

THE PHYSICAL SETTINGS AND
INFORMAL INTERACTION IN
WORKPLACES

THE ROLE OF SPATIAL STRUCTURE IN
SUPPORTING INFORMAL COMMUNICATION IN
ORGANISATIONS

ADEL M. BEN-YASEEN

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MANAGEMENT, DEPARTMENT OF ARCHITECTURE AND
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Dedicated to
my parents, sisters, and brother

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ABSTRACT

The broad aim of this study is to explore the human interfaces in organisations in order to support productivity. Informal interaction has been accepted by many organisations as a means to improve performance and effectiveness. However, the level of interaction among staff is mainly determined by the nature of organisation structure. Many studies have established a connection between organisation structure and the physical properties of the workplace¹. The role of the physical environment in influencing the social patterns in organisations is a rich area in the literature. The premise is that the spatial structure of layouts can be used as a tool to manage human relations. This research hypothesised that there would be a relationship between the nature of spatial structure of office layouts and the level of informal interaction. The hypothesis was tested on three levels. These were individual, small group, and large group. Through the concept of space syntax theory, the spatial structure of layouts was analysed in terms of the notion of depth (i.e. *integration*) and the notion of control (i.e. *connectivity*). The need for such research is prompted by the limited work in the literature that associates empirically spatial structure with social structure. The two measures of spatial intelligibility revealed different impacts on interaction on the three tested levels. However, the impact was stronger on the group than on the individual level.

The second aim of this thesis was to develop an integrated model of interaction describing the significant predictors of spatial, physical, and organisational variables that influence the level of interaction in organisations. The framework of the research was based on current and future office trends. There are three criteria that describe office trends world-wide. These are the increased use of information technology, increasing mobility, and the "churn" (i.e. changes). This research established a connection between these three criteria and social organisation.

¹Duffy, F., 1974b, Office Design and Organisations: 2-The testing of hypothetical model, *Environment and Planning B*, 1974, vol.1, pp.217-235.

See Sundstrom, E., 1986, *Workplaces: The psychology of the physical environment in offices and factories*. Cambridge University Press.

See also Farbstein J., D., 1975, *Organisation, Activity and Space: The relationship of task and status to the allocation and use of space in certain organisations.*, Ph.D. thesis, University of London.

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LIST OF ABBREVIATIONS

Interaction variables:

<i>sev/dy</i>	Interaction level on several times a day.
<i>a few/dy</i>	Interaction level on a few times a day.
<i>daily</i>	Interaction level on once a day.
<i>weekly</i>	Interaction level on once a week.
<i>rarely</i>	Interaction level on rarely basis.
<i>mn-int</i>	Mean interaction for all the previous interaction levels.

Spatial environment variables:

RRA	The global measure of <i>integration</i> .
CV	The local measure of <i>connectivity</i> .
<i>sm-rt</i>	An index to measure the same route opportunity.

Physical environment variables:

<i>vis-acc</i>	Visual accessibility.
<i>prox</i>	Proximity.
<i>enclos</i>	Enclosure.
<i>sm-rm</i>	An index to measure percentage of workspaces under the same room.

Organisational variables:

<i>task-ch</i>	Task characteristics.
<i>seat</i>	Percentage of time spent seated.
<i>stand</i>	Percentage of time spent standing.
<i>walk</i>	Percentage of time spent walking.
<i>leave</i>	Frequency of leaving the workspace.
<i>sm-dp</i>	An index to measure percentage of staff under the same organisational division (i.e. departments).

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CHAPTER : 1

INTRODUCTION

This study is concerned with the impact of the physical properties of the workplace on the level of human interaction. This area was the concern of previous research because of the belief that interaction promotes effective and fast communication, which is what all work-related activity is about ¹. In addressing the research problem and context, the researcher has summarised the scope of the research in the following way:

1.1. Type of adopted organisations in the study

The need for interaction in organisations was highlighted by different organisation theories. Both the humanistic and systems theories have emphasised interpersonal relations among members of organisations ². It is both management's and staff's decision to adopt the level of interaction that corresponds to organisational strategic objectives. Determining a certain level of interaction to be maintained among organisation members is probably not a difficult problem. What seems to be more difficult is the measures taken to achieve the desirable level of interaction. The need and pattern of interaction varies according to the nature of industry. In factories, where the production is in standard units, industrial organisations regulate the flow of production. Therefore, industrial relations is a significant factor determining how members of staff are in contact with each other ³. In offices, administrative organisations are not dealing with standard units; instead they are dealing with a diversity of business issues that are changing constantly. This necessitates the need for constant consultation, negotiation, and discussion among various members of the organisation. However, this study is conducted in the context of administrative and commercial organisations where staff are accommodated in an office environment that is believed to meet their expectations and the type of office work they pursue.

The research has selected six case studies in Saudi Arabia. These are Saudi Telecom Makkah branch office, Saudi Telecom headquarters office , Samarec

headquarters office, Samarec corporate engineering office, Dallah headquarters office, and Jaffali headquarters office. All offices are located in Jeddah except the first office, which is located in Makkah. The first two organisations pursue their business in the telecommunication industry. The third and fourth organisations are constantly developing organisations, which seek their business in marketing petrochemicals and oil production. The fifth organisation deals with finance and banking. The sixth organisation pursues its business in information technology products and car sales.

The bureaucratic dimension in these organisations is demonstrated in the ability of higher status staff to influence the decision-making processes, though some participation from the lower status groups exists⁴. On the other hand, the interactive dimension is demonstrated in the need for staff to share opinions, ideas and discussion. The first published report on Saudi governmental organisations strongly recommended the need for decentralisation and an improved chain of communication among staff⁵. The six organisations perceive the need for informal interaction as an important process in organisations that enhances work performance and increases productivity. These organisations were selected as they are thought to meet the expectations of other Saudi organisations.

1.2. Interaction and organisation effectiveness

The apparent trend in successful workplaces is to make use of their social aspect to the advantage of the individual, groups, and the organisation⁶. In today's offices, and with the introduction of information technology, some organisations have become resistant to the need for interaction. But others have realised that interaction fosters much more than transferring discrete information through telematics. In today's offices, some approaches demonstrate how the workplace should be designed and managed to encourage informal exchange among members of organisations in a way that contributes

to the ease of communication, creativity, innovation, social satisfaction, and productivity⁷.

Today's organisations have become aware of the significance of informal interaction and look at it as a significant channel that contributes to individual satisfaction and organisational effectiveness⁸. Informal communication was found to be related to work performance⁹. Interaction and ease of communication were found to make a key contribution to productivity¹⁰. Most employees spend their time talking¹¹. The importance of interaction is extended to the degree that it affects organisational processes such as decision-making, control, motivation, leadership and co-ordination¹².

1.3.Describing interaction

Interaction is a complex and interrelated process in organisations. Its complexity extends to various dimensions, such as a) interaction is a mixed blessing i.e. interaction is a process that could contribute to job satisfaction and productivity, whereas interaction, in some cases, could be a distracting and disturbing feature in the workplace and necessitate a sort of control. b) interaction is a process that researchers use as a tool to understand organisational structure, climate, and the physical features of the workplace. c) the need for interaction might change as organisations experience changes in their dynamic objectives. d) interaction is a process that takes different forms on different levels of analysis i.e. individual, small group, and large group¹³; the physical environment with its diversity and complexity has a great potential to shape the pattern of informal interaction.

However, interaction and the need for the ease of communication was a determining feature throughout the history of offices and the early release of the open plan office. It is always perceived as an effective means of communication¹⁴. Work-

related activities can be regarded in four ways: the activity itself (e.g. communication); the way in which work is done (writing, telephone, face-to-face); associated activities (e.g. listening to music, or eating); and the symbolic meaning of the activity (e.g., its overall implications) ¹⁵. This will substantiate the significance of interaction, since in some organisations it is a reliable and common channel for communication. In the meantime, its implications affect members of staff through developing similar images and event interpretations (i.e. organisational climate) ¹⁶.

1.4. Factors that determine levels of interaction

The level of interaction in any organisation is a series of decisions taken by staff, management and designers. Dimensions of organisation structure will dictate the appropriate level of interpersonal relations among staff. In bureaucratic organisations formal communication channels are likely to be dominant. On the other hand, in interactive organisations the emphasis is more on informal communication channels. Interaction is always affected by the level of participation in decision making, differentiation in hierarchical status and authority, the work-style, and the nature of tasks performed ¹⁷. Organisations that are characterised by the need for creativity and innovations will look at interaction as a key process¹⁸. The literature has provided evidence that designers, managers, and staff have used physical features in the physical environment to influence the level of interaction.

1.5. Interaction and the physical environment

As informal interaction is the focus of this study, previous research has established growing evidence of the role of the physical environment in supporting informal interaction among members of organisations. In fact, throughout the literature the physical environment is the strongest and richest subject with regard to informal interaction. The researcher has reviewed some models that describe the effect of the

physical environment on interaction activities within organisations. Becker (1981) has described the physical environment as having a second order effect (i.e. catalyst) on communication and interaction¹⁹. This occurs when the physical features of the environment regulate and control the pattern of informal behaviour. Markus et al (1972), in their approach to design for people, have incorporated five systems including activities systems (i.e. interaction) that work together simultaneously to provide environmental well-being ²⁰. Sims (1978) has described six dimensions for user-oriented design. These include social functions and behavioural circuit ²¹. Becker (1981) has also developed a model which describes the role of physical settings in shaping the social processes within organisations ²². Trickett has developed a model which describes the measures of differentiation in physical settings among organisations ²³. Other researchers such as Duffy (1974b) have established a connection between organisational structure (including interaction) and the physical properties of the workplace ²⁴. Farbstein (1975) established a link between types of organisations and their use of space ²⁵. All the previous studies have established growing evidence of the connection between the physical environment and organisational activities (i.e. interaction).

1.6. Office trends world-wide

There are three main criteria that characterise today's offices. These are: a) mobility ²⁶; the new approaches of successful workplaces abandon the idea of "fixed" position and encourage the design of multiple "activity settings" where staff will move around and share work-stations and facilities as to use the organisation's assets efficiently and create more opportunity for face-to-face contact ²⁷. This will keep staff in motion. b) information technology; the increased use of information technology and computers and the need for staff to have a regular break after working on VDUs (abiding by health regulations), in addition to the invention of compact light computers, will encourage staff to perform work from anywhere inside the office building. This will give staff the

opportunity to be more mobile in the office building. This in turn will increase the fit between technology and the social aspect of organisation, an approach which is supported by the sociotechnical issues of systems theory. This study argues that the increased use of information technology will in fact encourage rather than discourage informal interaction among staff. This is based on the assumption that the use of VDUs will entail staff having regular breaks, so the notion of mobility (i.e. movement) is introduced in a way that it is expected to affect the level of informal interaction. c) churn or changes-several changes could occur in organisations that inevitably necessitate an understanding of the way organisational components operate. Changes in business and economic circumstances, organisational structure including work style, culture, climate, and so on, will make the problem of understanding organisations a complicated issue. However, these changes, will dictate changes in the way facilities are managed so that the physical settings will become part of the changeable cycle of organisations.

1.7. Office trends in Saudia Arabia

The majority of governmental offices in Saudi Arabia are conventional offices²⁸. This kind of layout was adopted for two main reasons: a) the belief that the conventional plan would provide organisations with the opportunity to express the hierarchical structure of both status and rank among staff; b) the belief that the high level of physical enclosure in the conventional plan would respond to the need for privacy. As a consequence, the participative dimension in organisations was badly hampered and staff started to express their dissatisfaction with the level of informal interaction opportunity they possessed in their workplaces.

1.8. Existing research

The existing research that studies the connection between the physical environment and interaction is characterised by two main shortcomings. These are : a)

lack of an integrated model. Throughout the literature review, as far as could be determined with available information, there was no integrated model of physical, spatial, and organisational elements that would explain simultaneously and empirically the effect of various aspects of the physical environment on informal interaction within organisations. b) secondly, theories which associate spatial patterns with social patterns have acquired limited application. The spatial structure in this study refers to the morphology of the pattern of space²⁹. The space syntax theory developed by Hillier & Hanson (1984) has revealed some potential in its credibility in describing the structure pattern of space in a more consistent and quantifiable manner³⁰. The work by Peponis (1983) in factories³¹ and by Hillier & Hanson in elementary buildings³² has revealed some evidence of the effect of space morphology on informal interaction, though the conclusions have limited application in offices. Therefore, in this study it is hypothesised that the pattern of spatial morphology is associated with the frequency of informal interaction in offices (the main research hypothesis).

1.9. Research contribution

One aim of this study is to contribute to the understanding of how design can influence levels of interaction through space planning and management. This research claims that the level of physical enclosure in offices which gives the option of conventional vs. open plan choices, is not the only way to control interaction. Instead, offices could use the potential of spatial structure to control and manage the level of informal interaction among staff. The significance of this work lies in the lack of the previous work that associates empirically spatial patterns with social patterns in office environments. The study will increase organisations' awareness to the role of space management and planning in supporting organisational communication and therefore organisational effectiveness. So Saudi organisations will have another scope of design solution (i.e. spatial structure) different from the current approach (i.e. physical

enclosure) that could respond to the participative dimension of the organisations. Another significant contribution of this work is that Saudi organisations have not been studied in terms of their spatial quality.

The other aspect of the contribution is the need to develop an integrated model that describes the significant physical, spatial, and organisational predictors of interaction. Investigating the effect of the environmental and organisational variables on interaction will help to develop design guidelines that assist the design team to establish better knowledge of the implications that different environmental variables have for the problem of interaction in the workplace. These guidelines thereafter will be of great help in managing interaction throughout the life cycle of organisations which might be exposed to changes in interaction strategies.

1.10. Other shortcomings in the previous research

These are summarised in the following two points: a) most of the studies have not differentiated between physical enclosure and visual accessibility. Some have also confused visibility with distance ³³. In today's organisations, and with the need for different levels of control through visibility, and different level of privacy through enclosure, solid and glass walls are different in their visual enclosure property. This will make, in some cases, enclosure, visibility, and distance three different criteria describing the physical accessibility of the workspace. Examining the uncertainty of the connection between the open office and ease of communication ³⁴, this study investigates the impact of these three measures of physical accessibility (visibility, enclosure, and distance) on the frequency of informal contact . b) organisations experience churn (i.e. changes) in the way they operate. One aspect of task characteristics, managerial vs. clerical, is regarded as a critical dimension ³⁵. This also describes how much an organisation needs a

managerial vs. clerical work, in the sense that it reflects the status of hierarchy among staff.

However, throughout the literature review, studies which investigated the impact of task characteristics on informal interaction are somehow limited. Thompson (1967) and Kiggundu (1981) suggested that task interdependence is likely to increase the amount of contact required among staff³⁶. Hatch (1987) found that task interdependence is moderately associated with one or more aspects of interaction activities³⁷. Although Duffy has studied two types of organisations (bureaucratic vs. interactive) against two physical measures (differentiation vs. subdivision), he did not investigate the impact of task characteristics on interaction³⁸. The importance of this argument is extended from Sundstrom findings which suggested that workers with different task characteristics would perceive privacy differently. Since privacy and interaction are two significant criteria in workplace design. It is argued that task characteristics will be related to the level of informal interaction.

1.11. Implications

The research examines the impact of spatial, physical, and organisation variables on the pattern of interaction. This will enable the identification of the key characteristics of the workplace that influence interaction. Consequently, it will lead to better guidance for the design team. The researcher's task is to develop the set of variables that are hypothesised to affect informal interaction. Three groups of variables were developed. Two groups are related to the physical environment and the third group is related to organisation. The environmental systems in Markus's model (1972) consists of the spatial environment and the physical environment³⁹. Based on this model, the first group of variables is the spatial variables. This is related to the structure of the spatial morphology. Space syntax theory will be adopted as a descriptive tool to analyse the typology of

spatial structure. The second group of variables is the physical environment variables. These include visual accessibility, physical enclosure, and proximity. The third group of variables is the organisational variables. This is related to task characteristics in terms of managerial, administrative, or clerical work. Another organisational variable is the degree of mobility of staff within the office building. These variables are expected to influence the level of informal interaction in offices.

