks and squares. Moreover, the informal talks with the interviewees showed that Heliopolis is easily to navigate. Therefore, we selected Heliopolis to be studied. Cairo CBD shows another example of suburb with several high-density residential districts, ranging from slum to upper-class housing; and distinct European-style, specifically French. Heliopolis area is about 7.2 km²; Maadi is about 5km²; and Cairo CBD is approximately 2.75km²[1]. The outer suburbs of Maadi, Cairo CBD, and Heliopolis formed their far-flung colonies. Both of Maadi and Heliopolis were constructed in colonial epochs as imitations of garden suburbs. "Maadi and Heliopolis are home to wealthy Egyptians and to large expatriate communities, and are among the most western-looking parts of Cairo" (Beattie, 2005: 183).

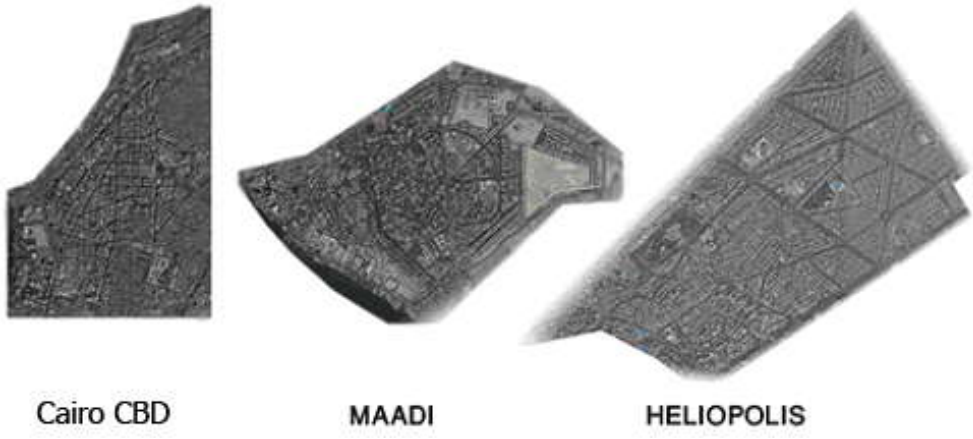

Figure4.1. Map of Case studies.

4.3. ANALALYSIS FRAMEWORK

4.3.1. Field Reconnaissance Analysis

Character : It is the identity of place which reflects its architectural style, culture, landscape, etc.

[1] Lynch had taken in is case studies an area of approximately 2.5 by 1.5 miles (mile=1.6093 km).

Continuity and Enclosure : It is the ability of defining private and public spaces and continuity of street frontages.
Ease of movement: It is permeability and degree of accessibility between places which make them connected with each others and integrated.
Legibility: It is the degree of understanding environmental surroundings. Legible city is that has clear image and help people to find their way around.

4.3.2. Interview And Sketch Mapping Procedure

The aim of this procedure is to get cognitive maps and explore the degree of legibility through degree of accuracy and completeness of sketch maps. The more sketch maps are complete and accurate the more the environment is legible. Comparing the results of this procedure with field reconnaissance analysis will indicate the gap between physical maps and the maps in people minds.

4.4. HELIOPOLIS (MISR AL-GEDIDA)

4.4.1. Historic Context

The earliest records of Heliopolis date back to the first decade of 20th century when Baron Edward Empain, the Belgain banker and business tycoon, bustled to Cairo in anticipation of the economic boom (Elsheshtawy,2004). In 1905, Empain established the Cairo electric railway and Heliopolis oasis company. Boughos Nubar, son of the country's first prime minister, assisted Baron Empain in purchasing the 5,952 feddans (1 feddan = 4,200 square meters) of empty desert from the colonial government at one pound each on which he built Heliopolis. Baron efforts culminated in 1907 with the building of the new town of Heliopolis, in the desert ten kilometers from the center of Cairo, situated between the airport and the city center. In fact, Baron was no simple investor, he was an innovator and his dream was

resting on solid foundation. It is said that he invited Ernest Jaspar[2], the chief designer of Heliopolis, for a riding trip to the site of the project and said:

> "I want to build a city here. It will be called Heliopolis, a city of the sun … I want it to be magnificent. I wish that the architecture will conform to the tradition of this country. I am looking for a specialist of Islamic art. You like the mosques, you are an architect; would you submit a concept design?." (Dobrowolska & Dobrowolski, 2006: 37)

It was thought that it is risky and ridiculous to erect a city in the desert. Baron brought to the project some 70 architects from all over Europe. He lived in a small palace designed by Alexander Marcel[3], Baron's palace (Qasr al-Baron). The palace was built between 1907 and 1910. "It still stands today and remains one of the finest examples of early creative use of concrete, of which it was entirely built"[4]. Baron died in 1929 and was buried in Basilica, the Church which was also built by Baron and designed on Istanbul's Hagia Sofia[5]. Basilica, close to Korba, was designed by Alexander Marcel who specialized in fancies. There was a tunnel or crypt between the Baron's palace and Basilica which was constructed 300 meters away.

Heliopolis was designed as a paradise or "city of luxury and leisure". One can feel the influence of Haussmann's Paris in the plan of Heliopolis, as it was designed to have a garden type city: its master plan contained public

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[2] Ernest Jasper is a Belgian architect began his studies in 1893 at the academie des Beaux-Arts in Brussels. He designed most of the important buildings in Heliopolis.

[3] A French architect born in Paris in 1860 and graduated from the faculty of architecture at the famous Ecole des Beaux Arts in Paris.

[4] http://en.wikipedia.org/wiki/Heliopolis_(Cairo_suburb).

[5] http://www.tripadvisor.com/Travel-g294201-d480156/Cairo:Egypt:Heliopolis.html.

gardens, parks and playgrounds; restrict building rules were set (no more than half of the private lots could be built up), and buildings heights were also set. The suburb is no longer a small and luxurious, as it has expanded to take in part of the growth of the metropolis[6]. Moreover, the Helioplis company allowed land owners to build all the entire spaces the lands as a result of rise of land prices[7]. Consequently, many shops encroached on greenery.

There is a religious tolerance emerges vividly in the existence of many places of worship in the suburb such as Saint Maron and Saint-Rita church in Beirut street, a Jewish synagogue in Al Missalah street, and the mosques all over the suburb[8].

Heliopolis suburb is full of recreational places. It contains many sporting clubs such as Heliopolis club (on Merghany street), El-Ghaba club (beside Suzanne Mubarak museum for child), El-Nasr club (located on Mahkama square); Heliolido club; many recreation areas such as The Merryland the famous recreational park; and modern cafes such as Cilantro, Costa Coffee, Beanos...etc[9].

The Heliopolis War Cemetery is placed on Nabil El-Wakkad street. It involves the Port Taufiq Memorial, a memorial to almost 4000 men of the British Indian Army who fell in the First World War. The original memorial

[6] http://weekly.ahram.org.eg/2005/741/feature.htm.

[7] http://weekly.ahram.org.eg/2005/742/fe1.htm.

[8] http://en.wikipedia.org/wiki/Heliopolis_(Cairo_suburb).

[9] http://www.essential-architecture.com/STYLE/STY-056.htm.

was originally located in Port Taufiq but was conveyed to Heliopolis after its destruction in 1967[10].

Figure 4.2. Heliopolis War Cemetery (source: http:// www. ww1cemeteries.com/othercemeteries/heliopolis_war_cemetery.htm)

Modern Heliopolis has always been the glamorous residence for cosmopolitans and native aristocratic Egyptians. "After the 1952 military coup d'état led by Nasser, it became home to much of Cairo's educated middle class"[11]. Today, Heliopolis has been absorbed into Cairo as a result of Cairo expansion. Furthermore, the gardens have mostly built over because of overpopulation[12].

[10] http://en.wikipedia.org/wiki/Heliopolis_(Cairo_suburb).

[11] http://www.search.com/reference/Heliopolis_(Cairo_Suburb).

[12] http://www.aisegypt.com/page.cfm?p=524.

Figure 4.3. Satellite map of Heliopolis.

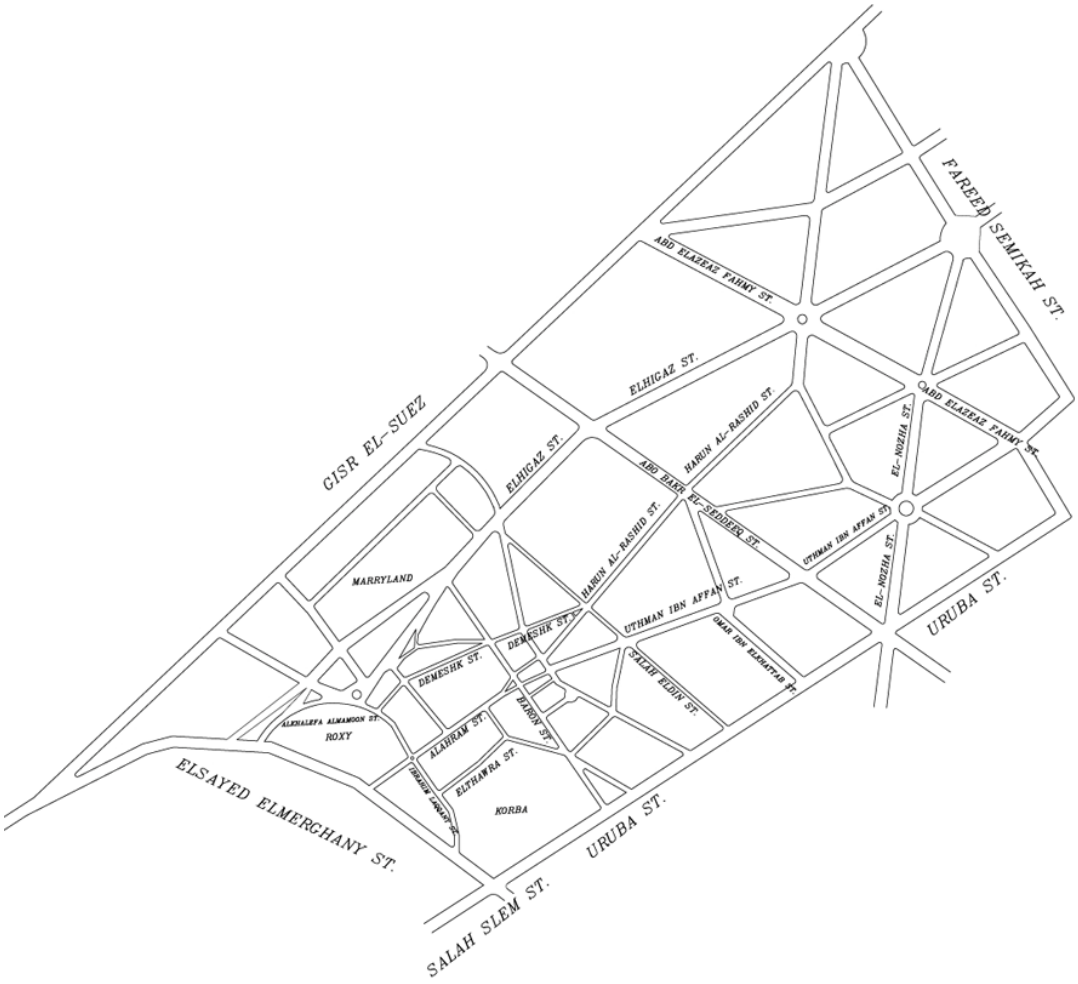

Figure 4.4. Heliopolis outline.

4.4.2. Field Reconnaissance Analysis

4.4.2.1 Character: A Place With its Own Identity "Sense of Place"

Heliopolis, the seat of power, original design is represented in grand avenues, spacious city squares linked by wide streets or arching boulevards; and a range of landmark buildings carefully placed to impose grand views on the cityscape. There was an attempt to give Heliopolis buildings an Islamic look, despite the fact that it has a Western urban layout. Today many of Heliopolis

old landmarks have disappeared and , "…tree-lined boulevards turned into traffic and pedestrian battlefields, and greenery swallowed by asphalt"[13].
The sunny sides of streets were ornamented with arches for three reasons: firstly, to protect passers from the searing rays. secondly, to make the change of perspective more attractive by limiting it to one vista at a time, the streets were designed in curves[14]. Thirdly, to give the buildings an Islamic look.

Figure4.5. Heliopolis arching boulevards: windows and arches accentuate the Islamic look to the suburb (source: photos taken from http://www. panoramio.com).

Korba and Roxy, the main of interest in Heliopoils, are the focus of Heliopolis historic character. They contain the best examples of the materials, built forms and townscape of Heliopolis. The suburb keep its unique and old style starting from Roxy square to Abo Bakr Elsddeeq avenue. After that, the rest of the suburb contains fewer buildings of quality but still reflects the area's massing, plot vision, variety of heights and materials. Towards the northern edge, surfaces are largely hard landscaped with minimal traces of plant cover. We could consider Abo Bakr Elseddeeq St. the edge that separates two areas of different styles and urban fabric. Many villas were

[13] http://weekly.ahram.org.eg/2005/742/fe1.htm.

[14] http://weekly.ahram.org.eg/2005/741/feature.htm.

demolished and replaced by ill-considered high-rises that tend to mar the beauty of the old style.

Commercial uses dominate the core of Heliopolis. Korba, a great market area, is a lovely shopping district surrounded by old villas and apartment buildings which are very interesting to see. This extends to Roxy (shopping district), and Medan Ismailia. Another interesting area is the market area "Medan El Gamia" (Square of the Mosque) which is famous for jewelry shops. Damascus street (former Boulevard Tawfiq) is famous for auto parts shops. “The architectural style is a European fantasy of the orient set in stone” (Maxwell, et al., 2006: 135).

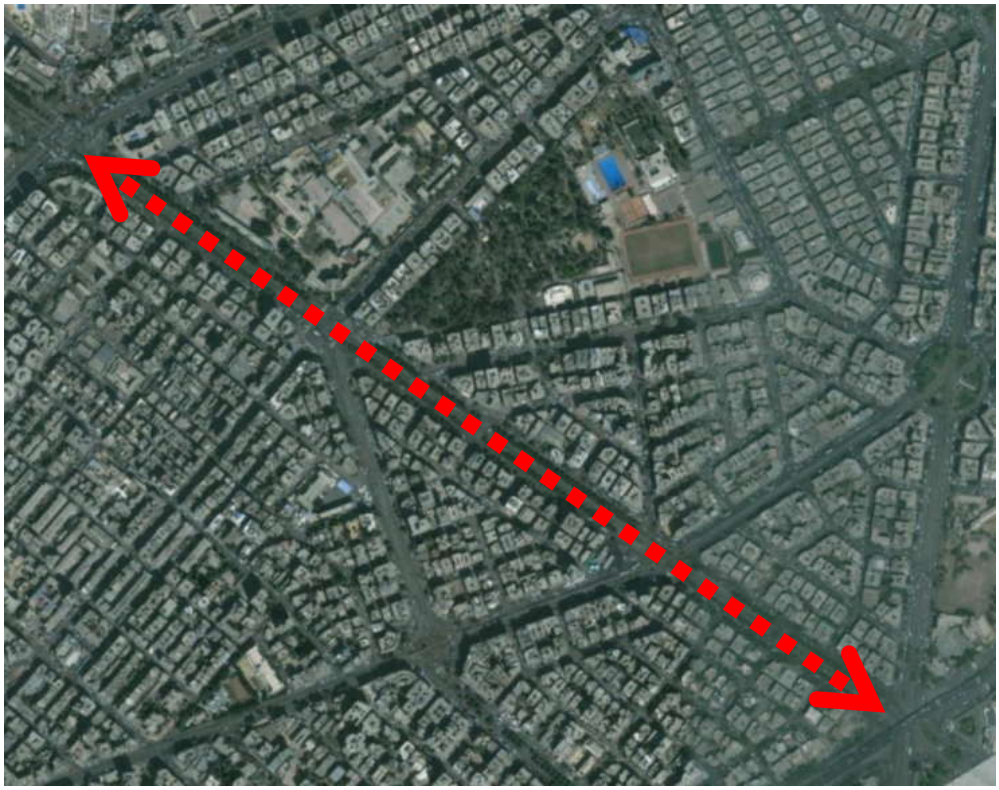

Figure 4.6. Abo Bakr Elseddeeq separates the old Heliopolis from new ill-considered architectural style.

> "Despite the mix of styles and the doubtful taste of some of the constructions, Heliopolis presents a unity that is deeper than what might derive from the rules of urban development. The recurrence in the decoration of pseudo-Muslim motives (often borrowed from mosques) gives the city a certain charm … Heliopolis definitely has a style of its own." (Raymond, 2007: 331)

Heliopolis relates itself to several architectural times. Its style is a whimsical and a unique mixture of the Moorish, Arabic and European styles which incorporate in a seamless mix represented in oriental buildings with covered archways in all the shopping districts. The designers attempted to perfectly implement the aesthetic and functional features of the three styles. Mixing the qualities of these types (Moorish[15] facades, Arabic sections, European plans) in a homogeneous unit; suitable for[16]:

1. The environmental conditions in the northern African countries (Implemented in sections).
2. The Arabic-Moorish sense of style in buildings (Implemented in facades). The recurrence of the decoration of pseudo-Muslim motifs gives the city a certain charm.

[15] Moorish Architecture : the style developed by the Moors in the later Middle Ages, as in North Africa and Spain.

[16] http://en.wikipedia.org/wiki/Heliopolis_style.


Figure4.7. Moorish facades: Elegant Moorish facades can still be seen on many buildings in Heliopolis central core (source: photos taken from http:// www.panoramio.com).

3. The customs and traditions of the Egyptian domestic life at the beginning of the century (Implemented in plans).

In fact, Heliopolis offers a wide range of architectural styles represented in many buildings like:

1- Baron's palace a Hindu-style temple designed on the temples of Angkor Wat in Cambodia and the Hindu temples of Orissa. "Balconies and verandahs are supported by grotesque mythical beasts, and conical towers rise to taper off as round domes" (Beattie, 2005: 185). Garden of the palace is full of statues and busts of dragons, Buddhas, Shivas, and Krishnas (Lindsey, 2005). The architectural style of this palace is in contrast with Empain vision about Heliopolis style when he said "I wish that the architecture will conform to the tradition of this country" (Dobrowolska & Dobrowolski, 2006: 37).


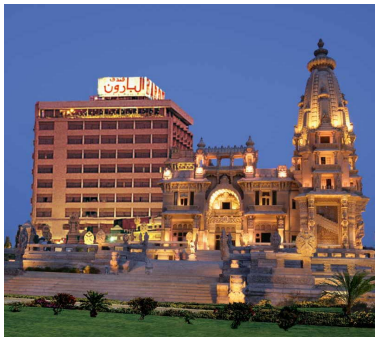

Figure4.8. Baron's palace in Uruba street (source: http://www. panoramio.com).

2- The Basilica, a quarter-sized version of Haggia Sophia in Constantinople, Istanbul, was built between 1911 and 1913 at the geographical heart of the city (Lindsey, 2005). It looks incongruous with the neo-Islamic forms of the buildings around it. However, classic, Islamic, and Coptic styles are seamlessly blended in the design of the church.


Figure4.9. The Basilica in Alahram street (source: http://www. panoramio.com).

3- Uruba palace, formerly the Heliopolis Palace Hotel, is located at the end of Baghdad street (Lindsey, 2005). It is a gigantic and much more Islamic in style than the rest of the buildings around it.

Figure4.10. Heliopolis Palace Hotel: It is situated in the intersection between Alahram and Elmerghany streets (source: Ilbert, 1985).

In contrast with previous unique style, the central area of Roxy offers many different styles that range from modern style façades seen on many buildings such as Horreya Mall, Sook Alasr Mall, Florida Mall, Roxy Cinema, and Heliopolis Cinema along with the new cinemas in Horreya Mall; to classic ones such as Normandy Cinema in Al-Ahram street. Definitely, the old style of Heliopolis looks as a diamond in a trash heap, as many new styles crept on unique ones and turned the northern end of the suburb into cement jungle. Moreover, the old style was deformed by the random installation of air-conditioners, and the closing in of balconies. This pathetic and inferior imitation of modern architecture style lacks authenticity and produces pale facades. Furthermore, it causes discontinuity and visual noise.

Figure4.11. Modern facades style in Roxy(source: http://www.panoramio.com).

Figure 4.12. Normandy Cinema in Al-Ahram street (source: http://www.flickr.com/photos/56043182@N00/tags/heliopolis/)

Figure 4.13. Somewhere in Heliopolis losses identity (source: http://www. panoramio.com).

Figure 4.14. Heliopolis architectural style.

4.4.2.2 Continuity And Enclosure

As with many of Heliopolis best urban qualities, Korba and Roxy exemplify good continuity and enclosure of public spaces except very few blank areas located in Alahram and Roxy squares. In Korba, streets are fine with active frontages that create continuous and well-defined urban routes.

Figure 4.15. Sense of enclosure: The enclosure of this street creates a strong sense of place –Korba –

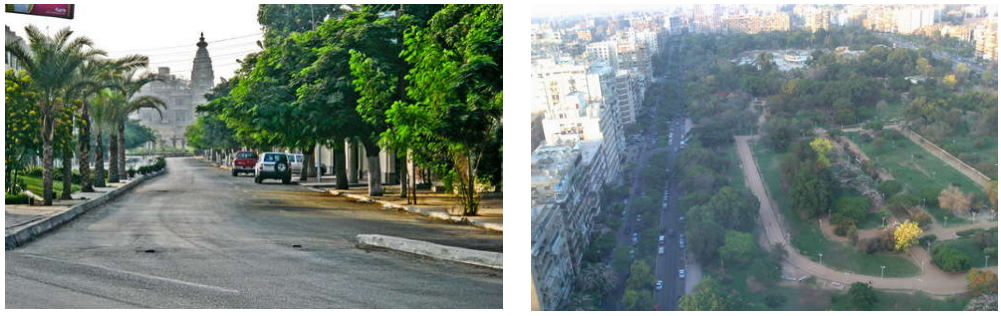

Figure 4.16. Trees help to create enclosure in weakly contained routes.

Heights of buildings located between El-Merghany and Abo Bakr El-seddeeq avenues are of 3-4 storeys except high landmark buildings that have positive role to play in defining places as essentially urban in character such as Horreya mall. The low buildings height appropriate the width of subways and reflects the intimacy and enclosure in the area.

Figure 4.17. Continuity of frontage in Korba

Figure 4.18. Continuity of frontage in Roxy.

The strongly defined public environment of Korba and Roxy begins to breakdown to the north of Abo Bakr El-seddeeq, and the definition of public and private spaces becomes confusing when leaving the shopping heart of the area. At the north of Abo Bakr El-seddeeq, continuous and well-defined routes and urban qualities dissolve and modern structure creep into Heliopolis day by day causing confusion of undistinguished buildings and break of frontage continuity. Abo Bakr Elseddeeq, as mentioned before, divides Heliopolis into two different sub areas with two different styles and urban tissues. This division causes isolation and break of continuity.

4.4.2.3 Ease of Movement

Well-designed streets encourage people to use them and stroll through them. Streets should provide attractive pedestrian environment.

While some of Heliopolis avenues encourage ease of movement for all users, others such as Elhegaz and Al-Nozha are biased towards vehicle traffic movement at the expense of pedestrian. While path system looks well-defined by clear origin at the start point of a particular street and clear destination at the end, the walking paths and traffic movement are confusing in general and provide low permeability. For instance, in Osman Ibn Affan street, the movement on the sub-way that springs from Salah Eldin Sq. to Ismailia Sq. is very difficult, as there is no any separate line between tramway and vehicular lanes, so both drivers and pedestrians use the tramway for movement. The situation gets worse, as drivers are confused with that misuse of tramway lane: for any of the two ways street could they use the lane?. In fact, accessibility through most of Heliopolis squares is limited and Difficult because of interference between vehicular lanes, pedestrian walks, and tramways. The problem of traffic jams increases by using sidewalks as parking areas which therefore reduce the routes width. Eventually, pedestrian links are poorly defined.

Figure 4.19. Vehicular movement dominates avenues.

Although Abo Bakr El-seddeeq street is distinguished by trees and greenery lined along its sides, it is not welcoming and underutilized as there is no place to sit or any element of street furniture. This is a general phenomenon in the suburb overall except few seats located along tramway stations. Abo Bakr El-seddeeq street works as a physical line that separates Heliopolis old style buildings from new ones. Furthermore, the street could be seen as less well-defined edge that the individual perceives as a barrier. It is worth mentioning that The isolation caused by Abo Bakr El-seddeeq St. is visually not structurally, as the sequence of nodal points handle the integration between different parts of the suburb.

Figure 4.20. Abo Bakr El-seddeeq St (source: http://www.panoramio.com).

Heliopolis is bordered by edges of highway streets like Gesr El-Suez from the west and Salah Salem from the east. Merghany street works as political southern edge because of its direct link with Uruba Palace. There are overhead edges borders the suburb such as El-Galaa bridge on Uruba street and El-Tagneed bridge on Gesr El-Suez. Likewise, tramway network provides weak edges among districts.

Figure 4.21. El-Galaa bridge as an overhead edge (source: http://www.panoramio.com).

4.4.2.4 Legibility: A place that has clear image and is easy to understand

The central and most important place in the city is the square located in Roxy area within which the Catholic church Basilica laid out. The main street is Sharia Al-ahram (Pyramids street), on which stands the Uruba palace. From the palace, at the first intersection with the splendid street Ibrahim Laqqany (former boulevard Abbas), is the open air cafeteria Amphitrion. Al-ahram street ends at the suburb's main square "Alahram square" (previously Yabasat) where towers the dome of Roman Catholic basilica. On the other side of the square, the street branches diagonally into two: Uthman Ibn Affan street and Harun Al-Rashid street (formerly Rue San Stefano). Another major boulevards such as Baron street (now Nazih Khalifa street) cross the square perpendicularly. The avenues span widths of 30-40m and the main streets 20-25m (Dobrowolska & Dobrowolski, 2006).Uthman Ibn Affan and Harun Al-Rashid streets runs along the suburb and intersects perpendicularly with many routs such as Abo Bakr El-seddeeq and Salah Eldin to form many nodal points such as Ismailia, Salah Eldin, and Sapheer squares. Smaller streets and alleys filled the space in between. In fact, The urban fabric of Heliopolis is radical with rigid grid pattern, so it is remarked with many obvious squares such as Roxy, Korba, Alahram, Salah Eldin, Elgamia, Beirut, Triumph, St. Fatima, Elhigaz, Heliopolis, Ismailia, Sapheer

and Mahkama squares. Alahram square measures 190 by 250 meters, and is mostly covered by greenery. It is composed of five streets forming a star with wide facades on edges to allow long perspective onto the streets (Dobrowolska & Dobrowolski, 2006).

The Basilica, Catholic church situated in Al-Ahram square, is a famous landmark in Heliopolis. It is modern for its time in its simple, bold design and with its grand porch of columns and a large domed structure that never forgotten. The church is located in a strategic viewpoint, as the avenue of Alahram that intersects with the two main diagonal streets of Osman Ibn Affan and Harun Al-Rashid at Alahram square, and the perpendicular avenue that ends with the Baron's palace form Heliopolis's simple, symmetrical framework (Dobrowolska & Dobrowolski, 2006).

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Figure 4.22. Basilica church (source: http://www.panoramio.com).

Behind the Basilica on the northern side of Alahram square, two large colonnaded buildings look as a background for the church when seen from the avenue of Alahram. Each has an ornamented minaret with features of an Ottoman epoch top. The function of these two minarets was to form a part of the city landscape (Dobrowolska & Dobrowolski, 2006). The two minarets were damaged in the 1982 earthquake (Lindsey, 2005). If we continue walking a few blocks down Harun Al-Rashid street, we see Heliopolis First mosque (Built in 1911) located in Midan Gamaa. Left of Midan Gamaa is

Merryland garden, a park with entertainment center and large artificial lake (Lindsey, 2005).

Figure 4.23. Two old residential buildings with two minarets with an Ottoman epoch top. The minarets accentuate the Islamic feel.

Heliopolis is rich of distinct landmarks such as Basilica, St. Fatima church (The Red church), Baron's palace, Africa planet restaurant, St. George Coptic church, Saint Mark's Church[17], the Heliopolis Palace Hotel, Eldar church, Saint Maron church, the English school, and other distinct buildings which imaged as focal points connected by wide and spacious avenues to create grand vistas.

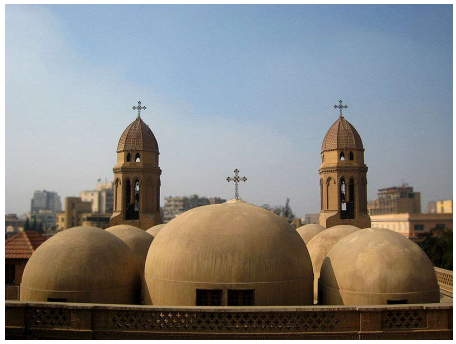

Figure 4.24. Saint Mark's Church (source: http://www.panoramio.com)

Figure 4.25. Eldar church (source: http://www.panoramio.com)

[17] the oldest church in Heliopolis.

Figure 4.26. St. Fatima church (The Red church) (source: http://www.panoramio.com).

Many streets have unique vista of landmark buildings at their ends. For instance, Baron street has the unique vista of Baron palace at its end, in Uruba St., which gives it a unique identity in the direction toward this end. This scene emerges in many of Heliopolis streets.

Figure 4.27. Closed vista (source: http://www.panoramio.com).

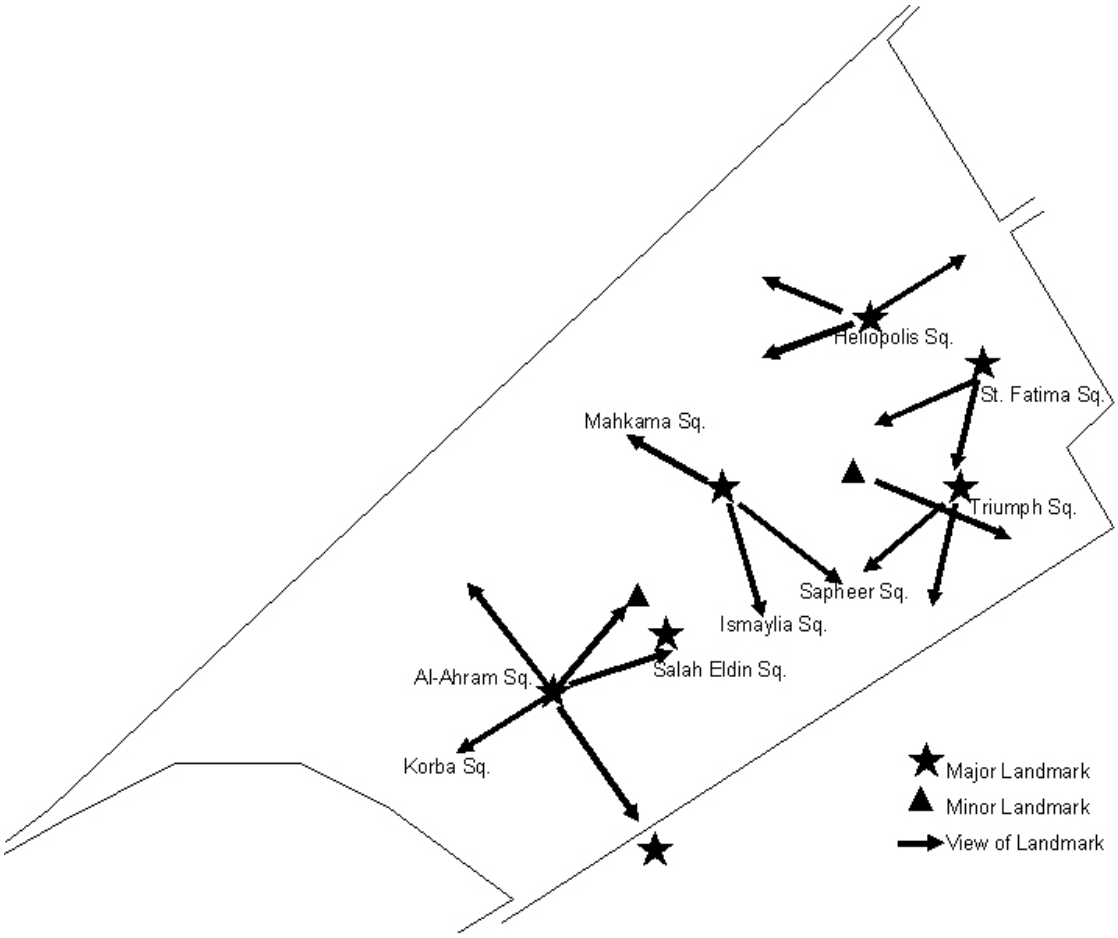

Figure 4.28. Heliopolis strategic points.

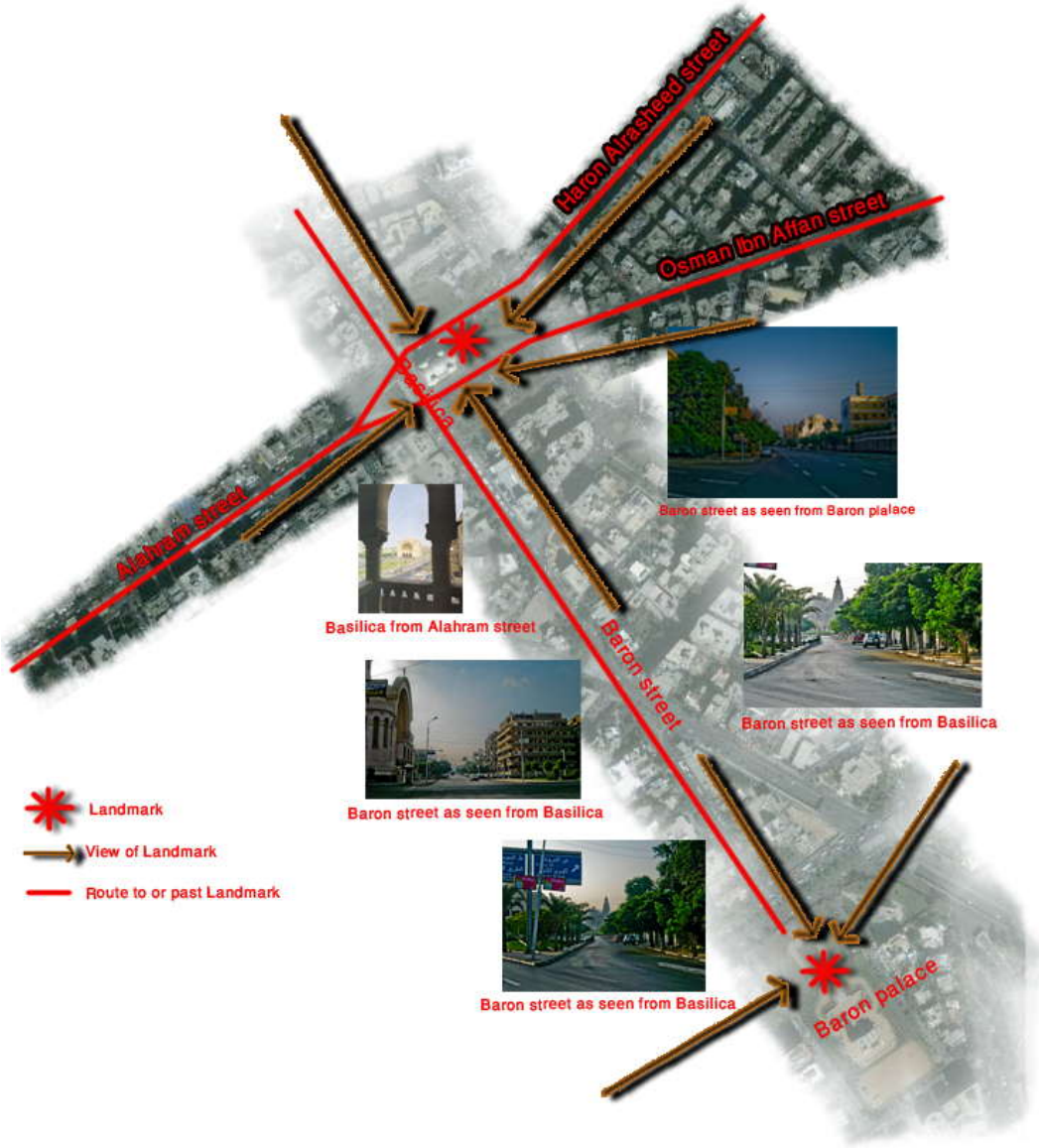

Figure 4.29. Legibility.

While Korba and Roxy are legible -Linear shopping streets with Landmarks (such as Basilica, the Heliopolis company building, St. Markos church, Saint Maron church) and clear visible routes and destinations- many other parts of the suburb are not. Legibility begins to breakdown to the north, and the

definition of districts becomes confusing when leaving the heart of Korba. Districts are separated from each other by obstacles such as tramways, and car parks.

Figure 4.30. Saint Maron church.

- Heliopolis does not always give a clear message for either pedestrians or drivers. For instance, routes north of the central core are similarly unclear, as they have the same features (radical streets end with squares work as nodal points which approximately have the same dissolved pattern in plan as a result of intersection between tramways and vehicular routes). Walking routes in particular are very unclear and navigation across squares is difficult. Branching of routes and locating many landmarks away from decision points increase confusion and wayfinding difficulties. On the contrary, locating other landmarks at strategic points of Heliopolis radical urban fabric creates high legible views. For instance, locating the English School at the intersection between Haron El-Rasheed St. and Abo Bakr El-seddeeq St. increases the legibility of triangular area that defined by central points of Haron El-Rasheed, Ismailia, and Sapheer squares, as from any point of the triangle one can see the other two points. This high imageable view emerges in many other places such as view of Basilica in Alahram square.

- Although Heliopolis squares are underutilized and structurally ambiguous, many of them are visually vivid because of existence of many landmark buildings located nearby or around them such as Planet Africa restaurant on

Triumph Sq., St. Fatima church on St. Fatima Sq., Greek Orthdox church of the virgin on Salah Eldin Sq., the oldest mosque in the heart of the indigenous zone of Elgamia Sq., and St. George Coptic church on Heliopolis sq. Furthermore, many of them are decorated by various artifacts of historic significance.

Figure 4.31. Ismailia Sq.: It is hardly used because of its weak connection with buildings around it. Moreover, the edges of flower beds which people would normally use to sit are uncomfortable(photos from http://www.panoramio.com).

Figure 4.32. St. George Coptic church (source: http://www.panoramio.com).

Figure 4.33. Planet Africa restaurant (source: http://www.panoramio.com).

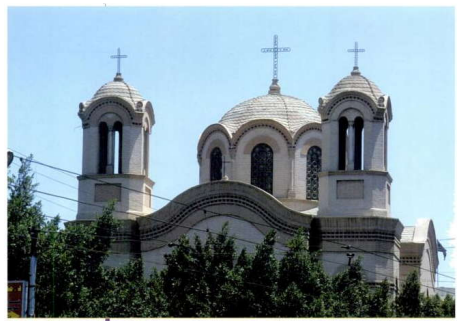

Figure 4.34. Greek Orthodox church
(source: Dobrowolska & Dobrowolski, 2006).



Figure 4.35. Triumph Sq.: Various artifacts (Art wall, Roman column, memorial) are on display at the square (photos from http://www.panoramio.com).

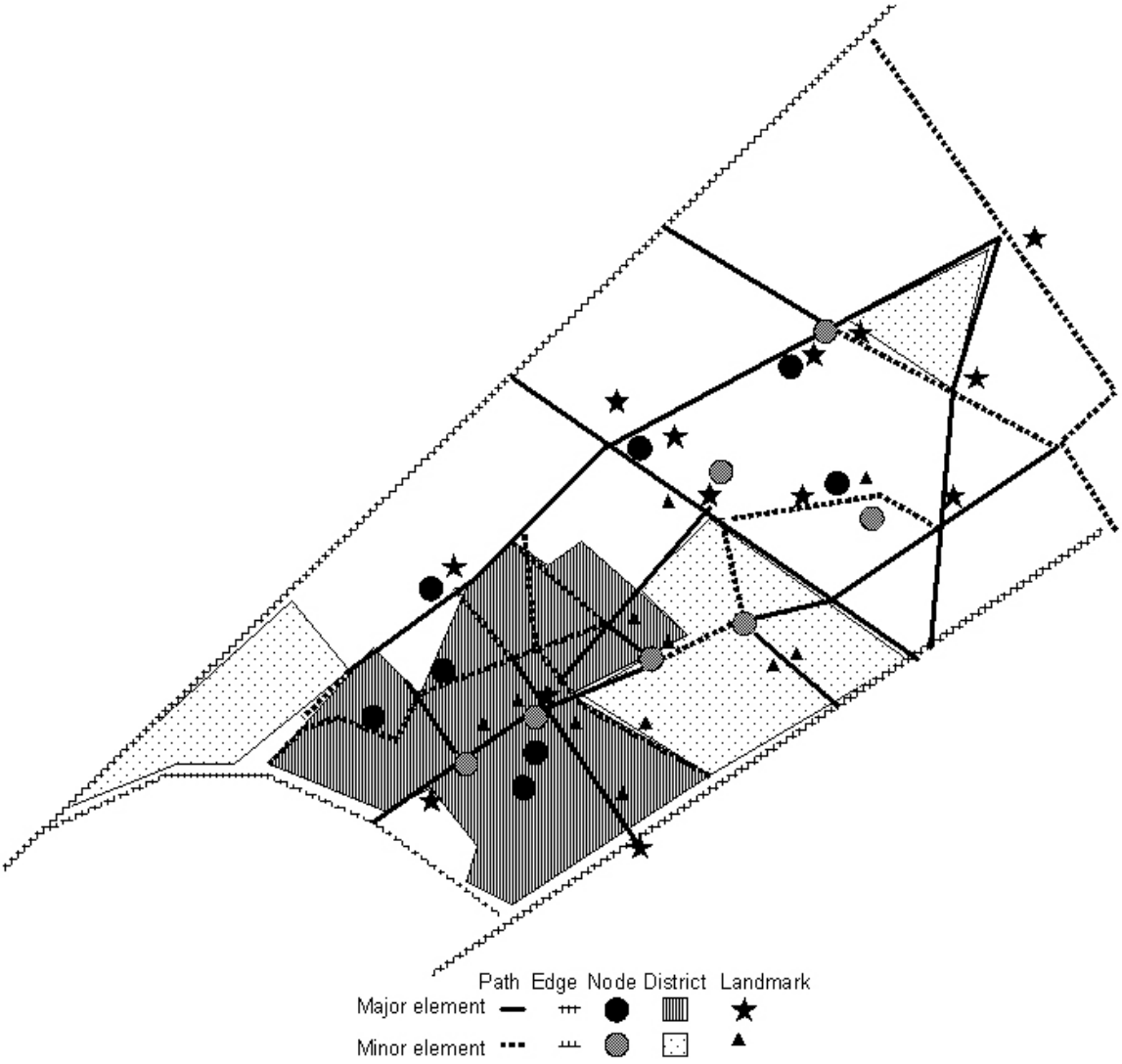

Figure 4.36. Heliopolis image as seen in the field.

4.4.3 Interview And Sketch Mapping Procedure

In this stage of our thesis, subjects were interviewed about their ability to navigate and reach a particular destination in Heliopolis. They were asked to draw a sketch map of the area as if they were describing it for a stranger. Thirty volunteers – fifteen of them female, the other fifteen male, were tested and had to answer questions like these:

- What does Heliopolis mean for you?
- Do you see it easy to find your way?
- What elements do you depend upon to find your way?
- List ten of the most important elements for you and describe three of them?
- If you have two ways to reach a particular destination; one is longer with less changes of directions and the other is shorter with more changes of directions, which one you choose?

Subjects	Gender	Age	Profession	Familiarity	Place of Residence
Subject1	Male	20	Commerce student	Not familiar	Sheraton
Subject2	Male	20	Commerce student	Fairly familiar	Abbasyia
Subject3	Male	21	Psychology student	Fairly familiar	Sayda Zainab
Subject4	Male	27	Accountant	Very familiar	Shobra
Subject5	Male	45	Employer	Very familiar	Ain Shams
Subject6	Male	23	Seller	Familiar	Nasr city
Subject7	Male	45	English professor	Moderately familiar	Heliopolis
Subject8	Male	39	Lifts technician	Familiar	Helwan
Subject 9	Male	21	Lifts technician	Very familiar	Helwan
Subject 10	Male	37	Barber	Very familiar	Zagazig
Subject 11	Male	32	Barber	Familiar	Zagazig

Subject 12	Male	45	Seller	Not familiar	Nasr city
Subject 13	Male	50	Mechanical eng.	Very familiar	Heliopolis
Subject 14	Male	29	Mechanical eng.	Very familiar	Heliopolis
Subject 15	Male	24	Seller	Moderately familiar	Nasr city
Subject 16	Female	23	Lawyer	Not familiar	Mataryia
Subject 17	Female	21	Medicine student	Familiar	Heliopolis
Subject 18	Female	21	Arts student	Moderately familiar	Nasr city
Subject 19	Female	35	House wife	Familiar	Heliopolis
Subject 20	Female	43	House wife	Very familiar	Nasr city
Subject 21	Female	27	Accountant	Not familiar	Shobra
Subject 22	Female	32	Chemist	Familiar	Nasr city
Subject 23	Female	25	Accountant	Fairly familiar	Heliopolis
Subject 24	Female	41	House wife	Familiar	Heliopolis
Subject 25	Female	34	Pharmacologist	Not familiar	Nasr city
Subject 26	Female	22	Commerce student	Familiar	Helwan
Subject 27	Female	25	Math teacher	Not familiar	Nasr city
Subject 28	Female	31	Social worker	Familiar	Al-Haram
Subject 29	Female	29	House wife	Fairly familiar	Heliopolis
Subject 30	Female	24	English teacher	Not familiar	Abbasyia

Table 4.3. Subjects tested, Heliopolis.

4.4.4 Imaginary Task Description

Subjects interviewed, were asked to draw an imaginary trip of a path starting from Roxy square to Triumph square. The path chosen for this trip is rich of many distinct landmark buildings along its sides which reflect the character of Heliopolis. Moreover, the path links old and new styles of Heliopolis. People were asked to describe all events and feelings that they may face along the path. The task consists of 3 subtasks that have to be performed in a sequential order.

Task	Going from	Going to
Task	Roxy square	Triumph square
Subtask 1	Roxy square	Korba square
Subtask 2	Korba square	Ismailia square
Subtask 3	Ismailia square	Triumph square

Table 4.4. Tasks and subtasks at imaginary path trip in Heliopolis.

Most of Heliopolitans drew poor maps, with no details or clear descriptions. Nevertheless, their maps were handled by concentrating on the sequence of joints or nodes. Many of interviewers could not describe many important places such as the northern end of the suburb and Alahram Sq.

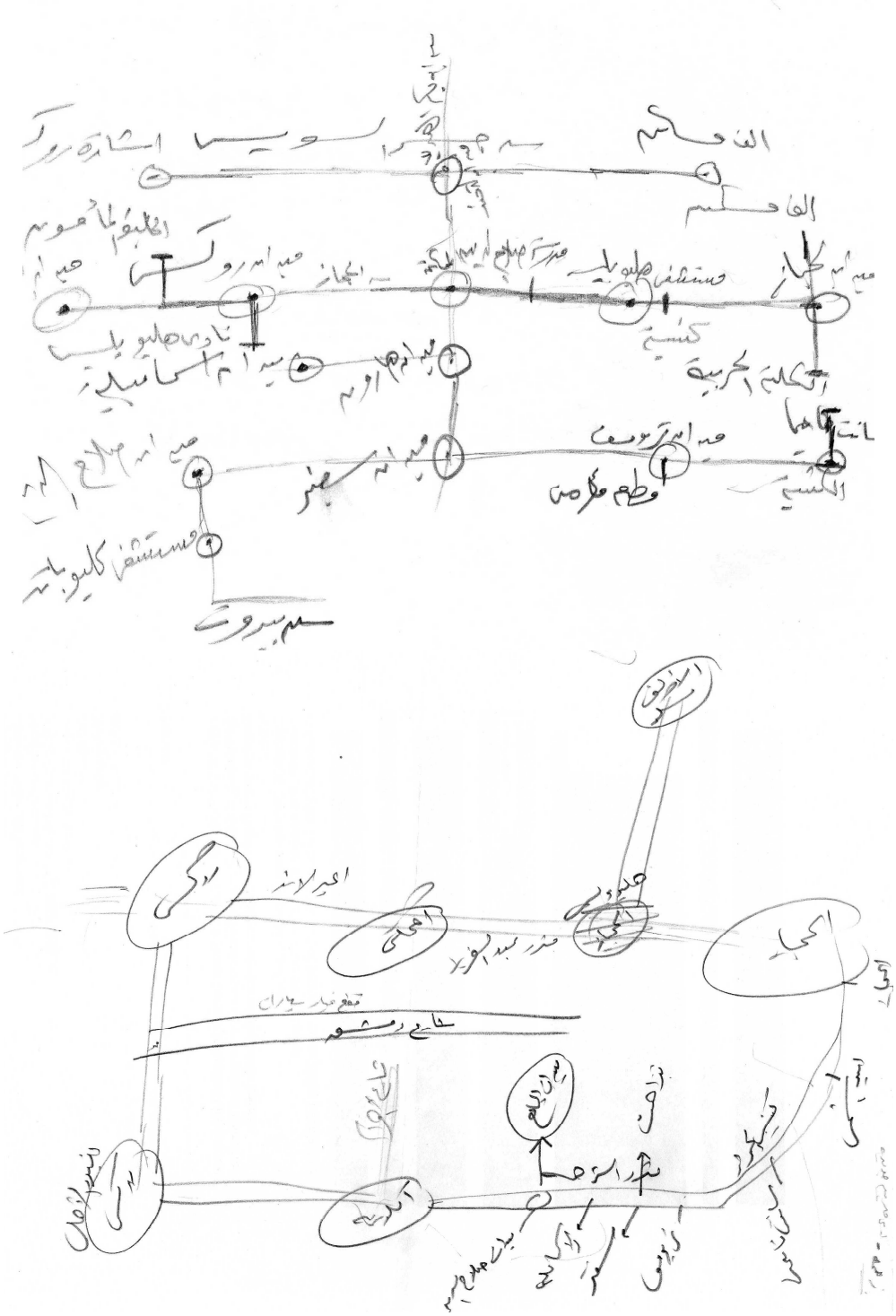

Figure 4.37. Sketch maps illustrate sequence of joints.

Figure 4.38. A poor sketch map drawn by subject 16.

One of the most interesting streets is Alahram street that includes many distinct landmarks such as Basilica, Horryia mall, Amphetrion cafeteria,. This street was omitted from the map for every person interviewed, even the one who was born and raised in the suburb. Moreover, Korba itself was a blank area on the cognitive maps except some famous landmarks such as President house and Groppi's sweet shop. Korba is an area of substantial size containing some known elements such as Baghdad[18] (former Boulevard Ismail) and Baron streets, but the paths themselves are not well-defined and the existence of restrict security and surveillance in the south end make the area itself as an edge for wayfarers.

[18] The heart of chic Korba neighborhood and one of Heliopolis most elegant promenades.

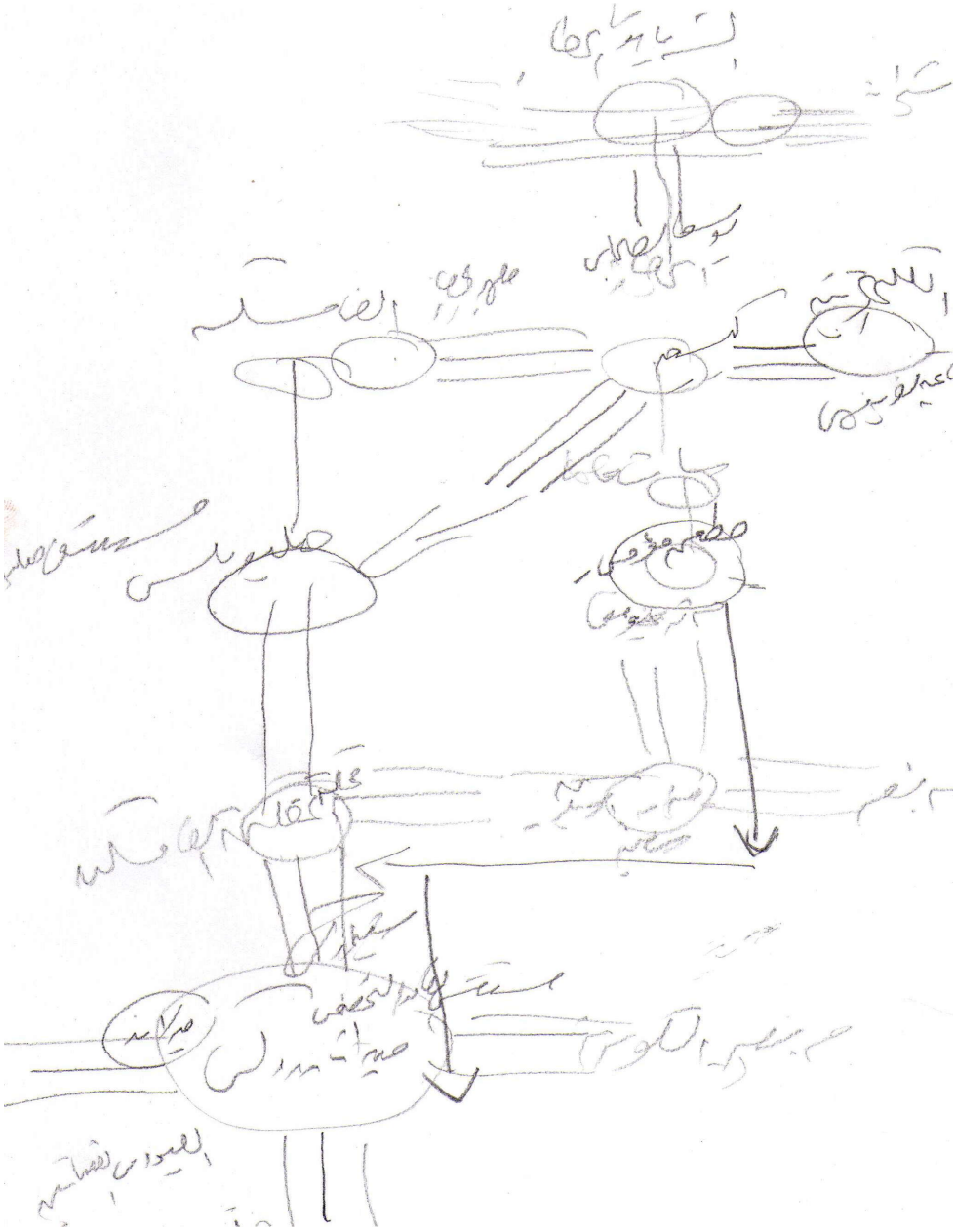

Figure 4.39. A sketch map drawn by subject 4 presented Korba as a blank area: This map is defined by destinations (drawn as circles and named) rather than routes (drawn as lines and left unnamed). It emphasizes the arrival rather than the journey.

Roxy for many subjects is the core of their image of the suburb. Heliopolis, in general, means something more than just a place to live. When Heliopolitans were asked what comes to their mind when mention Heliopolis, the answer was quietness and ingenuity. On the other hand, many interviewers were angry because of dwarfing chrome and beige art deco architecture by modern styles and unsightly billboards. They imaged the suburb as a place of their work not more. Some of them spoke about the suburb in the last times and remember its beauty describing their childhood and adulthood in it. They remember summer nights spent strolling the boulevards, the pure cool breeze and the scent of jasmine rising from the gardens of splendid villas. The scene that never forgotten is the enjoyment of Merryland picnics and sautrering through streets eating ice-cream from Groppi's sweet shop.

Many residents imaged Damascus street as a place for selling diamonds, jewelry, and Auto parts. They mentioned many landmarks such as Horryia mall, Merryland, Groppi, Normandy Cinema, Roxy Cinema, Heliopolis Hospital, St. Fatima church (the Red church), Greek Orthodox church, Imam Ali mosque, Joseph El-Sahaby mosque, Planet Africa restaurant, El-Nasr club, El-Shams club. On the other hand, they listed many semantic attractions such as Pizza Hut and Amo Hosny cafeterias, giving no hint to very distinct elements like Basilica. In fact, listing all previous landmarks in people mind is a good result, as the suburb is full of huge number of landmarks that hard to be saved overall in peoples memory because of limit of man-mind memory. Consequently, respondents rarely use the same landmarks in mapping the mental image of the suburb. The key element for drawing and remembering the suburb was sequence of squares (Roxy, Korba, Salah Eldin, Elgamia, Ismaila, Sapheer, Triumph, St. Fatima, Elhigaz, Heliopolis, Mahkama). All the maps drawn were about sequences of squares work as nodal points linked by routes and handled by many landmark

buildings located along them. This may be a natural result of radical urban fabric which reflects the importance of squares in original master plan. Most of cognitive map errors were in the true arrangement of squares, as some interviewers might locate a particular square before another. Moreover, subjects face problems in remembering streets names specially in Korba.

Table 4.4 illustrates Legibility of Heliopolis according to interviews and map drawings. The first column records the respondents; the second illustrate Lynchian elements; columns 3,4, and 5 evaluate how legible each respondent found paths, edges, landmarks, nodes, and districts, based on interviews and map drawings. Column 6 summarises characteristics of the sketch maps. Legibility was evaluated as high if half or over of survey respondents assessed the element as highly Legible, low if half or more respondents thought the element had low legibility, and moderate if legibility was more or less evenly divided between high and low.

No. of respondents	Design element	High	Moderate	Low	Overall
30	Path	0	7	23	Low
30	Edge	11	14	5	Moderate
30	Landmark	13	14	3	Moderate
30	Node	3	21	6	Moderate
30	District	5	9	16	Low

Table 4.5. Overall Legibility Score for Heliopolis.

From field reconnaissance and interviews, problems of Heliopolis image can be outlined. The most obvious problems are break of continuity, underutilization of nodal points, isolation, confusions, ambiguities, branchings, points of weak connection, and lack of character in many vital parts of the suburb. Figure 4.43 summarize these problems.

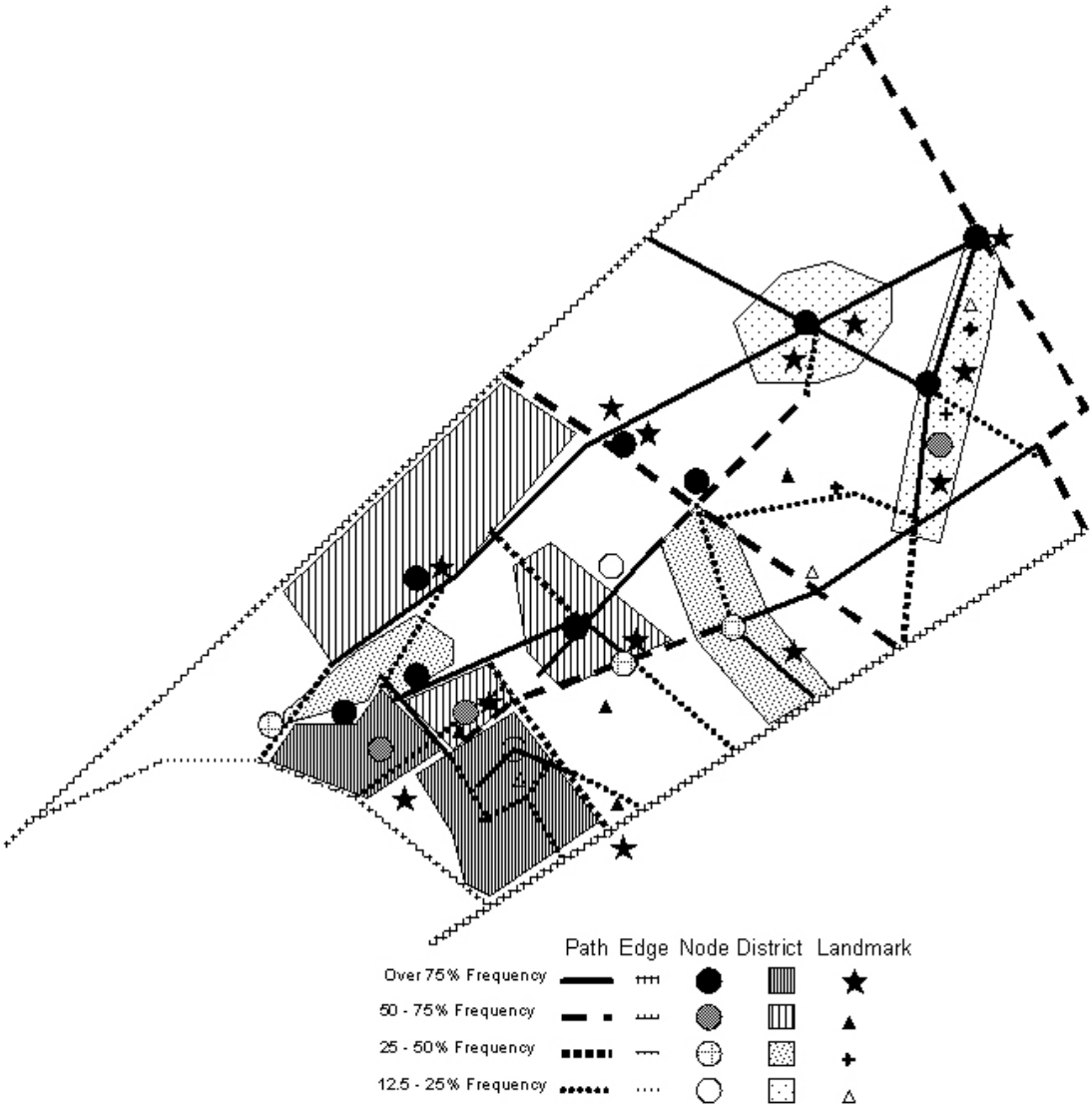

Figure 4.40. Heliopolis image as derived from sketch maps.

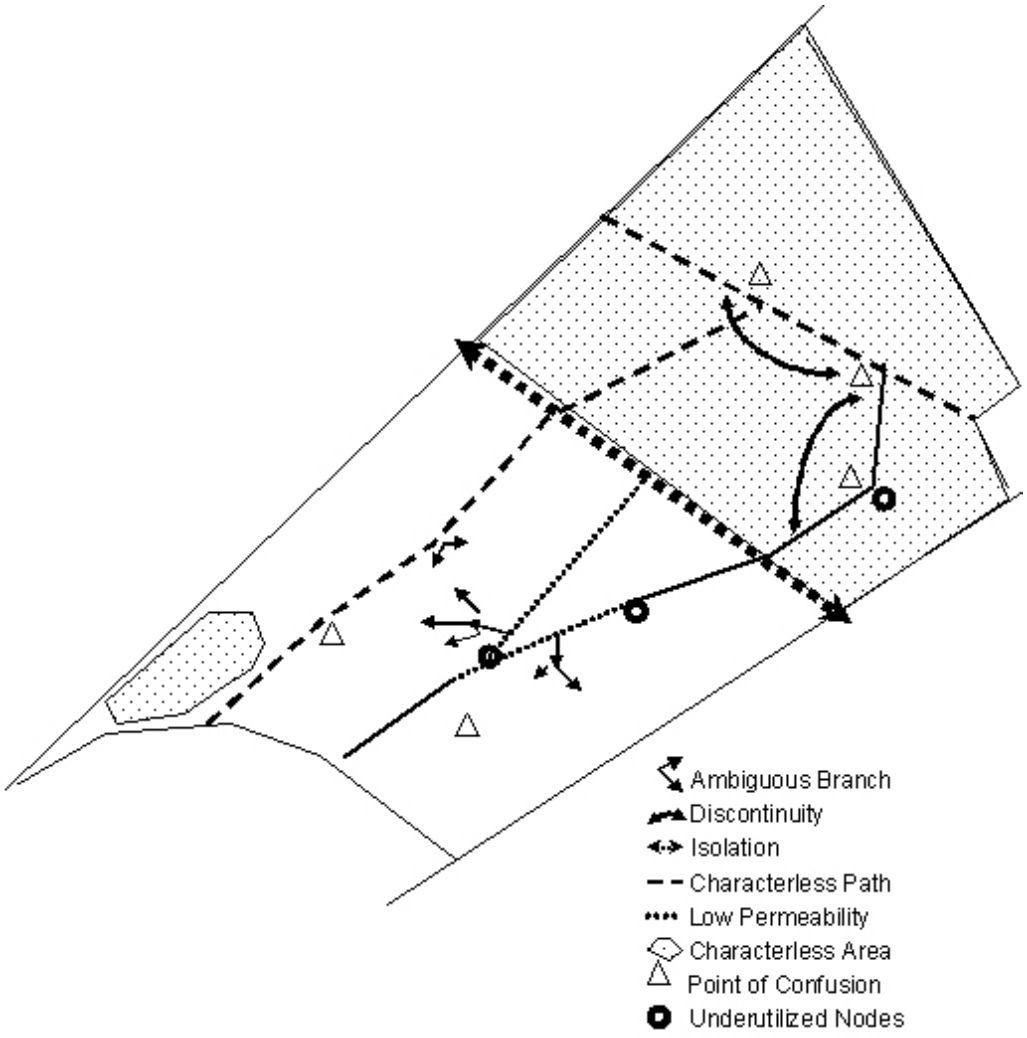

Figure 4.41. Heliopolis problems.

4.5. MAADI

4.5.1 Historic Context

Maadi, Cairo's greenest suburb, lies on the river Nile about 12 km upstream from Cairo CBD, on the east bank. Maadi denotes ferry boats and its name dates back to the late 19th century when it worked as important crossing point of the Nile.

The suburb tracks its modern history to 1904 when the railway between Cairo and Helwan was built. The whole area was laid out in the nineteenth century. It was planned in 1905 by a retired Canadian officer Captain Alexander J. Adams. There were very strict rules associated with residential development in Maadi with regards to the size of houses, how much of the property could be occupied by the house and how much had to be left for the garden, and the size of the sidewalks. “Even window shutters had prescribed colors (red or green)”[19].

The river is paralleled by the Corniche, a waterfront promenade of the kind found in many Egyptian towns. The main road into Cairo follows the Corniche.

Many embassies are situated in Maadi such as the Peruvian, Mexican, Japanese, and Argentinean embassies. The Cairo office for the USAID is also placed in this suburb[20]. Maadi is a quiet residence for foreigners and some well-off Egyptians. Life style in Maadi differ from most of Egypt neighborhoods. you may see shops for selling pets food like Pets House. Do not get astonished if you noticed an advertisement about lost dog or cat, as this scene is a natural phenomenon of this high life.

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[19] http://en.wikipedia.org/wiki/Maadi; http://weekly.ahram.org.eg/2007/830/fe1.htm.

[20] http://en.wikipedia.org/wiki/Maadi.

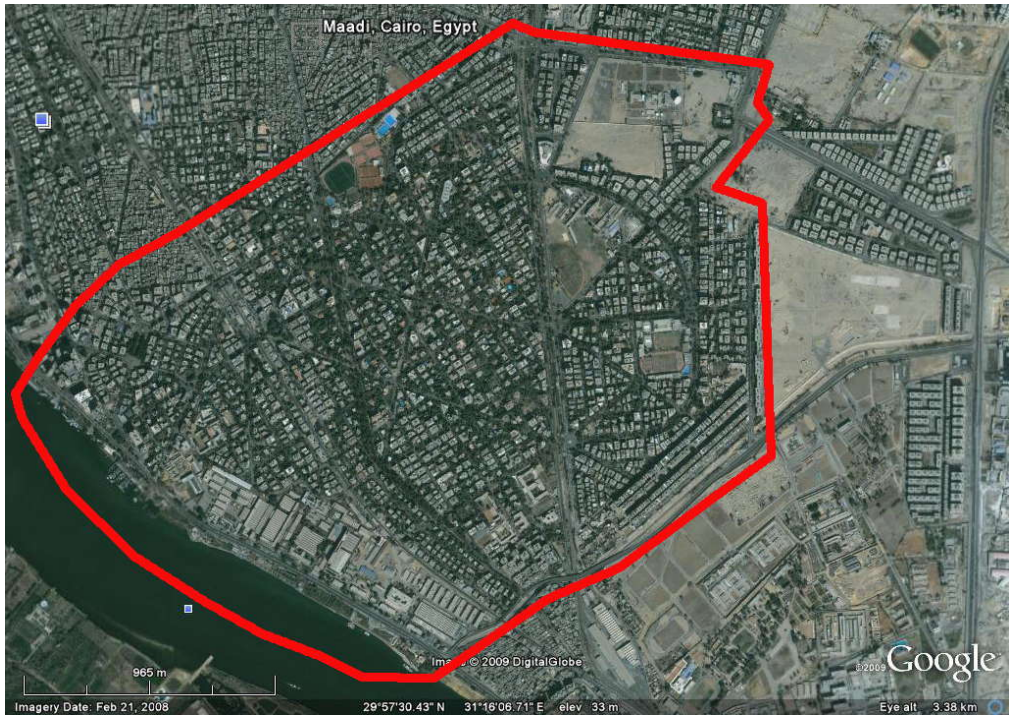

Figure 4.42. Satellite image of Maadi.

Figure 4.43. Maadi outline.


Figure 4.44. Photos reflect Maadi life style.

4.5.2. Field Reconnaissance Analysis

4.5.2.1 Character

Maadi is the least densely populated neighborhood in Greater Cairo. It is a green paradise built in English countryside cottage style. Its streets are laid out in a mostly grid pattern; nevertheless, there are several wide boulevards running at angles across the grid. Maadi's smart, low-rise apartments, and wide Villas line streets bristling with shady palms and sweetly-scented trees(Beattie, 2005). Maadi's greenery and quiet streets are distinguished by the kind of flowers planted in them. For instance, some streets had roses while others had Jasmine. In fact, the landscape features of the suburb form its distinct character. Many of the houses have yards filled with flowers and even garden vegetables. Currently, there is a series of ugly, high, and fat constructions along the Corniche by the river, as well as in the newer, eastern part of Maadi, known as Degla[21]. Furthermore, Wadi Degla, a 60million year old valley, was threatened by the encroachment of urban activities.