Testing the impact of spatial, physical and organisational variables on interaction will enable us to develop an overall model describing the significant predictors of interaction. The research has incorporated enclosure, visual accessibility, and distance as physical variables in conjunction with measures of spatial morphology, in order to test the ability of space morphology to add to the opportunity of informal contact compared to the other measures i.e. enclosure, visibility, and distance.

1.12. The research structure

The research was structured in ten chapters, the introduction and another nine chapters. The first four chapters are a literature review of the problem. The sixth chapter describes research design and methodology. The seventh, eighth, and ninth chapters examine the research hypothesis and interaction models. The last chapter is the conclusion. There follows a brief description of each chapter:

Chapter 2 gives a review of organisation theories and the need for interaction in each theory. The chapter also explores the nature of organisations as being more dynamic and changeable. Dimensions of organisation structure were identified as these dimensions vary among different organisations. The concepts of organisational climate and culture were introduced to develop the idea of how staff experience their physical settings within the organisational context. The chapter also focussed on both formal and informal

processes in organisations, as the formal processes could mirror the structural dimensions of organisation, and the informal processes could echo some aspects of the physical environment. Both formal and informal processes could be used as a tool to understand the way in which organisations operate. Moreover, the importance of interaction in organisation effectiveness, its aspects and characteristics and factors determining the level of interaction, are also discussed. The chapter then discusses the need for interaction with regard to the increasing use of information technology. Finally, the focus was on the context of the research, which was carried out in Saudi organisations.

Chapter 3 describes the connection between the physical features of the workplace and interaction. It starts by reviewing the history of office layouts and how the need for interaction has developed different office layouts. The chapter then concluded with some of the design features that are important to interaction. Furthermore, the focus was on investigating the congruence between some organisation structural dimensions and the physical environment. Finally the-state-of-the-art in Saudi workplaces was discussed in order to identify the current approach in controlling and managing interaction in offices.

Chapter 4 focusses on the spatial aspect of the problem. The chapter starts by investigating the relationships between spatial patterns and social patterns. This was conducted in the light of different theories. Then, the issue of the spatial dimension of organisations was investigated. Later, space syntax theory is adopted as a basis for analysing spatial structure. Finally, the technique of space syntax is described.

Chapter 5 brings the interaction problem within the scope of facilities management. It begins by identifying the process of selecting the physical settings. Later it focusses on the social processes in organisation, in order to highlight areas where

facility managers could intervene to manage interaction. Models in facilities management with respect to managing the physical settings and interaction are also discussed. Finally, the study reviews some examples of managing interaction in workplaces.

Having reviewed the problem in the literature, the study sums up the research problem and states the research hypothesis.

Chapter 6 describes the research design, and methodology. This includes describing the framework of the research design and the working hypothesis, the case studies, and methods of collecting data. Finally, the chapter presents the collected data.

Chapter 7 tests the main research hypothesis which associates the spatial quality of the workplace with the level of informal interaction on an individual level (level 1). The chapter also investigates the impact of visual accessibility, enclosure, distance, mobility, and task characteristics on informal interaction. Finally, the chapter concludes by developing a model describing the significant predictors of interaction.

Chapter 8 aims to test the spatial hypothesis of interaction on small groups and large groups. Two kinds of small groups were developed: the spatial group which shares the same physical enclosure (i.e. room), and the organisational group which shares the same organisational division (i.e. department). The spatial hypothesis of interaction on both types of small groups is tested (level 2). Finally, the spatial hypothesis of interaction is tested on large groups (level 3).

Chapter 9 is concerned with testing the variation between the three groups of staff (managers, administrators, and clerical) in their spatial, physical, mobility, and social patterns.

Chapter 10 features the conclusion, interpretation and discussion of the research findings. The chapter concludes with the implications of the research findings for researchers, managers, and designers.

Notes and References

¹ Becker, F., 1990: *The Total Workplace*, Van Nostrand Reinhold, New York, p.155.

² Sundstrom, E., 1986: *Workplaces: The psychology of the physical environment in offices and factories*. Cambridge University Press, p.335.

³ Ibid. p.262.

⁴Bureaucracy in Saudi's organisations is defined in terms of centralisation in decision-making, formalisation, and complexity of work. Staff are structured in a hierarchical pattern with the ability of high status staff to highly influence the decision-making process. Staff in higher positions have more complex work than staff in lower positions. The nature of work in Saudi organisations is characterised by being very complicated with a high level of routine. Most of the processes in Saudi organisations are formal, as there is a heavily reliance on formal communication channels. For further reading on bureaucratic organisations see pp.62-67 . On the other hand, participation in Saudi organisations reflects one aspect of bureaucracy, which is the level of participation in the decision-making process. In this study the participation dimension is found in the nature of the organisational and social context of Saudi organisations. For further reading about the participative dimension in Saudi organisations see pp.64-66.

⁵ Al-Malik, S., 1989: *Strategic Decision Makers: A Study of Business and Government Top Executives in Saudi Arabia*, Ph.D. thesis submitted to College of Business Administration, Georgia State University. p.336, 346, 348. The thesis was later published in 1990.

⁶ Becker, F.& Steele, F., 1990: *The Total Workplace, Facilities*, Vol.8, No.3, March 1990, p.9.

⁷ Ibid. pp.9-13.

See also Stone, P. & Luchetti, R., *Your Office Is Where You Are*, *Harvard Business Review*, March-April, 1985, pp.102-117.

⁸Organisational effectiveness is defined as an organisation's success in maintaining: a) satisfaction and commitment amongst its members. b) Communication and co-ordination within and amongst its work units. c) Adequate production. d) Mutually supportive relationships with its external environment. The total workplace in offices and factories has the potential to contribute to these proposed elements of effectiveness (source: Centre for Facilities Management, University of Strathclyde).

⁹ Campbell, D.& Campbell, T., 1988: A New Look at Informal Communication, The Role of Physical Environment. *Environment & Behavior*, vol.20, No.2, March 1988 , pp. 211-226.

¹⁰ Becker, F.& Steele, F., 1990: op. cit. p.10.

See also Sundstrom, E., 1986: op. cit. p.41

¹¹ Appeared in Lewis Gunn article from Henry Mintzberg (1974), Lewis Gunn, 1975, Communication and Information Management, *British Journal of Hospital Medicine*, May,1975, p.1.

¹² Ibid. p.1.

¹³ Sundstrom, E., op cit. p.1

¹⁴ Davis, K., 1953: Management Communication and Grapevine, *Harvard Business Review*, Sep-Oct.1953, p.43.

¹⁵ Rapoport, A., 1970: Symbolism and Environmental Design. *International Journal of Symbolology* 1:1-9. Cited in Becker, F., 1990, op. cit. p.155.

¹⁶ Rentsch, J., 1990: Climate and Culture: Interaction and Qualitative Differences in Organisational Meanings. *Journal of Applied Psychology*, 1990, Vol.75, No.6, p.668

¹⁷ Trickett, T., 1990: *The hidden dimension*, Proceeding paper, Facilities Management International Conference, "organisation" , 9-12 Apr.1990.

¹⁸ Stone, P. & Luchetti, R.,1986: op. cit. p.104

See Becker, F.,& Steele, F., 1990, op. cit. p.10

¹⁹ Becker, F. D., 1982: *The successful office*. Reading , Mass.: Addison Wesley. p.11.

- ²⁰ Markus, T. A., et al, 1972: *Building Performance*, Building Performance Research Unit, Applied Science Publishers Ltd., England, p.4
- ²¹ Sims, B., 1978: *Programming Environment for Human Use*: a look at some emerging approaches to generating user oriented design requirements, pp.489-498 in W.E. Rogers and W. H. Ittelson (eds.) *New Direction in Environmental Design Research*. Washington, D.C.: Environmental Design Research Association.
- ²² Becker, F. D., 1981: *Workplace*: Creating environment in organisations. New York: Praeger, pp. 23-36.
- ²³ Trickett, T., 1990: op. cit.
- ²⁴ Duffy, F., 1974b: office design and organisations: 2. The testing of the hypothetical model. *Environment and Planning B*, vol.1, pp.217-235.
- ²⁵ Farbstein J., D., 1975: *Organisation, Activity and Space*: The relationship of task and status to the allocation and use of space in certain organisations., Ph.D. thesis , University of London, pp.47-48.
- ²⁶ Mobility is the level of movement inside the office building. In this work two criteria were developed to measure the level of mobility. These are percentage of time staff remain seated, and frequency of staff leaving their workspace for any reason.
- ²⁷ Stone, P. & Luchetti, R., 1986: op. cit. pp.102-103.
- See Becker, F., & Steele, F., 1990: op. cit. pp. 9-10
- ²⁸ Conventional office is defined as a space surrounded by full-height, fixed partitions or walls (i.e. room). This space is either occupied by one or more. The conventional Saudi office consists of rooms of different size for single and multiple occupancy.
- ²⁹ Spatial structure is the structure of spaces in relation to each other. The concept includes all the local and global forces that shape the overall spatial structure.
- ³⁰ Hillier, B. & Hanson, J., 1984: *The Social Logic of Space*, Cambridge University Press, pp.82-142

³¹ Peponis, J., 1983: *Typology and Social Functions of Factory Space*, Ph.D. thesis submitted to Bartlett School of Architecture & Planning, University College, University of London.

³² Hillier B. & Hanson, J., 1984: op. cit., p.176

³³ Baker, P., M., 1984: Seeing is Behaving, Visibility and Participation in Small Groups, *Environment and Behavior*, vol. 16, No.2, March 1984, p.160.

³⁴ Sundstrom, E., 1986: op cit. p.267. Open plan is defined as a large open space with light and movable head-high partitions surrounding workspaces.

³⁵ Task characteristics in this study is defined in terms of the nature of staff work in performing managerial vs. clerical work. In Saudi organisations employees at the top positions of the hierarchical structure are the ones who carry out the managerial work, whereas employees at the lower positions of the hierarchical structure are the ones who carry out the clerical work. Managerial work in Saudi organisations tends to be more complex than clerical work.

³⁶ Thompson, J. D., 1967: *Organisation in Action*. New York: McGraw-Hill. Cited from Hatch, M. J., 1987: Physical Barriers, Task Characteristics, and Interaction Activity in Research and Development Firms, *Administrative of Science Quarterly*, September, p.390.

See also Kiggundu, M. N., 1981: Task Interdependence and the Theory of Job Design, *Academy of Management Review*, 6: pp. 499-508.

³⁷ Hatch, M. J., 1987: op. cit. p. 396.

³⁸ Duffy, F., 1974b: op. cit. pp. 217-235

³⁹ Markus, T., A., et al., 1972: op. cit. p.4

CHAPTER: 2

THE ORGANISATION THEORY AND INTERACTION

2.1.Overview

Interaction is a key activity in offices. However, the need of offices for this activity varies dramatically. The aim of this chapter is to give a brief background and a literature review of the connection between organisation and interaction. As this study aims to investigate the role of the physical environment supporting interaction, it becomes necessary to focus firstly on some organisational issues that could influence the level of interaction. It is also worth studying these organisational issues in the light of changes that take place over time, especially with regard to information technology, and seeing how the need for interaction is affected. These issues are concerned with organisation theory, the nature of organisations, organisation structure, climate, and culture.

Organisational structure is a determining factor of interaction. Issues related to interaction such as its importance , its role, its aspects, its channels, and its implications are also investigated. The chapter focusses on the importance of interaction in different organisation theories, the nature of organisations as being dynamic and experiencing constant change over time, and the basic constituent structural dimensions of organisations. The chapter also discusses the effect of interaction on organisational effectiveness, in addition to factors that influence the level of interaction in organisations. Finally, the chapter discusses the context of the problem in Saudi Arabia. This is achieved by an overview of the nature of Saudi organisations with respect to their need for interaction.

2.2. Organisation theories.

There are different types of organisational theories that could be used to influence the type and nature of organisational activities. That is why it is worthwhile reviewing theories of organisations, in order to establish guidelines for the nature of interaction activity in different theories. Sundstrom (1986) has summarised three types of theories of organisation that could affect people and their physical environment ¹. These are classical theories, humanistic theories, and systems theories.

Classical theories are concerned with formal processes and roles. In this respect, two aspects are significant. First, there is Weber's concept of bureaucracy, which deals with both *hierarchy of authority* and *roles* ². The theory emphasises the formal structures of specialised roles and individual duties. Each individual has a position in the hierarchical structure with specified duties. The theory stresses the importance of maintaining a unitary line of authority, uniform practices, reward based on performance, and separation of job roles from personal lives.

The second aspect is Taylor's concept of scientific management ³. Taylor took the idea of specialisation to its logical extreme. He suggested that jobs need to be broken down into their basic and smallest elements, then analysed to discover the most efficient work method. He also suggested motivation through pay, and alternating and modifying both jobs and tools in the interest of efficiency. His theory is concerned more with task design than the physical environment. His concern with the arrangement of work-stations in a way that saves time and motion to staff moving around was the basic criterion that influenced the design of both offices and factories.

Both Weber's and Taylor's theories dehumanised workers since they both considered workers as machines ⁴. On the other hand, humanistic theories are concerned more with the individual worker, as well as with the interpersonal relations within groups ⁵. Two basic ideas were established: firstly, the concern with job

satisfaction, and secondly, the concern with interpersonal relations. Regarding job satisfaction, Maslow (1943) argued that each person has a hierarchy of needs, including personal and social needs⁶. In his view people gain satisfaction from interesting work, autonomy, and social interaction.

Interpersonal relations, the other dimension of the humanistic theories, is concerned more with the formal and informal processes in the organisation. Likert's (1961) model has described the 'group' or 'family' as the relationship of each manager with his subordinates⁷. According to Likert's model, the whole organisation is viewed as a pyramid of overlapping families. This theory, in contradiction to classical theory, emphasises team and group relations.

Systems theories agree with the humanistic theories on the need for interpersonal relations. System theory emphasises the need for interdependence among organisation elements⁸. Systems theories are characterised by the need to establish a proper fit between technology and social structure of the organisation, i.e. the sociotechnical system⁹.

Organisational theories and physical environment:

Theories of organisations have different impacts on shaping the physical environment of offices. Among the classical theories, Sundstrom has described Weber's theory as having no explicit place for the physical environment, but its emphasis on status, the concept of 'office' could be implicitly applicable to his theory¹⁰. On the other hand, Taylor's theory motivates workers mainly by money and supervision. The emphasis on both supervision and motion has called for the need for visual accessibility or 'oversight' of workers. The connection between Taylor's theory and the physical environment appears to be weak, since the theory's concern is to let human components of the organisation work at their ultimate efficiency.

Maslow's concept of job satisfaction in the humanistic theories has a different impact on the physical environment. According to Maslow's theory, the physical environment provides both shelter and security to individuals. Moreover, Herzberg's theory of satisfiers and dissatisfiers looks upon the physical environment as a dissatisfier rather than a satisfier¹¹.

The other dimension of the humanistic theory which emphasised the needs for interpersonal relations has been reflected in more concern in the physical layout with groups rather than individuals. An early theory in this respect by Homans (1950) has captured the idea of interpersonal relations in the need for staff to maintain physical proximity so as to support informal contact among teams¹². The implication of Homans's concept of interpersonal relations was realised in the formation of group cohesiveness among people whose jobs and physical environment create the opportunity for frequent interaction¹³. The idea was also realised in the *Burolandschaft* of landscape office, where the concept of the layout was developed based on the argument that visual accessibility and the absence of intervening barriers would encourage interaction and improve communication among staff¹⁴.