[21] http://www.absoluteastronomy.com/topics/Maadi.

Figure 4.45. Maadi greenery streets.

Figure 4.46. Maadi old and new Villas (source: http://www.oldroads.org/pastblogs/archive_2006_august.htm).

Figure 4.47. Skyscrapers located in Maadi Corniche (source: http://www.panoramio.com).

All the roads in Maadi are assigned numbers; vertical grid lines have a sequence of arrangement of roads numbers while horizontal ones have another sequence. In other words, the roads parallel to each others have the same sequence while those perpendicular on them have another sequence. Furthermore, the radial roads have another sequence of arrangement (or names of persons rather than numbers) differ from the previous two types. In fact, there is a logic to them similar to that established in English towns, and this demonstrates that the suburb was designed for foreigners.

Road 9, parallel to the Metro line, is the main business section of the area. It contains restaurants, coffee shops, Bakries, vegetable stalls, grocery stores, and souvenir shops. The suburb also contains many shopping malls such as Grand Mall. Maadi streets consist of typical kiosks selling snacks, newspapers, and candy.

Figure 4.48. Road 9 (source: http://www.oldroads.org/pastblogs/archive_2006_august.htm).

Figure 4.49. Maadi Grand Mall (source: http://www.panoramio.com).

Figure 4.50. Typical kiosks selling snacks, newspapers, and candy (source: http://www.oldroads.org/pastblogs/archive_2006_august.htm).

Maadi has geographical boundaries make it semi-isolated. The suburb ends at the flash flood line -Magra Al-Seil located under Tura bridge- where a man made duct separates it from Torah to the south[22]. "The Autostrade and Wadi Degla Protectorate mark Maadi's eastern border and to the west is the River Nile"[23].

4.5.2.2 Continuity And Enclosure

Continuity is weakened by the extensive green verges, frequent intersections, and loose houses arranged regularly to the streets which result in blank facades/ fences fronting streets. There is also break of continuity in facades fronting Corniche. Generally, the suburb creates a good sense of enclosure because of its narrow streets – the building heights have been well matched to the streets widths–, and the spaces have been enhanced by using plant materials that dominate most of suburb roads. Points of average enclosure spread allover the central area of the suburb. On the contrary, other roads like 250 showed less enclosure represented in facades on one side opposite kiosks and plant shops lined on railway.

Figure 4.51. Trees create good sense of enclosure (source: http://travel.maktoob.com/vb/travel52908/).

[22] http://weekly.ahram.org.eg/2009/932/sc3.htm.

[23] Ibid.

Figure 4.52. Break of continuity and enclosure (source: http://www.panoramio.com).

4.5.2.3 Ease of Movement

The suburb is one of the most pedestrian-friendly areas in Cairo. Its quiet streets encourage strolling and enjoyment of natural scenes along them. Moreover, many roads are one way while others are tow lanes- tow ways without any island or barrier for separation except white line between lanes. This narrow width of roads provides low vehicular permeability and assure the priority of pedestrian movement. This semi-constant roads width has a visual dimension, as it causes confusion of differentiating main streets from subways.

Figure 4.53. Strolling in Maadi streets (source: http://www.panoramio.com).

Figure 4.54. Two ways- two lanes streets (source: http://travel.maktoob.com/vb/travel52908/).

The area is disrupted by strong edge formed by Al-Mahager railway. Every thing stops at this barrier of the railway which separate the suburb physically into two parts. In fact, the railway forms a major barrier of movement in the area. Nevertheless, the railway is used as a landmark or linear reference point, since most of main roads end at and spring from it leading to green roundabouts; the roads are all either parallel or perpendicular to the railway. Furthermore, the railway itself is decorated by plant shops. Metro line also makes a clear edge separates the area located in Corniche from Degla and El-Sarayat. Nevertheless, there are two bridges pass over the metro line to connect parts of Maadi with each others, they are Maadi and Mahata bridges. As mentioned before, Maadi is geographically isolated from the rest of Cairo, bordered by the Degla desert on one side and the River Nile on the other, and this isolation influence negatively on its degree of accessibility and permeability to other areas.

Figure 4.55. Al-Mahger railway (source: http://www.panoramio.com).

Figure 4.56. Plant shops hide the view of the railway (source: http://www.oldroads.org/pastblogs/archive_2006_august.htm).

4.5.2.4 Legibility

Road 9 is one of the most important roads in Maadi. It runs parallel to many important axes such as Metro line, Misr-Helwan road (parallel to the River Nile), 250 St., and El-Canal street. Roads 9 and 250 are connected with each others by important roads such as Port Said, Al-Nahda, and Mustafa Kamel. Road 250 has a great importance, as it runs along Al-Mahager railway and intersects with many roads forming a series of strategic nodal points represented in squares such as Midan Al-Golf (Al-Golf Sq.), and Midan Victoria (Victoria Sq.). this sequence of squares makes road 250 the main reference point of most trips in the suburb.

Most of Maadi squares suffer from underutilized potential. Very few people appreciate the quality of these spaces as nodal points. The situation gets worse, as the security polices around the buildings are very strict. Thus, pedestrians usually rush past these nodes towards more friendly ones.

Figure 4.57. Midan Victoria: The plaza has been fenced with a visually permeable fence which allows for visual connection but blocks physical access.

Road 206 has a distinct form in plan. It is crooked like half a circle springs from Digla level crossing and ends at Midan Abd Al-Minaim Riyad (Abd Al-Minaim Riyad Sq.). The area sandwiched between 206, and 250 roads contains two important schools: Victoria College (Al-Nasr), and Cairo American College (CAC).

Al-Nahda, another interesting street, runs from Abd El-Mineim Riyad Sq. in road 250 until Midan Al-Maadi in the cornich. The street consists of many landmarks such as Mexico embassy, and St. mark church; and nodal points such as Nahda, Port Said, Mahata (station) and Al-Gamia (mosque) squares. It intersects with many important streets like Oraby, and canal streets.

Although Maadi is a small size neighborhood distinguished by a significant style and overwhelming greenery dominating its streets, it never give a clear message for either pedestrians or drivers. Strolling in Maadi is similar to that

in a maze; and the houses can be hard to spot. Almost universally they are guarded from direct views by trees and shrubs and completely blocked off the streets by the use of high walls or fenced with fences which block physical access and produce points of weak connections along streets. Consequently, most of roads have the same characters like tracks in a jungle. One may pass by a known building but can not spot or notice it at all. Vistas are usually opened, they end either with nothing or with an indistinct nodal point represented in a square with no landmark object in it. "It used to be next to impossible for a foreigner to locate a street in Maadi; the few signs that did exist were only in Arabic"[24]. To find a road sign is like searching for oasis in the desert. You have to basically look at every corner, every wall and if you are lucky, you can find one with faded prints. The situation gets worse with the absence of clear hierarchy of roads, since most of roads are so similar in physical features of width, and views that one can not distinguish main roads from sub-ways.

Figure 4.58. Point of weak connection: the use of high wall blocks the buildings off the street.

[24] Marlowe, J., May-Jun 1996, Scouting magazine, Boy Scouts of America, Inc, p34.


Figure 4.59. Opened vista: Maadi streets end with nothing.


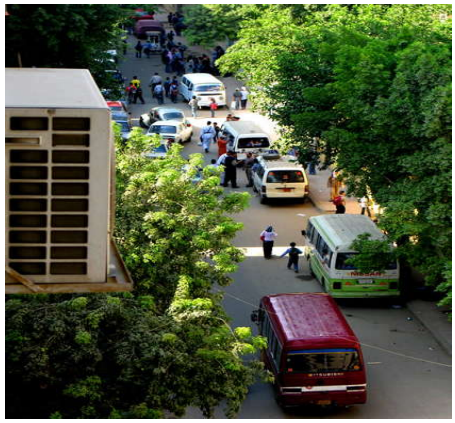

Figure 4.60. Trees dominate the views: This thick plant enclosure complements the hard landscaped road pavements.

- Branching of paths with confusing directions is a frequent feature in Maadi. It is kidding that if you entered Maadi, you should take a taxi to get out of it. Furthermore, Drivers themselves avoid Maadi trips for the same reasons. In other words, You may waste along time searching for a particular place in this beautiful labyrinth. unfortunately, some streets are off limits for both of cars and pedestrians, as there may be an American diplomat or wealthy businessman living inside a house located in them. Eventually, if you are to navigate in Maadi, it is advisable to have a guide to avoid falling into the trap of being lost.

Figure 4.61. An off limit street (source: http://www.oldroads.org/pastblogs/archive_2006_august.htm).

Both of the river Nile, and Kobry Shmal Tora (northern Tora bridge) make strong clear edges, as the river Nile borders the area from the south west and Kobry Shmal Tora- overhead edge- from the south east. Maadi is adjacent to slum areas such as Arab Al-Maadi and Basateen within which low or middle class live. It's separated from them through few tiny streets and alleys. The vivid contrast in life style, housing and degree of quietness between Maadi and adjacent slum areas make the suburb a suitable place for crimes. Recently, we heard about Saffah El-Maadi (Maadi killer). This reminds me of *Garima Fe Alhay Al-Hadea* film (crime in the quiet district).

There is a paucity of recognizable landmarks except few distinct elements such as Grand Mall (in Abd El-Mineim Riyad Sq.), Maadi sporting &Yacht club (in Swares Sq.), Satellite transmission station, St. John the Baptist church (in Port Said St.), and St. Mark church (in Nahda Sq.). In their navigation in Maadi, people rarely depend on landmarks, as many of these landmarks are not visually accessible because of their locations behind trees and shrubs. The Corniche with its unforgotten view formed by ferryboats and distinct waterfront along it, is the main promenade of Maadi. Another favorite sight was that of the suburb lights at night, especially at Ramadan nights.

Figure 4.62. St. John church (source: http://www.panoramio.com).

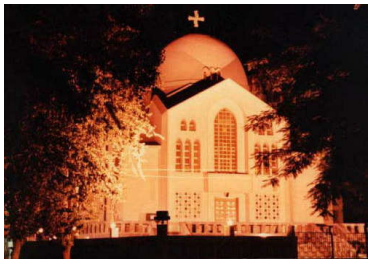

Figure 4.63. St. Mark church (source: htt://www.panoramio.com).

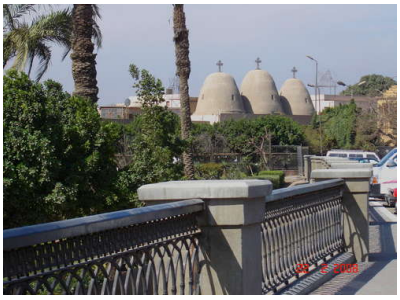

Figure 4.64. St. Mary church(source: http://www.panoramio.com).

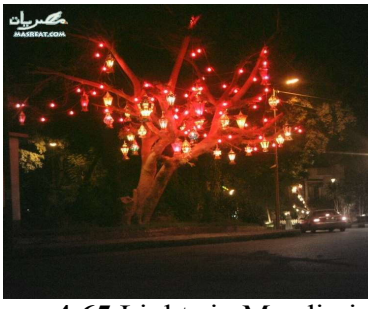

Figure4.65. Lights in Maadi night. (source:http://www.panoramio.com)

Figure 4.66. The river Nile as the main promenade of Maadi (source: http://www.panoramio.com).

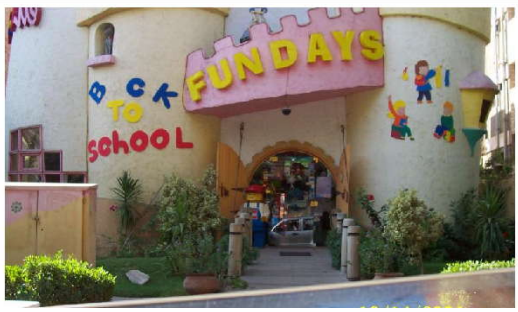

Figure 4.67. Distinct façade of a nursery in Maadi (source: http://www.panoramio.com).

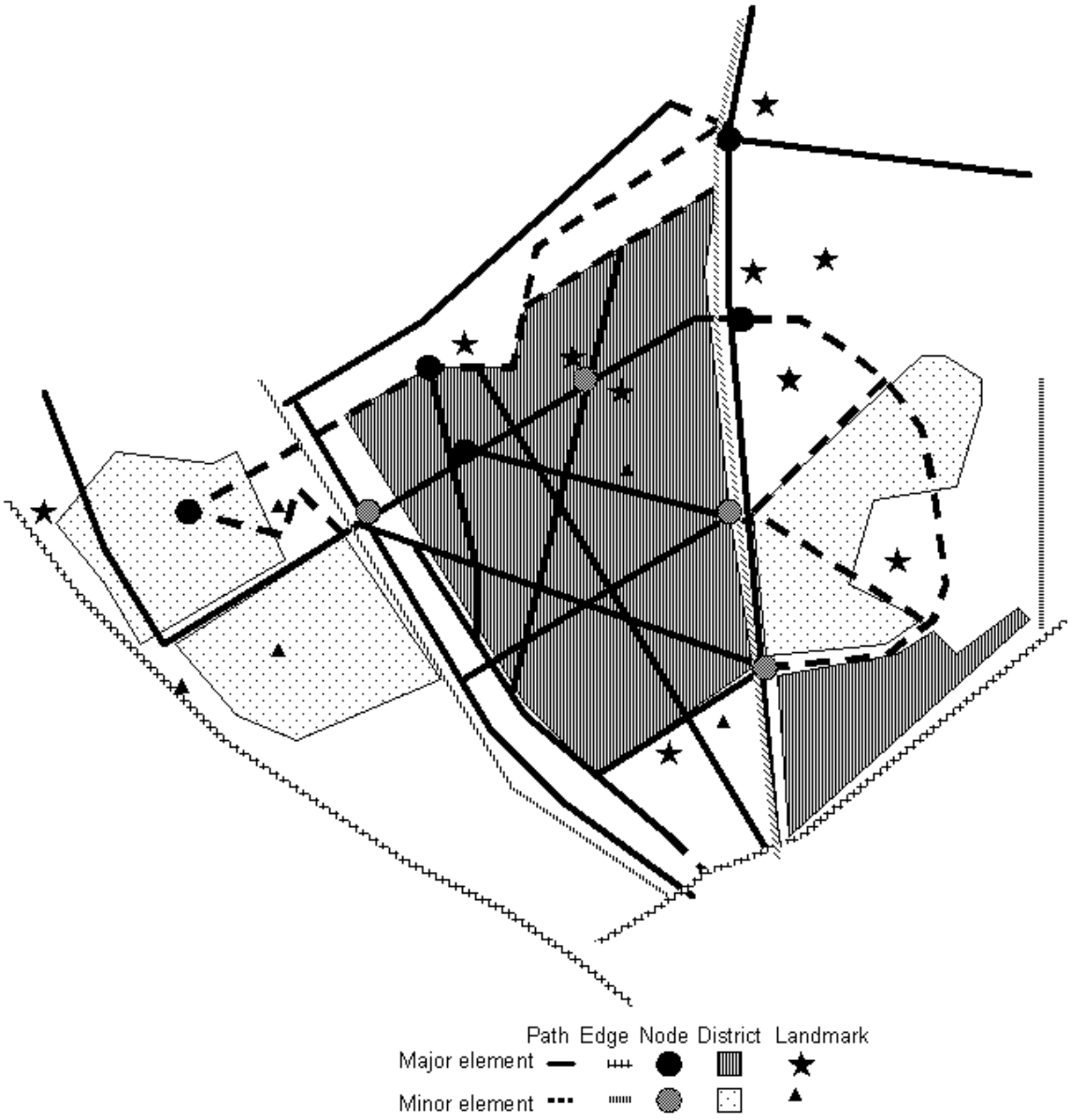

Figure 4.68. Maadi image as seen in the field.

4.5.3 Interview And Sketch Mapping Procedure

Subjects	Gender	Age	Profession	Familiarity	Place of Residence
Subject1	Male	27	Seller	Very familiar	Hadayek El-maadi
Subject2	Male	45	Seller	Very familiar	Maasara
Subject3	Male	24	Seller	Familiar	Maasara
Subject4	Male	31	Accountant	Very familiar	Maadi
Subject5	Male	29	Seller	Moderately familiar	Arab El-maadi
Subject6	Male	23	Seller	Familiar	Helwan
Subject7	Male	20	Student	Moderately familiar	New Maadi
Subject8	Male	33	Accountant	Not familiar	Shobra
Subject 9	Male	25	Barber	Not familiar	Arab El-maadi
Subject 10	Male	12	Barber	Not familiar	Arab El-maadi
Subject 11	Female	21	Seller	Familiar	Hadayek Helwan
Subject 12	Female	26	Socialist	Familiar	Maadi
Subject 13	Female	23	Seller	Not familiar	Dar El-salam
Subject 14	Female	39	English teacher	Very familiar	New Maadi
Subject 15	Female	20	Commerce student	Familiar	Al-Haram
Subject 16	Female	37	Doctor	Moderately familiar	Maadi
Subject 17	Female	24	Housewife	Not familiar	Maadi
Subject 18	Female	21	Student	Moderately familiar	Sakr Korish
Subject 19	Female	22	Secretary	Familiar	New Maadi
Subject 20	Female	43	Housewife	Familiar	Sakr Korish

Table 4.6. Subjects tested, Maadi.

Maadi has a structure which is hard to be understood. The maps drawn by subjects were often fragmented, with large blank areas, concentrating most

often on clear edges and few unmistakable landmarks. Most interviews found it difficult to draw or image the suburb as a whole, and most obtained information was verbal more than sketched. In fact, There was a paucity of information sources about the environment for two reasons: firstly, the environment itself was nearly bare of its physical components like signs, landmarks, ..etc. secondly, it was also nearly bare of people in its streets, although people are very important sources of information, whether we spoke to them or not, as a gathering of people may interpret the building function.

Subjects had great difficulty in picking up their way in Maadi even those who are very familiar with the suburb face problems with orientation too. They felt that the grid is like a maze[25]. The grid pattern creates a huge number of intersections that work as nodal points or points of traffic interchange which can not be distinguished from each others. Furthermore, quiet streets with illegible environment make it hard to search for someone to ask about directions except doormen and security. It is advisable to go a head in a main street ignoring all intersections located on it to get out of the maze, otherwise you will fall in the trap of being lost. Subjects referred wayfinding problems into two reasons: first, strong similarity in roads characters revealing that all views are repeated; Second, confusion of streets names, as one may notice multi types of streets names converged of one section. For instance, Mustafa Kamel, 250, 87, 204, 206, and 208 roads spring all from Digla level crossing. Likewise, Port Said, 210 (Digla), 213, 216, and 20 spring all from Midan Victoria – Victoria square–. The situation gets worse when notice that several names may be applied to one street. For instance, Sharifa Dina is also called road 78. Likewise, Digla is also called road 210. These several names definitely cause confusion.

[25] Maadi's mazy streets make it tricky for the people to navigate.

Wayfarers depend upon two clues to reach a particular destination. First, they never stop asking passers by about directions. Second, they follow the few streets signs. This means that they are totally confused with the path system of the area.

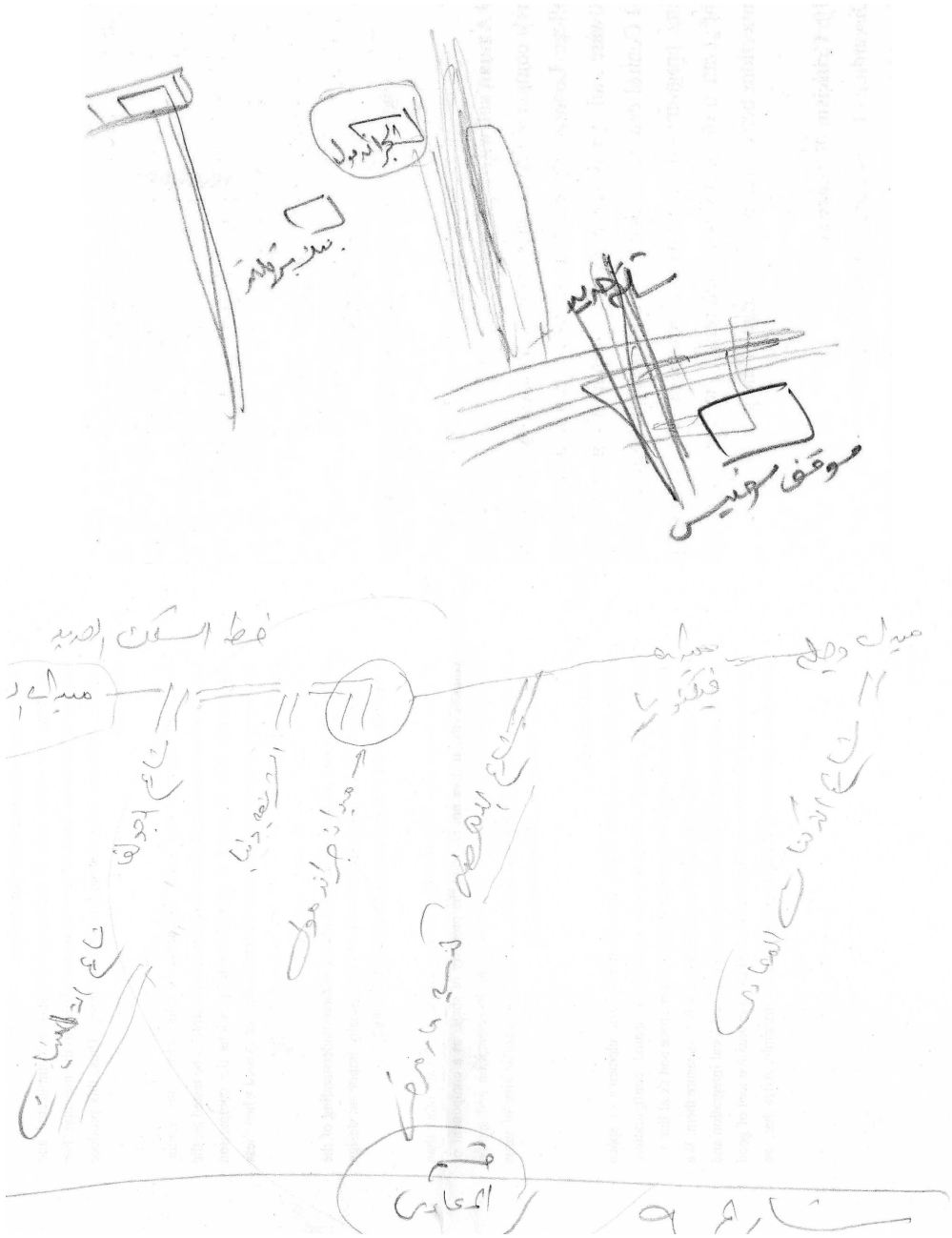

Figure 4.69. Sample of poorly drawn sketch maps.

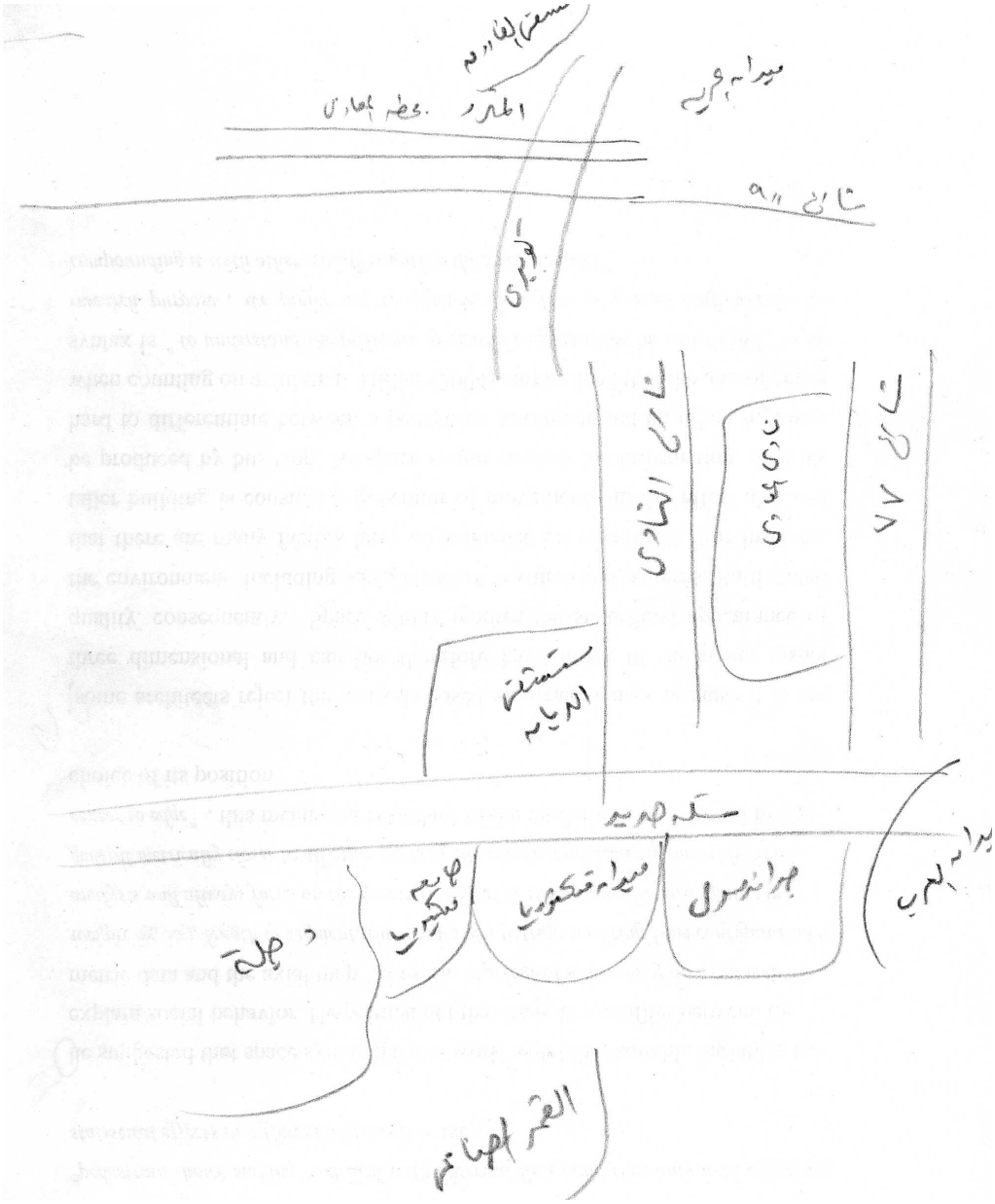

Figure 4.70. Old Maadi presented in a sketch map as a blank area.

The problem of wayfinding emerges vividly in the following verbal interview :

> “I decided to walk all the way back to my apartment at Maadi. Are you ready for my adventure? Get Set, deep breath...relax...and GOO. My starting point is the road called Misr-Helwanall. The buildings have the same colour and structure. The road names are mostly in Arabic and even if it's in English, it's erratic. I crossed the overhead bridge above the metro rail. Pedestrian and motorcyles are sharing the bridge and I believe donkeys use it too. I planned to take road 72 and connect to the long Road 77. After too many small alleys, I managed to "guess" my way into Road 12 (couldn't find any road sign) and reached the main Road - Ahmed Zaki Street. I couldn't find any sign to enter into road 77. But I re-positioned myself with the sighting of the big Maadi Sporting & Yacht Club. Road 77 is quite unique. It's long and it's was cluttered with shop houses, very old shop houses. I proceed and reached the intersection between road 77 and Abd Al-Mineim Riyad. I couldn't make up my mind where I should continue when I reached this junction. I couldn't find any sign leading to the smaller section of Road 77. Few buildings were torn down at this area and I believed they torn down the road sign 0n the wall as well. I spent around 20 minutes in searching for true way. I was happy when I see the rail road at Al-Golf square, at that moment I thought I was on the correct Raod 77. I was wrong, but I was lucky also. Because it lead me to a distinguished landmark later. So I crossed this unguarded, no barrier rail road (while watching left and right just to make sure I don't get run over by a train), and walked happily towards the satellite station. I stopped for awhile at point H and realised that I was not on Road 77. I was not panic at all. I looked around and saw 2 giant white mushrooms not far away: big satellite dish! I know this place!. Finally, I reached my home I decided to reward my self”.

In all this description we have three landmarks: Maadi sporting club, Mahagir rail way mark, and Satellite transmission station. We notice also

that this subject depends in his navigation on signs and streets names. Here is another example describes how to reach to the Church of St. John the Baptist - located at 17 Port Said Road near the intersection of Rd. 17 and Rd. 82- :

> "From Maadi Grand Mall, go north across the railway tracks and then immediately turn Left. Go west approximately 1 km to the next major intersection (Port Said Rd). Turn right and go approx. 3 blocks. The church entrance is on the right. If traveling South into Maadi from the Corniche on the Nile, take the Maadi Square exit and proceed across the flyover to the Port Said Square go approx 1/3 around the square and exit onto Port Said Rd. The Church is 3 blocks up on the left"[26].

In this description we have no visual image at all, as the description confined to just turns of left and right.

Figure 4.71. Mahagir rail way mark

Figure 4.72. Maadi sporting club.

Figure 4.73. Satellite transmission station.

[26] http://www.maadichurch.org.

Although people took great delight in flowers, vegetation, and beauty of the suburb, they fear strolling in Maadi roads because of security spreaded all over the area. Consequently, subjects familiarity with the area is reduced. When asked to describe the suburb as a whole, the subjects used certain words: paradise; kingdom of numbers; high-class life; cleanliness; and a green heaven on earth with a rural village feeling.

Many subjects imaged road 9 as a linear commercial street consists of many known shops and cafeterias like Celantro. They listed many distinct landmarks such as Sharifa Dina villa, Grand Mall, Lycée Francaise, Cairo American College (CAC), Canal school, Satellite transmission station and Maadi sporting club.

Figure 4.74. Maadi Canal school.

Subjects mentioned many important nodal points like Midan Digla (Digla Sq.), Swaris and Al-Horryia squares. They also imaged many paths like Al-Nady, and Al-Golf roads. It worth mention that many subjects imaged short subways such as Al-Sharifa Dina street for the existence of the villa within which Sharifa Dina lived.

Figure 4.75. Sharifa Dina street (road 78)(source:http://www.panoramio.com).

Figure 4.76. Swaris square (source: http://www.panoramio.com).

Figure 4.77. The Hashemite villa in Queen Dina street (source: http://www.egy.com/maadi/99-02-18.shtml).

No. of respondents	Design element	High	Moderate	Low	Overall
20	Path	0	4	16	Low
20	Edge	17	3	0	High
20	Landmark	5	2	13	Low
20	Node	4	10	6	Moderate
20	District	2	7	11	Low

Table 4.7. Overall Legibility Score for Maadi.

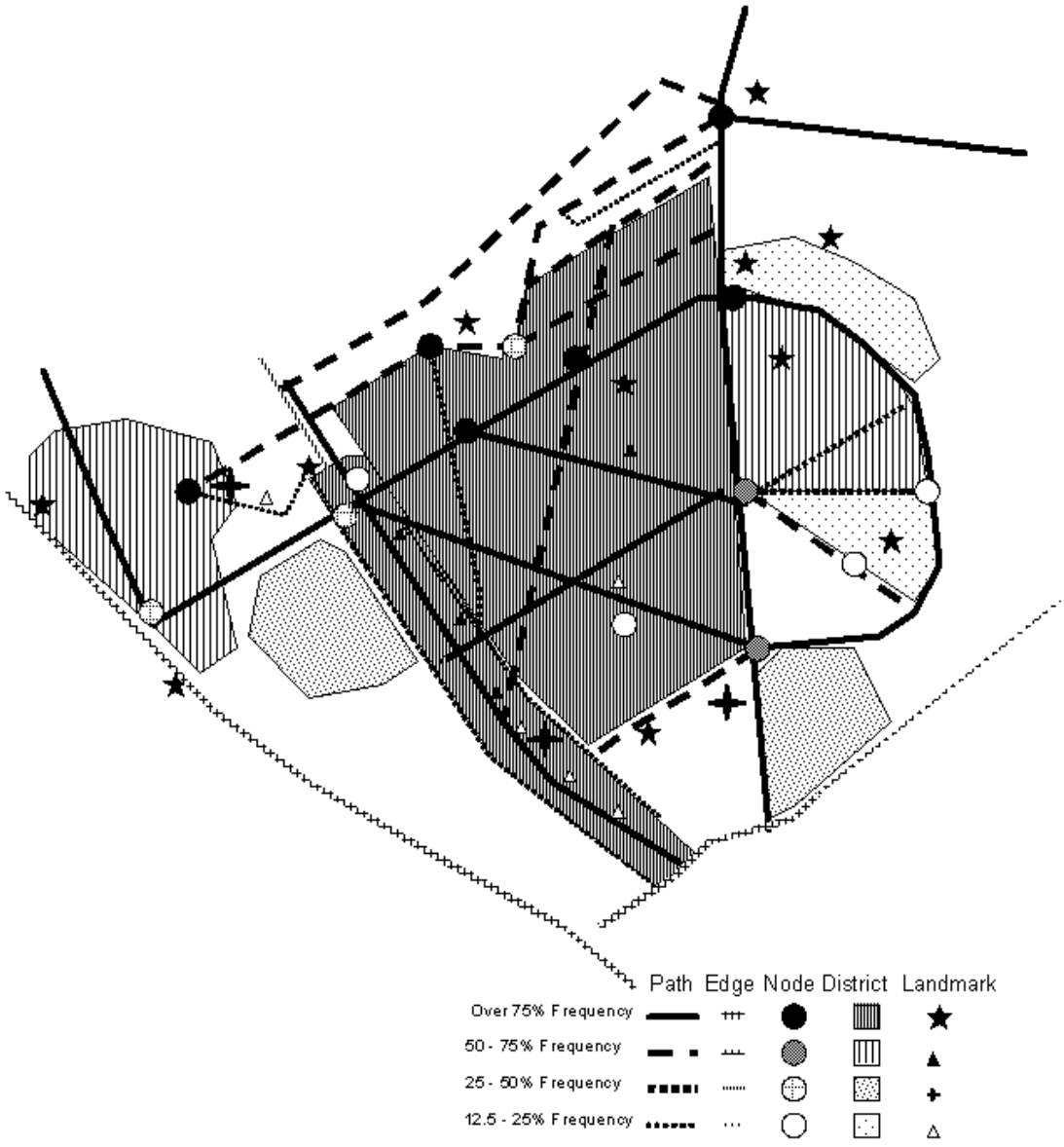

Figure 4.78. Maadi image as derived from sketch maps.

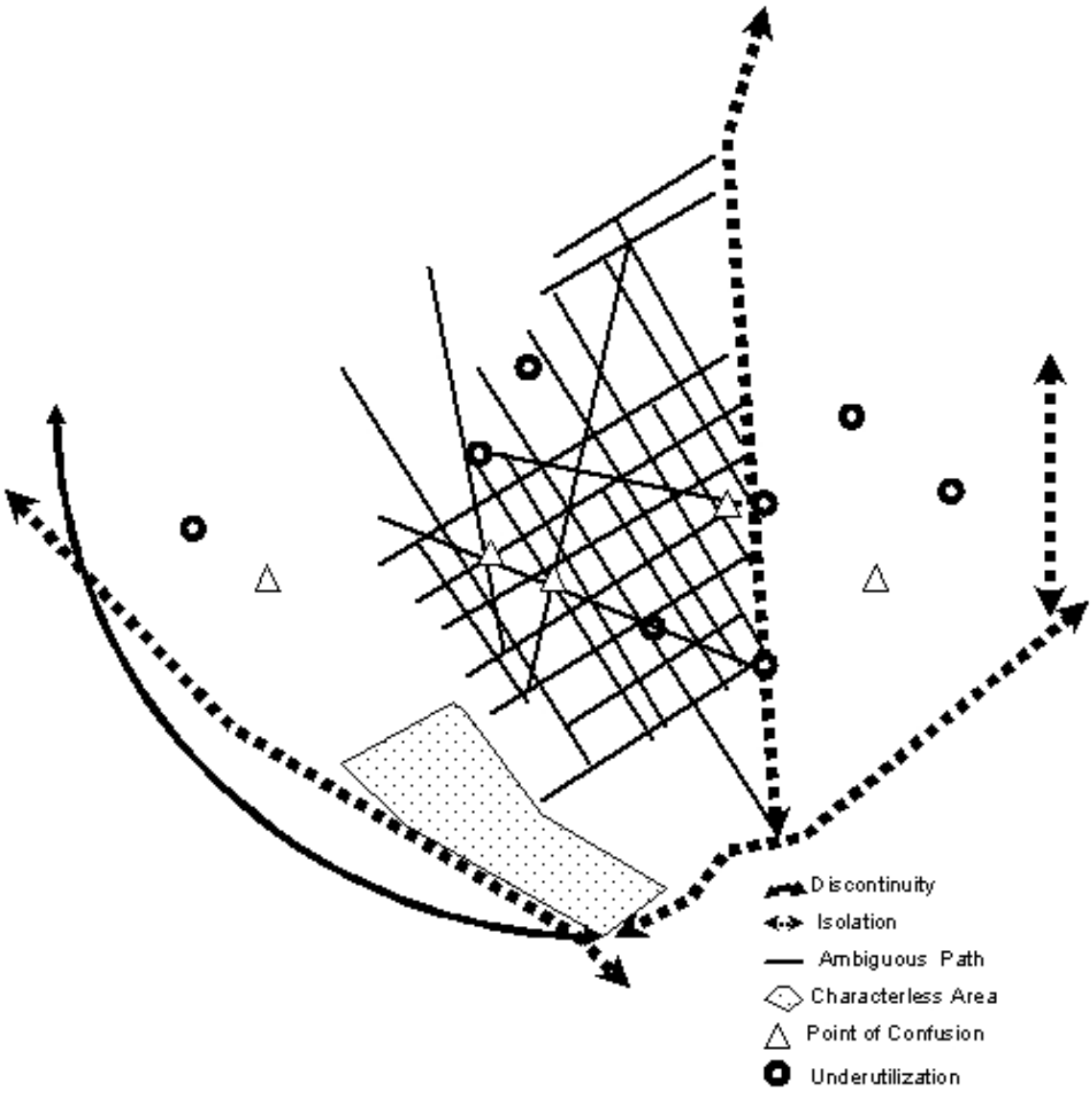

Figure. 4.79. Maadi problems.

4.6. Cairo CBD

4.6.1 Historic Context

The real drive to modernise Egypt was made by Khedive Ismail's ancestor, Mohamed Ali Pasha (1805-1848), who established the history of modern Egypt. Khedive Ismail (1863-1879) wanted to Europeanize Cairo and make it the Paris of the region. His visit to Paris in 1867, as a special guest of Emperor Napoleon III, was the starting point that influenced the future of Cairo. He observed the progress of Paris and admired of Hussman planning "the city of light". He noted closely the new Paris and with his minister, Ali Mubarak, thought of a new style in Cairo similar to that in Paris. To be fair, Europeans played a powerful role in constructing the new capital, they were employed in Egypt's Ministry of Public Works, and also in private practice[27]. Ismail wanted to make Cairo the capital of enlightenment in the East, like Paris in the West. The first step he made was to convey the seat of power from the Citadel to Abdeen palace. He constructed Mohamed Ali Avenue to connect old city with his new capital[28]. After that, he planned the Cairo CBD district to be the business center of the city. Grand Beck, a French planner and a student of Hussman, was commissioned by Khedive Ismail to prepare a new planning scheme for Cairo CBD. The vision was to make Cairo CBD as an open air museum; wide and clean streets with areas for pedestrian only and spacious gathering points for cultural discussions. For instance, cultural nourishment was held in the music kiosks in Al-Azbakeya Garden. "The area around the Ezbekiyya Gardens was once a vast lake but was drained in 1837"[29]. Cairo CBD still maintains remarkable characteristics such as: squares, promenades, and streets (Elshahed, 2007).

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[27] http://www.touregypt.net/featurestories/paris.htm.

[28] http://weekly.ahram.org.eg/2007/851/sc3.htm.

[29] http://www.touregypt.net/cairo/caironew.htm.

Cairo CBD, or as the Arabic Speakers call it Wust El-Balad which literally means the center of the city[30], stands for the area sandwiched between the old Fatimid Cairo and the river Nile to the west. The District was established from the late 19th and early 20th centuries. Cairo CBD is known as Khedivine Cairo or Ismailiyya because it was commissioned by Khedive Ismail vision for modernizing and westernization of Egypt. It was built over a span of forty years by landlords (Elshahed, 2007). The area was designed by prestigious French architects.

In 1869, Khedive Ismail gave instructions to erect an opera house to solemnize the opening of the Suez Canal in 1869[31]. The Italian architects Pietro Avoscani and Rossi were commissioned to designed the building. The Opera House was made mostly of wood. It was situated between the districts of Azbakeya and Ismailyya in the new capital. Tragically, In the early morning hours of October 28th 1971, the opera house was entirely destroyed by a fire. Currently, The site is occupied by an ugly multistory concrete garage, but the square overlooking the building is still called Opera Square[32].

a) The opera before the fire (source: www.flickr.com/photos)

b) The opera today (source: http:// www.panoramio.com).

Figure 4.80. Opera building in Opera square.

[30] http://en.wikipedia.org/wiki/Downtown_Cairo.

[31] http://en.wikipedia.org/wiki/Cairo_Opera_House.

[32] http://www.modis.ispras.ru/wikipedia/Aga_Khan_Trust_for_Culture.html.

Figure 4.81. Satellite image of Cairo CBD.

4.6.2. Field Reconnaissance Analysis

4.6.2.1. Character

Cairo CBD forms a triangle, its three furthest points situated at Al-Tahrir Square, Ramsis and Abdin[33]. It reflects the architectural ingenuity of nineteenth and early twentieth century: wide boulevards and even grander buildings European-style doorways and sculptures, designed in a mixture of art deco, art nouveau, baroque, Roman-Byzantine, and a little later, neo-Islamic styles[34]. Many buildings have unique style with Tuscan columns or ionic pilasters and pedimented windows. Cairo CBD adopted straight, open-ended streets rid of narrow allies and dead-end streets. This urban fabric reflects the French character. On the contrary, the area sandwiched between Mohammed Ali St. and Gomhuriyya St. is of winding urban tissue consisting of very crooked and irregular roads, dead ends and narrow alleyways. Tragically, many historic and unique buildings were demolished and replaced by ugly high rises.

Cairo CBD contains a high artistic ornamentation of frontages like that established in Paris. In other words, one can observe the distinctive French touches in balconies: iron work, ornate cantilevers, marbles steps and entrances. Of course, over the decades much beauty has been tampered with, by both the hands of time and the absence of good maintenance[35].

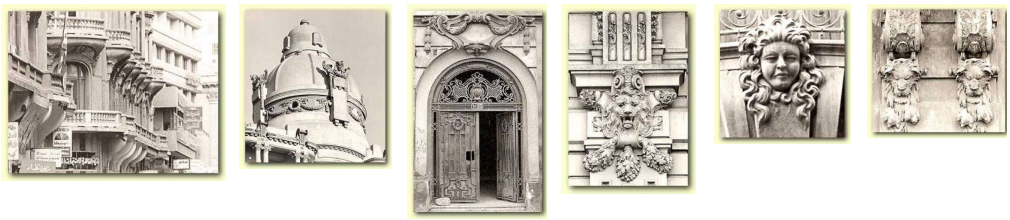

Figure 4.82. Cairo CBD architectural vocabularies (source: Myntti, 1999) .

[33] http://weekly.ahram.org.eg/2001/535/special.htm.

[34] http://weekly.ahram.org.eg/2009/930/feature.htm.

[35] Ibid.

Cairo CBD is said to be a robust environment as it offers more than a single use. It is a mixture of business, leisure, commercial, government, and residential uses. It is a vibrant urban environment for residents, workers, and visitors. The area serves as great place to shop; ground floors were filled by commercial activities. We can see restaurants for western fast foods, clubs and bars (particularly in the hotels), cinemas, theaters, banks, street vendors, and all manner of shops[36]. The area is generally marked by the crowds.

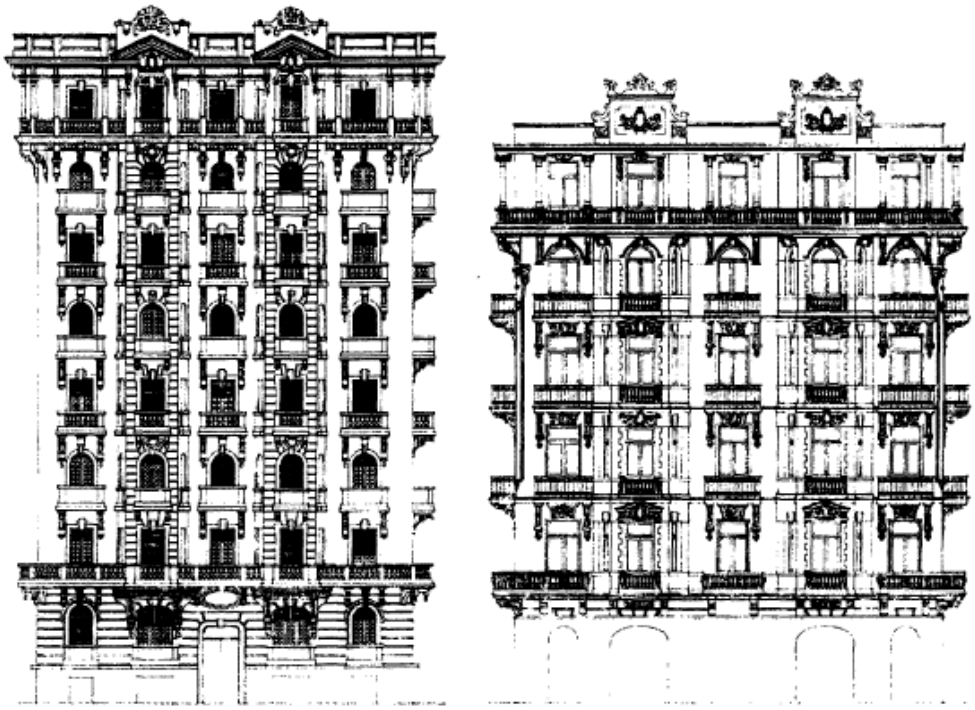

Figure 4.83. Cairo CBD facades from 1927 (source: Elshahed, 2007).

[36] http://www.touregypt.net/cairo/caironew.htm.

Figure 4.84. Colonial buildings loom over Cairo CBD (source: www.cultnat.org).

a. Baehler Building at Cairo CBD

b. Same style building on Geneva's Rue de la Corraterie No. 5 built in 1901.

Figure 4.85. Comparing architectural style in Cairo CBD with that in western world (source: www.egy.com/zamalek/99-10-28.shtml).

Figure 4.86. A market at Cairo CBD.

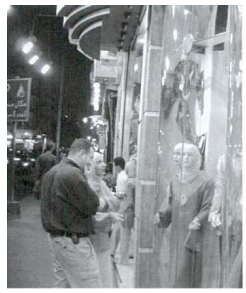

Figure 4.87. Shopping.

Figure 4.88. A cinema at Cairo CBD.

4.6.2.2. Continuity and Enclosure

Throughout the CBD area, buildings are typically built to the front edge of the property line. This historic street wall of facades is broken by ill-considered constructions. While many streets of Cairo CBD provide high degree of Enclosure, others are not because of frequent changes of buildings height, demolished buildings, vacant lands, and scattered parking lots. At points of highest enclosure, the streets are narrow and very tall buildings overwhelming the pedestrians and creating an unpleased enclosure, as people tend to avoid such areas making them deserted and insecure. Conversely, water fronts show less enclosure because of open scenes, and wide streets.

Figure 4.89. Sense of enclosure :Good sense of enclosure at Talaat Harb square (source: http:// www.panoramio.com).

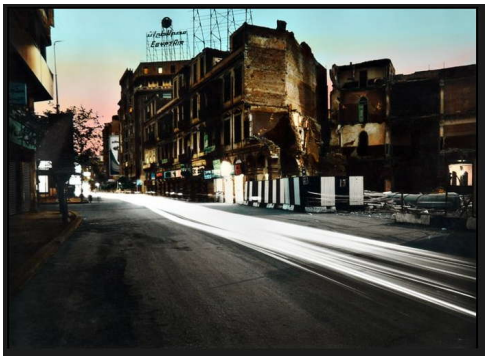

Figure 4.90. Demolished buildings in Emad El-deen St. decrease enclosure (source: www. panoramio. com).

Figure 4.91. Changes of skyline decrease enclosure (source: www.cultnat.org).

4.6.2.3 Ease of Movement

Cairo CBD is very crowded, no place to sit or walk, as vehicular movement dominates the streets; and Traffic and pollution are unavoidable. The streets are choked day and night with a ceaseless stream of ancient Peugot taxis, battered smoke-belching buses. The problem get worse for two things: first, most of roads are one-way which logically cause low permeability and increase traffic jams at intersections; Second, the area is full of nodal points along paths such as Cinemas, theaters, clothes shops, Malls, coffee shops, and restaurants. Moreover, crossing main squares and intersections is generally unsafe. Squares itself are confusing, as one may lost long time either waiting for traffic lights or thinking of how to find his way. All previous reasons are measurably decrease the use of plazas and increase the time of decision making.

Figure 4.92. Nodes: Congestion of people and vehicles dominate streets because of frequent nodes.

People park their cars at any place as there is no clear parking spot. In other words, it is impossible to get a parking place. Passers can notice all kinds of vehicles penetrating streets. There is no place to sit or walk, as congestion dominate the views. Furthermore, many streets are scattered because of parking lots located haphazardly in them such as parking areas at Tahrir street; the corner of Shampilion and Kasr El-Nile streets; and the area facing Dar El-Kadaa El-Ali (Cairo supreme court)at 26 July street.

Cairo CBD has three strong clear edges represented in the River Nile (natural edge) from the west, 6 October bridge (overhead edge) from the northern-west and Kobry Al-Azhar (Al-Azhar bridge) from the northern-east. Although 6 October bridge provides a strong boundary, it conveys noise and fumes to residents of high stores. Moreover, it decreases degree of privacy and form a barrier facing facades. Furthermore, it causes isolation, discontinuity, and low permeability.

Figure 4.93. 6 October bridge (source: Golia, 2004).

Figure 4.94. Al-Azhar bridge (source: www.urbanharmony.org).

4.6.2.4. Legibility

Cairo CBD is a boom suburb; it represents the heart of the city activities; crowd, traffic jams, and smell of toxic fumes are at first overpowering. The streets are lined with a motley assortment of faded buildings, from baroque Colonial and streamlined Art Deco to brooding Soviet concrete monsters.

Nevertheless, it is rich of high imageable elements that enhance the legibility of the area. One of the most important nodes is Tahrir square- nucleus of CBD activities- that more heavily used as a recreation area than other squares of Cairo CBD. It was the location of Africa's first Hilton hotel, which today houses the Arab league building. Tahrir square, the vast public square at the epicenter of modern Cairo, contains numerous distinct buildings such as the Egyptian Museum, the bureaucratic city of Moga'maa Al-Tahrir building -opened in 1952 and located to the south of the square-, the modern Umar Makram Mosque, American University in Cairo[37], many famous hotels, retail outlets, travel agencies and restaurants. The Corniche, Cairo's main thoroughfare, runs from north to south parallel to the east bank of the River Nile. The east end of Cairo CBD is marked by Ataba square, the starting point of Islamic Cairo.

Figure 4.95. Tahrir square: 1,2) Moga'maa Al-Tahrir building 3)The Egyptian Museum 4) Samiramis Hotel.

[37] Recently, moved from its campus near Tahrir Square, in the heart of Cairo CBD, to the suburb of New Cairo.

Sharia Tahrir (Tahrir street) springs from Tahrir Square. Down the street, to wards the east, is Falaki square, a square located in Bab al-Lug area. At the far eastern end of the street is Midan Al-Gomhuryya (Square of the Republic), and Abdeen Palace Museum, where artifacts, mostly gifts and awards of former Egyptian rulers, are on display. Retrace our way up Al Tahrir street back west, passing the turn on it until we arrive at Talaat Harb street[38].

The center of Cairo CBD is Talaat Harb Square, previously Sulayman Pasha square, located to the east and north-east of Tahrir Square "Liberation Square", previously Ismail square. Talaat Harb square is rich of many landmarks such as the statue of Mr. Harb, Groppi's tearoom, Madbouli bookshop, and Wahba Pasha building. The square forks into 6 branches causing confusion to visitors. Talaat Harb street is distinguished by many landmark buildings that work as nodal points located along the street such as Talaat Harb shopping mall; Miami, Metro, Renaissance and Mar Girgis cinemas; and Yacoubian Building. The street runs until coming to Midan Orabi (Orabi square), where eating establishments are scattered about. Talaat Harb street intersects with vital axes like 26 July, Adly, Abd El-Khalik Tharwat, and Kasr El Nile. Adly street is famous for the existence of the Shar Hashamain Synagogue, where the Jewish faithful still come to pray[39]. Likewise, 26 July street contains important buildings like Dar El-Kadaa El-Ali building (Cairo supreme court). In Cairo CBD one can also see several theaters located within easy walking distance of each others.

[38] http://www.touregypt.net/cairo/caironew.htm.

[39] Ibid.

Figure 4.96. Talaat Harb street : 1,2) Talaat Harb square 3) Groppi shop 4) Talaat Harb Mall 5) Yacoubian Building 6) Metro theater.

Al-Gomhuriyya street springs from Ramses square and ends at Midan al-Gomhuryya. All vital paths are perpendicular on it, Alfy street is connected with it from the east, Abd El-Khalik Tharwat street intersects with it at a parking tower that was once the Midan Opera. Many landmarks are located at strategic points of the CBD like Kakhia mosque, located at the intersection between Al-Gomhuriyya St. and Kasr El-Nile St.; Immobilia building at the intersection of Sherif Pasha and Kasr El-Nile streets; and Strand building at the intersection of Mohammed Nagib and Sherif streets. At the far end of Al-Gomhuriyya St. is Al-Gomhuriyya theater. Furthermore, end vista such as Abdeen palace at the far end of Al-Tahrir St. provide legible views.

Many of Cairo CBD squares are underutilized. For instance, while Al-Tahrir square is well paved with street furniture, it is unfriendly node. Likewise, Al-Gomhuriyya square discourages people from using it because of existence of security at the area of Abdeen palace. Since people tend to sit on the edge of spaces rather than in the middle of them, boundaries of plazas should be planned for seating and viewing. They should be divided into subspaces to encourage their use.

Figure 4.97. Abdeen palace: the palace has been fenced with a visually permeable fence which allows for visual connection but blocks physical access.

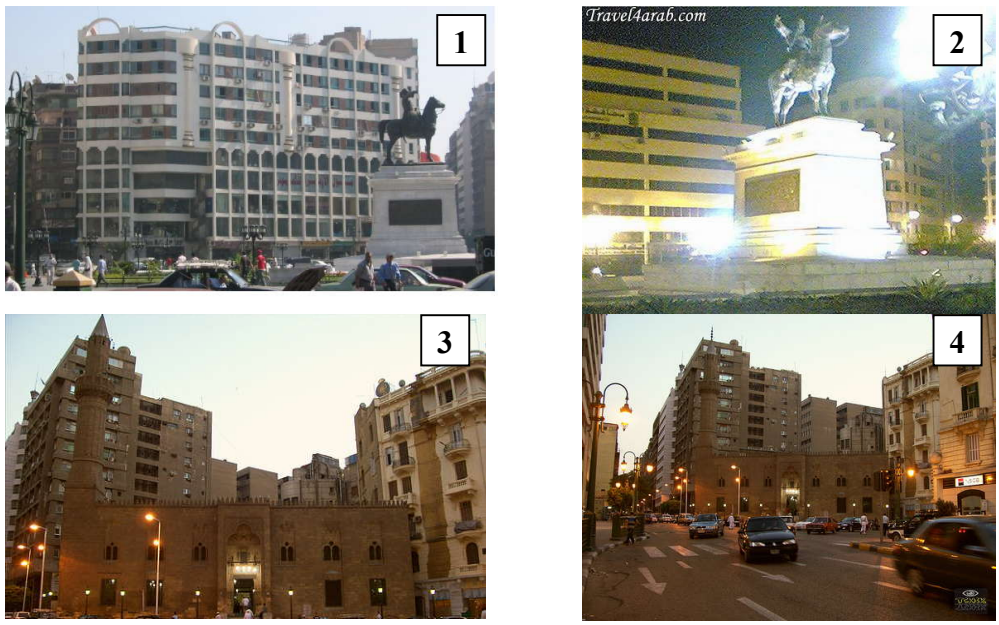

Figure 4.98. Al-Gomhuriyya street: 1,2) Opera square 3,4) Kakhia mosque 5) Al-Gomhuriyya theater.

Figure 4.99. Immobilia building (source: Gabr, 1998).

Figure 4.100. Closed vistas in Talaat Harb St.

Figure 4.101. Gamiaa Al-Fath emerges from Al-Gomhuriyya St. as a high imageable landmark.

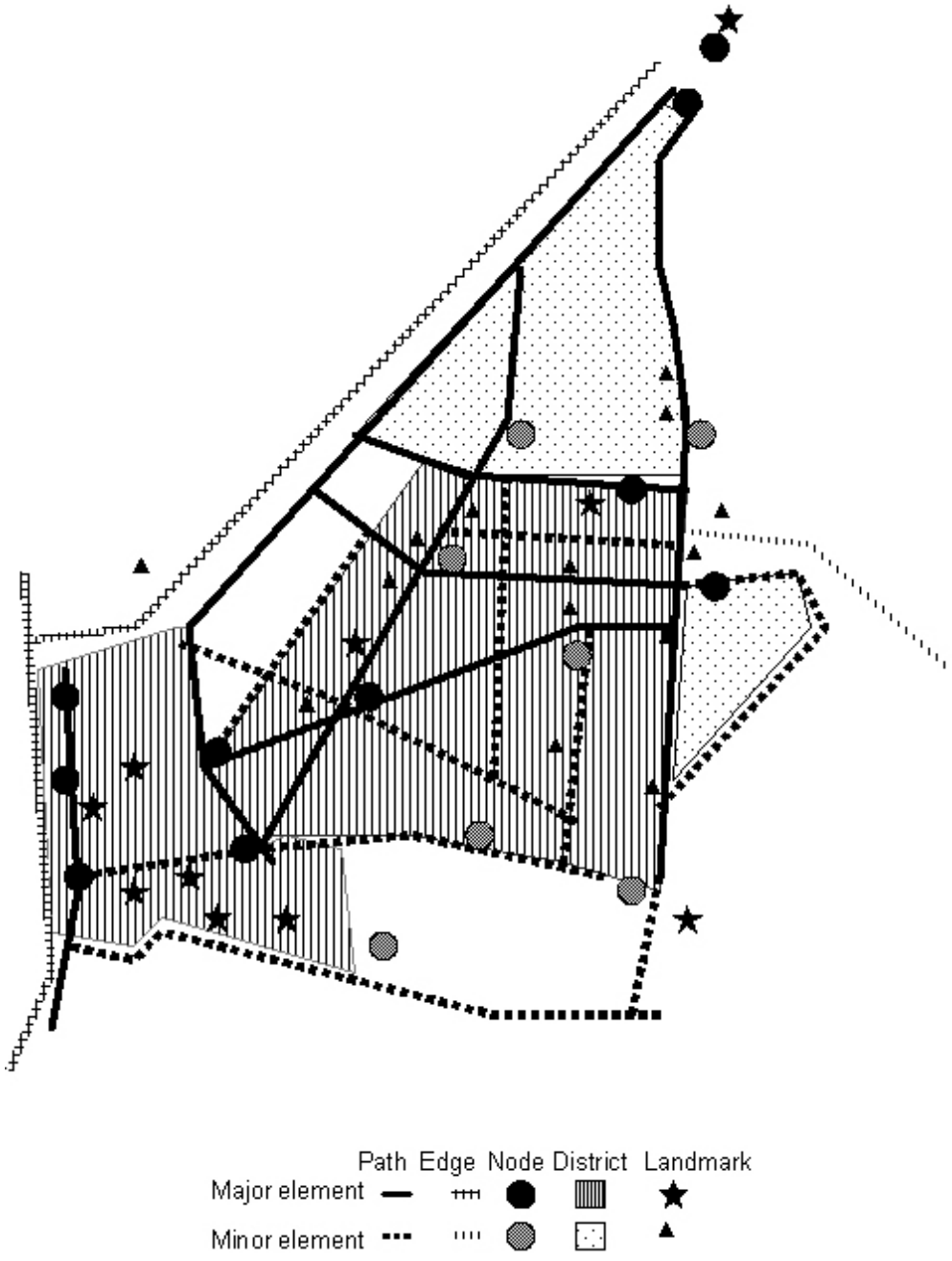

Figure 4.102. Cairo CBD image as seen in the field.

4.6.3 Interview And Sketch Mapping Procedure

Subjects	Gender	Age	Profession	Familiarity	Place of Residence
Subject1	Male	27	B.A. of commerce	Familiar	Helwan
Subject2	Male	23	B.A. of computer science	Very familiar	Al-Haram
Subject3	Male	33	Seller	Familiar	Banha
Subject4	Male	22	B.A. of arts	Not familiar	Nasr city
Subject5	Male	23	Seller	Familiar	Dar El-salam
Subject6	Male	26	B.A. of history and civilization	Familiar	Zagazig
Subject7	Male	30	B.A. of I.T.	Very familiar	Ataba
Subject8	Male	23	B.A. of media science	Familiar	Nasr city
Subject 9	Male	41	Seller	Very familiar	Al-Darrasa
Subject 10	Male	35	Professor of English	Familiar	Al-Haram
Subject 11	Female	24	B.A. of arts	Not familiar	Helwan
Subject 12	Female	37	Housewife	Moderately familiar	Dar El-salam
Subject 13	Female	31	B.A. of commerce	Familiar	Shobra
Subject 14	Female	22	B.A. of arts	Not familiar	Old Cairo
Subject 15	Female	26	Seller	Familiar	Zahraa Al-maadi
Subject 16	Female	31	B.A. of social services	Very familiar	Shobra
Subject 17	Female	42	Housewife	Very familiar	Shobra
Subject 18	Female	20	Nurse	Not familiar	Imbaba
Subject 19	Female	43	Housewife	Familiar	Helwan
Subject 20	Female	25	Seller	Not familiar	Ain Shams

Table 4.8. Subjects tested, Cairo CBD.

While most of verbal maps were rich of information which reflects their familiarity with the area, many sketch maps were approximately bare. many Subjects find it is a hard task to draw what in their minds. They were familiar with the area by the reasons of workplace and leisure. They listed a huge number of landmarks and nodal points through verbal interviews. Some of mentioned landmarks were the Egyptian museum, AUC, Moga'maa Al-Tahrir, Semiramis hotel, Talaat Harb Mall, El-abd shop, Groppi, Anglo bookshop, Sherif bookshop, Immobilia building, Dar El-Kadaa El-Ali, Yacoubian Building, and Metro cinema. Likewise, they mentioned important gathering points such as Al-Tahrir, Talaat Harb, Mustafa Kamel, Mohammed Fareed, and Opera Squares. However, most of these nodal points are intimidating and not welcoming, as most of them are devoid of planting and street furniture. Furthermore, crossing or entering them make subjects in danger of traffic jams. Consequently, people tend to path through quickly or stick to the roads sides. They can not enjoy using plazas to sit in the sun, eat a bag lunch, or as a pleasant walking-through space. Eventually, plazas create less pleasing visual appearance.

Figure 4.103. Sample of poorly drawn sketch maps.

Figure 4.104. Sample of a well-drawn sketch map.

Figure 4.105. Some of Cairo CBD landmarks: 1,2) Dar El-Kadaa El-Ali (Cairo supreme court); 3,4) AUC; and 5) Mustafa Kamel square.

Subjects were confused of path system, they dropped many important streets from their sketch maps. For instance, Ramsis street, in spite of its remarkable buildings such as the institute of Arabic music, Egyptian Society of Engineers, and Cadastral Registrar, was erased from all sketch maps. The reasons beyond disability of differentiation and way-finding problems of Cairo CBD may refer to branching of roads, weak entrances, spatial chaos, congestion, Cairo CBD's too many landmarks and similarity of buildings facades. Nevertheless, many respondents find no problem in orientation depending upon their familiarity with the area. They divide the area into three parts: The Corniche district; Main street of 26 July; and Talaat Harb

Area. Many subjects symbolized Cairo CBD as Heritage; great market of clothes; and leisure. On the contrary, other subjects posted that nothing special come to mind except chaos of Cairo, and lateness; one woman put it:

> "Crossing the street, amidst honking and yelling a car stops short before me and a man shouts out his car window. I keep walking, smiling, I am just another part of Cairo's wondrous chaos"

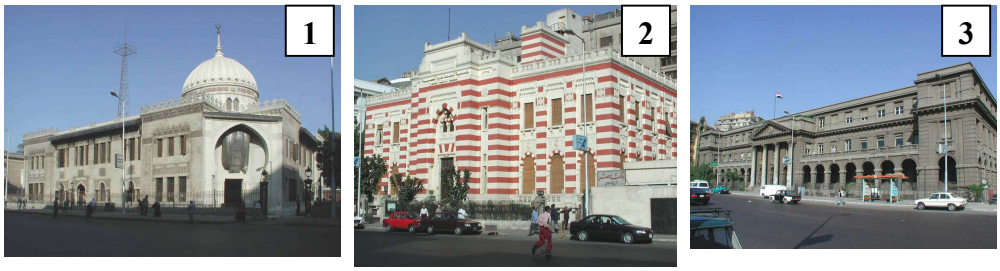

Figure 4.106. Remarkable buildings of Ramsis street, Cairo CBD (source: www.cultnat.org).
Notes: 1) Institute-of-Arabic-Music 2) Egyptian-Society-of-Engineers 3) Cadastral-Registrar.

Figure 4.107. A sketch map illustrates branching of roads, Cairo CBD: Names are in the right order, but not geographically. The detailed sketch with street names guess that the subject has worked in the area for along time.

No. of respondents	Design element	High	Moderate	Low	Overall
20	Path	2	11	7	Moderate
20	Edge	1	5	14	Low
20	Landmark	16	3	1	High
20	Node	20	0	0	High
20	District	3	6	11	Low

Table 4.9. Overall Legibility Score for Cairo CBD.

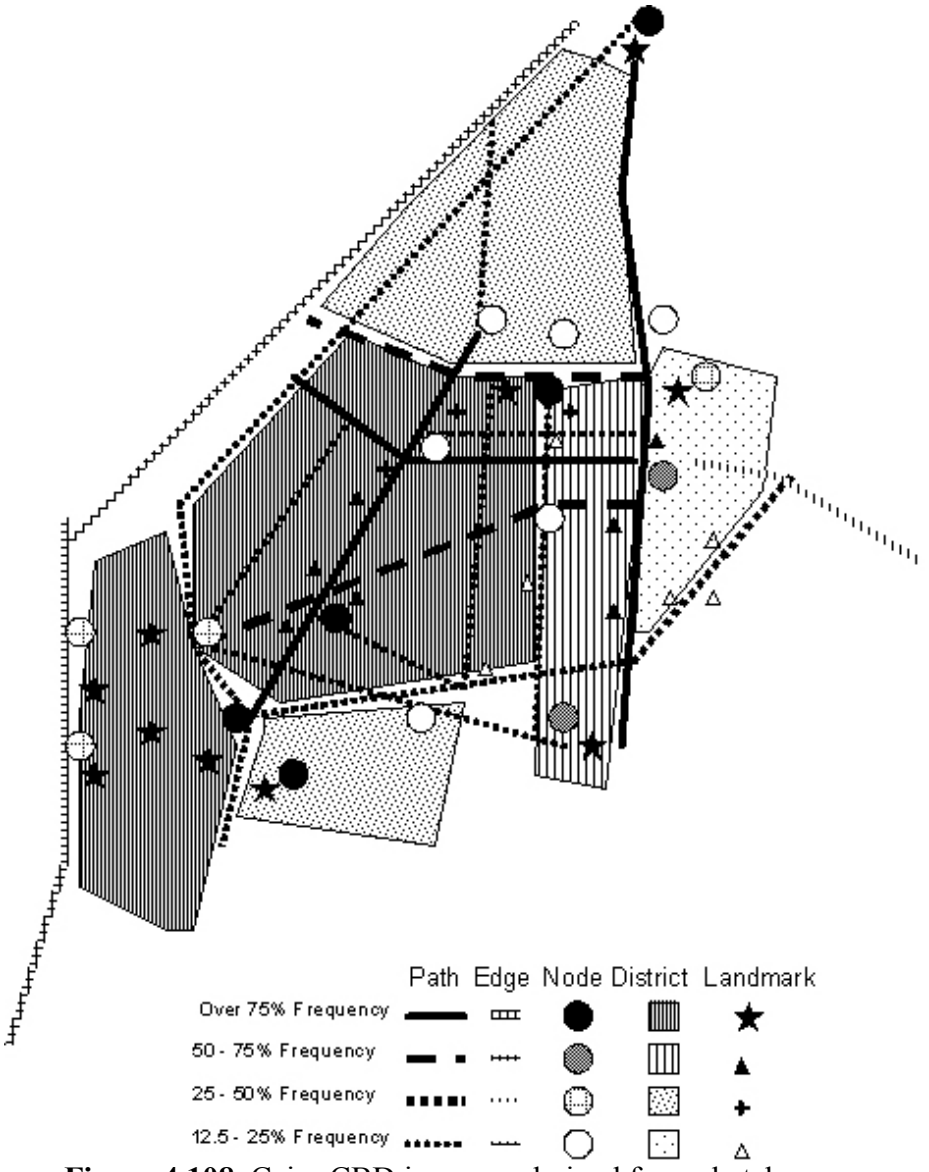

Figure 4.108. Cairo CBD image as derived from sketch maps.