Finally, the systems suggested that technology, equipment, and physical layouts have to support jobs and relationships between workers. Systems theories treated the physical environment as one aspect of the technological component of an organisation.

In brief, the role of physical environment in the organisation theories varies dramatically. Among the classical theories, Weber emphasised the formal roles and was better reflected in symbolic office, whereas Taylor's emphasised individual efficiency and job design. This was realised in the need for economy in time and motion. Of the humanistic theories, Maslow and Herzberg have dealt with the environment as a satisfier or dissatisfier. While Homans focussed on the need for

interpersonal relations and established a relationship between the physical environment and interaction, systems theories focussed on the sociotechnical aspect of the organisation. They emphasised the interdependence among all organisation components, particularly the fit between social aspects of the organisation and technology including the physical environment.

The change in business, the increasing use of technology, the change in economic situations, and the change in work style will force organisations to respond which in turn will necessitate changes and modifications in organisation components. If today's organisations are characterised by these attributes, then systems theory is the closest one to describing today's organisations. The recent approaches in today's workplaces fit with the concepts of systems theories. For example, the approach by Stone & Luchetti (1985) of multiple 'settings' and workstations, and the concept of shared workplaces and facilities to increase organisation effectiveness ¹⁵. Another example is the approach of the 'total workplace' by Becker & Steele (1990), which fosters the need for team-work and the importance of informal contact to improve creativity and innovation ¹⁶. These approaches reflect the concept of the systems theories through the importance of the social aspect of the organisation, the interdependence among the components of the organisation, and the role of the physical layout of the settings in supporting the basic objectives (i.e. in these two examples it is informal interaction).

2.3. The nature of organisation.

Today's organisations are characterised by rapid changes. These changes are motivated by several factors in the way organisations operate. Changes are likely to occur in the work style, work force, economic situation, facilities, social process, communication pattern, information technology, etc.. Such changes will cause changes in the way the physical settings of organisations are laid down and utilised. Moleski & Lang wrote:

"In today's dynamic world, corporate organisations are faced with massive changes, affecting both the nature of these organisations and the people who comprise their memberships. Changes occurring in the social environment, business climate, and human values have wrought a radical redefinition of organisational structures and process-restructuring work tasks and, perhaps more important, reordering priorities for meeting individual needs. It has been long evident that new managerial strategies are required to cope with these changes to take place, it is also necessary to make innovations in the design corporate work space: including as part of these innovations is the restructuring of the environmental planning process. The major thrust in corporate office planning must be the integration of organisational objectives and the individual needs of the worker"¹⁷ .

The current approach of looking at organisations as being static with standard procedures is no longer able to cope with the new characteristics of today's organisations. The force behind the need for changes in the corporate planning process is mainly due to changes in the business environment. The scale, the complexity, the diversity of business, all will dictate changes to the planning processes¹⁸.

Ellis (1991) has described two types of changes in organisations ¹⁹. These are extrinsic changes, which are initiated by pressure from outside the organisation, such as market conditions; and intrinsic changes, which are initiated by pressure from inside the organisations, such as changes in individual or group needs.

An organisational system consists of a sequence of activities that takes place within physical settings. This system always requires adaptation to cope with future changes. In this case the organisational processes will be the networks that link the system together, not organisational structure ²⁰. Beckhard (1968) has suggested that the organisational processes will describe the fluid state of structure, and therefore organisations that experience constant changes should look at their activities as processes rather than as static structures ²¹.

Moleski & Lang (1982) have described three main dimensions for office facility planning²². These dimensions are linked in interrelated networks in which any one of them could affect the others. Changes that occur in business environment, staff, facilities, work style, etc. will dictate changes in these dimensions. These dimensions are: *organisational effectiveness* as represented in work flow, tasks, activities, communication, problem solving, and status; *organisational destiny*; which refers to growth predictions, and adaptation and flexibility; *quality of the work environment*, represented in informal structure, revitalisation, objectives, and small group planning.

BRE & DEGW (1992) conducted a study of changes in organisations in order to develop key criteria for a responsible workplace²³. The study revealed that organisations make their buildings work not according to the building of the future, but with today's constrained resources²⁴. Findings from case studies showed that among the most important pressures for change were changing organisational structures, information technology, and telecommunications. The study suggested that the most important aspects of the workplace were location, servicing the workplace, layout of closed or open offices, and security/access. The basic conclusion of the study was that there was an uncomfortable gap between what these innovative organisations were trying to achieve and the buildings²⁵. It was also reported that there was a great diversity of needs among organisations, without there being a clear new office stereotype that would accommodate them all. BRE & DEGW have recommended that the most important aspect of the future workplace is the ability of the workplace to adapt to changes in organisational needs and be more responsive to user's needs²⁶.

As organisations are dynamic due to the change in their needs and the change in business conditions, it becomes worthwhile to understand the way facilities respond to these changes. Becker has developed a model describing three types of

organisations with respect to the change in their facilities ²⁷. The three types of facilities organisations are based on the 'fit' between the organisation policy and practice and the organisation's stage of evolutionary development. These are: loose fit organisation, tight fit organisation, and elastic fit organisation. He described the loose fit facilities organisation as moving from indifference to complacency. The tight fit facilities organisation was described as fighting for survival. The elastic facilities organisation was described as always moving from efficiency to effectiveness. Questioning the fit between facilities and the changing needs of organisation in order to support its objectives has become the main mission of facilities managers.

2.4. Organisational structure and dimensions.

Organisational structure refers to relatively stable characteristics of organisations ²⁸. These characteristics usually describe the nature of the organisation, especially with regard to work roles, work-units, and their interrelationships. Several studies have tried to define the dimensions of organisational structure. Each dimension is a structural element that describes some of the organisational properties. Empirical research and theoretical analysis have revealed several dimensions of organisation structure ²⁹. These dimensions in totality will shape the nature of organisations.

James & Jones (1976) have described seven dimensions that could describe organisational structure ³⁰. The *size* of the organisation refers to amount of assets. This includes the number and amount of people, equipment, and facilities. *Centralisation* of decision-making, control, and authority will also shape the hierarchical pattern of status and ranking. *Configuration* of roles and work-unit includes the division of groups and subgroups, the depth of control span, vertical versus horizontal divisions of staff, the number of workers per supervisor, and so on. *Formalisation* of roles refers to role specification, emphasis on formal channels of communication and status. *Specialisation* refers to the number of different jobs or

specialities. *Standardisation* refers to formal processes and specification of tasks. *Interdependence* is between different individuals and tasks. These seven dimensions go along with the dimensions identified by Payne & Pugh (1983). Sundstrom has considered *technology* as an additional dimension of organisational structure³¹. This refers to the degree an organisation incorporates technology, which will determine the degree of automation.

Communication and organisational structure

The communication pattern in organisations is highly affected by dimensions of organisational structure. A study by Conrath (1973) has established some connection between type of organisational communication and organisation structure³². Three types of organisational communication: the pattern of written communication, the pattern of telephone communication, and the pattern of informal contact were found to be similar to three dimensions of organisational structure: authority structure, task structure, and size (in this case represented by the distance among workers) respectively³³.

Several studies have tried to define communication dimensions in organisations. The directionality of information flow e.g. whether it is vertical, horizontal or lateral was a single side of communication facet³⁴. Accuracy and distortion of information was another dimension studied by Read (1962)³⁵. Modalities of transmitting information was another issue which was studied by Lawler & et-al (1968)³⁶. Perhaps the most comprehensive study which summarised communication dimensions was by Roberts & O'reilly (1974), where they added three non-communication variables to communication dimensions since they were correlated with other communication variables³⁷. They defined communication as a process rather than a static variable, and it was described in term of: *desire for interaction, directionality upward, directionality downward, directionality lateral, accuracy, summarisation, gate keeping, overload, satisfaction, written modality,*

face-to-face modality, telephone modality, trust, influence, and mobility (i.e. how important it is for staff to progress upward in the organisation). The last three dimensions were regarded as non-communication variables.

The importance of understanding communication extends to the degree that it could affect organisational culture. Schall (1983) has adopted communication rules in organisations as an approach to study organisational culture³⁸. Formal and informal communication among members is a critical area that provides an approach to understanding organisational structure³⁹, perception of organisational events⁴⁰, and the trend of employees' perception⁴¹.

Formal communication in organisations was an area of interest for many researchers. An early study by Davis (1953) on communication management led him to describe two main issues related to the way organisations are divided, which in turn will affect the management of communication in organisations⁴². These are the *horizontal levels* and the *vertical levels*. The *horizontal level* describes the organisational hierarchical authority, whereas the *vertical level* describes the functional division of organisations, in another words organisational departments such as production, sales, personnel and so on. The *horizontal level* gains its significance from being related to authority and status. The number of horizontal levels in an organisation depends on the size of the firm. The ratio of managerial levels to the workers level is critical in the sense that it influences the pattern of communication. This happens when the horizontal levels increase, the communication channel is lengthened and gets more complicated⁴³.

Davis' case study revealed that executives at higher levels communicate more often and with more people than do executives in lower levels. He also realised that news at the bottom level did not reach the higher level. In this respect, management should pay careful attention to the degree to which each level holds or transmits

information to the next level. This should make organisation think of the most suitable channel of communication that supports the process of information exchange. As a consequence, management should know to which degree staff of the same level are accessible to each other, as this will give opportunity to staff of different horizontal levels to communicate informally.

The second level, which is the *vertical level*, deals with the way in which organisations are divided functionally ⁴⁴. As managers in each functional department know the staff they have contact with, the broad question is degree to which the functional classification in organisations creates interaction barriers between different vertical groups. Three significant issues were determined by Davis that are related to communication management in vertical levels. These are: *Staff in the know-* management should know that a larger size of staff of the same level could have a better opportunity to communicate with each other. This has to do with the size of group and is highly related to the chain of communication which involves a larger number of staff. The level of mobility in each level is also significant because in this case the staff not only receive information but have the opportunity to transmit it. *Cross communication-* among departments ⁴⁵. This could be promoted by having staff with general interest. Social relationships were also important in this respect. *Group isolation-* groups could be isolated from informal contact due to cultural differences, geographical separation, work association (being outside the main procedure or at the end of it), social separation, and being at the lower level of a group ⁴⁶.

Successful management of the interaction activity should be derived from a full understanding of the implications of interaction in organisations. Managing the grapevine in organisations has become an area of concern for managers. Davis wrote:

"No administrator in his right mind would ever try to abolish the management grapevine. It is a permanent as humanity is. It should be recognised, analysed, and consciously used for better communication".⁴⁷

Lewis Gunn has identified five insights of communication management in organisations⁴⁸. The first insight was with respect to *telecommunication engineering*, which refers to the physical processes ranging from the simplest method of transmitting information to the most sophisticated electronic systems. This includes the sources of information, method of encoding, method of transmission, channel types (visual or audio) and capacity, leakage of information, and level of noise. The *perception* insight explains that messages are not only received but also perceived. The critical issue here is whether the message is perceived as intended by the sender. Individual perception in this respect involves several processes. This includes: a) the awareness of an external stimulus; b) the interpretation of the stimulus; c) relating the message to what one already believes or knows; d) acting or failing to respond as intended. The third insight relates to the *organisational design*. This refers to the study of the theory of organisation, human relations, formal and informal processes, system analysis, etc.. The theory of organisation will shape the pattern of communications in organisations according to the nature of the main structural dimensions of the organisation. The vertical, horizontal, and lateral patterns of communication in classical organisations will shape the overall formal channels of communications among members. The fourth and fifth insights are an extension to the third insight. The *human relations and social psychology* insight includes all informal and unofficial channels of communication. It also refers to group network and structure, friendship, and ease of interaction. This insight will necessitate an understanding of intra-group and inter-group relations. The last insight is concerned with *system analysis and managing information systems*. This insight is quite sophisticated as it is related to the basic "functions" which the organisation must perform if it is to survive and achieve equilibrium with its environment. This includes systems and sub-systems that act as a set of connected and interdependent parts shaping the total organisation.

Interaction is a very complicated issue in organisations. Managing interaction among the staff has caused a shift in the way managers perceive their organisations. The informal communication channels as one significant aspect of interaction has not been well addressed by organisations. One significant shortcoming that resulted in the misconception of informal channels of communication was caused by top management. Although top management recognise the importance of communication and want to do something about it, their wish is often frustrated by the use of standard communication "packages", instead of dealing with individual problems⁴⁹. Or the emphasis in management is more on means of communication (communication techniques) rather than the ends (objectives of communication)⁵⁰.

2.5. Organisational climate and culture.

Organisational climate

Climate was an area of research for several studies. Early studies described organisational climate as enduring organisational or situation characteristics that organisational members perceived⁵¹. Measuring organisational climate was focused on the objective characteristics of organisations in the way people perceive them. In the seventies a shift in thinking occurred where researchers started to give more concern to an individual's perception than to organisational characteristics⁵².

Schneider & Hall (1972) have examined how the perception in information processing of individuals was formed⁵³. Throughout this stage the psychological meaning of climate definition has become apparent⁵⁴. Recently the term organisational climate mainly refers to meaning and sense-making as perceived by individuals in the physical settings context⁵⁵.

Rentsch (1990) has described organisational climate as the way people perceive and interpret *events* in the organisation⁵⁶. In other words, the way people describe *events*. *Events* were defined as anything in the organisation that members

interpret or attach meaning to in their attempt to make sense of the workplace. The concept was developed from one of the assumptions of the climate theory, when members of organisations start to perceive and make sense of the objective properties of organisations (i.e. policies, practices and procedures) in psychological meaningful terms⁵⁷. Examples of events are firing a particular person, moving to a new building, introducing a new facility, etc. The meaning of *events* to members of organisations is always critical to climate theory, since meaning is a qualitative aspect and varies dramatically among individuals.

Organisational Culture

Culture is a more complicated issue. It takes the definition of meanings in organisations to a different level. Most of the research in the early 80's has defined organisational culture as shared interpretations and understanding of organisational events⁵⁸. In order to understand shared meanings, previous research has focussed on the study of all issues relating to developing a particular meaning. Jelnick, Smircich, & Hirsh have focussed on the structures of meaning⁵⁹. Sathe (1983) has focussed on important understandings⁶⁰. Ott and Schein have dealt with beliefs and values, whereas Smircich has focussed on the study of patterns of symbolic relationships and meanings⁶¹. Cultural researchers have assessed the shared understanding and meaning in many ways. Rentsch has summarised them into organisational stories, signs and symbols, patterns of assumptions, expectations, shared understanding and interpretations, reward systems, and organisational transactions⁶². Further studies have tried to study organisational culture through communication rules⁶³.

Organisational climate and culture have been assessed through different means. Rentsch (1990) has described the differences between climate and culture. He wrote:

"The qualitative approaches traditionally used to study meaning in culture research may provide a richer, more comprehensive view of meanings in organisations than does the questionnaire approach preferred by climate researchers. Moreover,

culture researchers may actually be measuring a different kind of meaning than climate researchers. Climate questionnaires directly assess descriptions, indirectly assess patterns of relationships among these descriptions, and do not assess organisational members' interpretations of events. Culture research focuses on assessing the sense-making meaning of events. The data used in culture research may better represent meaning as it is discussed in climate theory, but the qualitative methods of culture researchers lack the objectivity and comparability of the quantitative methods of climate researchers".⁶⁴

The importance of studying organisational climate and culture in the social context of the organisation lies in the growing evidence that staff who share the same understanding and interpretations of organisational events tend to interact more with each other. The study by Rentsch has confirmed the hypothesis which argued that people who interacted together would interpret organisational events similarly and that different interaction groups would interpret organisational events differently.⁶⁵ Improving the social competence in organisation could also take a new dimension. To the extent that organisations influence the way people develop meanings and interpret events, the interaction pattern among groups could be shaped accordingly. Organisations that support informal contact among their members should ensure compatibility in the way members perceive organisational climate and culture. In bureaucratic organisations, as staff in the hierarchical structure vary dramatically in the status, decision making, authority, autonomy, and physical settings, differences could be generated in the way they perceive climate and culture. Such an argument is anecdotal and empirical research is required to investigate the variation in people's perception of climate and culture in bureaucratic and non-bureaucratic organisations. This will lead to a better understanding of the social pattern of groups in conjunction with organisational climate and culture.