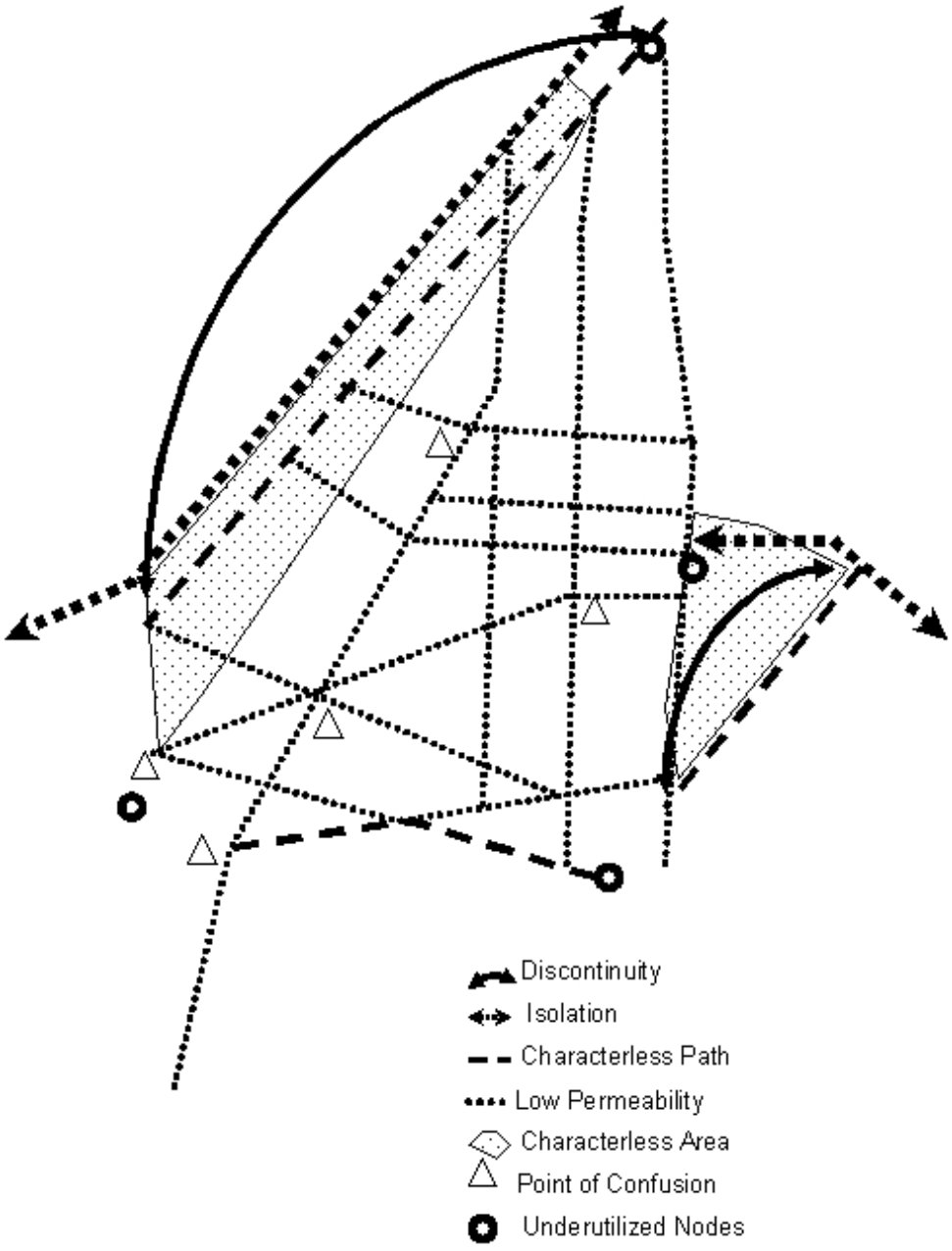

Figure. 4.109. Cairo CBD problems.

4.7. WHICH IS THE MOST IMAGEABLE?

Comparing previous three areas is definitely important to get the preliminary reasons behind wayfinding problems. Table 4.10 illustrates this comparison.

Type of analysis	Heliopolis	Evaluation	Maadi	Evaluation	Cairo CBD	Evaluation
Character/ Identity	Heliopolis has a strong identity dominating the area except the part northern of Abo Bakr Elsedeeqe. Heliopolis is less in greenery and quietness than Maadi. The suburb is distinguished by clear Hierarchy of roads. The use of Heliopolis is more equally distributed between work and shopping.	●	Maadi has a unique character, as vegetation dominates the suburb. The suburb is the most greenery. Height of buildings is about 2-4 stores in general. It is the most quiet than other two cases. Miserably, hierarchy of roads is totally absent. The major use of Maadi is residence, so people's knowledge is limited in the parts which are distant from their active areas.	●	Cairo CBD has a unique character of French facades. It is higher in density than other two cases. Cairo CBD is crowded and noisy. Its streets are congested of traffic. Although there are main streets drawing its map, hierarchy of roads is approximately absent. The area serves a variety of purposes; commercial, residential, etc.	●
Continuity and Enclosure	The southern part of Heliopolis shows good sense of continuity and enclosure. The more we move towards north the	○	Landscape dominating Maadi streets provides a good sense of enclosure. However, facades	○	Cairo CBD is more enclosure than Maadi and Heliopolis. This is because of its high buildings dominating its	○

	more this sense decreases.		are about lined-trees, as buildings are at the backdrop of them.		streets. It also provides a good continuity except few street facades broken by ill-considered high rises.	
Ease of movement	Heliopolis has no problem of traffic flow except few sub-ways and some major nodes. Its main streets provide permeability higher than other two cases.	○	Although all of Maadi roads are one-way and have narrow width, there is no problem of traffic flow because of quietness that dominates its streets. However, the suburb itself provides low permeability. Moreover, it is geographically isolated.	○	Although Cairo CBD is highly accessible, it provides low permeability as most of its streets are one-way. The problem increases when know that Cairo CBD is a main destination for multi-uses, so there is always high density of traffic especially at entrances and exit points.	○
Legibility	Heliopolis is more legible than Maadi and Cairo CBD. It is rich of strong identity, landmarks, nodes, districts, and defined paths. There is a strong interrelation among suburb elements compared to Maadi and Cairo CBD. In Heliopolis, the districts are joined with paths, and paths are connected with nodal points which distinguished by	●	Maadi is the most confusing suburb. This refers to many things: absence of roads hierarchy; ambiguity of paths caused by redundancy of ambiguous scenes; points of weak connections caused by fences, walls and off limit streets; underutilization of squares; isolation of the suburb and fear of navigation in it because of	○	Cairo CBD is rich of Lynchian elements, but there is a poor correlation among them. Furthermore, most of Cairo CBD nodal points are underutilized. Nevertheless, the familiarity with the area increased by reasons of work and variety of uses which activate the area and thus, expand the people's	○

	landmarks. Clear hierarchy of roads provides a strong clue of defining paths. The problem of legibility is approximately confined to defining strong districts and ambiguity of some paths.		existence of security which intimidates pedestrians and reduces familiarity; and paucity of landmarks and nodes.		knowledge. Cairo CBD major problem is basically in path system. Branching of paths and low permeability influence Cairo CBD legibility negatively. Furthermore, weak system of hierarchy of roads double the problem. It worth mentioning that Cairo CBD's too many landmarks undermined their helpfulness. Moreover, the chaotic nature of Cairo CBD overwhelm our ability to discern which information is relevant.	

Table 4.10. Comparison between case studies.

Notes: ● Good ○ Fair ○ Bad

It is noticed, in all case studies, that subjects tend to prefer longer routes with fewer changes of directions to shorter ones with more changes in direction. This may refer to reasons of safety, and enhancing better ability of arranging map categories mentally, as more changes in direction may cause wayfinding problems and increase complexity of map pattern. Fortunately, these results are congruent with space syntax principles. Space syntax method will be focused and applied in the following chapter.

4.8. CONCLUSION

This chapter tackled case studies according to Kevin Lynch thoughts.

First, we have showed the vital reasons upon which we have built our choice of the case studies. Some of these reasons are related to urban fabric characteristics and others to visual ones.

In the next part of this chapter, we mapped case studies according five elements of Lynchian map. The data of case studies were collected through the researcher's site observation and interviews. The researcher's site observation produced physical form maps whereas, results of interviews produced mental maps. The difference between the two types of maps predicted the degree of case study Legibility.

In the last section, we compared imageability of case studies. This comparison is crucial to reach the real reasons of wayfinding problems. Moreover, it enriched possibility of formulating useful recommendations for strengthening legibility of case studies. The outcomes showed that the stronger the city elements are, the legible the urban area is. The results also illustrated the influence of land use on city legibility, as the peoples' familiarity and knowledge are limited in the parts which are distant from their active area.

Chapter Five
MAPPING CASE STUDIES ACCORDING TO SPACE SYNTAX TECHNIQUE

5.1. INTRODUCTION

By this chapter, our thesis reaches the second stage of analysis which basically concerned with the analysis of spatial configuration according to space syntax technique. This method provides an objective way of analysis that differs from that applied, according to Lynchian thoughts, in the previous chapter. Analysis of depth, control, integration values, and intelligibility will be studied here. This chapter is also includes comparing the results of case studies spatial configuration analysis with each others. Before we start analysis we should first establish the axial map (model) of each area.

5.2. STAGES OF ANALYSIS

5.2.1 Drawing The Axial Maps

The axial map of an area consists of the fewest and longest sets of lines till all entire spaces are covered. Once an axial map obtained, it can be used to get various values of properties of the geometry of the an area.

5.2.2 Processing The Axial Maps

Processing axial maps means to run UCL Depthmap on them In order to get values of integration (with different radii), connectivity, control, mean depth, and intelligibility. Although these values were defined in chapter three, it is useful to mention them again here. The definition of them as following:

- **Integration :** counting how deep or shallow each line in is from all lines up to n steps away. The type of integration vary according to radius-n, if n

includes all levels then the integration obtained is called global integration. Likewise, if n is up to three steps then the integration obtained is radius-3 integration etc. connectivity is integration when n equals one. Intelligibility stands for the relation between global and locale integration. It is a synonym of legibility. Depth is in contrast with integration values, as high integrated line means low depth and vise versa. Control value is "the degree of choice that each space represents for its immediate neighbours as a pace to move to" (Hillier, 1983: 237).

5.3. THE MAP OF HELIOPOLIS

5.3.1. Integration Values

The axial map of Heliopolis was drawn by AutoCAD program and exported as dxf. cad file to UCL Depthmap software. The processing of axial lines helped getting integration values with different radii; the greater the radius, the more global the extent of the measure. The axial lines are represented from black to light gray, black means the highest value of the parameter while light gray means the lowest. For instance, for the integration value, the black lines means the most integrated (have the fewest changes of direction from others on average); the light gray ones mean the most segregated (least integrated). Figures 5.1-5.5 represent the global and local integration maps of Heliopolis. The suburb is composed of 501 lines represented from black to light gray in terms of their degrees of integration.

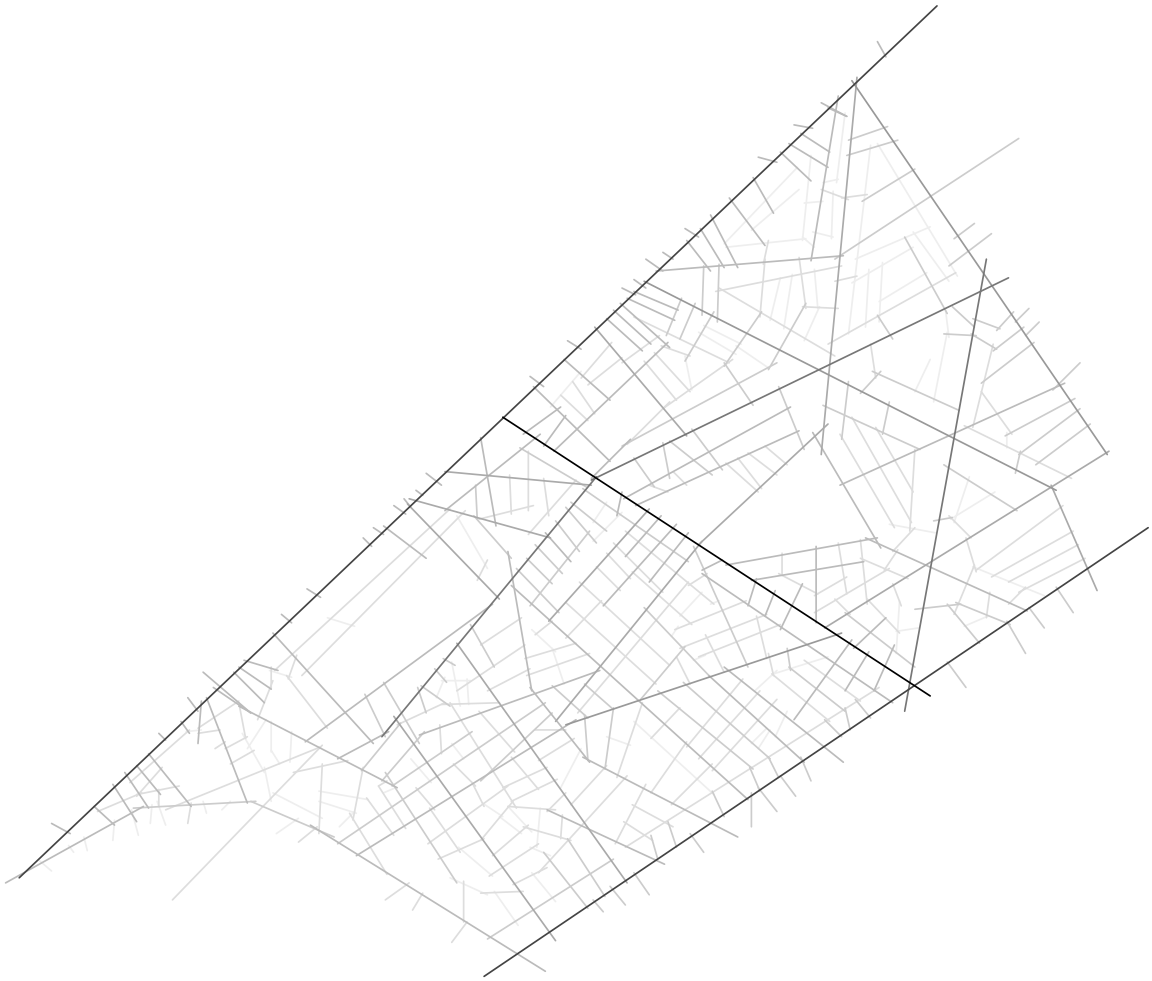

Figure 5.1. Heliopolis global integration.

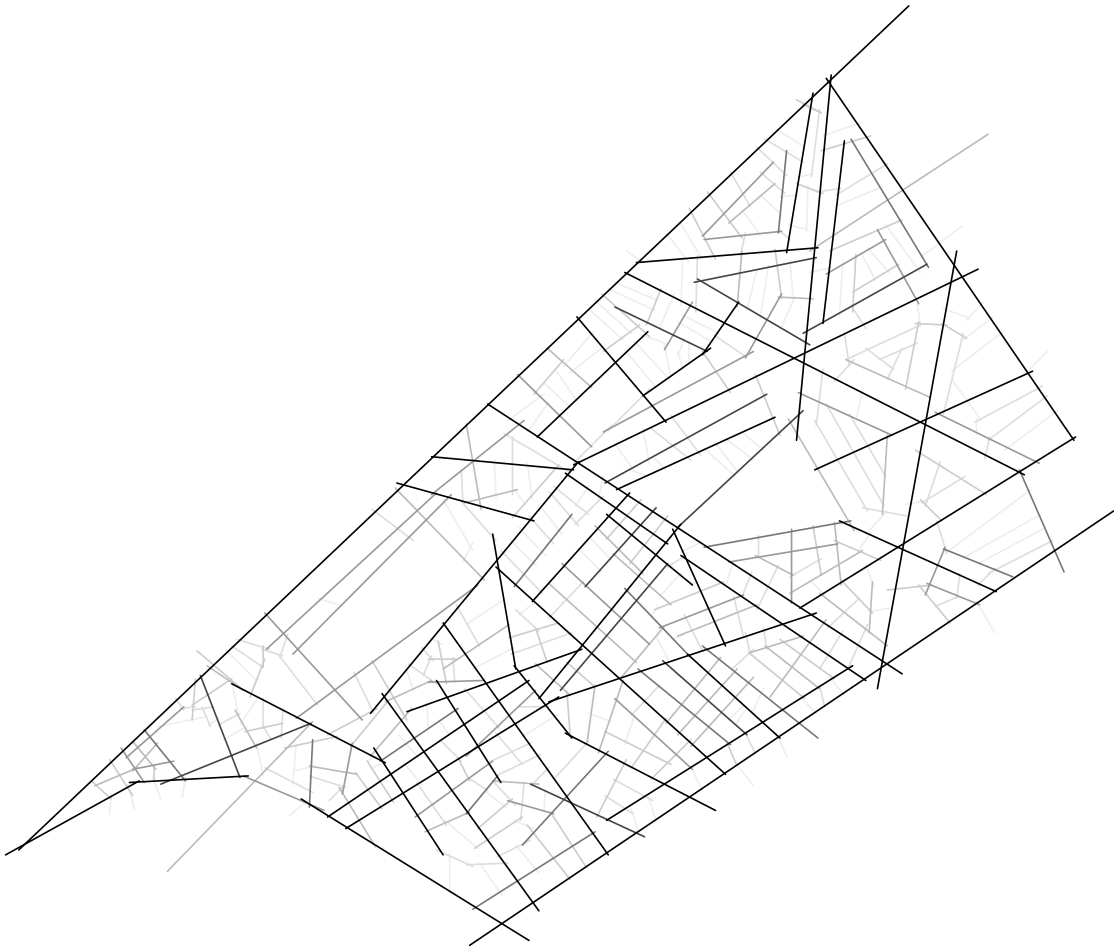

Figure 5.2. Heliopolis connectivity.

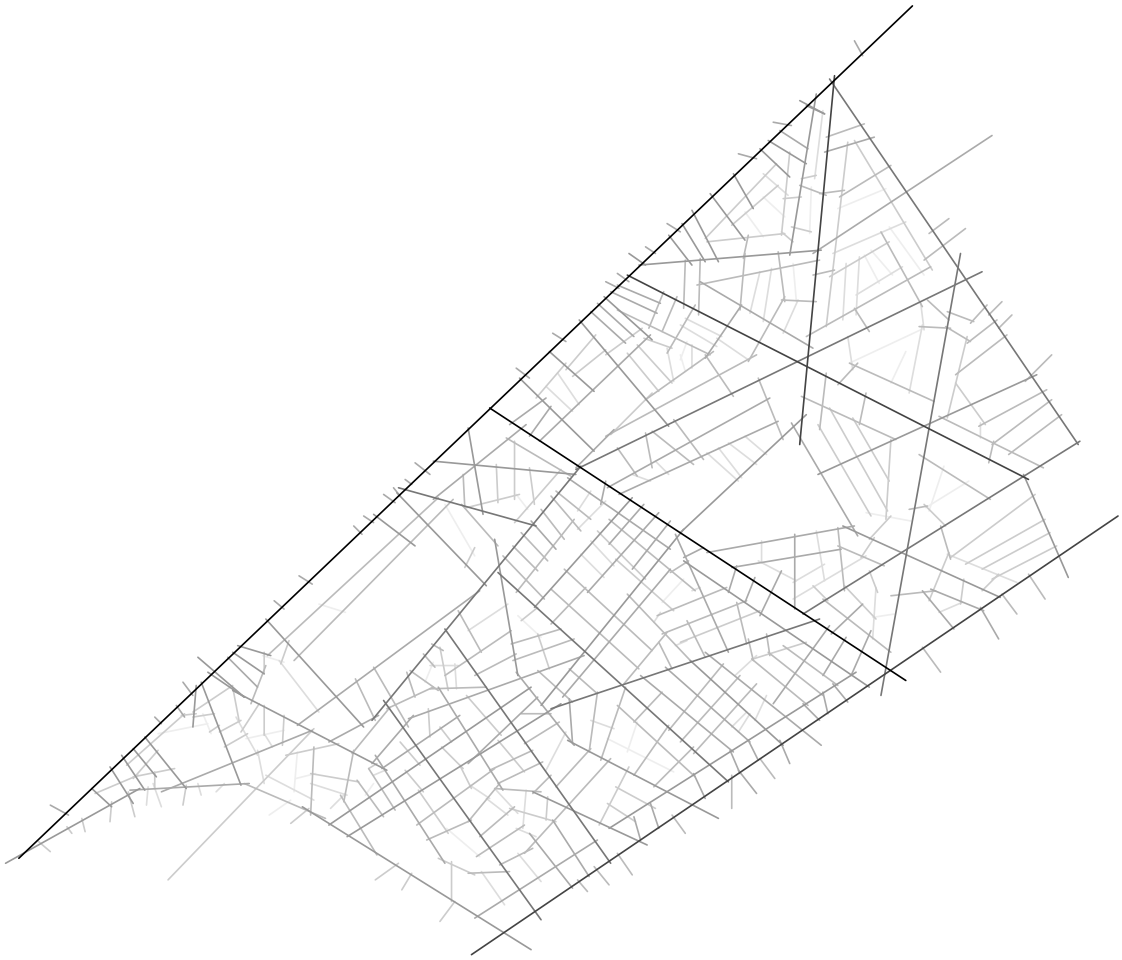

Figure 5.3. Local integration R 3.

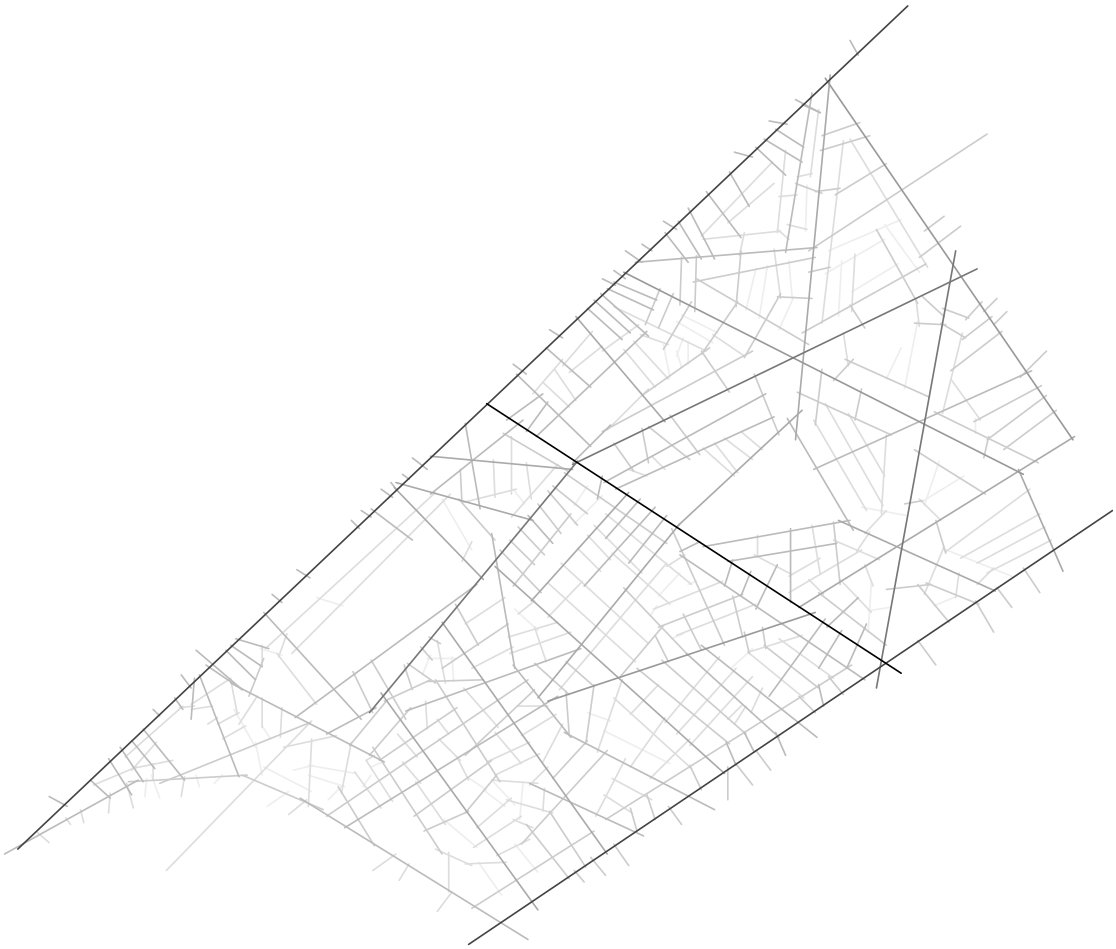

Figure 5.4. Local integration R 5.

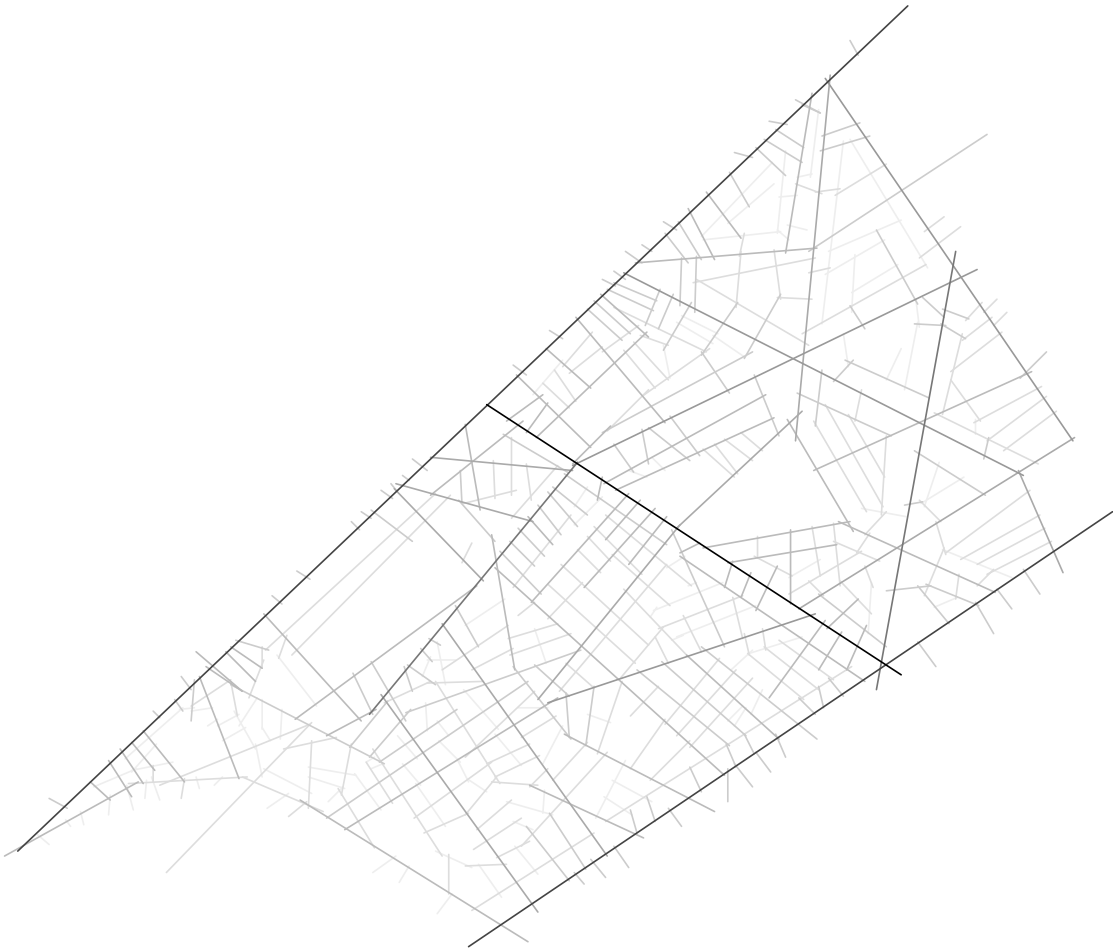

Figure 5.5. Local integration R 7.

Attribute	Minimum	Average	Maximum
Global integration	1.21846	1.99448	3.88606
Connectivity	1	4.37126	65
Local integration R3	0.916667	2.46953	4.57272
Integration R5	1.26105	2.08381	3.88606
Integration R7	1.27676	1.99651	3.88606
Control	0.0153846	1	31.6332

Mean Depth	1.13902	9.37467	6.256
Mean Depth R3	2	2.69513	2.91304
Mean Depth R5	2.648	3.98958	4.72174
Mean Depth R7	2.648	4.30265	5.82664

Table 5.1. Confgurational values of Heliopolis.

-The suburb showed a good global integration. It is sandwiched between tow major axis, Gesr El-Suez and Uruba streets. The most integrated segments are the main streets in Heliopolis. They are usually the longest segments like Gesr El-suez, Abo Bake Elseddeeq, and El-Higaz street. Uruba showed the most globally integrated street. After it comes Abo Bakr Elseddeeq and Gesr El-Suez. The most segregated segments are the shortest ones. The association between integration value and frequency of recall exist. Fortunately, the most integrated axis appeared in the mental maps.

-The area southern of Abo Bakr Elseddeeq St. showed global integration value higher than that located in the northern side. This result is matched with the real observed use of spaces, as the southern part contains the core of activities and rich of distinct elements rather than the northern one. The zone located at the far north-western end of the suburb showed the most segregated pattern comparing to other parts of the suburb.

- El-Merghany St. showed low integration value. This assured that the street works as a political boundary, since the President house located on it. Thus, existence of security and low movement are logical features.

- The maps of local and global integration raise the importance of streets like Baron and Ramsis is major links in the area.

Axis	Global integration	Local integration R3	Degree of importance in the area (% compared to the most integrated axis R3)	Degree of appearance in mental maps(%)
1- Uruba	3.777	4.0584	81	83
2- Abo Baker Elseddeeq	3.7299	4.4901	90	74
3-Gesr El-suez	3.5737	4.5727	91	100
4- El-Nozha	3.1957	3.8145	76	69
5-El-Hegaz (southern segment)	3.1672	3.7106	74	83
6-El-Hegaz (northern segment)	3.0938	3.6926	74	83
7- Abd El-aziz Fahmy	3.0095	3.8707	77	77
8- Fareed Semikah	2.9567	3.8085	76	55
9- Osman Ibn Affan (southern segment)	2.8926	3.5826	72	71
10-Osman	2.7917	3.5057	70	71

Ibn Affan (northern segment)				
11-Mahmoud Adel	2.77	3.8558	77	11
12-Ramsis	2.6885	3.4920	70	31
13- Baron	2.6706	3.5979	72	42
14- Al-ahram	2.4112	2.9784	60	35
15- Damascus	2.2921	2.9696	59	79
16- Harun Al-Rashid (northern segment)	2.6268	3.1468	63	63
17- Harun Al-Rashid (southern segment)	1.9944	3.4105	68	63

Table 5.2. The comparison between the pattern of the axes in mental maps and the pattern of highly-integrated axes.

- It is noticed that the degree of appearance of streets in the sketch maps is somewhat significantly correlated with their degree of importance in the area regarding to the values of most integrated axes. This means that the spatial syntax of sketch maps and spatial syntax of the environment are closely related.

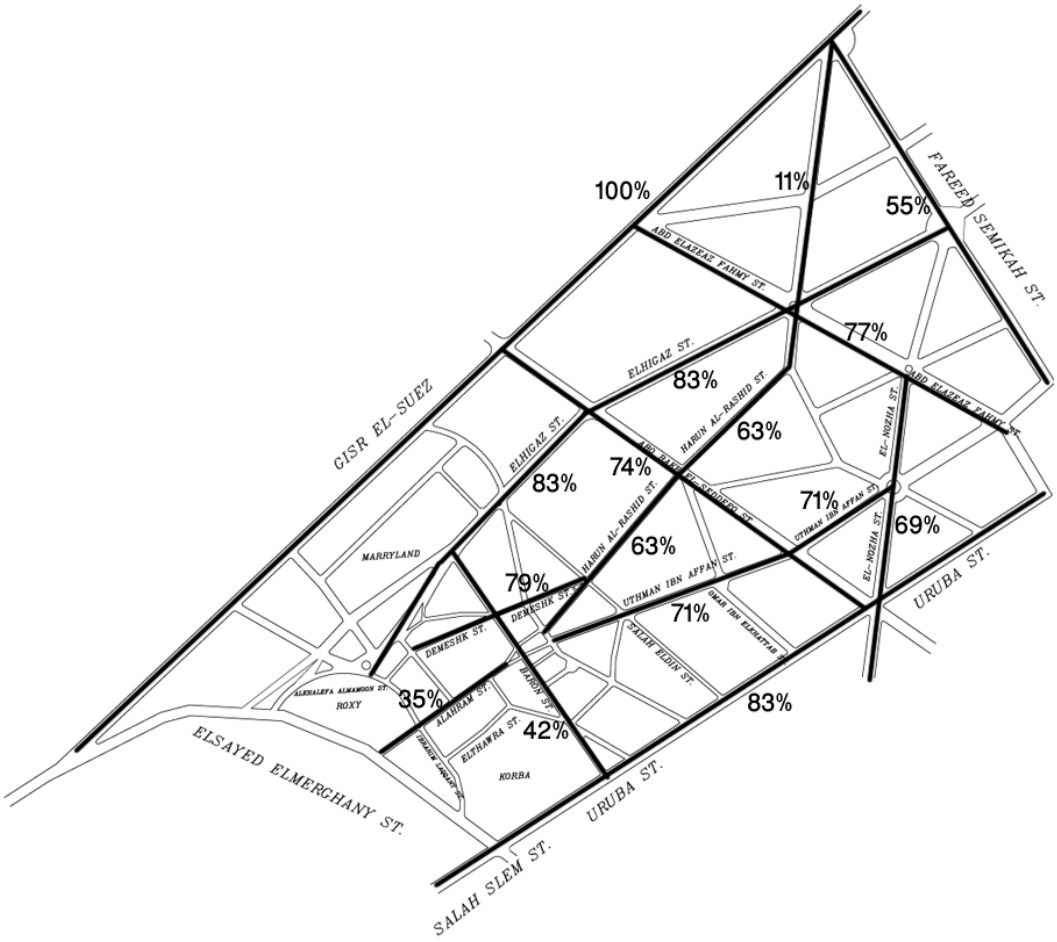

Figure 5.6. Map showing degree of appearance of axes in mental maps, Heliopolis.

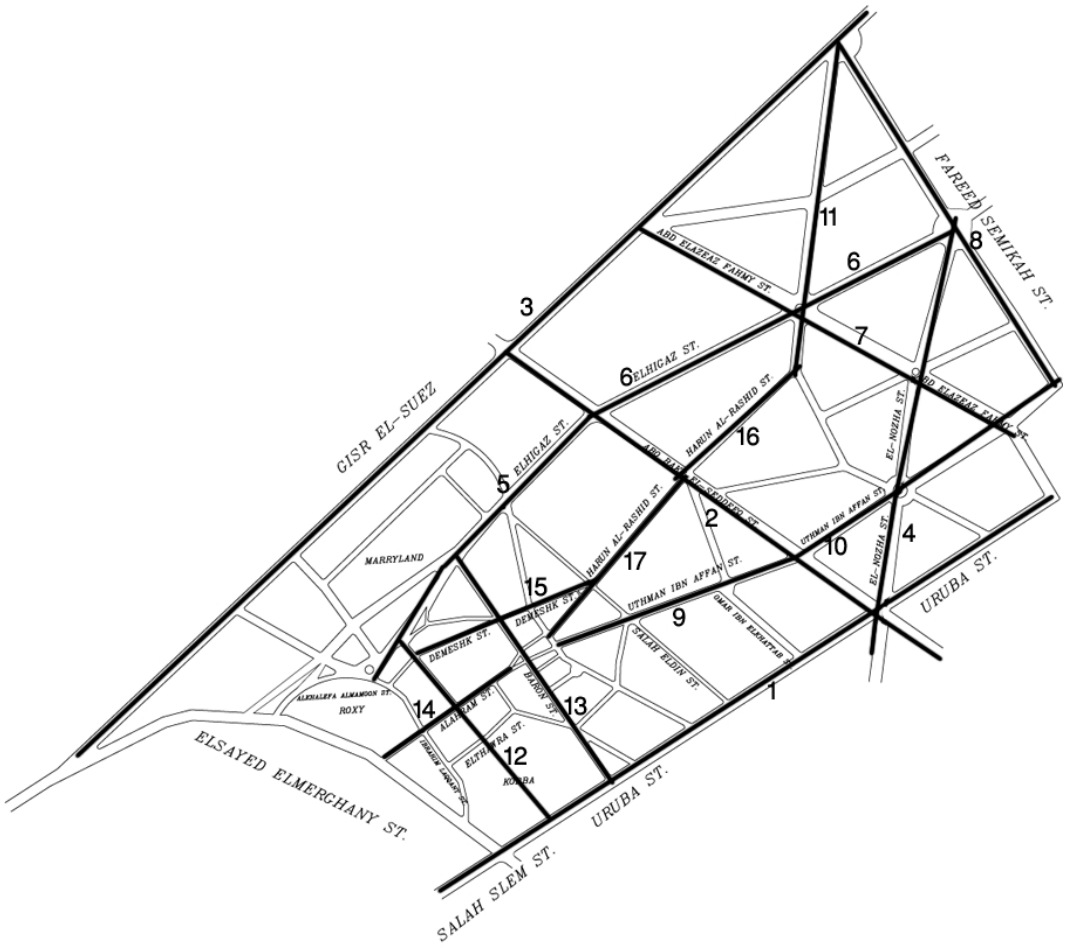

Figure 5.7. Ranking of the high-integrated axes, Heliopolis.

Notes: Numbers attached to each street does only refer to their sequence in global integration map regardless of intervals among them.

Key: 1) Uruba; 2) Abo Bake Elseddeeq; 3) Gesr El-Suez; 4) El-Nozha; 5) El-Hegaz (southern segment); 6) El-Hegaz (northern segment); 7) Abd El-aziz Fahmy; 8) Fareed Semikah; 9) Osman Ibn Affan (southern segment); 10) Osman Ibn Affan (northern segment); 11) Mahmoud Adel; 12) Ramsis; 13)Baron; 14) Al-ahram; 15) Damascus; 16) Harun Al-Rashid(northern segment); 17) Harun Al-Rashid(southern segment).

5.3.2. Intelligibility

The degree of intelligibility can be read by using scattergram that shows the relation between global integration and connectivity. Essentially each line will have both an integration value and a connectivity value. If we can imagine a graph, with integration values on one axis (say the x axis) and connectivity values along the other axis (say the y axis) then each and every axial line can be plotted as a dot, somewhere on the graph, its position being found by its x (integration in this example) and y (connectivity in this example) values. What is of interest, it the extent that the scatter of the points fit to a line and this is what the r2 value is describing. If they fit perfectly onto a line, the r2 is 1 and both integration and connectivity perfectly predict each other (this never happens in reality). If r2 is 0, then the pattern of dots is random and x and y are completely unrelated. If this is a spatial system, then it is completely unintelligible. In this case, the intelligibility of the system is the r2 value, if we are using integration and connectivity to calculate it. This is the r2 calculated by Depthmap[1].

The value of p is a confidence test, broadly speaking it is to do with both the value of r2 and the number of points used to produce the value of r2. For example, if we only had just 2 points, we would always get an r2 of 1, as we would always be able to draw a perfect straight line through the points, but it would be meaningless. As a rule of thumb, the more points we have and the closer to 1 (or -1) the value of r2 is, the higher will be the value of p as well. However, in space syntax we rarely bother with the p values, as usually our systems tend to have a lot of axial lines anyway. The significance of

[1] From an email discussion between the researcher and Dr Ruth Conroy Dalton.

intelligibility drops below about 40-50 lines anyway, so as long as we are above this threshold, we will not need to worry about p-values at all[2].

Figure 5.8.a shows the scattergram between connectivity and global integration while figure 5.8.b shows the scattergram between integration R3 and global integration.

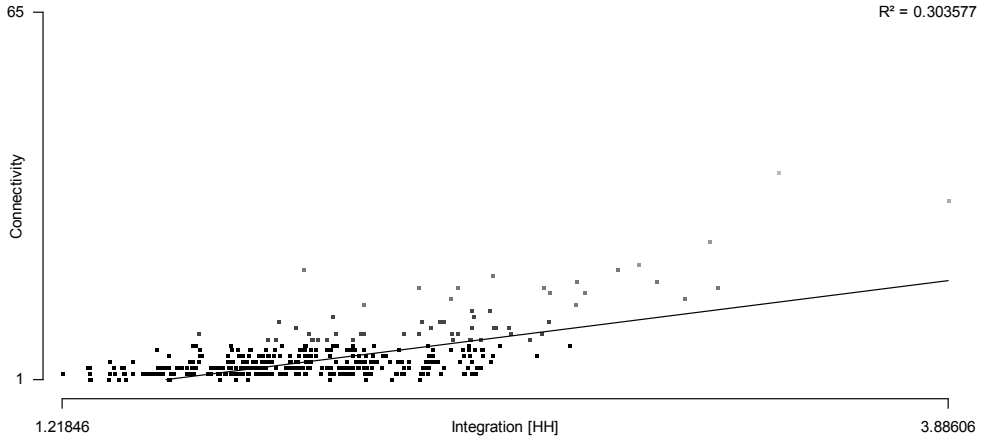

Figure 5.8.a Scattergram of Heliopolis Intelligibility.

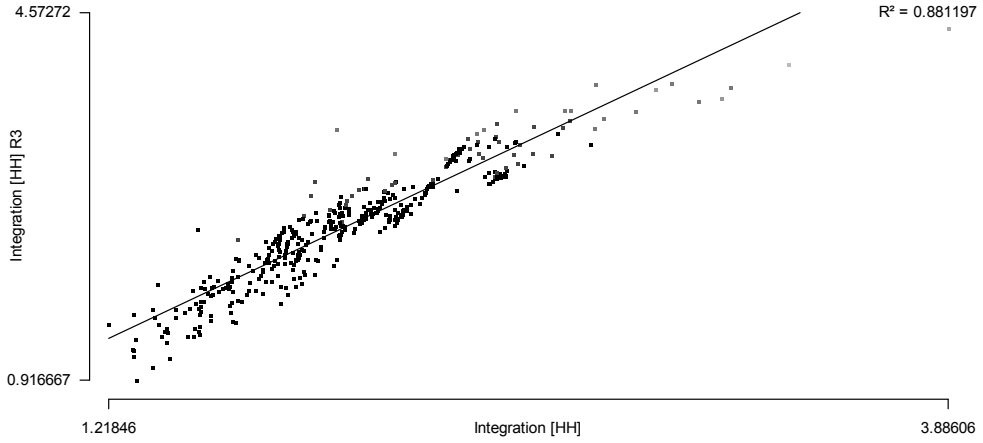

Figure 5.8.b Scattergram of Heliopolis Synergy.

[2] From an email discussion between the researcher and Dr Ruth Conroy Dalton.

Measure	R^2
Correlation integration n / integration3 (Synergy)	0.881197
Correlation integration n/ Connectivity (Intelligibility)	0.303577

Table 5.3. Heliopolis Synergy and Intelligibility.

- It can be seen that the points form of the Synergy scattergram is tighter and linear, while Intelligibility scattergram is little diffused. The intelligibility and synergy of Heliopolis is 0.30 and 0.88, respectively. This indicates that the area has a reasonable level of intelligibility.

5.4. THE MAP OF MAADI

5.4.1. Integration Values

The axial map of Maadi was processed at the same way applied to Heliopolis. Streets continuity is broken by the Metro line, so they should be un-linked by using the unlink tool provided by the Depthmap software. Figures 5.10- 5.14 represent the global and local integration maps of Maadi. The suburb is composed of 443 lines. The lines are represented from black to light gray in terms of their degrees of integration. The black lines are the most integrated; the light gray ones are the most segregated.

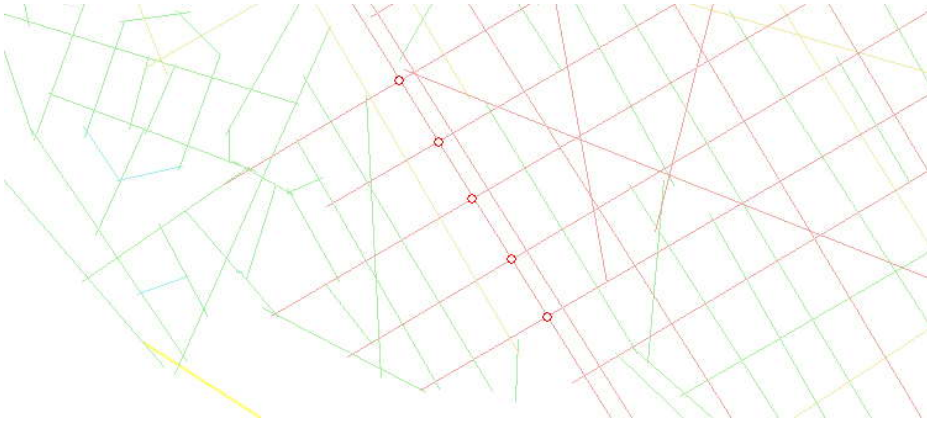

Figure 5.9. Using unlink tool at the intersection between Metro line and streets which are perpendicular on it.

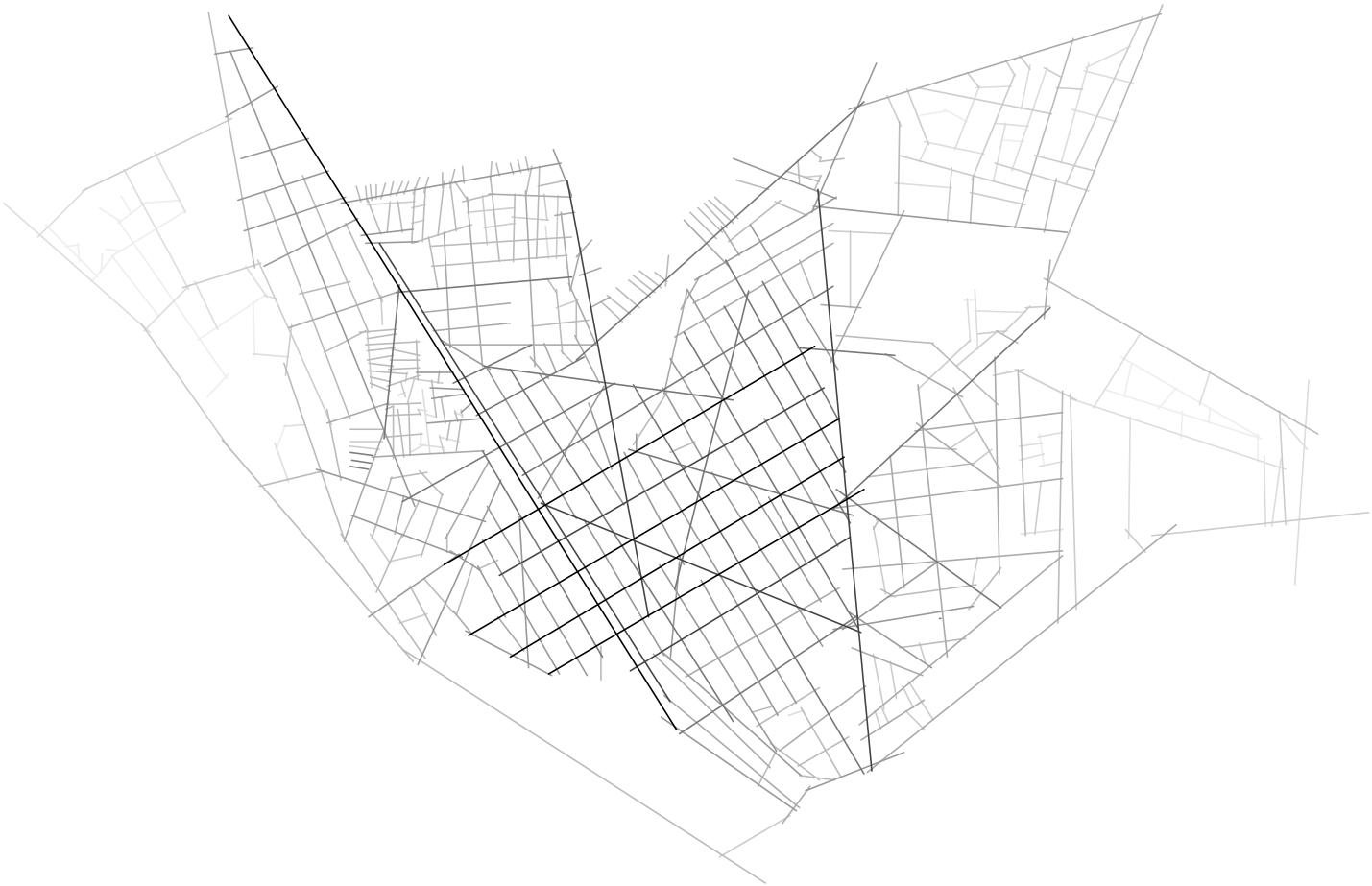

Figure 5.10. Global integration

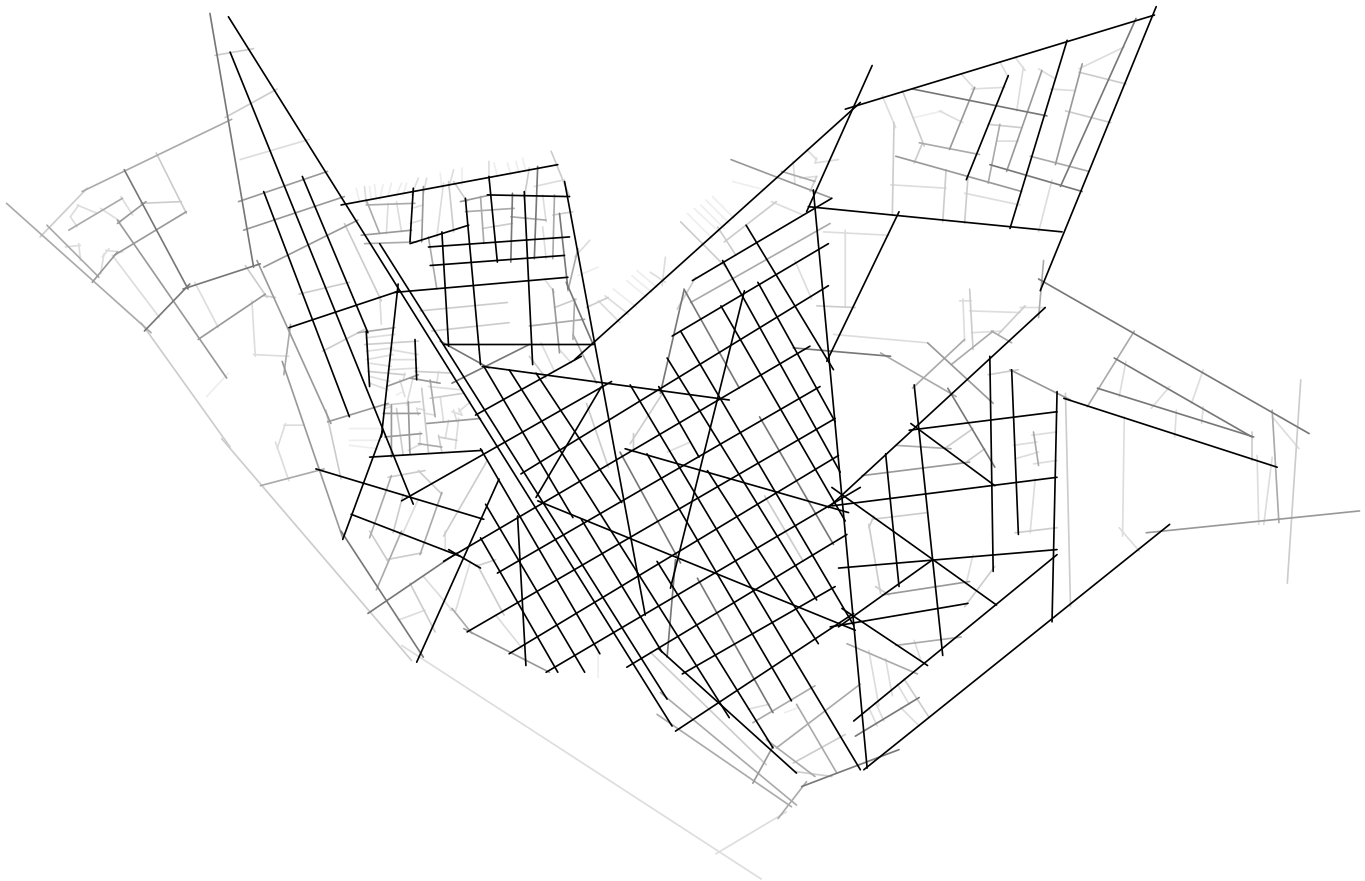

Figure 5.11. Connectivity.

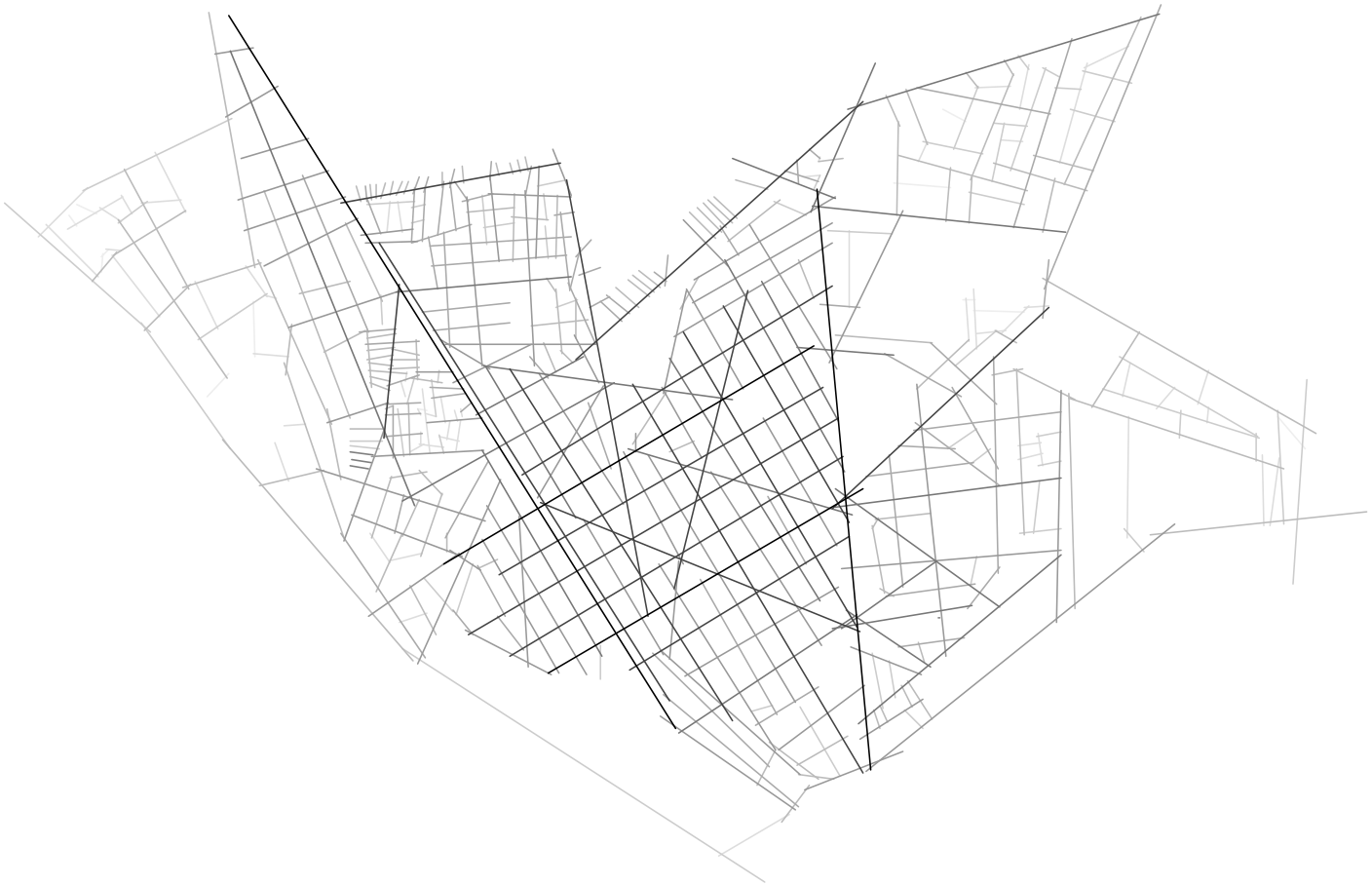

Figure 5.12. Local integration R3.

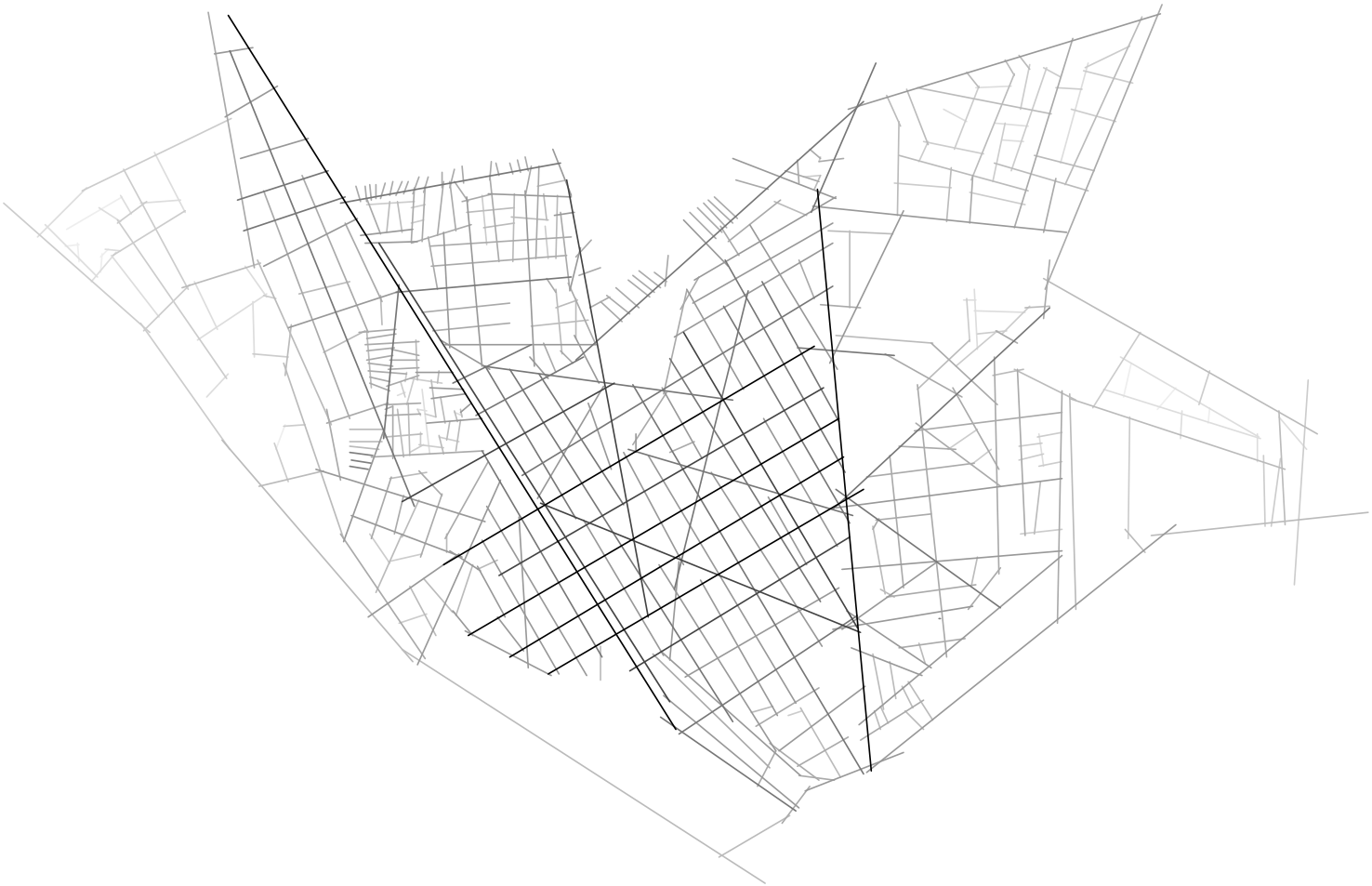

Figure 5.13. Local integration R5.

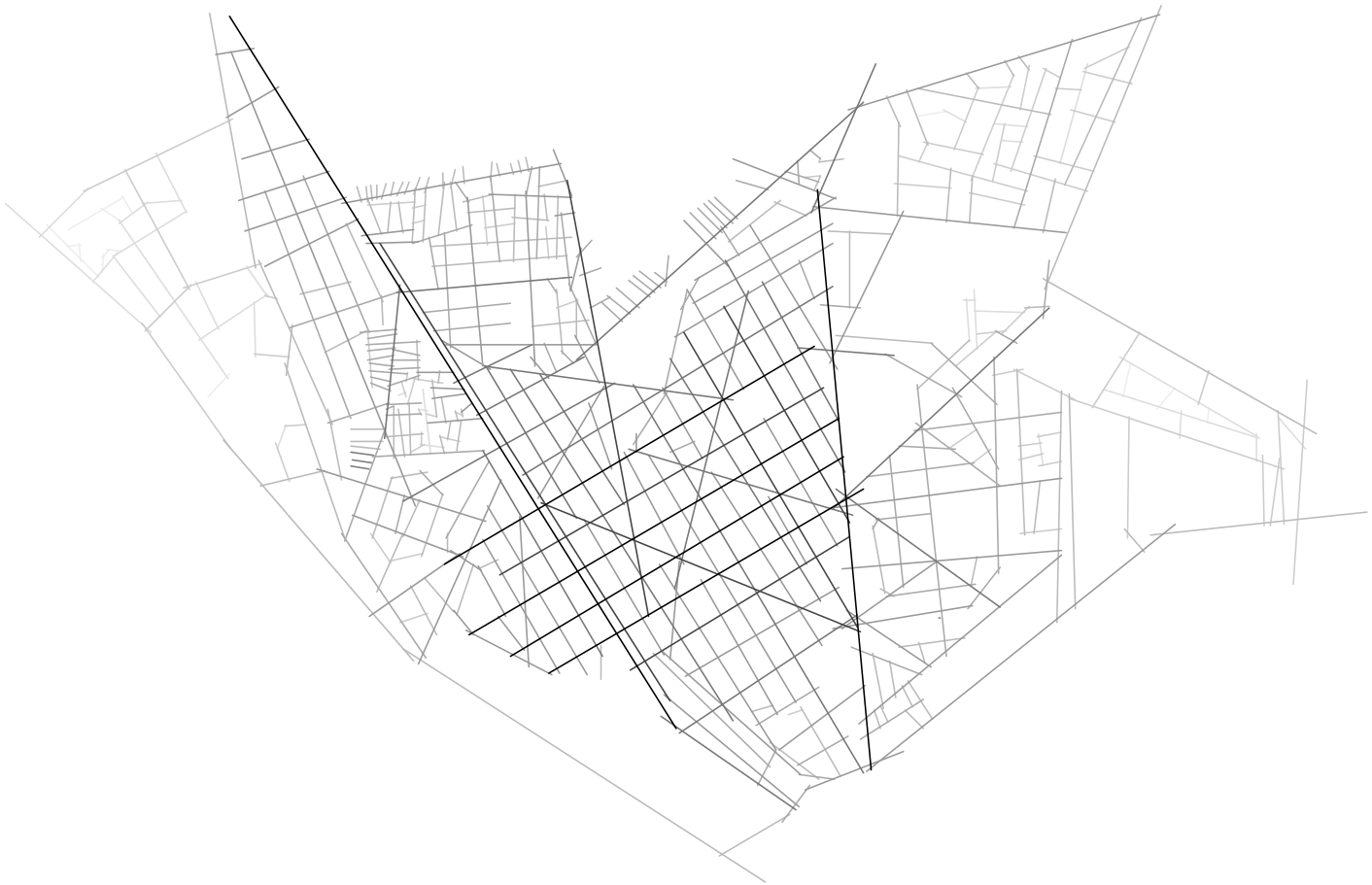

Figure 5.14. Local integration R7.

Attribute	Minimum	Average	Maximum
Global integration	0.6063	1.5835	2.8180
Connectivity	0	4.88143	35
Local integration R3	0.56608	2.2452	4.1194
Integration R5	0.55	1.8355	3.1061
Integration R7	0.5488	1.6703	2.8589
Control	0.0344828	0.991051	18.2563
Mean Depth	3.2104	5.0945	11.2738
Mean Depth R3	1.8333	2.5671	2.8607
Mean Depth R5	2.9733	3.9300	4.7006
Mean Depth R7	3.2104	4.9574	7.8441

Table 5.4. Confgurational values of Maadi.

- The area sandwiched between Metro line and Seket Hadid Elmahager (parallel to road 250) showed the most globally and locally integrated pattern which geometrically and Mathematically represents the core of the area. The explanation of this might be the orthogonal grid pattern of this area. On the contrary, the area eastern of Road 250 showed the most segregated one. The general results are congruent with the general expected ones, as the area eastern of Road 250 is isolated from surroundings by olive plantation (Degla desert) and Autostrad from the east, flash flood line from the south, and Seket Hadid Elmahager (Elmahager railway) from the west.

Axis	Global integration	Local integration R3	Degree of importance in the area (% compared to the most integrated axis R3)	Degree of appearance in mental maps(%)
1- Metro line	2.8180	4.0893	82	100
2- Road 84	2.7615	3.8012	76	77
3- Nahda St.	2.6834	3.8206	76	79
4- Road 82	2.6678	3.7083	74	0
5- Road 83	2.6652	3.6997	74	0
6- Road 250	2.5235	4.1194	82	82
7- Canal St.	2.5029	3.6678	73	41
8- Road 9	2.4003	3.4701	69	100
9- Road 77 (segment 2)	2.3078	3.2978	66	75
10- Road 11	2.3020	3.4283	69	0
11- Road 77 (segment 1)	2.2791	3.4782	70	75
12- Road 79	2.2347	3.4595	69	60
13- Orabi St.	2.1851	3.4312	69	65

Table 5.5. The comparison between the pattern of the axes in mental maps and the pattern of highly-integrated axes.

Figure 5.15. Map showing degree of appearance of axes in mental maps, Maadi.

Figure 5.16. Ranking of the high-integrated axes, Maadi.

Notes: Numbers attached to each street does only refer to their sequence in global integration map regardless of intervals among them.

Key: 1) Metro line; 2) Road 84; 3) Nahda St.; 4) Road 82; 5) Road 83; 6) Road 250; 7) Canal St.; 8) Road 9; 9) Road 77 (segment2); 10) Road 11; 11) Road 77 (segment 1); 12) Road 79; 13)Orabi St.

- Comparison of most integrated axis showed results away from reality, as it submitted many axis like Road 84, Road 83, and Road 82 as more integrated

than Road 9 and Road 250. However, They are approximately bare of activities, as they are residential axis. Conversely, Roads 9 and 250 are the vibrant axis in the suburb.

5.4.2.Intelligibility

It can be seen that the points form is tighter and linear in the scattergram of the correlation between global integration and local integration (figure5.17.b). Conversely, the scattergram of the correlation between global integration and connectivity is little diffused (figure 5.17.a). Likewise, the values of intelligibility showed in table 5.6 confirm that the suburb is somewhat intelligible.

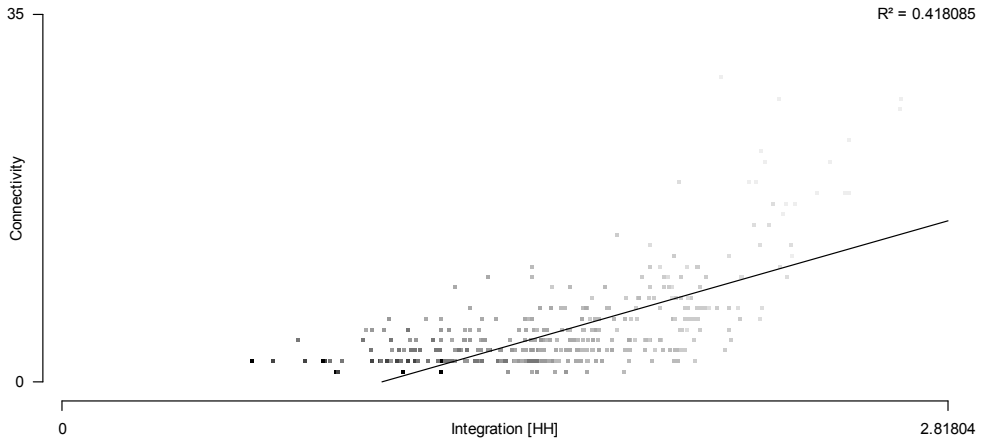

Figure 5.17.a Scattergram of Intelligibility.