2.6. Formal and informal processes in organisations.

The study of the formal and informal processes in organisations has become a means to recognise and describe the organisational environment. Throughout the

literature review, most of the studies have focused on formal and informal communication in organisations as an area that would provide a descriptive view of the nature of organisations. The formal structure in organisations adopts its pattern as a network of relationships among positions within the organisation and since relationships are determined by one's role, structure is viewed as a static entity which conforms to a top-down configuration ⁶⁶, whereas the informal process arises out of a combination of human needs and formal factors ⁶⁷. Thomas Allen (1977) has concluded that while formal communication could be more important than informal communication, the two are functionally independent of each other ⁶⁸. The connection between formal and informal processes was described by Hartman & Johnson (1990) as follows:

"Since social structure is created and recreated through communication processes a dialectical relationship exists between formally dictated and emergent structures; formal and emergent structures coexist". ⁶⁹

His argument was based on the study of Monge & Eisenberg ⁷⁰. Conrath has focused on organisational communication as a tool to study organisational structure ⁷¹. Conrath (1973) has defined three aspects of organisational communication. These were the written, the telephone, and face-to-face patterns of communication. His hypothesis was that there will be a relationship between these communication patterns i.e. *written, telephone, and face-to-face* and three aspects of organisational structure- *authority structure, task structure* and the physical environment represented in the *physical distance*. Findings of his study showed that both patterns of *written* and *telephone* were significantly closer to the *authority structure* than that based on *face-to-face* communication. The *telephone* usage pattern is most similar to the *task structure*, significantly more so than the pattern of *written* communication and not quite significantly more so than *face-to-face* interaction patterns. The *Face-to-face* pattern was more similar to *task structure* than the *written* pattern. The last finding was that the *face-to-face* pattern of communication is highly correlated (negatively) with the *physical distance* among pairs. Conrath wrote:

"We recognise that we are just at the beginning of an effort to understand the role of organisational communication . and particularly its ability to represent and influence the prescriptive models of structure found in the literature. We feel that the patterns of organisational communication will provide us with an empirical approach to the study of the organisational environment. research for which the data requirements can be met". ⁷²

Rentsch (1990) has used the informal interaction among groups as a way to study staff perception of organisational events ⁷³. His broad hypothesis was "*people who interacted together would interpret organisational events similarly and that different interaction groups would interpret organisational events differently*". Organisational events were defined in term of organisational climate and culture. Results have supported his argument. This conclusion emphasises the importance of interaction in organisations, not only as a mechanism of information exchange but also as a technique and tool to understand the nature and structure of organisational culture and climate.

As a support to Rentsch's findings, Dean & Brass (1985) have examined the impact of social interaction on the perception of job characteristics in organisations ⁷⁴. The hypothesis which claims that increased social interaction leads to a convergence of perception was supported. Such results should increase the awareness of management of the significance of social interaction among groups. Increasing the number of interactive groups within the same organisation will diversify perceptions of events among groups, whereas decreasing the number of interactive groups will eliminate the diversity of perception and members of organisation could perceive events similarly.

Another study by Muchinsky (1977) was concerned with investigating relationships between organisational communication, organisational climate and job satisfaction ⁷⁵. *Organisational communication* was described in terms of sixteen dimensions. These are: trust, influence, mobility, desire for interaction, accuracy,

summarisation, gate keeping, overload, directionality-upward, directionality-downward, directionality lateral, written modality, face-to-face modality, telephone modality, other modality, and satisfaction with communication. *Organisational climate* was defined in term of interpersonal milieu, standards, affective tone toward management/organisation, organisational structure and procedures, responsibility, organisational identification. *Job satisfaction* was defined in terms of satisfaction with work, satisfaction with supervision, satisfaction with pay, satisfaction with promotions and satisfaction with co-workers. Of all the sixteen dimensions of organisational communication, only seven dimensions were found to be significantly correlated with one or more dimensions of both organisational climate and job satisfaction. The seven organisational communication dimensions were trust, influence, desire for interaction, accuracy, directionality-upward, directionality-lateral and satisfaction with communication.

The concern about the formal organisation began to weaken in the 1980's⁷⁶, as it was realised that the study of the formal organisation on its own is insufficient to understand the nature of behaviour in organisations. It is no longer valid to study individuals in isolation from each other. As a matter of fact individuals represent groups in which they all act in a social context⁷⁷. As the study of formal organisation factors in conjunction with the physical environment was related to employee performance⁷⁸, the same research revealed the importance of informal organisations represented in the social context of organisations. The unit of the social context is groups which consist of single individuals. Individuals and groups are expected to influence informal organisation through social status, informal exchange, roles, norms, etc.⁷⁹.

Further studies give more evidence in connection with the role of formal aspects of organisation on the informal aspects. Friedkin (1983) has conducted a study investigating the impact of interpersonal communication networks within

organisations on informal control⁸⁰. Two hypotheses were tested. Firstly, the likelihood of observability declines with the distance between two persons in the network. Secondly, the likelihood of observability increases with network cohesion, defined in terms of the multiplicity of communication channels joining two persons in the network, controlling for channel length. The informal control was defined as the process of monitoring and evaluating performance and the process which influences the monitored and evaluated performance. The communication network was measured in terms of distance separating two members of the network. The distance was determined by the length of the shortest communication channels connecting them, i.e. the number of direct interpersonal communication relations (lines) that are involved in the shortest communication channel connecting them. The results revealed the following:

"The major results of the analysis are these : 1- awareness-without-contact relations are unlikely in dyads that are connected by a single shared contact; 2- the probability of an awareness-without-contact relation increases with increases in the number (n) of shared contacts; and 3- the number of connections through two contacts that join *u* and *v* has a negligible association with the probability of *u* being aware of *v*'s current work".⁸¹

Hartman and Johnson (1990) have studied communication within formal and informal groups and investigated their relationships with role ambiguity⁸². Two hypotheses were tested. The first hypothesis claims that "*groups will have a greater impact on role ambiguity than will the entire network of individual relationships*". The second hypothesis claims that "*informal groupings will have a more pronounced effect than formal groupings on levels of role ambiguity*". Results support the first argument, whereas the second hypothesis was not supported. The first argument indicates that people who share a role, like university professors, may have a clear perception of their role; but others, like administrators, may have different expectations⁸³. Although the second hypothesis was disapproved giving more superiority to informal groups than formal groups with respect to role ambiguity,

Hartman and Johnson suggested that both types of group play key roles in the process of role ambiguity.

In summary, both formal and informal functions in organisations are interrelated processes in the way that one can affect the other. The study of formal and informal activities in organisations could be used as a technique to understand and describe organisational dimensions and environment.

2.7. The importance of interaction

Interaction is part of daily life. In social interaction, people perceive and judge each other based on this activity. The study of social interaction is relevant to the ways in which we experience our social world, and has covered a wide range of critical issues in organisations⁸⁴. These issues are of a great importance to organisation performance. Communication in organisations has interested sociologists and social psychologists for a long time⁸⁵. Throughout the literature, many studies were conducted investigating the importance of interaction to employee satisfaction and organisational effectiveness. Offices designed for productivity looked at interaction and the ease of communication as a key point⁸⁶.

In the 1960s researchers such as Rosemary Stewart recorded the large proportion of managers' time spent "just talking"⁸⁷. Henry Mintzberg (1974) has emphasised the "informational roles" of managers⁸⁸. Communication and information management are important managerial activities on their own, and of a critical influence on other organisational process such as decision-making, control, motivation, leadership, and co-ordination⁸⁹.

Organisations perceive interaction as a mechanism for exchanging information and ideas. Interaction is considered as a means of making use of the resources and expertise invested in individuals. The process of decision making and

innovation in organisations often takes place through interaction activity. In fact the process of decision-making should not be confined to a limited number of staff as participation in both decision-making and social support was found to be associated to workplace stress , burnout ,and job satisfaction ⁹⁰. This will increase the need for providing staff with the opportunity to meet each other casually inside their workplaces so to promote the process of participation in decision-making and the exchange of views, ideas, and information. Interaction is also the activity that enables employees to make friends and shape their social life in organisations. Researchers have found a relationship between the ease of interaction in offices and satisfaction with job and with productivity ⁹¹. The quality of work produced was also found to be related to the number of different people known to each other and their locations and distribution within organisations ⁹².

The grapevine as a mean of informal exchange has been accepted as an effective means of information exchange , where ideas and information are transmitted in a quicker and more effective way than in formal communication channels ⁹³. Informal communication, defined as relatively unstructured information exchange that tends to occur in face-to-face encounters during "off-task" moments, has acquired a significant interest in today's organisations ⁹⁴. Research shows that managers and organisation members rely on spontaneous, unplanned meetings with others ⁹⁵. The Quickborner team in their interaction survey has considered written and telephone communication as a substitute for informal contact. They regard informal contact as superior to both written and telephone communications. Pile wrote:

"Inclusion of written and telephone communications in interaction surveys since these types of contact do not require physical closeness. The obvious comment is that these are only substitutes, more or less cumbersome, for direct, spoken contact that would be used instead if it were convenient. The inconveniences of telephone communication are well known (busy signal, no answer, interruption of on-going conversation or task, lack of visual signalling, etc.) and written communication tends to be slow and formal , and can be easily ignored by the recipient. Therefore,

these kinds of contact are assumed to be inferior alternatives substituting for preferable direct contact".⁹⁶

Several studies found a link between informal communication and work performance, although the distinction between formal and informal communication flow is not clear⁹⁷. The model developed by Campbell (1988) shows how informal communication in organisations could affect work performance⁹⁸. Furthermore, in his model, informal communication can strengthen the individual's sense of identification with and commitment to his organisation. As employees have the feeling of being "in" an organisation, this will work to decrease the feeling of alienation and isolation within an organisation⁹⁹. This in turn will contribute to a greater job satisfaction, lower absenteeism, and lower turnover¹⁰⁰. Trickett (1992) has described six measures of successful design in organisations¹⁰¹. Informal communication among different levels in the organisation was one of these measures. Two significant studies found relationships between the opportunity to initiate face-to-face interaction and job satisfaction. The first study was by Muchinsky (1977), where he found a significant correlation between the desire for interaction and three aspects of job satisfaction; these are satisfaction with work, with supervision, and with co-workers¹⁰². The second study was by Oxley and Barrera (1984), where a correlation of .46 was found between these two variables¹⁰³.

The desire for interaction among employees was found to be a very significant aspect of organisational communication. A study by Roberts and O'reilly (1974) of the measurement of organisational communication revealed significant results. Ten aspects of organisational communication were included in the study. Among them were the *desire for interaction* and *face-to-face-modality*¹⁰⁴. Results showed that the *desire for interaction* is positively associated with *accuracy of communication* and negatively associated with *communication overload*. The same study showed that *face-to-face modality* is highly associated with *written modality* and *communication overload*. Another study by Leibson (1981) found that most of the engineers in the

firm exchange their ideas and views through face-to-face contact , and a large number of them were reported to be reluctant to travel for long distances to get information and they do not prefer using telephones¹⁰⁵. Trickett (1990) suggested that encouraging opportunity for face-to-face communication among staff is one of the significant roles of facilities managers in today's organisation ¹⁰⁶.

Oldham & Brass (1979) referred to two studies by Berkowitz (1956) and by Chapman and Campbell (1957) that relate interaction to task performance ¹⁰⁷. In the first study there was a significant positive relationship between air crew members' attitudes toward one another and two measures of their combat effectiveness. The second study found that the desirability of an individual to work in a team is significantly associated with the success of the team to which he belongs to. The study by Oldham & Rotchford (1983) of the impact of office characteristics on employee reaction has shown that friendship opportunities is significantly correlated to work satisfaction, social satisfaction, and degree of office satisfaction.¹⁰⁸

2.8.Aspects and characteristics of interaction.

One significant aspect of communication which tends to concern organisations is communication within its own group. This in fact depends on how effective the management of communications in organisation is ¹⁰⁹. Such interest necessitates more attention to both formal and informal channels in organisations. More description of interaction was discussed under communication as an important dimension of organisation structure ¹¹⁰. However, this section will discuss briefly some of the characteristics of interaction .

The grapevine as one aspect of social interaction has been described by Davis as a neglected aspect of informal channels due to poor management ¹¹¹. The grapevine is defined as all the informal interaction that takes place within a group. It denotes everything, including informal communication (useful information) ¹¹².

The formal aspects of communication such as conferences, reports, memoranda, and so on represent the basic means of transferring information, and management thinks of it as the most reliable and simple way of communication ¹¹³. Davis (1953) has described four characteristics of the grapevine ¹¹⁴. First there is the *speed of transmission*. It was found that the grapevine carries news faster than formal channels of communication. Second there is *Degree of selectivity*, where the grapevine usually acts without conscious direction or thought. It will carry anything, anytime, anywhere. The third characteristic is *Locale of operation*. In some companies the grapevine is not restricted to the place of work, but it is extended when staff meet each other after work, especially if the scale of the city is small or if the company provides an accommodation facility in one compound for its staff. The fourth characteristic of grapevine is its *relation to formal communication*. Both formal and informal communication could be jointly active or jointly inactive. The Davis study found that where there was a lack of formal communication among staff, the grapevine could not fill the void in communication, but the grapevine was active when there was effective formal communication ¹¹⁵.

In fact Davis (1953) realised that both formal and informal communication may supplement each other, and formal communication is simply used to confirm or expand what has already been communicated by the grapevine ¹¹⁶. His research on a leather manufacturer company described the way in which information could be spread. Four different kinds of communication chains were identified ¹¹⁷. This included *the single strand chain*, where A tells B, who tells C, who tells D, and so on. This in fact spread in a linear form in a chain to a distant receiver. Such a pattern will filter the transmitted information till it becomes unrecognisable. The *probability chain* is where A communicates randomly to anyone; for example F and D, then F and D tells anyone, all communications being liable to the law of probability. In the *gossip chain* A tells everyone else. In the *cluster chain* A tells three selected others; perhaps one of them tells two others; and then one of these two tells one other.

The types of communication that are beneficial to organisations should be identified by the top management. This is crucial since different types of communication serve different issues. Thomas Allen (1977) has distinguished three types of communication¹¹⁸. Firstly, communication to co-ordinate the work; secondly, communication to keep individuals informed about his specialisation; thirdly, communication to stimulate creativity. In the meantime, Lewis Gunn (1975) has described four types of communication that cover a wide range of types of human interaction¹¹⁹. *Informative communication*, such as describing an object or event, includes explanation of reasons and clarification of ideas. *Evaluative communication* includes expression of opinion or attitude inferences from facts. *Action-initiating communication* includes orders, requests, persuasion, advice, etc. *Social-emotional communication* includes the expression of feelings to others. To the degree that organisations become capable of identifying types of communication that serve their basic strategic objectives, communication in this respect will contribute to organisation effectiveness.