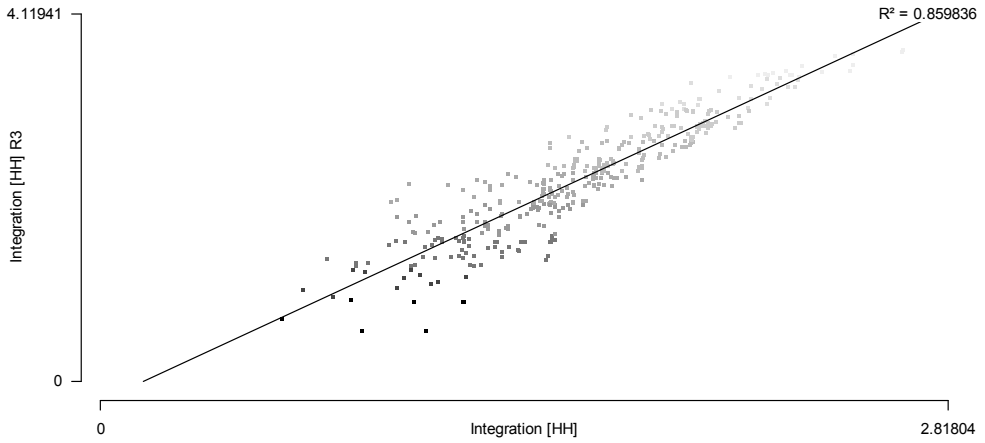

Figure 5.17.b Scattergram of Synergy.

Measure	R^2
Correlation integration n/ integration3 (Synergy)	0.859836
Correlation integration n/ Connectivity (Intelligibility)	0.418085

Table 5.6. Maadi Synergy and Intelligibility.

- The intelligibility and synergy of Maadi is 0.42 and 0.86, respectively. This indicates that the area has a higher degree of intelligibility, as the correlation coefficient is prefect.

5.5. THE MAP OF Cairo CBD

5.5.1. Integration Values

Figures 5.18-5.22 illustrate local and global integration values of Cairo CBD, showing how integrated or segregated each space is. The suburb is

composed of 523 lines represented from black to light gray in terms of their degrees of integration.

Figure 5.18. Global integration.

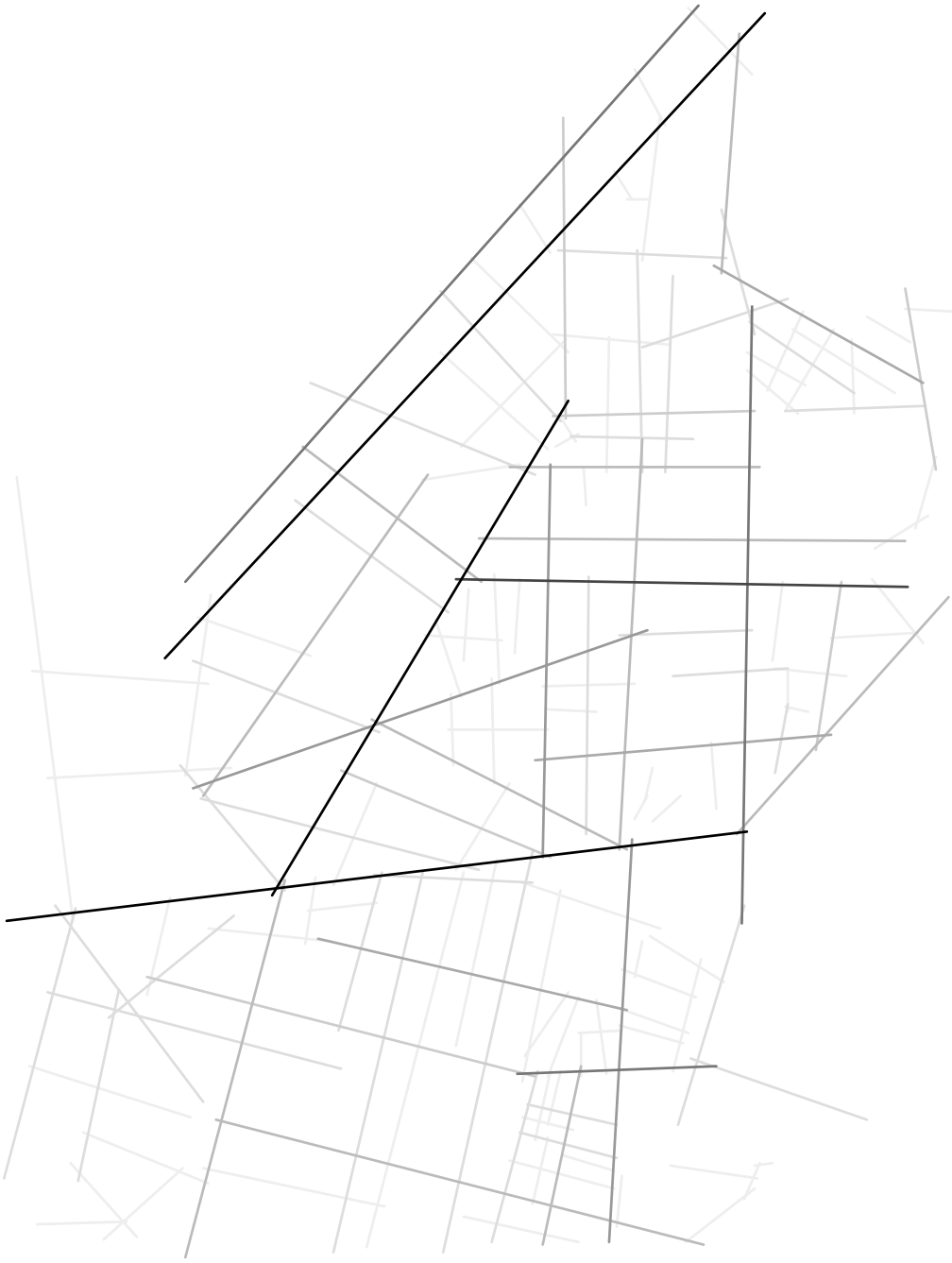

Figure 5.19. Connectivity.

Figure 5.20. Local integration R3.

Figure 5.21. Local integration R5.

Figure 5.22. Local integration R7.

Attribute	Minimum	Average	Maximum
Global integration	0.3333	1.34613	2.2537
Connectivity	1	3.60911	28
Local integration R3	0.3333	1.95613	4.0250
Integration R5	0.3333	1.69724	2.93556
Integration R7	0.3333	1.5334	2.5243
Control	0.04761	1.45161	10.1345
Mean Depth	5.07447	9.8134	13.9029
Mean Depth R3	1.71429	3.66055	2.8888
Mean Depth R5	2.3333	5.94928	4.70909
Mean Depth R7	3.88889	7.68943	6.50787

Table 5.7. Confgurational values of Cairo CBD.

Axis	Global integration	Local integration R3	Degree of importance in the area (% compared to the most integrated axis R3)	Degree of appearance in mental maps(%)
1- Al-Gomhuriyya (segment 1)	2.2537	3.7355	75	85
2- Segment of Abd El-salam Aref and Al-Tahrir	2.25084	4.02504	80	40

3- Abd El-Aziz	2.1140	3.5203	70	75
4- Abd El-Khalik Tharwat (segment 1)	2.0174	3.6657	73	80
5- Talaat Harb	1.9364	3.8682	77	90
6- Al-Gomhuriyya (segment 2)	1.9124	3.1197	62	85
7- Abd El-Khalik Tharwat (segment 2)	1.8311	3.4488	70	80
8- Al-Gomhuriyya (segment 3)	1.6811	3.1949	64	85

Table 5.8. The comparison between the pattern of the axes in mental maps and the pattern of highly-integrated axes.

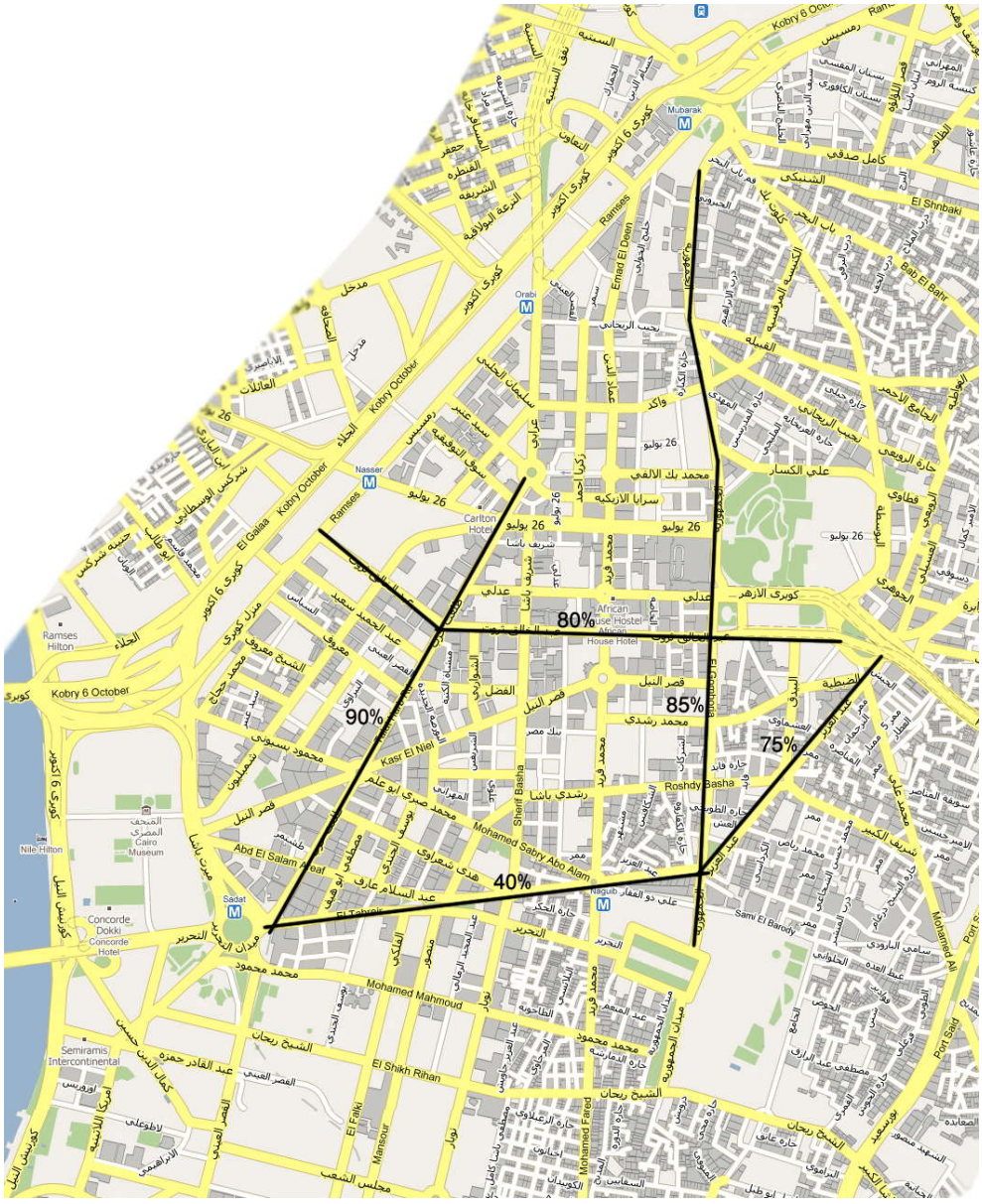

Figure 5.23. Map showing degree of appearance of axes in mental maps, Cairo CBD.

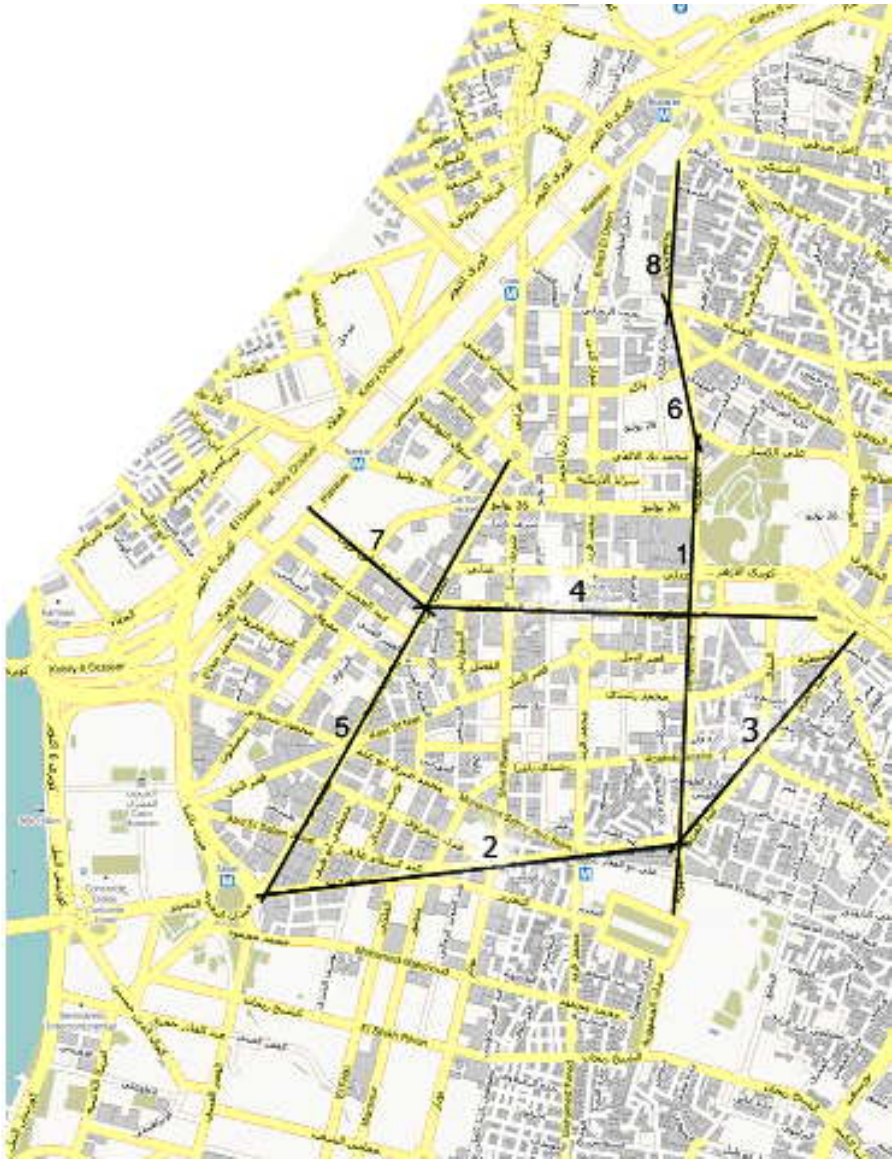

Figure 5.24. Ranking of the high-integrated axes, Cairo CBD.

Notes: Numbers attached to each street does only refer to their sequence in global integration map regardless of intervals among them.

Key: 1) Al-Gomhuriyya St. (segment 1); 2) Segment of Abd El-salam Aref (previously Al Bustan) and Al-Tahrir; 3) Abd El-Aziz St.; 4) Abd El-Khalik Tharwat St. (segment 1).; 5 Talaat Harb St.; 6) Al-Gomhuriyya St. (segment 2); 7) Abd El-Khalik Tharwat St. (segment 2); 8) Al-Gomhuriyya St. (segment 3).

- As it seen from the figures of integration values, the major streets like Kasr El-Nile and Mohammed Fareed showed high integrated values, whereas minor ones like Merit Basha and Shampilion showed low integrated values. The pathways between Cairo CBD buildings are the least integrated roads. These results are matched with Space syntax principle which indicates that longer axis with fewer changes of directions are more integrated than those shorter with many changes of directions.

- Abd El-salam Aref street showed the most locally integrated street. After it comes Talaat Harb street. Likewise, Al-Gomhuriyya St. showed the most globally integrated one. After it comes Abd El-salam Aref and Abd El-Aziz (famous for mobile shops) streets. Nevertheless, Al-Gomhuriyya St. starts to lose some of its global integration value at the northern direction toward Ramsis street.

- Local integration R3 showed Abd El-Khalik Tharwat St. as highly integrated street. It loses much of its local and global integration at the second segment after it passes the intersection with Talaat Harb St.

- The south-eastern part of the area tends to be segregated because of snaky, and narrow streets; and dead ends which represent a part of the urban fabric of Fatimid Cairo[3].

[3] Fortunately, the results of Cairo CBD analysis were matched with the results of professor Salheen dissertation : Salheen, M., 2001, A comprehensive analysis of pedestrian environment: The case study of Cairo city center, Ph.D. thesis, Heriot-Watt University, Edinburgh College of Art, Faculty of Environmental Studies, School of Architecture.

5.5.2. Intelligibility

Figure 5.25.a and 5.25.b show that the scatter is little diffused, as the points didn't form any perfect line, that indicates that the correlation is somewhat poor. The values calculated in table 5.9 revealed that the settlement doesn't have a perfect intelligible layout.

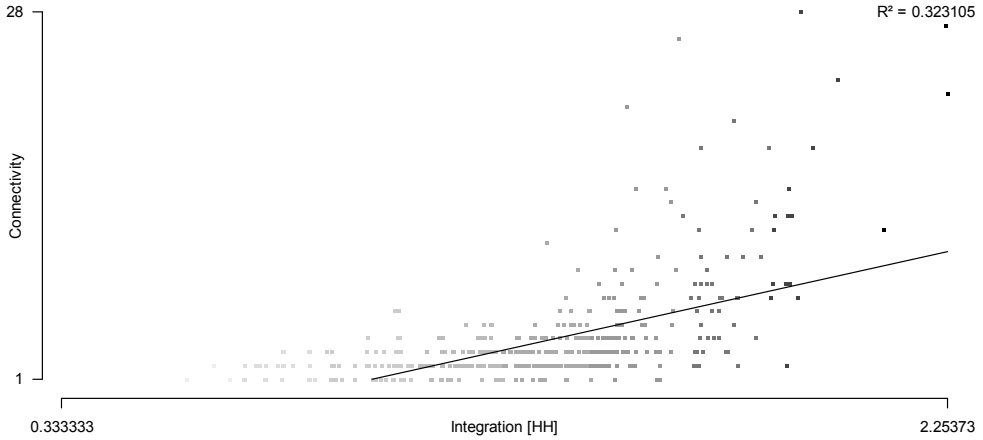

Figure 5.25.a Scattergram of Cairo CBD Intelligibility.

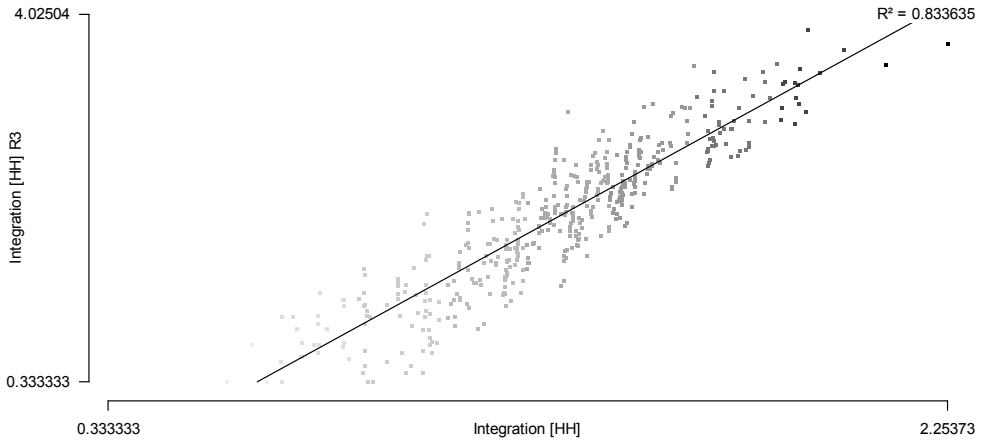

Figure 5.25.b Scattergram of Cairo CBD Synergy.

Measure	R^2
Correlation integration n/ integration3 (Synergy)	0.833635
Correlation integration n/ Connectivity (Intelligibility)	0.323105

Table 5.9. Cairo CBD Synergy and Intelligibility.

- The intelligibility and synergy of Cairo CBD is 0.30 and 0.80, respectively. This indicates that the area is somewhat intelligibility.

5.6. HELIOPOLIS > MAADI> Cairo CBD

The results of the comparison between case studies showed that with 100 % of confidence there are differences between the three urban layouts. Maadi has shown the highest intelligibility, while Heliopolis and Cairo CBD are approximately have the same degree of intelligibility.

Measure	Heliopolis	Maadi	Cairo CBD
Correlation integration n/ integration3 (Synergy)	0.881197	0.859836	0.833635
Correlation integration n/ Connectivity (Intelligibility)	0.303577	0.418085	0.323105

Table 5.10. Comparing the synergy and intelligibility of the three urban layouts.

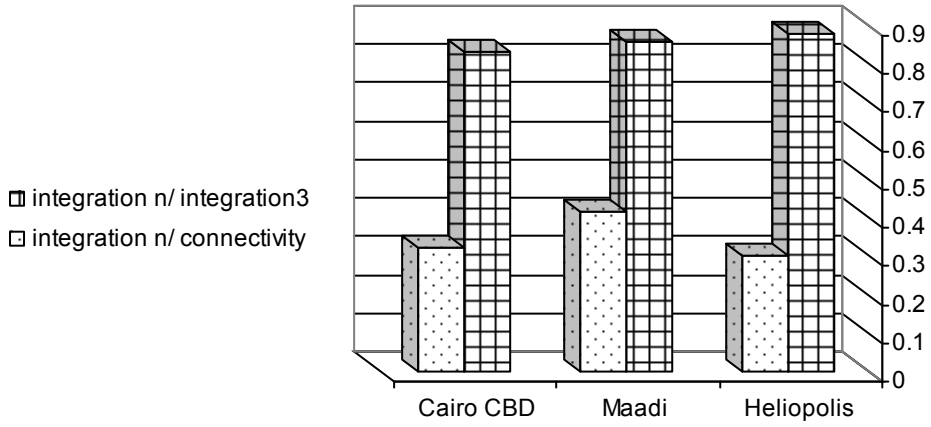

Figure 5.26. Comparing the intelligibility of the three urban layouts.

In fact, without seeing the maps, knowing how many lines are in each area, and the extent of the 'buffer' area around each district, it is hard to give any accurate interpretation for these results, as These kind of statistical correlations can be affected greatly by a small number of streets that are quite different to the majority. This means that we need also to look at the scattergram to see what it is that is producing the correlation, and then at the axial map for each measure to see which streets are the outliers, and to check that these are properly represented. We need also to think about what the measures mean independently.

The initial interpretation indicates that: In the cases we show here the interesting effect is that the order of synergy Heliopolis, Maadi, and Cairo CBD is the opposite of the order of intelligibility. This is on the face of it surprising, and so interesting. There are various possibilities - are we comparing like with like? Are they composed of more or less equal numbers of spaces (correlation coefficients are very affected by number of data points) ?. Or is this telling us something more fundamental - the boulvards of

Maadi would seem to be locally well connected but are they the same alignments that form the global structure of the whole of Cairo? Is there something more localised about the way Heliopolis is structured?

The axial maps of Heliopolis, Maadi, and Cairo CBD are composed of 501, 443, and 523 lines respectively. Furthermore, Maadi is physically isolated from the whole of Cairo as it is surrounded by strong edges from its sides: the River Nile from the south west; Kobry Shmal Tora and a flash flood from the south east; and Degla desert from the east. Moreover, this beautiful suburb is adjacent to slum areas from the north. So the sizes of case studies are comparable and we would seem to have a genuine effect. Maadi is more localised - its boundaries are strongly defined - this means that the system we are analysing is closer to the complete system. It is not so surprising that it has higher intelligibility. Heliopolis - the radius 3 integrating spaces are also the integrators at a global level – has a higher synergy. Unfortunately, these results are opposite to those obtained from field reconnaissance analyses and sketch mapping[4], as interviews and questionnaire confirmed that Maadi has locational difficulities. This conflict will be discussed in the next chapter.

[4] See chapter four.

5.7. CONCLUSION

This chapter analyzed the spatial configuration of case studies according to space syntax technique by using Depthmap software. The values of Local and Global integration, Depth and Control were measured for every case.

After that, the most integrated axial lines of every case study were ranked and compared with those presented in mental maps. The results of this comparison showed that the spatial configuration of an environment influences people's spatial cognition.

In the next part of analysis, the scattergrams of intelligibility were drawn for every case. Looking at the shape of the scattergrams illustrated the degree of ability to read the whole from the parts. After that, the results of the three urban layouts where compared to each others; The arrangement of case studies according to degree of intelligibility came Opposite to the results of questionnaire and city elements analysis.

Chapter Six

DISCUSSION, RECOMMENDATIONS AND CONCLUSION

6.1. INTRODUCTION

This chapter discusses the correlation between spatial configuration and visual form according to the results obtained in chapters four and five. Here, the research tries to answer many questions like: Is there a conflict between the results obtained by sketch mapping and those obtained by space syntax technique or they are closely related?; Is using space syntax technique efficient to give accurate prediction about wayfinding ability or it needs to work with other techniques like sketch mapping?. In other words, are space syntax and sketch mapping need to work with each other to give accurate interpretation for wayfinding problems? Why can not people find their way in Maadi, although it has a high degree of intelligibility?; etc. After that, the research will give overall recommendations for improving wayfinding ability.

6.2. HELIOPOLIS > MAADI> Cairo CBD

6.2.1. The Juxtaposition Between Legibility And Intelligibility

Evaluating the legibility of case studies has showed that Heliopolis is the most legible. After it, comes Cairo CBD, while Maadi has showed the lowest scores. On the contrary, measuring intelligibility showed that Maadi is the most intelligible at 0.42, while Heliopolis and Cairo CBD are approximately have the same degree of intelligibility (0.30). Definitely, intelligibility and synergy values for Maadi are away from reality, as they are unmatched with the legibility inferred by mental maps. So, the question is how to solve this conflict between legibility and intelligibility? In other words, how can we

interpret people's wayfinding problems in Maadi: space syntax analysis confirmed that it has higher intelligibility, while sketch mapping and interviews confirmed that it has wayfinding problems and one can not find his destination.

In Fact, the three cases differ from each other in character, and the pattern of pathway configuration. Although Maadi has showed high degree of intelligibility, it actually has low legibility of city elements caused by visual, structural, and semantic reasons:

1. All streets have the same width[1]; and they are similar in character like a beautiful maze, the problem increases with grid pattern.
2. All streets vistas ends with nothing; there is a paucity of landmarks[2] specially in squares; and low number of signs specially English ones.
3. The branching of roads with constant width make spatial decision making impossible.
4. underutilized nodal points lead to lifeless and contribute negatively to the social interaction and therefore the negative perception of the suburb.
5. The semantic reasons are names and numbers of roads which cause confusion. The streets sometimes have numbers and other times have names, so a particular intersection may converge various streets with various types of names. Furthermore, there are several names to one street.

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[1] This encourages us to make an inference that road hierarchy is an important clue for enhancing wayfinding ability. Especially, when we notice how hierarchy of Heliopolis's roads increased its legibility comparing to Maadi and Cairo CBD.

[2] Most of Maadi landmarks are limited and visually not accessible, so many indistinct buildings, due to their function, may act as landmarks for those familiar with the suburb, but can not orient visitors perfectly.

6. The need to the security measures increased, so the use of suburb's public spaces is confined to the use of inhabitants. In fact, the few numbers of peoples in the streets make it difficult to find someone to ask about directions (we are supported by people).

We suspected that there may also be a problem of understanding global orientation as the various angles at which the main grid and the diagonals run seem not to be related to very much in the wider world. We tested this by questioning people on the street, asking them First if they are local and know the area well or just visitors, then: a) to point in the direction of some global landmarks that cannot be seen directly but are well known and quite explicit b) we asked people to suggest which road they would take to get there from where they are; c) we asked them to point to the North. We noted the actual directions people point for these on the real map which we have lined up with a compass (but we didn't show them this). We made this for a number of people in each area and have got a good idea of how disoriented people are, and how much they are influenced by the orientation of the street grid they happen to be standing in.

For Heliopolis and Cairo CBD, although the value of intelligibility scored for Cairo CBD nearly equals that for Heliopolis, people have wayfinding problems in Cairo CBD more than Heliopolis. So, the problem is related to the visual form more than spatial configuration. We elicited the reasons of low legibility in Cairo CBD in the following:

1. Bad sense of enclosure comparing with Heliopolis, as there is a bad relation between buildings' heights and streets width in Cairo CBD. Furthermore, the skyline form is dramatically bad.

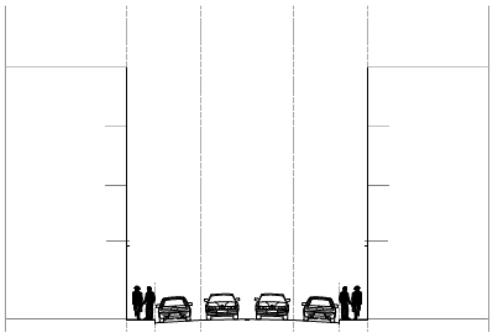

Figure6.1. Enclosure in Heliopolis: width to height ratio of 1:1 (source: researcher)

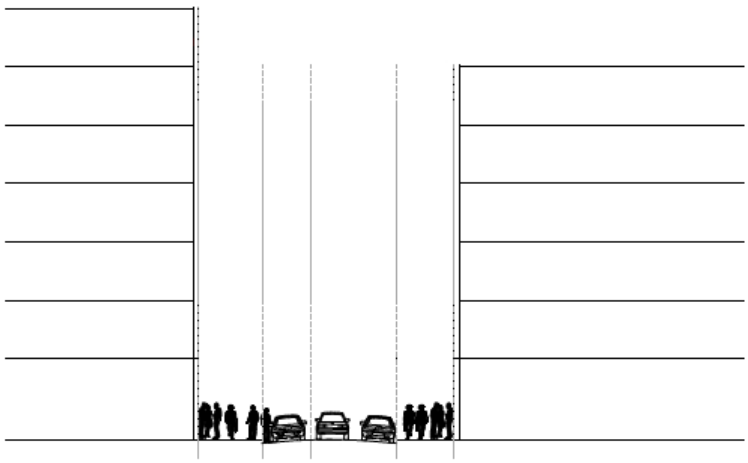

Figure6.2. Enclosure in Cairo CBD: width to height ratio of 1:2 (source: researcher)

2. The existence of too many landmarks in Cairo CBD with concentration and haphazard distribution for some of them caused confusion for wayfinder. On the contrary, most of Heliopolis landmarks are well-located, as they are at focal points enhancing the ability of spatial decision making. Furthermore, Heliopolis plan identifies a simple sequence and hierarchy of spaces by which the visitors would move through it easily. Fortunately, each space (square) at this sequence contained a landmark to guide wayfinders to

the next point within the overall sequence of space until they reach their destination.

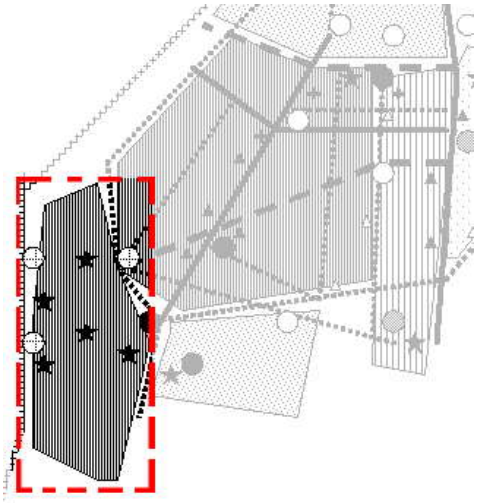

Figure6.3. Bad correlation between landmarks and spaces at Al-Tahrir square, Cairo CBD.

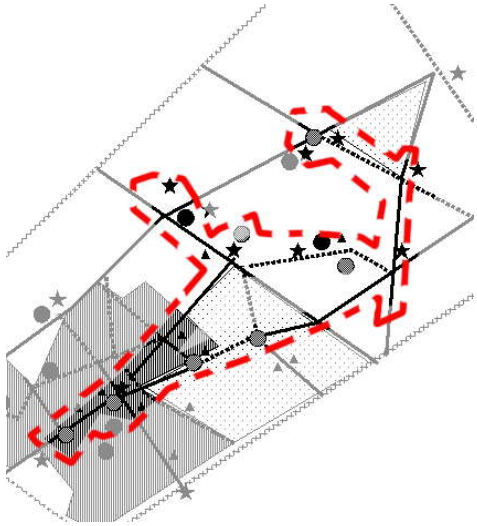

Figure6.4. Good correlation between landmarks and focal points at Heliopolis.

3. Traffic jams; scattered and poorly designed gathering points in Cairo CBD make it difficult to find your way smoothly, as chaotic environment overwhelm our ability to discern which information is relevant. Definitely, Cairo CBD is not welcoming, as you have to negotiate dangerous intersections to get to green spaces, and if you've got kids you have to risk dodging the traffic. Likewise, you may get fed up of waiting for a bus.

4. Lower permeability in Cairo CBD comparing with Heliopolis. Furthermore, the absence of road hierarchy and branching of paths made legibility in Cairo CBD dramatically low. On the contrary, hierarchy of roads in Heliopolis improved the process of wayfinding.

5. The disjointed organization between the elements required for orientation decreases their legibility to wayfinders[3].

6.2.2. Road Width And Wayfinding

As mentioned before, the results of Maadi's spatial configuration analysis has showed that the suburb is highly intelligible, although it is actually not. This deviation from reality lies in the constant and narrow width of most of Maadi roads. Although narrower width and absence of road hierarchy discourage traffic flow and pedestrian movement; and decrease familiarity and wayfinding ability, but the error here is related to axial map itself. Someone may claim that space syntax has nothing to say about road width especially the issue of road hierarchy. But this is definitely not right, as the axial map does not neglect this, the way that an axial map is drawn means that longer and more connected lines get through wider streets[4]. In narrower streets, slight deviations from being straight lead to more lines. In other words, road width does in fact get represented in the axial graph. We can add road width (or hierarchy) as an attribute of the line and then look at it statistically in our analysis of the results. We use multiple regression to see what independent effect road width and the various syntax measures have in explaining traffic flows. This interprets the error in results of Maadi's spatial configuration analysis.

6.3. FINDINGS

- It is noticed from the comparison between spatial syntax of configuration and imageability of every environment that:

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[3] Despite huge number of landmarks and signs, studies show that most of Cairo CBD visitors have trouble in finding their way around and worry about getting lost.

[4] This principle does not apply to Maadi, as both of longer lines and shorter ones have the same width. This is absolutely abnormal, so Maadi and the like are odd/ special cases.

- Heliopolis has showed moderate legibility in cognitive maps of volunteers, and somewhat intelligible environment in spatial syntax of configuration. This means that there is a juxtaposition between legibility and intelligibility; and there is a positive relation between them.

- Maadi has showed low legibility in cognitive maps -paucity in landmarks and bad correlation between Lynchian city elements- and high intelligible environment in spatial syntax of configuration. These opposite results are actually caused by a flaw in Maadi's axial map analysis, as it is common that longer lines get through wider streets and shorter lines get through narrower ones. But in Maadi, the case is different and abnormal, as both of axial map's longer and shorter lines have the same narrow width. So, the problem lies in space syntax methodology of analyzing spatial configuration for this type of axial maps. To conclude, we like to say that space syntax can not predict degree of intelligibility and wayfinding ability in special cases such as Maadi and the like which definitely need methods other than space syntax to interpret and predict wayfinding difficulties within them.

- Cairo CBD has showed moderate legibility in cognitive maps. Likewise, the settlement showed somewhat intelligible environment in spatial syntax of configuration. This confirms that there is a positive relation between legibility and intelligibility.

- The spatial configuration of an environment and spatial cognition are closely related, as the degree of appearance of streets in the sketch maps is somewhat significantly correlated with their degree of importance in the area regarding to the values of most integrated axes.

- Although it can interpret wayfinding problems in special cases that space syntax can not analyze correctly, Lychian method is subjective in general and not appropriate tool for estimating the quality of structure comparing with space syntax technique, so it needs to co-operate with an objective method like space syntax which can give us a quantitative results about spatial configuration. This means that combining the two methods will be helpful and powerful in analysis, as Lynchain method will give us a real prediction about the city image; and space syntax will estimate the quality of structure perfectly. So, the two methods should be complementary.

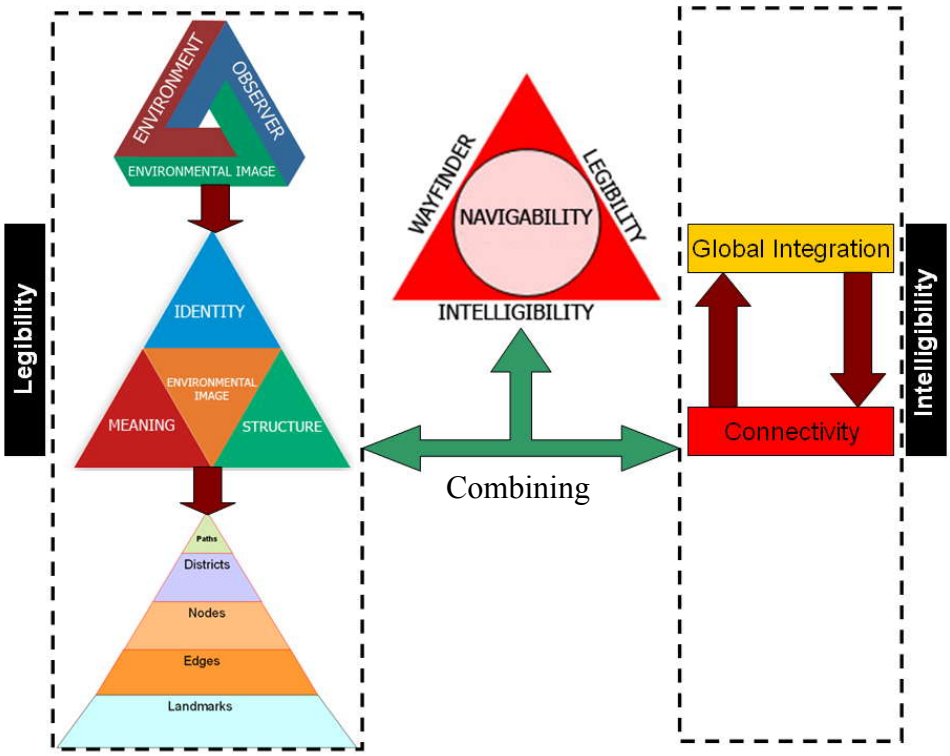

Figure6.5. Schematic figure for combining Legibility and Itelligibility.

- Depending on environmental information through urban navigation increases in unfamiliar environments, whereas frequent visit and strong familiarity make people depend on spatial structure more than visual clues, as wayfinders move from a point to another spontaneously.

- Sequence and hierarchy of spaces with a landmark in each space help to direct people through wayfinding process.

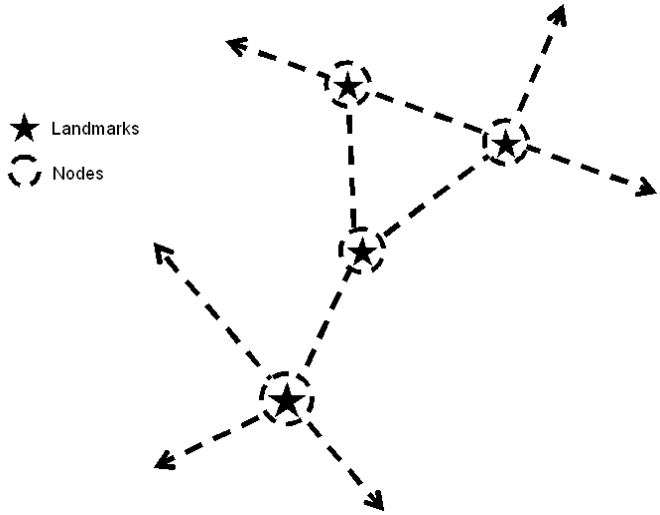

Figure6.6. Sequence of spaces: Locating landmarks at focal points increases legibility (Source: the researcher)

6.4. RECOMMENDATIONS

The results obtained suggest a series of recommendations for the further improvement of case studies:

6.4.1. Overall Recommendations

- Landmarks should be located at strategic points, points of pedestrian trip origins and destinations, and places where there is possible ambiguity for effective enhancing of the ability of spatial decision making. In other words, they should be done in very close proximity to the streets or at

nodes and streets corners. They should also not too many, as the huge number of landmarks can undermine their helpfulness.

- Cities should be legible visually and structurally. This confirms that spatial configuration and spatial cognition are closely related.
- There should be a balance between vehicular and pedestrian movement.
- Junctions should clearly indicate the next destination and support the ability of linking ones current position with all surrounding paths on the network.
- Street furniture should never be obscured, as it is a vibrant tool for using spaces effectively and provides a strong clue for orientation.
- Creation of points of high enclosure should only be allowed in areas where there are wide streets. In other words, the height of buildings should proportionally be related to the width of the spaces between them. Likewise, gaps in the lines of buildings should be avoided.
- There should be a clear distinction between public and private spaces.
- Nodes should be created as catalysts providing the unique character to regions and creating social interaction.
- Primary entrances should be distinct and strong in order to create a strong impression and facilitate orientation for first-time and frequent visitors.

6.4.2. Heliopolis

- Both Osman Ibn Affan and Harun Alrasheed paths require a critical improvement to increase permeability.

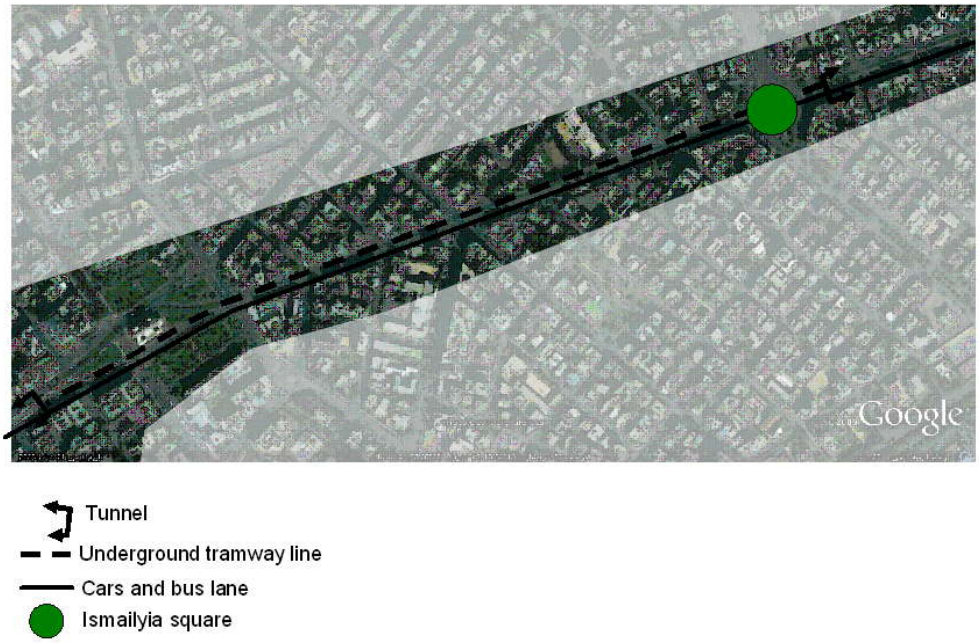

Figure6.7. Improvement of Osman Ibn Affan St. permeability.

- The northern part of the suburb should be upgraded in order to complete the character of the suburb and create integration between southern and northern parts. In other words, this area should be softened through increased plants and soft landscaping; and facades of ill-considered constructions should be beautified and redesigned giving them the common sense of old Heliopolis buildings. This will positively change the character of this part of the suburb and make the area more welcoming to the users.
- The interference between tramways and vehicular movement should be treated well especially at the nodal points.

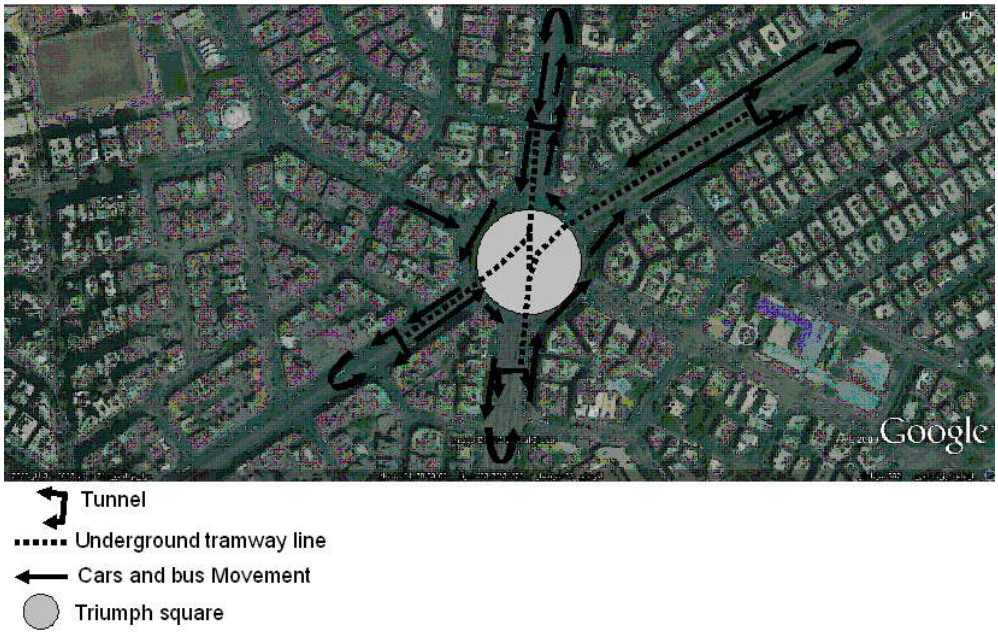

Figure6.8. Separating vehicular movement from tramway, Heliopolis.

- The old Heliopolis should be preserved from the encroachment of new construction.
- Streetscape should be protected from deterioration by citizens.

6.4.3. Maadi

- Vistas should end with objects like landmarks or signs in order to improve orientation. Furthermore, theses provided landmarks should be visually accessible for assisting users in establishing visual sequences for self-orientation.
- Squares should be decorated by landmarks to improve the ability to differentiate them from each others.

Figure6.9. Locating landmarks at Maadi focal points.

- The suburb should be covered by a well-planned system of signage, although signs are not substitute for good design.
- Streets' names system should be reconsidered, reinforced with signage, and tackled in a way congruent with the nature of society who live or visit the suburb. Likewise, applying several names to one street should be avoided.
- The area should be well-connected with the adjacent areas in order to increase its global integration and overcome isolation.
- The fantastic landscape and old buildings of the suburb should be preserved from deterioration and demolishment by owners.
- Points of weak connections should be eliminated through removal of obstacles barring streets from each others and more appropriate security options should be considered.

- The human ability to perceive this beautiful maze should be improved by educating users to order it, and learn more about it.

6.4.4. Cairo CBD

- The parts of the area should be well-connected with each others by not only the subway lines but also walkways. In other words, the path system should confirm the priority of pedestrian movement.
- The gathering points like Al-Tahrir square should be redesigned providing safety and beauty for visitors.
- Parking areas should be located in a well accessible lots to facilitate wayfinding and parking search. In fact, suitable strategy of movement should be adopted first.
- Skyline should be reconsidered under the umbrella of architectural preservation.
- Signs should be well designed and placed to prevent visual noisy and reduce chaotic environment of irrelevant information.

6.5. FUTURE RESEARCH

- Increasing the number of data collection sites may generate more accurate results.
- Using other techniques to measure degree of legibility / intelligibility may be effective.
- Although this thesis suggested a co-operation between Lynchian method and space syntax technique[5], it was mainly focused on understanding wayfinding process and how to enhance the ability of wayfinding

[5] The hints provided in findings of this thesis about combining the two methods are just suggestions, as the field of evaluating of these two great methodologies needs performing many tests and deep readings about them for accurate criticism which definitely not available on M.Sc. scale.

especially in case studies. This point of view can be changed into how to develop the methods themselves in another research. In other words, how to envisage a combined methodology that would acquire both approaches?. The notion can also be shifted to be more focused on the evaluation of the effectiveness and validity of the methods themselves and this definitely will be opposite to our thesis which mainly concerned with improving the navigation in case studies regardless of the methods evaluation.

6.6. CONCLUSION

This chapter tried to shed light on the correlation between legibility and intelligibility for better understanding of urban navigation. The correlation outlined according to the results obtained from both spatial configuration and sketch mapping analyses in a more realistic trail for linking the two methods. The chapter was divided into four points:

First, we tried to solve the conflict between results of legibility and intelligibility of the three case studies. The argument about representing road width in axial maps has been discussed and showed that road width is already taken into consideration in the construction of the axial map, and the axial map gives rise to both connectivity and integration values which form the intelligibility correlation. Road width is absolutely taken into account in intelligibility. So, the error in measuring Maadi intelligibility is abnormal and confined only to Maadi and the like.

Second, we outlined the main findings of our thesis. Third, we formulated general recommendations and gave recommendations for improving wayfinding process in three case studies. Eventually, we suggested ideas and hints for future research.

APPENDIX 1: Subjects Questionnaire

- Subjects were interviewed in their local work places, cafes, plazas, and in bus and tram stations in order to get the mental representations of their environment. They were told that this questionnaire is a part of a study that concerns with urban environment and that all the collected information will be confined to academic purposes. We paid their attention that we try to find out a way for better understanding of the environment and easy navigation. The questionnaire form was divided into two types:

1- PERSONAL INFORMATION

1.1) The sex of subject

A Male B Female

1.2.) How old are you?

1.3.) What suburb do you live in?

1.4) What is your highest level of your education?

1.5) Where is your work?

1.6) Are you local and know the area well or just a visitor?

2- THE IMAGE OF THE CITY

2.1.) What does the area mean for you?

2.2.) How did you get into here? Walk ( ) bus ( ) car ( )

2.3.) Why do you walk in this area? Health ( ) no parking available ( ) save money ( ) other ……...

2.4.) Do you enjoy walking in or to this area? Y ( ) N ( )

2.5.) What is the main reason of your visit to the area? Work ( ) Shopping ( ) Services ( ) other…….

2.6.) How often do you come into_____ ( ) days per week? [write in number]

2.7.) Do you find it easy to find your way in the area?

2.8.) What clues do you depend on to find your way?

2.9.) Please list ten elements of the area you think are most distinctive and explain why if possible?

1

Reason:

2

Reason:

3

Reason:

2.10.) Describe three of the elements listed in question 2.5.?

2.11.) Draw a quick sketch map of the area as if you describe it to a stranger?

2.12.) Describe your trip from your home to work, and describe events and the sequence of things you would see, hear, or smell?

2.13.) Do you have any particular emotional feelings about various parts of your trip?

2.14.) Can you locate the parts of the trip you feel confused and disoriented?

2.15.) Can you specify the direction of north on your map?

2.16.) Arrange the following areas according to their degree of legibility from the highest to the lowest

A Maadi B Heliopolis C Cairo CBD

- Subjects were asked indirect questions like:

1.) How do I get to _____?

2.) How will I recognize it when get there?

3.) How long will it take me to walk there?

Thank you for your assistance

All above questions measure the ability of respondents to understand their environment and give a generic prediction of their degree of familiarity with the area.

BIBLIOGRAPHY

-Appelyard, D., 1976, Planning a pluralist city: Conflicting Realities in Ciudad Guayana, Massachusetts, Cambridge University, MIT Press.

- Arthur, P.& Passini, R., 1992, Wayfinding: People, signs, and architecture, Michigan, McGraw-Hill Book Co, New York.

-Bafna, S., 2003, "Space Syntax: A Brief Introduction to Its Logic and Analytical Techniques," Environment and Behavior.

- Bailey, S. & Bilak, P. (Eds.), 2007, Dot Dot Dot 13, Princeton Architectural Press.

-Banerjee, T., & Southworth, M.(Eds.), 1990, City sense and city design: Writings and projects of Kevin Lynch. Cambridge MA: MIT Press.

- Batty, M.& Rana, S., 2002, Reformulating space syntax: The automatic definition and generation of axial lines and axial maps, Center for Advanced Spatial Analysis (CASA), University College London, London.

-Beardsley, M., 1975, Aesthetics from classical Greece to the present: a short history, University of Alabama Press.

- Beattie, A., 2005, Cairo: a cultural history, Citiscapes Series, Oxford University Press US.

- Bechtel, R., 1997, Environment & behavior: an introduction, SAGE.

- Bechtel, R., Churchman, A. and Ts'erts'man, A. (Eds.), 2002, Handbook of Environmental Psychology, John Wiley & Sons, New York.

- Bell, P., Greene, T., Fisher, J. and Baum, A., 2005, Environmental Psychology, Routledge, Fifth edition.

- Benedikt L., 1979, "To take hold of space: isovists and isovist fields", Environment and Planning B: Planning & Design.

-Bentley, I.(Ed.), McGlynn, S. and Smith, G., 1985, Responsive environments: a manual for designers, Architectural Press.

- Bilsen, A., eds., 2006, Urban transformations and sustainability: progress of research issues in urbanism 2005, IOS Press.

- *Bornstein, M. & Lamb, M., 1999, Developmental psychology: an advanced textbook, Lawrence Erlbaum Associates, 4th edition.*
- *Broadbent, G., 1990, Emerging Concepts in Urban Space and Design, Taylor & Francis Routledge.*
-*Broadbent, G., Bunt, R., and Liorens, T. (Eds.), 1980, Meaning and behaviour in the built environment, Michigan, J. Wiley & Sons. Ltd.*
- *Bruce, V., Green, P. and Georgeson, M. (Ed.), 2003, Visual perception: physiology, psychology, & ecology, Psychology Press.*
- *Carmona, M.(Ed.), 2003, Public places, urban spaces: the dimensions of urban design, Architectural Press.*
- *Carmona, M., Carmona, S. and Gallent, N., 2003, Delivering new homes: processes, planners and providers, Routledge.*
- *Carmona, M., & Tiesdell, S.(Eds.), 2007, Urban design reader, Architectural Press.*
- *Conroy Dalton, R.,2003, "The syntactical image of the city : A reciprocal definition of spatial elements and spatial syntaxes" ,Georgia institute of technology, USA.*
- *Conroy Dalton, R.,2002, Is spatial intelligibility critical to the design of large-scale virtual environments?, Georgia institute of technology, Colleges of Architecture and Computing, USA.*
- *Crane, D., 1961, Review of the image of the city, J. of Amer. Institute of Planners.*
- *Cullen, G., 1995, The concise townscape, Architectural Press.*
- *Dichter, E., 1961, The strategy of human desires, Chicago , American society of planning officials.*
- *Dobrowolska, A.*& *Dobrowolska*, J.,2006, *Heliopolis: rebirth of the City of the Sun, American University in Cairo Press.*
- *Downs, R., & Stea, D., 1973,. Image and Environment: Cognitive Maps and Spatial Behavior, Michigan Univ., Aldine Publishing Company.*

- *Downs, R. & Stea, D. (Eds.), 2005, Image & environment: cognitive mapping and spatial behavior, Aldine Transaction.*
- *Elshahed, M., 2007, Facades of modernity: Image, Performance, and Transformation in the Egyptian Metropolis, unpublished Msc. Thesis, Massachusetts Institute of Technology.*
- *Elsheshtawy, Y.(Ed.), 2004, Planning Middle Eastern cities: an urban kaleidoscope in a globalizing world Planning, history, and the environment series, Routledge.*
- *Eysenck, M., & Keane, M., 2000, Cognitive psychology: a student's handbook, Taylor & Francis, 4th edition.*
- *Fan, T., 2002, The Urban Structure of Harbin, China :An urban design approach, master thesis, The University of Calgary, Faculty of Environmental Design.*
- *Fancher, R., 2008, Pioneers of Psychology. Paw Prints.*
- *Fanek, M., 1997, The use of space syntax methodology in predicting the distribution of crime in urban environments, Ph.D. Thesis, Texas Tech University.*
-*Foster, N., 1997, "Cities and urban life: London and elsewhere," Structural Engineer.*
- *Fyfe, N.(Ed.), 1998, Images of the street: planning, identity, and control in public space, Routledge.*
-*Gabr, A., The Immobilia Building: A 1997 Rediscovery, In Medina Premier Issue: Architecture, Interiors & Fine Arts. British Virgin Islands: Medina Magazine, (January 1998): 76 - 79.*
- *Gärling, T. & Evans, G. (Eds.), 1991, Environment, cognition, and action: an integrated approach, Oxford University Press US.*
- *Gibson, J., 1986, The ecological approach to visual perception, Lawrence Erlbaum Associates.*

- *Gibson, D., 2009, The Wayfinding Handbook: Information Design for Public Places, Princeton Architectural Press.*
- *Golia, M., 2004, Cairo: city of sand, Reaktion Books.*
- *Golledge, R., 1992, Place Recognition and Wayfinding: Making sense of space, Geoforum 23 (2): 199-214.*
- *Golledge, R., 1999, Wayfinding behavior: cognitive mapping and other spatial processes, JHU Press.*
- *Gordon, I., 2004, Theories of visual perception, Psychology Press, 3rd edition.*
- *Grant, J., & Herbes, B., 2007, Ballarat Transit City Development: Pedestrian and Wayfinding Strategy.*
- *Great Britain. Dept. of the Environment, Transport and the Regions, 2000, By design: urban design in the planning system : towards better practice, Thomas Telford.*
- *Hayes, N., 2000, Foundations of psychology, Cengage Learning EMEA, 3rd edition.*
- *Hergenhahn, B., 2009, An Introduction to the History of Psychology, Cengage Learning, 6th edition.*
- *Hillier, B., Hanson, J., Peponis, J., Hudson, J., & Burdett, R., 1983, Space Syntax: a different urban perspective, The Architects Journal, 30 November, 1983, London.*
- *Hillier, B., & Hanson, J., 1984, The Social Logic Of Space, Cambridge: CUP.*
- *Hillier, B., 1996, Space is the Machine: a configurational theory of architecture, Cambridge University Press, Cambridge.*
-*Hillier, B., & Penn, A., 2004, Rejoinder to Carlo Ratti, Environment and Planning B: Planning & Design.*

- Hillier, B., & Iida, S., 2005, Network and psychological effects in urban movement, Proceedings of Spatial Information Theory: International, New York: Springer.

- Howard, R., 1995, Learning and memory: major ideas, principles, issues and applications, Greenwood Publishing Group.

- Ilbert, R., 1985, Heliopolis: Colonial Enterprise and Town Planning Success, In The Expanding Metropolis: Coping with the Urban Growth of Cairo. Ahmet Evin, ed. Singapore: Concept Media/The Aga Khan Award for Architecture.

- Imanishi, Emi, 2004, Evaluating Legibility of Montreal's Underground City and Toronto's Underground City, unpublished research, School of Urban and Regional Planning, Queen's University, Canada.

- Jacobson, R., 1999, Information Design, Cambridge, MIT press.

-Kaplan, R., Kaplan, S. and Ryan, R., 1998, With People in Mind: Design and Management of Everyday Nature, Washington D.C., Island Press.

- Kelly, A., 2001, Building legible cities, Bristol Cultural Development Partnership.

- Kelly, A., Kelly, M., Bristol Cultural Development Partnership, 2003, Building legible cities 2: making the case, Bristol Cultural Development Partnership.

- Kim Y O, 1999, Spatial configuration, Spatial cognition and spatial behavior: The role of architectural intelligibility in shaping spatial experience, Ph.D. thesis, University of London, London.

- Kim, Y O., and Penn, A., 2004, Linking the spatial syntax of cognitive maps to the spatial syntax of the environment. Environment and Behavior.

- Kitchin, R., & Freundschuh, S. (Eds.), 2000, Cognitive mapping: past, present, and future, Routledge.

- Klippel, A., 2003, Wayfinding Choremes: conceptualization Wayfinding and route direction elements, University of Bremen, Germany.

-Kosslyn, S., 1975, Information representation in visual images. Cognitive psychology.

- Kruijff,E.,2000,Wayfinding, unpublished research, Bauhaus-Universitaet Weimar, Germany.

- Kumar, P., 2007, The value of design: A study of pedestrian perception in New Delhi, India, master thesis, Queen's University, Kingston, Ontario, Canada.

- Lang, J., 1994, Urban Design: The American Experience, John Wiley and Sons.

- Lawson, B., 2001, The language of space, Architectural Press.

- Lawton, C., 2001, "Gender and Regional Differences in Spatial Referents Used in Direction Giving,". Sex Roles.

-Lawton, C. & Kallai, J., 2002, "Gender Differences in Wayfinding Strategies and Anxiety About Wayfinding: A Cross-Cultural Comparison," Sex Roles.

-Lay, M., Reis, A., Dreux, V. and Becker, D., 2007,Urban Security and Spatial Behavior: syntactic and perceptual analysis of the central area of Porto Alegre, Proceedings, 6th International Space Syntax Symposium, Istanbul.

- Leach, E., 1978, Does Space Syntax Really "Constitute the Social"? Social Organization and settlement: Contribution from Anthropology, Archaeology, and Geography (Green, D., Haselgrove, C., & Spriggs, M., Eds.) British Archaeological Reports, International Series, 47, 1978, 385-401.

- LeGates, R., & Stout, F.(Eds.), 2003, The city reader, Routledge.

- Lindsey, U., 2005, Heliopolis looks back on its first hundred years, Cairo Magazine (12-18 May 2005): 14-19.

- Ljubljana, Solvenia, 2006, "physical aspects of design and regeneration: what makes my square? ", paper presented at the ENHR conference.

- Long, Y., 2007, The relationships between objective and subjective evaluations of the urban environment: space syntax, cognitive maps, and urban legibility, Ph.D. thesis, the Graduate Faculty of North Carolina State University, Raleigh, North Carolina.

- Long, Y., Baran, P., Moore, R., 2007, The Role of Space Syntax in Spatial Cognition: evidence from urban China, Proceedings, 6th International Space Syntax Symposium, Istanbul.

- Lynch, K., 1960, The image of the city, Cambridge, MIT Press.

-Lynch, K., 1972, What time is this place?, Cambridge, MIT Press.

-Lynch, K., 1981, Good city form, Cambridge, MIT Press.

-MacCall, R., O'Neill, S., Caroll, F., Benyon, D., & Smyth, M., 2005, Responsive Environments, Place and Presence, Napier University, Edinburgh, UK., PsychNology Journal, Volume 2, Number 1, 35-73.

- Malnar, J. & Vodvarka, F., 2004, Sensory design, U of Minnesota Press.

- Martin, M., 2003, The street image: An urban analysis of Nkrumah road, Mombasa, BA research paper, University of Nairobi, Kenya.

- Mather, G., 2006, Foundations of perception, Psychology Press.

- Maxwell, V., Fitzpatrick, M. and Jenkins, S., 2006, Egypt, Lonely planet.

- Ministry for the Environment, 2006, Urban Design Toolkit, Wellington, New Zealand.

- Moughtin, C., 2003, Urban design: Street and square, Architectural Press, 3rd edition.

- Myntti, C., 1999, Paris Along the Nile: Architecture in Cairo from the Belle Epoque, American University in Cairo Press.

- NHS Estates, 2005, Wayfinding: effective wayfinding and signing systems: guidance for healthcare facilities, The Stationary Office.

- Norman, D., 1988, The design of everyday things, Doubleday, New York.

- Passini, R., 1992, Wayfinding in architecture, Van Nostrand Reinhold, University of Michigan.

- *Omer, I., & Jiang, B., 2008,Topological qualities of urban streets and the image the city: A multi-perspective approach, 11th AGILE International Conference on Geographic Information Science, University of Girona, Spain.*

- *Penn, A., Hillier, B., Banister, D., and Xu, J., 1998, Configurational modeling of urban movement networks, Environment and Planning B, Planning and design, volume 25, p59-84.*

- *Penn, A., 2001, "Space syntax and spatial cognition or, why the axial line?", Peponise, J., Wineman, S., Bafna, (Eds.), proceedings, 3rd International space syntax symposium, Atlanta.*

- *Peponis, J., Zimring, C., Choi Y K, 1990, Finding the building in wayfinding: Environment and Behavior.*

- *Perdikogianni, I., 2007, From Space to "Place": The Role of Space and Experience in the Construction of "Place", Proceedings, 6th International Space Syntax Symposium, Istanbul.*

- *Portugali, J., 1996, The construction of cognitive maps, Springer.*

-*Raafat, S., 1994, Maadi 1904-1962: society and history in a Cairo suburb, Palm Press.*

-*Raban, J., 1975, Soft city, Fontana, Virginia.*

-*Raban, J., 1998, Soft city, Harvill Press, London.*

- *Ratti, C., 2004, Space Syntax: some inconsistencies, Environment and Planning B: Planning & Design.*

- *Raubal, M.,1997,* Structuring Wayfinding Tasks with Image Schemata*, Master Thesis, University of Maine, U.S.A., Orono, ME.*

- *Raubal, M., 2001,* Agent-based Simulation of Human Wayfinding: A Perceptual Model for Unfamiliar Buildings*. Ph.D. Thesis, Vienna University of Technology, Vienna.*

- *Raubal, M., & Winter, S.,2002, "Enriching Wayfinding Instructions with Local Landmarks", unpublished paper, University of Munster, Germany.*

- *Raubal, M., & Egenhofer, M., 1998, Comparing the complexity of wayfinding tasks in built environments, Environment & Planning B, 25 (6): 895- 913.*

- *Raymond, A., 2007, Cairo: City of History, American Univ. in Cairo Press.*

- *Reisman, J., 1991, A history of clinical psychology, Series in clinical and community psychology, Taylor & Francis, 2nd edition.*

-*Rossi, A., Ghirardo, D.(Ed.) and Eisenman, P., 1984, The architecture of the city, Cambridge, MIT Press.*

- *Russell, J., & Roberts, C., 2002, Angles on environmental psychology, Nelson Thornes.*

- *Sakr, T., 1993, Early twentieth-century Islamic architecture in Cairo, The American University in Cairo Press.*

- *Salheen, M., 2001, A comprehensive analysis of pedestrian environment: The case study of Cairo city center, Ph.D. thesis , Heriot-Watt University, Edinburgh College of Art, Faculty of Environmental Studies, School of Architecture.*

- *Salheen, M., 2003, An application of universal distance using space syntax analysis, Proceedings, 4th International Space Syntax Symposium, London.*

-*Salmi, P., Ginthner, D. & Guerin, D., 2002, An exploration of critical factors for accessibility and wayfinding for adults with mental retardation, unpublished master's thesis, Minnesota University.*

- *Schwartz, R . (Ed.), 2004, Perception, Wiley-Blackwell.*

- *Shokouhi, M., 2000, Legible cities: the role of visual clues and pathway configuration in legibility of cities, unpublished Ph.D. thesis, University of Sheffield, U.K.*

- *Singerman, D.& Amar, P.(Eds.), 2006, Cairo cosmopolitan: politics, culture, and urban space in the globalized Middle East, American Univ in Cairo Press.*

-Southworth, M., 1969, The sonic environment of cities: Environment and behavior, Michigan, Sage Publications.

-Steinitz, C., 1968, Meaning and the congruence of urban form and activity, J. of Amer. Institute of Planners.

- Sternberg, R., 2008, Cognitive Psychology, Wadsworth.

- Szalapaj, P., 2001, CAD principles for architectural design: analytical approaches to computational representation of architectural form, Architectural Press.

- Tatarka, A., Larsen, D., Olson, T., and Kress, N., 2006, Wayfinding in the library: usability testing of physical spaces, ARL Library Assessment Conference, University of Chicago.

- Thorndike, E. L, 1911, Animal intelligence: Experimental studies. New York : Macmillan.

- Tichener, E.B.,1901, Experimental psychology: A manual of laboratory practice, New York: Macmillan.

- Tokarczyk, P., 2008, Automatization of data acquisition and processing for pedestrian navigation system purposes, M.Sc. thesis, institute for Geoinformation and Cartography, Geoinformation Research Group, Technical University of Vienna.

- Transport for London, 2007, Legible London: Yellow book : a prototype wayfinding system for London, Transport for London.

- Tuncer, E., 2007, "Perception and intelligibility in the context of spatial syntax and spatial cognition: Reading an unfamiliar place out of cognitive maps". Proceedings, 6th International Space Syntax Symposium, Istanbul, 127.01-127.07.

- Tzinis, A., 2005, The Egocentric City, M.Sc. thesis, Bartlett School of Graduate Studies, University College London.

- Vaughan, L., 2007, The spatial syntax of urban segregation, published research paper, Bartlett School of Graduate Studies, UCL, London.

-Weisman, J., 1981, Evaluating architectural legibility: Wayfinding in the built environment. Environment and behaviour.
-Wohlwill, J.F., 1966, The physical environment: a problem of a psychology of stimulation, J. of Social Issues.
- Yahia, O.,2004, The Emotional impact of architecture: A proposed model for investigation life and complexity in building, master thesis, Faculty of Engineering, Cairo University, Giza, Egypt.

– المقرن ,عبد العزيز,٢٠٠٢,تصميم المستشفيات العامة :تقويم الحركة الرئيسية ونظـــام معرفـــة الطريق من وجهة نظر المرضى والزوار :حالة دراسية لمستشفى الملك خالد الجامعي بالرياض , مجلة الإمارات للبحوث الهندسية ,مجلد 7 , العدد ١, ص ١ – ١٢.

– ثابت، أيمن، ٢٠٠٣ ، العثور على الطريق كمدخل تصميمي تطبيقا على المستشفيات ، رســـالة دكتوراة ، كلية الهندسة ، جامعة القاهرة ، الجيزة ، مصر.

– سليمان، مروة، ٢٠٠٧، عناصر التصميم العمراني المؤثرة على الإدراك البصـــري لمـــداخل المدن، رسالة ماجستير، كلية الهندسة، جامعة القاهرة، الجيزة، مصر.

– معزوز ، سعيد ، ٢٠٠٧ ، دراسة تطبيقية لنظرية " صيغة التركيب الفراغـــي " فـــي رصـــد العلاقة بين التغيرات العمرانية والسلوكيات الاجتماعية بأحيـــاء الســـكنية ، نـــدوة الإســـكان ٣ ، الرياض ، المملكة العربية السعودية.