Size of the group

Another significant characteristic of interaction is the size of the group. Many studies were conducted of the impact of group size on interaction. Most of these studies have established a relationship between the size of the group and pattern of interaction. Davis (1953) realised that the larger the staff in the same organisational level, the better the communication among the members¹²⁰. Most of the studies of interaction within different group sizes focussed on the notion of *boundary* in interaction. The boundary in case of Sommer (1969) on personal scale is an imaginary boundary between human contact¹²¹. It was defined as being invisible and not necessarily spherical. The invisible boundary of personal space can be discovered by approaching closer until somebody complains. This boundary of personal space was proposed by Sommer to be impermeable. However, the boundary in the case of a group is entirely different. Some studies concerning group interaction focussed on the

degree of permeability of group boundary. This was studied in conjunction with the size of the group. Various studies showed that the size of the group is associated with the level of interaction. Among these studies is the American research by psychologists on the effect of group size on the permeability of group boundaries ¹²². Results of the American research showed that the tendency for larger groups to have less permeable boundaries is highly significant but of a small magnitude . This impermeability generally increased as a function of the relative size of the larger group. Durkheim (1951,1964), a sociologist, has concluded that societies become more specialised and complex as their populations increase in size and density ¹²³. Both Durkheim and Tonnies (1957) have considered size as a determinant factor of the nature and quality of relationships among members of a society ¹²⁴. The fact that the size of the group will affect the pattern of interaction has promoted sociologists to define small and large groups. But a problem arises with these labels when one asks how small is small and how large is large . Wilson (1978) wrote:

"While the unity of small groups is based on the interaction among members as it emerges naturally, large groups must institute official rules and duties to assure their unity." ¹²⁵

Such understanding indicates that the unity of small groups refers to the natural preferences of individuals as well as to the physical environment they occupy. On the other hand, the large group will be mainly governed by the organisational ties and formal communication. In summary, although it seems sensible to define group size in numbers, in any research it becomes necessary to define what is meant by a small group and large group. This definition is not necessarily by number, but could also be by defining the concept and condition of the group.

Measures of interaction

Interaction can be described in many forms. These include frequency, latency, duration, density, and sequence ¹²⁶. Frequency refers to the number of times an event occurs. Latency is more related to studies of internalisation, and has to do

with self-control, inhibition, and resistance to temptation. The duration measure usually refers to the length of time required for an event to "run-off". Density measures were reported to be more common than duration measures ¹²⁷. The studies by Walters & Parke (1964) have considered densities to be the total number of seconds involved in the activity ¹²⁸. Sequence is related to the sequential nature of an event within the ongoing behaviour stream of single or many individuals. In general frequency was the most widely used throughout the literature. Lamb, Suomi, and Stephenson (1979) have referred the reason for the domination of frequency of social interaction in the literature to two main reasons. They wrote:

"Frequencies have been most widely used in the literature; other measures have been used relatively rarely. Frequencies, from which rate measures are derived, have dominated the literature for two main reasons: a) to determine the presence or absence of an act, either in terms of its onset or its ongoing occurrence, involves a conceptually- straightforward judgement; and b) rate of occurrence is widely believed to be correlated with the strength of the internal response disposition or the frequency of prior reinforcement---i.e., the measure is theoretically - relevant."¹²⁹

Lamb, Suomi, and Stephenson (1979) claimed that the reason for the infrequent use of density and duration is due to their ambiguous connection to any theory of social action. ¹³⁰

2.9. Factors affecting the level of interaction.

The level of interaction in any organisation is a key issue that is mainly determined according to the nature of organisation structure. It is a significant issue to know how the work is performed in any organisation. Is it through specified roles for each member of staff which reflect the bureaucratic system of management, or through teamwork which reflects the level of participation among the staff?. The model developed by Trickett (1990) has described the measures of differentiation among organisations in three dimensions ¹³¹. These are the interpersonal style (formal vs. informal), the authority system (concentrated vs. dispersed), and the working

procedure (participative vs. individual). Employing Trickett's model, the level of interaction can be determined according to these three dimensions. These dimensions in fact shape the structure of the organisation.

In post-occupancy evaluation, Duffy (1974b) has described two types of organisations in terms of bureaucratic vs. interactive ¹³². Interaction was defined in terms of internal interaction, external interaction, and confidentiality. How much each employee needs to interact within his own group as well as across the group will determine staff level of interaction. The organisational structure will determine the level of interaction through the nature of tasks each group of staff pursues. Hatch (1987) has conducted a study on the impact of task characteristics on several aspects of interactions ¹³³. Task characteristics in his study included position level, task interdependence, and uncertainty. However, the nature of tasks in terms of complexity (managerial vs. clerical), and interdependence (individual vs. participative) could highly influence the level of interaction. The impact of task characteristics on interaction was highlighted by Sundstrom's findings, where he suggested that staff with different job duties would perceive the need for privacy differently ¹³⁴. Because both privacy and interaction are two interrelated measures in the workplace, task characteristics become a determinant factor for the level of both privacy vs. interaction.

One question is always crucial to organisations. Do they always maintain the desired level of interaction?. The answer to the question is somewhat complicated. This is because interaction is an activity that is always influenced by the physical environment and problems occur when the physical settings of any organisation fail to support the required level of interaction. This also includes the dysfunctional effect of buildings . Secondly, the churn that occurs in the organisation will always affect the experienced level of interaction.

One critical aspect is how to control interaction in organisations. This includes control over the carriers of news and gossip among executives and supervisors. Undoubtedly, the grapevine was found to affect the affairs of management ¹³⁵. Some regard the grapevine as an evil, which destroys morale and reputations. Others think of it as a good thing because it acts as a safety valve and carries news fast. Whether the grapevine is perceived as an asset or liability depends to a great extent on how it is being managed in organisations. If informal interaction is considered as a boon in some organisation, it might be a burden in others. This is simply because organisations vary dramatically in the way they perceive the need for informal interaction. That is why the level of informal interaction to be maintained among staff should be carefully considered.

Another aspect of control over interaction that is always required is the control that enables staff to maintain a desirable level of privacy. The problem arises when staff lose control over their workspaces. To the extent that staff are unable to isolate themselves to concentrate on serious tasks, interaction will be perceived as a source of constant distraction. Successful workplaces have been described as the ones that enable staff to possess a high level of control over their workspaces. The way in which the concept of "activity settings" has been developed by Stone & Luchetti (1985) for more responsive workplaces demonstrates the idea of control over the workplace. They wrote:

"Privacy versus participation, independence versus inclusion- these are the basic quagmires of office design. We argue that compromise cannot resolve the tensions between these needs, but multiple activity settings can". ¹³⁶

Wineman (1982) has considered control over social interaction as a major issue of concern that relates to workspace satisfaction ¹³⁷. Privacy and interaction are always an interrelated problem. It is equally easy to create workplaces of a high level of privacy through highly enclosed offices, and workplaces of a high level of interaction through open plan offices without any intervening barriers. But it is a more

complicated issue to create workplaces that give staff the opportunity to maintain different levels of privacy and interaction simultaneously.

Westin (1970) identifies different levels of privacy. Solitary privacy of an individual alone, intimate privacy of two persons involved in a conversation, and so forth ¹³⁸. Privacy was defined by Altman (1975) and further explained by Wineman (1982) :

" it involves control over access to oneself or one's group. It includes the ability of people and groups to regulate the transmission of information about themselves to others and to control inputs from others". ¹³⁹

Wineman (1982) has described satisfaction in workplaces as associated with such privacy-related considerations such as the ability to concentrate, conversational privacy, and visual privacy. ¹⁴⁰

In general, interaction is a critical activity that contributes to employees' satisfaction and organisation performance. However, control over interaction is inevitable in successful workplaces. Losing control over interaction will deprive employees of the desirable level of privacy that is essential for certain tasks. A key criteria for the office of the future is the degree to which employees possess control over their workspace.

2.10. Information technology and the need for interaction.

The introduction of *telematics* (telecommunication and computer) for the purpose of generating, storing, manipulating, retrieving, and communicating with no concern for physical distance, has caused a shift in the way organisations look at their workplace ¹⁴¹. Telematics affects offices in two ways: first, the ability to perform work from home; secondly ,the impact of telematics within the office building. Telematics has provided organisations with the opportunity to operate from homes. Linking home and office through telematics has become a concern for many

organisations. This trend reflects the nature of changes that can take place in organisations. Such an approach has many implications. These include: 1) the economic impact of eliminating numbers of workspaces and amount of facilities needed in the organisation; 2) the social impact of losing social interaction and friendship among staff; 3) reluctance of organisations to control their staff; 4) the loss of face-to-face communication, especially with regard to conferences, meetings, and seminars; 5) the loss of the feeling of being "in" the organisation.

However, the social, economic, and technical aspects of telecommunication technology are just beginning to be explored ¹⁴². A report surveyed some companies in California evaluating managers' opinions of staff working from homes through on-line computer networks ¹⁴³. Results showed that most of the companies are unhappy about staff working from homes for three reasons. These are 1) most managers were unable to judge staff performance through computers; they insist on the need for face-to-face contact. 2) managers lose control over staff working at homes. 3) managers believe that once the concept of "working from home" is introduced, work-style and the way organisations perceive their basic component elements should be modified accordingly. Other problems such as financial issues were also a matter of concern.

The use of computers in today's offices is the main issue that causes change in the way work is performed. The fatigue caused by VDUs (visual display units) represented by stress, radiation, visual fatigue, and eye strain has become a dominant problem in today's offices ¹⁴⁴. Grandjean's (1980) and Cakir et al (1980) have discussed the health problems associated with the use of VDUs ¹⁴⁵. They found that VDU operator headaches were caused by visual overload ;excess electromagnetic radiation; photosensitive epileptic episodes; muscle, joint, and tendon pain; irritability, depression, anxiety; blurred vision, burning and irritated eyes, eye strain, and glare discomfort. The response of management in most organisations was to ask staff to

take regular breaks as a rest period after a certain period of working with VDUs.

Mauro (1981) reports that:

"for example, Volkswagen requires a minimum rest period of 15 minutes per hour for all workers who interact with VDT (visual display terminals) for extended periods".¹⁴⁶

Makower (1981) reports:

" in Germany agreements have been reached between banks and bank tellers for the following breaks: 10 minutes after 80 minutes of 'feeding' the computer and 10 minutes after 50 minutes reading from the screen".¹⁴⁷

Makower (1981) has also quoted the recommendation of NIOSH (U.S. National Institute of Safety and Health):

" there should be mandatory work-rest breaks of at least 15 minutes every 2 hours for VDT operators under moderate visual demands and 10 minutes every hour for workers under high visual demands".¹⁴⁸

One could think of computers as a successful means of initiating face-to-face contact. This happens when staff are required to have regular breaks after a certain working time on VDUs. In this respect the staff will have the opportunity to leave their workspace and go to the coffee-break area , a place where informal interaction is likely to take place. Management could even support this more, by forcing the whole staff to have their regular break at the same time. This will help to bring a large number of staff in the gathering places at the same time and allow them to communicate informally. The introduction of small and light computers will allow staff to carry out their work any where in the workplace. This will also increase mobility and therefore increase the opportunity of staff to contact with each other. Stone & Luchetti (1985) suggest that electronic bulletin boards and electronic mail are increasingly popular ways to link people. They wrote:

"...when managers need to get information themselves rather than delegate the search to others. When a manager enters a problem on the company electronic bulletin board, he or she is likely to receive replies from distant parts of the organisation. Initial discussions over computer networks become a basis for forming various ad hoc groups. In this way, networks can actually facilitate face-to-face exchanges, not just substitute for them".¹⁴⁹

Another recent study cited in Stone & Luchetti by Juan Rada (undated) has shown that large volumes of informal electronic communications across organisations can create confusion for those used to an orderly, channelled world ¹⁵⁰. In an attempt to associate computers with social organisation, Thomas Morgan argued that technology in organisations has tended to be installed along rigid bureaucratic lines ¹⁵¹. His 25-strong team of psychology and computer scientists is looking at how technology could be used to enhance social opportunities at work. He proposed two screens in each employee's office, one for the formal working task, and the other videoing people present in gathering areas. In this case employees are always informed with people present in common areas, as they can leave the workspace and go to the common areas to hold a conversation with the required person.

Evidence of the impact of telecommunication on work and social structure is neither systematic nor empirical ¹⁵². However, Vail (1978) has investigated the impact of telecommunication on the social-psychological aspect and mental health ¹⁵³. Other studies have focussed on communication modality preferences, transportation, and saving energy due to substitution by communication networks ¹⁵⁴.

In summary, the expectation that the increased use of information technology would eliminate the need for interaction is unlikely. In contrast, the review has established a connection between the use of computers and social organisation.

2.11. The Nature of Saudi Governmental Organisations

The kingdom of Saudi Arabia has used five year plans since 1970. This five-year plan shapes the future of Saudi society based on the economic situation of the country. By the end of the fourth plan, the kingdom had finished the construction of the main infra-structure of the country. The plan consists of the basic strategic objectives of the country with respect to health, education, industry, trade, etc.. One basic objective of the kingdom is to raise the standard of living of the Saudi individual within the context of Islamic principles. As a consequence, the kingdom tried to

respond to all the basic requirements of Saudi individuals. In this respect, the country was able to provide free educational and health services to all members of the society. The boom in the Saudi economy in 70's and 80's has been reflected in the increase of the number of governmental organisations to cope with such a situation. The study will describe in details two important aspects of Saudi's organisations. These are the organisational context, and the social context.

A. The Organisational Context Of Saudi Organisations

The structure of Saudi governmental organisations has been shaped by the Council of Ministers. These organisations belong to different governmental sectors including oil and mineral resources, health, commerce, municipal and rural affairs, education, higher education, industry and electricity, telecommunications, finance and national economy, etc.. The Council of Ministers with the king as President is the only authority that has the right to make major changes in the way these organisations operate. The study will describe the nature of Saudi organisations in the light of their basic structural dimensions.

As the government established different organisations since 1950, the size of these organisations has increased dramatically thereafter to respond to the economic situation of the country. Although in the 50's and 60's the government was keen to provide the necessary number of Saudi organisations to cover all the social, industrial, medical, and managerial aspects of the economy, they realised afterward the need to expand these organisations in their actual size. The size of the organisation refers to the number of staff as well as the amount of facilities. In the early 50's the number of Saudi organisations was very few . They were located in Makkah in the western part of the country as it was the only heavily populated area in the whole kingdom. These organisations belonged mainly to finance and religious affairs with a limited number of staff and facilities. Suddenly, these organisations were moved to Jeddah and thereafter to Riyadh with an increase in their numbers and size. Although each governmental

organisation has its main headquarters in Riyadh to run the organisations, there is a sub-headquarters in each province to run the organisation's affairs on a regional scale. Moreover, these organisations have branches in almost every city in Saudi Arabia. The need to establish headquarters in Riyadh and in each province has dramatically affected the size of organisations.

Staff in these organisations are structured in a hierarchical form with high status staff occupying the top of the pyramid and lower status at the bottom of the pyramid. At the top of each organisation is the minister. Each organisation is a group of organisational units (i.e. departments) with a manager and subordinates. The process of decision-making is often characterised with the notion of centralisation. Staff at the higher positions have more powerful authority to make decisions. Saudi organisations like other organisations in other parts of the world suffer from formalism and unnecessary bureaucratic routines and procedures which affect their efficiency and the utilisation of the available resources ¹⁵⁵. The centralisation in decision-making has affected productivity remarkably. In some cases bureaucrats control even minor issues and they take an unreasonable period of time to take decisions.

There are several factors concluded by Al-Malik (1989) that have contributed to encourage bureaucracy in these organisations such as a) the nature of civil service law which guarantees career security and tenure for all employees ¹⁵⁶. All employees in these organisations have secure jobs where they stay on their jobs until retirement unless they commit a social crime or misconduct. There is no basic incentive for productivity. This has led to wide-spread carelessness among the whole staff. b) the lack of clear-cut responsibility and authority to carry out actions. This has affected role ambiguity which in turn led employees to prefer more stable jobs with repetitive functions than ones with responsibilities. c) Weakness in some measures such as performance appraisal, controlling, accountability, and disciplinary systems. d) Lack

of effective motivational systems such as rewarding. This has diminished the motivation behaviour among the staff.

Although these types of organisations exhibit the bureaucratic system of management through the hierarchical structure and the differentiation in rank and status among staff, the participation dimension is perceived as a strong criterion that would enhance organisational performance and increase productivity. The first published report on the strategic decision-makers in both business and governmental organisations in Saudi Arabia has revealed the need to improve communication channels and promote participation through decentralisation. The study was conducted on 127 governmental officials and 139 business executives ¹⁵⁷. The report showed that:

"Participants indicated the need for improving the administrative bureaucracy by simplifying work procedures and requirements, clarifying rules and regulations, specifying the roles and authorities, improving the chain of communication, speeding up the process of making and implementing decisions, improving employees' productivity and enhancing their level of satisfaction, commitment, loyalty and public spirit". ¹⁵⁸

The recommended remedies of the study were to seek further decentralisation as an approach to better management:

"Obtain strong commitment and support from administrators for decentralisation as an approach to management." ¹⁵⁹

The participation dimension is found to be in several aspects: a) the process of decision-making in these organisations goes through two sequences. First, subordinates have the right to suggest decisions. Secondly, managers are the ones who select the decision. In this case, subordinates always need to exchange opinions and ideas about the suggested decisions. As a matter of fact, staff used to discuss the suggested decisions informally and then do it formally through the written forms. This confirms the Davis (1953) study where he found that formal communication confirms or expands what has already been discussed informally ¹⁶⁰.

b) Although the overall system of management in these organisations is bureaucratic, top management in each organisation has the right to select the desirable level of participation among staff. As these governmental organisations vary in their nature of business, this will dictate different needs for participation among different organisations. As a consequence Saudi Telecom , an organisation that is always improving its services to customers, realised the need for cultural change towards more participation among staff .

c) Results of the interview with some organisations' management indicated that the top management in these organisations argued that the lack of participation and the opportunity for informal discussion among different organisational divisions (i.e. departments) is one of the main factors that hampers productivity. They referred to the slowness and ambiguity of the formal communication channel (i.e. writing) to describe the complexity of work. They complained that in most cases, work is being passed around and around different departments, each uncertain of any decision due to the lack of co-operation and participation. The interview with top management also signifies the importance of participation among members of the organisation.

d) The introduction of information technology in some organisations has been a dramatic influence on the way management perceives work. The computer networks that are accessible to most of the staff have encouraged participation within and across departments. As a result, most staff have become involved in the process of decision-making since they are aware of most of management decisions. Furthermore, the use of small, light computers has increased mobility because work can be performed anywhere. The increased level of mobility will increase the opportunity of staff to interact.

e) The cultural aspect in Saudi Arabia is a very strong dimension in the way that it affects the way organisations operate. The need for all staff in organisations to

perform the noon prayer together has given the organisation the image of unity and the one team character. Once the prayer is finished, the staff have the opportunity to converse informally to each other regardless of status and rank. Staff rely substantially on the informal communication opportunity they possess from meeting at prayer.

The five perspectives of Saudi organisations with regard to participation have prompted some organisations to take positive measures. As a consequence, some organisations have shown a more positive attitude toward participation than others. For example, Saudi Telecom perceives the need for participation as an essential key criteria for productivity. Others like SAMA (Saudi Arabian Monetary Agency), and SAUDIA have realised that the need for participation among different staff to support industrial relations and communication is necessary. These organisations have reflected the need for participation and interaction in the physical layout of their workplace.

In brief, Saudi organisations could be described as bureaucratic because of their hierarchical structure of staff and the differentiation in status and rank. On the other hand, the participation dimension was perceived as a critical dimension that would enhance organisational performance. The researcher argues that the forces behind the need for participation will cause Saudi organisations to move forward towards a more participative work style.

Another dimension in the structure of Saudi organisations is the level of formalisation which refers to role specification and the level of adopting formal or informal communication. Saudi organisations, as was mentioned earlier, suffered from the problem of role ambiguity, which was one of the main reasons that led staff to rely on informal communication. In fact, role ambiguity was a serious problem that encouraged centralisation where in some cases when the law is unclear employees keep referring the work to the higher status. Most of the transactions in these

organisations are formal (i.e. written modality). There is no transaction approved through informal conversation although informal communication was used to clarify work ambiguity. The full dependence on written type of communication in most organisations has always caused delay in work.

The Saudi organisations adopt the idea of specialisation of work (i.e. single job for single staff). Each staff could only perform one type of job. The idea of increasing the number of different jobs within and among staff in order to increase productivity does not exist. This led staff to work independently of each other, causing further delay in work.

In summary, the government organisations in Saudi Arabia are characterised by bureaucracy, centralisation, and role ambiguity. Work is mainly accomplished through formal communication channels. The survey conducted by Al-Malik (1989) on 127 high status government employees examining their responses and satisfaction (1-5 scale) with some organisational dimensions in Saudi Arabia revealed the following: a) The average response for risk-taking is 2.63, job satisfaction 3.77, job commitment 4.05, managerial power 2.48, role ambiguity 2.27, formalisation 3.86, and uncertainty 3.92 ¹⁶¹.

B. The Social Context of Saudi Organisations:

The social dimension in Saudi organisations is different from that in western organisations. It could be easily said that Saudi organisations are typical eastern organisations where both religion and culture have a great impact in shaping the overall social pattern. Saudi Arabia is an Islamic country and all the Saudi citizens are Muslims. The country has a unique mission to the Islamic world since Islam spread from the western part of the country fourteen hundred years ago. The kingdom has incorporated the principles of Islam in all aspects of life including the way

organisations are run. All the objectives of the country are to be fulfilled within the domain of Islamic principles.

The impact of religious belief on employees at work was very distinctive. The need to pray five times a day on time and in groups has entitled all the staff to gather daily at noon to pray together. This has had many effects, particularly on the way work is performed. One direct implication is the need for the staff to have a prayer break from 12:00 hours to 13:00 hours. This has become an official break for all the staff. All the staff should stop working and join the prayer. All the staff without regard for rank or status will have the chance to talk to each other every day. This has provided staff with the opportunity to maintain a good chance of informal interaction with each other. Staff in this case have a chance to bump into each other while they are on the way to toilets to perform ablutions, or while they are on the way to perform prayers. The chance for staff to bump into each other is relatively high since all staff start to move at the same time. Just after the prayer staff spend at least 10 to 15 minutes with each other discussing informally a variety of topics.

Another impact of the religious factor on employees is the need for staff to greet each other. Islamic principles urge people to greet each other even if they are unknown to each other to the extent that any Muslim who does not exchange Islamic greetings with others commits a sin. By the time any of the staff start moving inside the office building he is interacting through greeting a large number of his colleagues. That is why staff in the same organisation are almost known to each other.

Islamic principles also segregate men and women. In Islamic societies males and females are always hidden from each other. All the governmental organisations are run by men. The absence of a female side in Saudi organisations has an impact on the social dimension of the organisations especially with regard to informal interaction. Although there is evidence on the capacity of sex and other personal

characteristics to affect the level of interaction in organisations, it is quite unclear whether organisations with single sex experience a better level of informal interaction than those of mixed sex ¹⁶². Such an argument necessitates a comparison between the pattern of interaction in Saudi organisations (i.e. single sex) and western organisations (mixed sex).

The other side of Saudi organisations refers to the cultural issue. In this respect it is quite important to expose the reader to the nature of Saudi society in terms of their habits and their social customs. The Saudi society is a very friendly society. Their religion always urges them to be friendly and caring to others. People always have strong social ties among each other. Staff in Saudi organisations are always keen to meet each other away from the work atmosphere. In some organisations, staff meet after work almost weekly. This strengthens the social relations among staff. Sometimes some social customs hamper organisation performance. For example, due to the strong social ties among staff, they spend a long time socialising and discussing personal issues with no concern about work. The feeling of having secure jobs (under any circumstances they are not going to be sacked, even if their productivity is low) has escalated the problem.

Staff usually interact with each other in both working and non-working areas. The overwhelming social ties among staff in Saudi organisations has made employees' workspaces more accessible to each other. Any employee can intrude on any other's workspace any time for any reason (including needs for socialisation). As a result, privacy in most of Saudi organisations is a serious problem. Most of the employees find it difficult to concentrate to perform difficult tasks since other staff keep invading their privacy. The problem is exacerbated by Saudi social customs, since it is an insult to ask others to stop visiting your workspace. On the other hand, interaction in non-working areas was found to take place mainly in corridors, staircases and lifts, and public facilities. In Western organisations there is always a coffee corner in offices

which helps to bring staff in contact with each other. In Saudi organisations there are no coffee corners for all staff. Instead there is a tea-man who is in charge of providing tea to all staff in their workspaces.

Members of the same family are always keen to be in the same organisation. This is a remarkable social attitude among Saudis, to the extent that you find brothers, cousins, uncles, and nephews in the same organisation. This trend is taken sometimes to a larger scale where in some cases you find that most of the staff in the same organisation belong to the same tribe. Friends are also keen to join the same organisation. Usually employees in organisations ask their jobless friends to join them. This has given the Saudi organisations an image of unity where all the staff are very close to each other. As a result some organisational corruption takes place, due to the prevalence of personal interest. Discipline is always a problem in Saudi organisations. Some like giving friends and relatives better service than ordinary persons, and this is another crucial problem.

In summary, the impact of religion and culture issues on shaping the social organisation in Saudi Arabia is very distinctive. That what is makes Saudi organisations different from western organisations. The need to clarify the organisational and social context of Saudi organisations lies in the ability of these issues to influence the overall pattern of informal interaction.

2.12. Summary.

The chapter aimed to explore the connection between organisations and interaction. The nature of organisational structure will determine the appropriate level of interaction for any organisation. The chapter focussed on relevant issues in organisations that are important to interaction. The literature has shown that different organisation theories vary in the way they perceive the importance of interaction. Purely bureaucratic organisations dehumanise staff and the social dimension is

somehow missing. Both humanistic and systems theories have established a broad and significant dimension for the social organisation. Organisations based on these theories will differ in their basic structural elements , which in turn creates different climates and cultures within the workplace.

Organisations were found to be acquiring a dynamic image. This is due to the churn that is taking place, especially with regard to information technology. The review in this chapter exposed the impact of the increased use of information technology on the need for interaction. The need for the connection between the social aspects of organisation and technology (i.e. the sociotechnical aspect) is the challenging force of the systems theory of organisations. The literature focussed on the potential of information technology to support the social dimension in the organisation. Three criteria of today's organisations were developed. These are the increased use of information technology, the increased level of mobility, and the churn in needs. The study established a connection between these three criteria of today's organisations and interaction.

The chapter also covered the importance of interaction, its aspects and characteristics, and factors influencing the level of interaction. Formal and informal communications were a vital aspect in organisations that researchers could use as a tool to understand the way organisations operate through the understanding of the structural dimensions of organisations. In brief, interaction was found to have strong relationships with more than one aspect of organisations that will contribute to organisational effectiveness. These include job satisfaction, performance, friendship, and productivity. Its importance lies in its ability to support the communication processes through informal communication channels as well as strengthen the social ties among staff. On the other hand, control over interaction is generating a crucial problem in today's offices, where staff are deprived of the level of privacy which is necessary for some tasks.

The context of the study focussed on the situation of Saudi organisations. The study showed that although these organisations are bureaucratic, the participation dimension does exist and it has been neglected. The missing participation dimension in Saudi organisations is hampering the organisations' effectiveness.

In summary, the chapter identified four variables that could affect interaction with regard to organisational aspects. These are: a) task characteristics with regard to its complexity, and the position of staff in the hierarchical structure¹⁶³; b) the level of mobility; c) interaction within formal communication channels (i.e. interaction within and across different organisation divisions); and d) group size.

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CHAPTER: 3

THE PHYSICAL FEATURES OF WORKPLACE AND THE INTERACTION ACTIVITY

3.1.Overview

The concept of the 'total workspace' refers to the need to look at the complexity of the workplace where employees perform different tasks. The total workplace incorporates all the social, physical, and organisational issues that could influence the nature of the workplace ¹. In this study the concept of the workplace will be examined in terms of physical, social, and management issues.

The notion that organisations could use some features of the physical environment in the workplace to support their basic needs has become common. The chapter aims to explore how offices throughout history have used aspects of the physical environment to control and manage organisation processes. As the study here is concerned with interaction as an informal process in organisations, the focus will be on physical features of the workplace that influence interaction.

Designing for a single client who has limited requirements will enable the design team to develop a more responsive design solution. On the other hand, designing for an organisation seems to be more a complex task. The problem arises from the complexity of the organisational structures when they are operating together and the difficulties of generating the kind of physical environment that will respond positively to all aspects of organisation structure. The chapter also aims to investigate the congruence between some dimensions of organisation structure and the physical environment. Moreover, employees who occupy different physical settings will experience their environment in such a way that they start to interpret events and physical stimuli in a way that could affect the climate and culture of organisations which are important to interaction. The chapter finally examines the physical features of workplaces in Saudi Arabia. This is in terms of the kind of office layouts and measures taken to control interaction.

3.2. History of office layouts and interaction.

The history of the open office started in 1958 when the Quickborner team, a management consulting group having its headquarters near Hamburg in the suburb of Quickborn, tried to pay attention to the realities of office work space². Their intention was to improve the functional performance in offices as they had become aware that the existing office layout did not support good work performance. In 1960-1962, a project was released conveying the idea of the open plan office with no private work space or rooms, an approach in flat contradiction to the conventional office layout. Furniture and equipment were scattered in an irregular pattern³. The approach entirely abandoned the idea of designing in a grid pattern or in geometrical shapes, which is what conventional office design was like. The team was mainly concerned with improving organisational performance through the physical settings of the workplace. The team strongly criticised the conventional office⁴. They claimed that the conventional offices did not support organisational activities, and most likely hampered communications among co-workers. Pile (1978) wrote:

".....all offices are small, fixed rooms lined up along halls in small buildings. Departments are thus broken up in illogical ways with staff often distributed on various floors and even into several different buildings. Several people sharing a small office are in excessive contact that may have no basis in work needs and that may well be a source of distraction and irritation. In other situations where work contact might be helpful, a wall or a distant separation may hamper communication".⁵

The conventional office was also criticised for its impracticality and lack of flexibility to differentiate among employees' workspaces in terms of size and locations, a differentiation that will express rank and status among the staff. In conventional offices, a large office could be either allocated to a manager to express his rank or occupied by several people, a solution that has no other immediate alternatives⁶. The fact that conventional offices were designed based on the pattern defined by an organisational chart means that they did not usually respond to actual, everyday needs. The study of the importance of face-to-face contact needed among

staff in conventional offices was mainly limited within each group. The overall chart that describes the need for organisational members to be in contact with each other has been characterised by upward and downward connections, a pattern of communication that leaves each group in isolation from the other ⁷. The need for horizontal communication only appeared in the top management level at the top of the chart, which revealed the need for the head of departments to be in contact with each other. Such a need ends up with bringing the top executive managers together in a restricted high status zone, separating them from their subordinates ⁸.

The Quickborner team claimed that logical and efficient work patterns usually do not and should not follow the rigidities of the organisation chart. The team insisted on the need for horizontal communication along functional lines. The open plan developed by the team was claimed to be more responsive to organisational change over time as well as economic changes ⁹. Organisations have to consider that their needs could change from the time of planning to the time of construction, a mechanism that does not suggest the conventional office as an architectural solution as changes in the physical settings of the conventional offices tend to be more difficult.¹⁰

In general, the Quickborner team's intention was to take the office planning concept out of the narrow definition of conventional planning. Pile (1978) cited their main intention as follows:

" 'Let us plan in a green field,' they said, that is, in unrestricted open space with no known boundaries or limitations. Personnel would be placed at work stations grouped strictly according to working needs for easy communication. Needs for space and for privacy would be realistically evaluated and only what was really required for a particular kind of work would be provided. All furniture and privacy barriers would be made easily movable (not in the limited sense of the movable partition, but instantly movable by anyone). Storage would be reduced to the absolute minimum that daily work equipment really requires. Files would be consolidated in a truly efficient central file and only the papers needed on a given day would be out in light, open file carts or racks. Environmental conditions-

lighting . air temperature and humidity. and acoustical conditions- would be made ideal throughout the office space so that rearrangement of equipment in any pattern anywhere would be unrestricted".¹¹

The approach was significant with respect to two main dimensions. Firstly, there were the environmental requirements in term of openness, i.e. the largest possible unrestricted office floors, in addition to concerns with uniformity of lighting throughout the whole space and provision of sound-absorbent materials to reduce noise level. Secondly, there were organisational requirements concerned with the communication survey reflecting the actual pattern of communication, interaction charts indicating the density of contacts among each pairs, locations of each group from the central position to the edges, participation of users in criticising and assessing the proposed plan, rules to govern the process, and finally revising the layout on a regular basis so as to cope with all changes raised over time.¹²

In the early 60's the idea of the landscaped office spread in Germany and became clearer as it was developed by the Quickborner team, causing shock to most staff in organisations¹³. People were reluctant to accept this type of layout for two reasons. First, the seemingly random scrambled nature of plan layout; secondly, the absence of partitioned private offices, even for top executives.¹⁴

In 1967, the response to office landscape in United States began after a department of DuPont in Wilmington moved into an office landscape floor. The Quickborner team was involved in the planning process. This was in fact a test of the idea of office landscape. Managers reported that on balance it was all right, although they might have preferred a bit more privacy.¹⁵

The idea of office landscape has promoted three basic rules concerned with communication. Pile (1978) mentioned them as follows:

"An office is a centre for communication and information processing . Work relationships are not to be understood in term of administrative departmental

organisation nor in terms of rank and status . but only as matters of communication".¹⁶

Secondly:

"The real patterns of work communication should be the basis for physical planning . Those who need frequent communication must be placed close together . Groups that work as teams need to be placed in a way that makes the group a visibly identifiable unit".¹⁷

Thirdly:

"Discovering the real patterns of communication and the functioning work groups requires a survey of communication that can be converted into numerical values displayed on charts".¹⁸

An advanced idea for landscaped office was released by Herman Miller in 1964 under the name of "*Action Office*"¹⁹. The concern was towards analysing the needs of each individual. Standard desks, chairs, and files were replaced by units that combined work surfaces, storage, and seating in components endlessly adjustable into different configurations. Panels standing free on feet, carried storage boxes, shelves, and work tops. American planners welcomed the idea of open plan with Action Office furniture. The Action Office was clearly more tolerant of the desire to provide storage at the individual workplace, and it tended to provide more private spaces through the panels that support storage.

The issue of furniture in open plan offices became an area of interest to many furniture manufacturers. The individual workstation was based on three primary directions. These were: the Quickborner landscape concept; Action Office related systems; and Work stations based on enclosed furniture modules²⁰.

In summary, the type of office layout one can deal with was summarised by Grajewski, (1990) into seven possible layouts²¹. *The traditional open plan* consists of rooms for a group of staff .The furniture is laid down in a regular pattern with no panels or screens. *The Cellular configuration* consists of individual rooms fully enclosed and they are linked by corridors. *Burolandschaft*, or landscaped office

developed by the Quickborner team, is characterised by a fully open plan with unpartitioned floor space comprising light furniture and minimum storage workstations. The physical layout of the office is in an irregular pattern reflecting the actual interaction pattern among the staff. The *Action Office* as a modification to the idea of the landscaped office is characterised by individual workstations with storage cabinets and free stand screens. This type of office provides more privacy than the landscape office of the Quickborner team since each workstation has at least one enclosed side. *The Contemporary Furniture Systems*, derived from the Action Office, has high flexibility in the level of screening and the way they are assembled, in addition to more concern with the convenience of furniture items to support the nature of work. *The Shell and Scenery* concept was developed by Duffy, Cave and Worthington (1976) and described buildings in their long-time life i.e. the shell which is concerned with the basic structural system of the building ;and the short-time life i.e. scenery which is concerned with all the physical elements in the building envelope. Buildings of different shell systems were evaluated according to their ability to accommodate different kinds of scenery. For example, a shallow shell is more suited to accommodate a conventional office with cellular rooms, whereas a deep shell is more convenient to accommodate a Burolandschaft office. Finally, *the Contemporary layout type* is a combination of cellular and open plan. The physical settings are laid down in a way to support task requirements and status. Staff are allocated multi-workspaces with the central area providing common facilities and a place to hold meetings.

The previous types of layout have emerged from two basic office layouts. These are the conventional office with cellular rooms fully enclosed, and the open plan office with different levels of enclosure. Most of the empirical work on environment and behaviour was conducted on these two types of layout.

3.3. The role of physical environment.

The notion that the formal process in organisations should dictate design guidelines to our buildings is no longer valid. What has happened is that over time in an occupied building the physical settings with their ability to influence people's behaviour will reveal the informal image of the building. This informal process will be imposed on occupants and sometimes overwhelming the formal process, and the informal cues become more prevalent. Becker (1981) has described this phenomenon :

" A new building or a renovation is completed and the facility occupied. Over time, beginning with initial occupancy, programmatic dysfunctions related to the environment will occur. These are usually ignored until the dysfunctions reach the point where they have been recognisable to everyone for years and are now such an overwhelming barrier to effective organisational functioning that a decision is made to return to the drawing board".²²

The fact is that no building is perfect, and the level of programmatic dysfunction is expected to increase as a function of time ²³. Some organisations try to reduce that effect by undertaking some modification to cope with any constraints ²⁴. The effect of the programmatic dysfunctions could reach a serious level when it starts to have a negative effect on the accomplishment of certain tasks and activities which will influence organisational effectiveness. The prospect of today's workplace is to provide a highly flexible and adaptable workplace that can respond to any future changes, whether they are caused by virtue of organisational changes or by virtue of experiencing the physical settings of the workplace. The programmatic dysfunctions effect can not be avoided; it takes place everywhere in unexpected ways. However, the study of environment and behaviour in offices will enable professionals to anticipate some aspects of programmatic dysfunctions in organisations which help to provide workplaces that respond in a better way to organisational needs.

Becker (1981) has described two models explaining human-environment relations. The first model is when the environment acts as a support (first -order

effect). This is when the physical settings support an organisational job or a certain activity in an effective way. Examples of this type of support is level of noise, temperature, lighting etc. However, this kind of relation will always have a direct effect on behaviour ²⁵. The second model is more critical, describing the environment as a catalyst (second-order effects), and is more difficult to understand ²⁶. When the physical setting acts as a catalyst it operates in a series of linked events and behavioural reactions which could take positive or negative forms. According to Becker's definition of human-environment relations, the activity of interaction falls in the second category, where the physical settings act as a catalyst. This happens when some environmental factors stimulate types of social interaction and facilitate face-to-face contact among staff. This in turn will affect some relevant aspects of organisational effectiveness ²⁷. Becker (1981) explained the kind of relationships between physical settings, interaction, and organisation performance. He wrote:

"The chain of events from a social-relation perspective, then, leads from office environment to interaction level to attraction/liking to performance. The direct first-order consequence of the physical setting is interaction level. The second- and third-order consequences are attraction and performance". ²⁸

Throughout the literature review, there is some evidence which suggests the role of the physical environment is to support both formal and informal interaction. Most of the studies conducted in this area focussed on formal face-to-face contact. These studies were concerned with the ability of physical accessibility to support both formal and informal contact among workers. Proximity and physical enclosure were regarded as important criteria that could influence interaction. Although some studies disprove the relationships, others have established a significant connection between accessibility (both distance and enclosure) and interaction. The researcher found that most of these studies could be subsumed under four aspects of the physical environment. These are proximity, physical enclosure including visual accessibility, spatial pattern, and arrangement of facilities and the creation of gathering spaces. The impact of these features on interaction was conducted as a post-occupancy evaluation

in open plan offices including landscape offices and conventional offices. Most of these studies tried to assess employees satisfaction with their perceived level of privacy and their reaction towards distraction and ease of communication. Research conducted under these four areas will be reviewed briefly.

Proximity and formal contact:

The effect of physical proximity on supporting communication was an area of concern for many researchers. Conrath (1973) has tested the hypothesis which claims that both formal and informal contact (i.e. the interaction pattern) would be similar to the physical environment pattern (i.e. distance) ²⁹. Findings have confirmed the relationship between face-to-face contact and proximity. The study by Duffy (1974b) has not shown a correlation between communication (work related face-to-face contact) and accessibility represented by the four nearest workplaces ³⁰. Also Farbstein (1975) has not found a significant correlation between average distance between co-workers and the amount of time spent in contact (work related face-to-face contact)³¹. The interaction survey of the Quickborner team which investigated the density of interaction among staff led the team to allocate people whose jobs required contact with each other a shorter travelling distance or a pleasant walkway ³². The study by Szilagyi & Holland (1980) of a corporate office showed an association between inter-workspace proximity and amount of formal contact between supervisor and supervisee ³³.

Keller & Holland (1983) in their research on communicators and innovators in research and development organisations had claimed that physical propinquity would be positively related to the formation of strong components among communicators, innovators, and other professional employees. The argument was supported where the physical propinquity to information sources (formal and informal) was greatest (i.e. less walking yards) for those in a strong component ³⁴.

Proximity and informal contact:

In factories, two studies by Walker & Guest (1952) and by Faunce (1958) have confirmed the connection between proximity and informal conversation with neighbours (based on distance) ³⁵. In offices, on the other hand, Gullahorn (1952) in an office with 37 employees working in clerical jobs took observations for more than 4 months as to who conversed with whom. Results showed that the closer the desks, the more workers conversed. Correlations between proximity, informal conversation and friendship were strongest among the younger employees ³⁶.

Homans (1954) found a relationship between proximity and informal conversation. His study was conducted on 10 young female employees. Results showed that although the employees had different jobs they had formed cliques:

"The most important determinant of clique formation was the position of a poster's table during their first year on the job. Those who sat near each other then had many chances to interact and tended to become friends".³⁷

Another study by Wells (1965b) in an insurance company with 297 staff occupying one floor found that friendships decreased steadily with distance between workspaces ³⁸. In brief, informal contact in most of the conducted studies was found to be associated with physical proximity. The study by Conrath (1973) also found a similarity between the informal face-to-face pattern of interaction and distance ³⁹.

Another critical dimension is the arrangement of the office workspace. This refers to desk and seat arrangement. Studies suggested that seat arrangement could be vital to interaction by virtue of proximity. An association between physical distance and psychological closeness was established by Hall (1966) ⁴⁰. He realised that people select different distances for different encountering. Later a model describing four "distance zones" was developed. Each zone is related to a different type of encounter⁴¹. Connections between the seat arrangement that provides eye contact, and within conversation distance, and interaction were established ⁴².

Physical enclosure and formal contact:

Physical enclosure is another factor that can influence both formal and informal interaction. The study by Hundert and Greenfield (1969) did not establish a relationship between office landscape (less intervening barriers) and an improvement in the flow of information ⁴³. The study compared conventional with landscaped offices. Landscaped offices were hypothesised to improve comfort, attractiveness of the environment, flow of information, personal relations, and awareness of organisational functioning. Results showed that while more information flowed in the sense of duration, privacy decreased, and distraction and interruption were reported to increase.

Brookes and Kaplan (1972) evaluated 120 employees' perception of functional efficiency before and after moving from a conventional office to landscaped office ⁴⁴. Results showed a decrease in the perceived efficiency represented by an increase in the level of noise, loss of privacy, and visual distraction. Therefore, the study failed to support the claim that the landscaped office increases efficiency and improves communication.

The study by Boyace (1974) has shown that employees have reported almost the same ease in communication having moved from a conventional office to an open plan office. Employees again have experienced a lack in the level of privacy ⁴⁵. Duffy (1974a-c) has studied the impact of enclosure on formal face-to-face contact. Results show that enclosure is not correlated to the average of frequency of communication, with the frequency of visitors, or with the average percentage of the staff who were contacted daily or weekly by employees ⁴⁶. In a study by Dean (1977), in which a sample of 62 employees were occupying an open-plan office, two thirds of the staff reported that they preferred working in a closed office plan rather than in an open office plan ⁴⁷. The desire to work in a closed office plan was stronger among professionals than clerical staff. Employees were hesitant about the ease of

communication in an open plan office, but they were sure about constant interruptions.

Since *Burolandschaft* and thereafter, the open plan offices concept has suggested that unobstructed views, the absence of intervening barriers, and the seeking of more openness in the plan would be associated with ease of both formal and informal communication ⁴⁸.

The concept of openness and the absence of barriers was explained by Mehrabian (1976) in the term "cabbage patch". He wrote:

"if someone comes across something on an invoice that looks a bit strange, he might look across the open bit at someone and ask "Hey, Joni, we got a rep in Bangor, Maryland ?" But if he has to stand up, leave his cubicle, and walk ten paces, or shout over two or three intervening modules, he may just shrug and pass it on ...In a cabbage patch you can see if someone you need to talk to is at his desk, on the phone, or has a visitor". ⁴⁹

The failure of the landscaped office to facilitate communication appeared in a study by Clearwater (1980) ⁵⁰. The study focussed on the communication and interaction within and between departments after a move from a conventional to a landscaped office. After a three months period, communication and interaction had not shown any improvement, in fact they had significantly worsened. Staff were greatly disturbed, distracted, and dissatisfied. The problem got worse when confidential conversation was needed. Sundstrom (1980) has hypothesised that for people who are involved in routine tasks , social interaction could provide a source of stimulation and will act as a facilitator of job performance ⁵¹. Results showed that even in routine tasks staff preferred private spaces to more accessible work spaces. Job performance was higher in the more private spaces.

The findings of BOSTI (1981) showed that after staff change their office, those whose physical enclosure decreased did not report a greater ease in

communication (face-to-face related work) than those whose physical enclosure increased or remained the same⁵². Results obtained from the assessment of the ease of formal communication after changing to open plan (post-occupancy evaluation) were entirely inconsistent⁵³.

Becker (1981) suggested that the absence of walls is expected to enhance the performance feedback employees receive from each other, and to encourage staff to communicate in a more effective way, in order to resolve any conflict that could arise in the organisation ⁵⁴.

The study by Becker & et al (1983) on the impact of different office layout on work in colleges has revealed that there is more distraction and greater impairment of faculty work behaviour and faculty-student interactions in open as compared to closed offices⁵⁵.

However, evidence on the absence of barriers to support formal communication is very weak. Sundstrom (1986) has summarised some studies that are concerned with the evaluation of the ease of communication after changing to an open plan. He wrote:

"Of the studies that reported ratings of communication in general, two reported no change, and two reported an improvement. One other found the open office more "sociable". Another found more face-to-face conversation and more time communicating, but fewer phone calls and meetings in the open office. As for ratings of specific aspects of communication, contact among departments improved in one study, but friendship and feedback declined in another. Privacy for confidential conversation declined in three studies" ⁵⁶.

Physical enclosure and informal contact:

On the other hand, informal contact showed a stronger relation with physical enclosure. Gullahorn (1952) studied the informal interaction between employees

occupying three rows of desks separated by filing cabinets. His results showed that informal interaction took place mostly within rows.

The study of small group ecology by Sommer (1965, 1967 & 1969) has suggested that absence of interior walls and barriers in open plan offices facilitates the development of social relationships among staff, which in turn positively influences employee motivation and satisfaction ⁵⁷. Moreover, the study revealed that furniture arrangements has an impact on the level of interaction and friendship making. Openness in offices was defined by Gump and Ross (1977) as the ratio of total square footage of the office to the total length of the of its interior walls and partitions ⁵⁸. Therefore, offices with fewer interior boundaries are considered more open than offices with many walls and partitions. An old study (the detail of the study is missing) found that informal interaction is associated with visual accessibility. The empirical study was conducted on two executives occupying the same room, but one facing a door and one facing a wall. The study has concluded that visual accessibility promotes communication, presumably formal and informal:

"set up a test situation in an oblong room with the door off-centre in one of the long walls. The room was of ample proportions for two men. The two desk arrangements were identical and separated by a partition extending from the wall opposite the door. Into this situation were put two junior executives who were as equal as possible in their gregariousness and need for contact with other workers. In a short time... the one subject out of sight of the door began losing contacts... even the number of his phone calls dropped. The other subject experienced an increase in contact with others . When the subjects were reversed, so was their intercommunication."⁵⁹

Hatch (1987), in his study on two high technology firms in San Francisco, tried to investigate relationships concerning physical barriers, task characteristics, and interaction activities. Interaction was defined in many ways including work alone, work together, meetings, interruption, building relationships, socialising, phone and computer mail, breaks, and personal time. Results showed that partition height, number of partitions, and use of door or secretary were all positively associated with

one or more forms of interaction. The door variable contributed significantly to both working together and building relationships ⁶⁰.

In general, previous studies have established growing evidence of the role of the physical enclosure in influencing the level of interaction and communication, though others have not confirmed the relationship. The researcher realised that these studies have not differentiated between two aspects of physical enclosure; a) the visual properties of the physical enclosure, b) the spatial properties of the physical enclosure. However, this study claims that enclosure in its visual and spatial properties will have a different impact on interaction. The physical enclosure of the workplace may vary in its visual properties (i.e. glass vs. solid), but the spatial property of enclosure remains the same. Baker (1984) emphasised the role of visibility on interaction. His argument claimed that previous works have confused proximity with visibility. However, in his research on the impact of both visibility and proximity on peoples interaction around tables, he found that visibility is the strongest predictor of interaction and proximity could not explain the variance in interaction.

Interaction and the spatial properties:

Evidence of the role of spatial properties of workspace and their ability to support informal interaction is limited. The study by Campbell (1988) of twenty-five departments in a midwestern university investigated the impact of physical characteristics of lounges on the number of users and social interaction including informal communication. Thirty-two design features in lounges were hypothesised to be related to the use of the space. These included location on a major traffic way, on cross-roads, central locations, near classrooms, visual contact, availability of food, flow through traffic, seating, nearness to administrative offices, and so on. The conclusion of his study was that the physical design characteristics of lounges were of a great importance in predicting lounge use ($r = .39, p < .05$). Another finding was that the total number of design features was positively correlated with the variety of

observed activities and with the number of occupants observed engaging in some form of informal communication. ($r = .61, p < .01$; $r = .44, p < .05$, respectively). In his second study his main hypothesis was supported. Lounges with more of the desirable physical characteristics tended to be more heavily used. The most attractive design feature that was related to lounge use was *lounges located on major traffic way* ⁶¹. Such a finding highlights the role of spatial location in interaction. Steele (1973a), in his suggestion for the creation of gathering places to promote informal contact among employees, emphasised the "centralisation" of the activity, where people would naturally pass through it on their way to other places⁶².

Conrath (1973) found that face-to-face interaction among staff is more highly affected by spatial arrangement and proximity than by task or authority relationships ⁶³. The spatial arrangement, as shaped by the location of walls, partitions, furnishings, and other intervening barriers, affects work group cohesiveness and interaction with other work groups ⁶⁴. Parsons (1976) also realised that workers on the same floor are more likely to interact with each other than with those on another floor, since walking upstairs requires more effort and energy. Even using elevators will waste some of the staff time spent in waiting ⁶⁵.

The study by Weisman (1981) aimed to discover the relationship between the spatial characteristics of floor plans and ease of way-finding. The plan configurations were described in terms of five criteria. These were simplicity, preference, describability, memorability, and plan legibility. The study relied on a questionnaire distributed over subjects evaluating 10 sample settings of the University of Michigan campus. Results showed that simplicity is the highest predictor of way-finding ($r-sq = 56\%$). Familiarity was also a secondary predictor ($r-sq = 9\%$) ⁶⁶.

The impact of spatial accessibility on interaction has attracted much research. A study by Oldham & Rotchford (1983) examined the impact of architectural

accessibility as one office characteristic on employee reaction, including friendship making and interaction opportunity. Architectural accessibility in his work refers to the extent to which an employee 's individual workspace (e.g., desk) is accessible to the external intrusions of others ⁶⁷. Workspaces that were surrounded by walls or partitions were considered inaccessible , as the physical boundaries would limit behavioural and visual intrusions. His results did not reveal a direct significant relationship between architectural accessibility and friendship opportunity ⁶⁸.

Another aspect of spatial potential is the pattern of spatial structure. This refers to the nature of the pattern of space in terms of its complexity and size. Research in this area is very limited. This is mainly due to the ambiguity of methods used to describe the structure of spatial pattern. The limited understanding of the spatial properties and therefore the ability to develop a descriptive theory that describes the spatial and social relations, has hampered research in this area. However, Alexander (1965) in his early description of patterns of spatial structure in cities developed two approaches of structure (the tree, the semi-lattice) ⁶⁹. He argued that the old cities were structured in a semi-lattice pattern, whereas today's cities are structured in a tree pattern. In his view, the semi-lattice pattern is a more complex and subtle pattern compared to the tree. He ascribed the superiority of friendship and neighbourhood in old cities compared to today's cities to the basic differences in spatial structure. However, this is speculation and no empirical work has been conducted based on this concept. Vestal & Schnell (1986) studied the influence of environmental complexity and space on the social interaction of mice. The researchers used three types of mice and investigated the role of three different spatial environments on their encountering. Spatial complexity in their work was limited to numbers of boundaries within a certain spatial environment, which would only affect the size of arena (i.e. spatial enclosure) ⁷⁰.

Another theory which described spatial structure was the "space syntax" by Hillier & Hanson, (1984) ⁷¹. The theory has been used as a tool to describe the connection between space and society. Peponis (1983) used this theory to investigate the impact of local and global measures of space on informal interaction in factories ⁷². His results showed there is a positive relationship between the two measures of spatial system and informal interaction. As this area is considered the focus of the research, Chapter 4 is devoted to tackling this problem in detail.

The arrangement of facilities and creation of gathering areas:

Interaction among employees does not always take place in working areas. In fact, interaction takes place in non-working areas as well. These include corridors, photocopying rooms, cafeterias, mail rooms, locker rooms, and around water fountains, coffee pots, vending machines, or bulletin boards. These are places where people meet casually. Studies on gathering places have always suggested creating an "*activity node*". This concept suggests creating places where people's paths cross during their regular daily activities ⁷³. Some characteristics of gathering places that could support interaction were summarised by Steele (1973a) as follows:

"One is that it be central-that is, that people would naturally pass through it on their way to other places. A second is that there be places to sit or come to rest comfortably. Third, people need to be able to stop there, and converse or watch others, without blocking the flow of vehicular or foot traffic by their stopping. As I recently observed, a bulletin board in a busy narrow hallway is almost useless, since no one can stop there long enough read it or chat with others about the notices without clogging up the whole hallway".⁷⁴

Wicker (1979) has summarised Bechtel's view regarding gathering places and the creation of focal points into five criteria. He wrote:

"1. Choose central locations that are easily reached by all occupants of the building. 2. Locate necessary and well-attended functions near the intended focal point, so that it is at a cross-roads of traffic. Proximity to mailboxes, coffee pots, restrooms, and supply rooms could be helpful. 3. The intended focal point should be a voluntary setting where people are free to come and go. It should not have an important official function that requires commitment from the occupants. 4.

Minimize visual barriers. Keep the setting open on three sides. Make it easy for people passing by to see who is there. 5. Provide comfortable seating that will allow people to converse in groups of variable size and will allow them to observe the traffic flow."⁷⁵

Empirical research in this area is still limited. Markus (1970) surveyed the opinion of 20 teachers in connection with their habit of space use. Staff were observed to have their coffee away from the 'staff room' and in different locations of the building. Some staff did not see each other for more than a year. The 'staff room' failed to act as a successful gathering space because most of the staff thought that it was small and far from classrooms, despite its central location ⁷⁶. Mehrabian (1976) has observed the use of a lounge in one small company. The lounge was regarded as a place for common use and relaxation. He realised that the lounge was almost never used because employees felt reluctant to be seen relaxing and socialising with others. The other reason was that the lounge was furnished as a formal living room ⁷⁷.

3.4. The connection between physical settings and the organisation.

Becker (1981) claims that organisational theorists are more concerned about work in organisations in their social situation rather than their physical settings. Such a misconception becomes worse when, for analytical or methodological purposes, the physical environment is separated from social behaviour, and job design is separated from social context. He wrote:

"A cake can be described in terms of its separate elements; flour, butter, sugar, eggs; but to know anything about cake, one needs to know how these elements interact, especially under different environmental conditions". ⁷⁸

The broad question that will be investigated in this section is whether there is a connection between physical settings and organisations. It is indeed a critical question that needs further investigation as to the nature of the relationship that links people with physical settings. Churchill wrote:

" We make our buildings, and afterwards our buildings make us". ⁷⁹

Duffy (1974a) described the relationship between man and building as reciprocal ⁸⁰. Such a definition was obtained since there is always an overlap between factors that shape the design choices and the way in which people perceive and respond to design. The study of the relationship between buildings and people in research is getting more difficult, since the design decision in the physical environment is not exactly a mirror that reflects people behaviour. Such a problem was studied by Rapoport (1969), where he described building design as 'low criticality'. Duffy (1974a) explained this term as follows:

Generally several solutions are possible , all of which satisfy the basic physical requirements of controlling temperature, excluding rain, etc. and which all meet basic user requirements for convenience, space, and essential adjacencies. Once a fit has been provided between design and these simple 'critical' requirements and once economic and technological problems have been solved, an area of 'slack' is available within which design decisions are a matter of expression of values; conveying meanings, indulging whims, or simply of being arbitrary . It is obvious that design consists of manipulating several environmental properties in a hierarchy of decreasing criticality. From a research point of view low criticality means that the relationship between buildings and people is a wide ill-defined field which can be studied in as many ways as there are branches of social science-from cultural anthropology to the boundaries of clinical psychology-but with little chance of clear-cut success"⁸¹

Trickett (1990) argued that no two organisations are alike. He suggested that although some successful organisations seek different ways of management, which proves that there is no one best way to manage, they are similarly idiosyncratic in their physical settings ⁸². Such a suggestion supports the connection between physical settings and organisations. The hypothesis of congruence between building and people was studied by Michelson (1970).He suggested that people tend to create an environment congruent with their activities and that buildings incorporate characteristics consistent with the activities of occupants ⁸³. Furthermore, the theory of sociotechnical systems suggests that the effectiveness of organisations is enhanced

when their technological components, including buildings, go along with both social and psychological elements ⁸⁴. The above evidence confirms the connection between man and building. Such evidence has led researchers to focus on the role of the physical environment in responding to people's needs.

The concern of several studies in this matter is to define the dimensions on which the internal physical environment of the workplace can affect organisations. Throughout the literature review, the researcher came across several approaches that described the impact of the physical settings on organisations. The researcher found that it is worth-while to review the approach of every study separately.

Gutman(undated) has described eight dimensions of the physical environment that can affect behaviour. These are ; the location of facilities and structures (spatial organisation), circulation and communication, physiological and psychological functions of humans (ambient properties), visual properties, facilities built in the environment (amenities), social values, attitudes, status, and cultural norms expressed by the environment (symbolic properties), and aesthetic properties ⁸⁵. Steele (1973) has described six basic dimensions that represent the various functions of physical settings. These are: *shelter and security*, *social contact*, *symbolic identification*, *task instrumentality*, *pleasure*, and *growth* ⁸⁶. Steele developed these dimensions based on the "functionality" of the settings. *Security and shelter* is related to harmful and unwanted stimuli in one's surroundings. *Social contact* is concerned with the arrangement of facilities and spatial layout in supporting face-to-face contact among the member of organisation. *Symbolic identification* refers to messages sent by settings to tell what an individual or a group is like. *Task instrumentally* refers to managing and arranging all facilities in the setting to support task activities. *Pleasure* is concerned with how much a certain setting makes its users pleased and happy. *Growth* refers to the stimulus for growth the setting gives to the user. Although in this definition the six dimensions appear to perform discrete functions independent of

each other, Steele has strongly stressed the interconnections among these functions. He claims that a setting often promotes one function because it affects another function positively ⁸⁷. For example, a setting that provides *pleasure* could also enhance *social contact* and *task* output.

Pfeffer (1982) described the internal physical environment with six dimensions ⁸⁸. These are: *size, quality, flexibility, arrangement, privacy, and location*. *Size* refers to the scale of the organisation and therefore the size of facilities required to run the organisation. *Quality* refers to the *well-being* of the settings and its standard. *Flexibility*, is related to the degree to which certain settings allow changes over time. *Arrangement* is concerned with the way the facilities are laid down, such as type of spatial layout. *Privacy* refers to the degree to which a certain setting provides the desirable level of privacy for its user. *Location* is related to the physical location of staff inside the settings, such as in the centre of the building, on the main corridors, on the edges of the building and so on, as this could affect the level of social contact among the staff. In another study Becker (1981) suggested that there are :

"alternative ways of thinking about the design, management, and evaluation of physical settings in complex organisations that are in keeping with trends towards increased democratization" .⁸⁹

Such an approach necessitates focussing on the physical settings of organisations in conjunction with business and public administration, environmental psychology and design, and organisational behaviour.

Davis (1984) claimed that there is a misinterpretation in the way the internal environment is perceived ⁹⁰. He claimed that these previous approaches explain the benefits that the physical environment provides for organisation members, and they do not differentiate the features of the physical environment to which these properties belong. Davis has defined three dimensions of physical settings that can influence

organisations. These are: *the physical structure*, which includes building design and physical location, furniture and seating arrangement, and open vs. closed offices; *physical stimuli*, including removing and introducing physical stimuli, and ordering or blocking out physical stimuli; *and symbolic artifacts*, which include professional image cues, status cues, task effectiveness cues, and aesthetic cues. He claimed that these are the main constituent features of the internal physical environment that are likely to have a pervasive effect on managerial behaviour in organisations. The physical structure was described in the way physical settings could affect social interaction among members of an organisation (see previous section on the role of physical environment).

The second dimension, the *physical stimuli* which are generated by physical settings, was defined as aspects of physical settings that intrude into a manager's or organisation member's awareness and influence his or her behaviour. Davis has urged people to think of all kinds of stimuli that can be initiated by telephone calls, desks of others, messages over intercoms, the smell of the coffee, or cigarettes, printers and so on. Luthans & Davis (1979) and Davis & Luthans (1980a) examined the ways in which the presence or absence of stimuli in the environment controls managerial behaviour and how managers can make use of these stimulus to increase their productivity⁹¹. The time has come when managers should remove all stimuli that cause interruption and distraction to their work. Most managers get frustrated with the amount of paper that collects in their office. Davis & Luthans (1980a), in their study of an advertising manager of a newspaper, found that the manager was unaware of the different categories of paperwork that reached his office⁹². The large amount of paperwork he received ended up in piles of papers around his office. He was continually distracted since he was not able to pick up the desired paper from these piles. In this case, the manager was able to eliminate the amount of interruption by limiting the amount of paperwork that entered his office, or assigning the task to his secretary to hold or reroute some of these papers. Furthermore, the manager tried to

inspect most of the paper on his secretary's desk. On the other hand, Davis (1984) mentioned how to introduce physical stimuli that have desirable responses in managers⁹³. He claimed that in some offices, nothing in the settings help the manager to remember what to do. In case of the advertising manager the "in-out" was placed to cue the needed response, and a magnetic disk to indicate time of his return.

The benefits of the introduction of physical stimuli cues in offices were determined in the study by Davis & Luthans (1980a) and were used to help reduce time spent on the telephone by managers, the tendency for managers to leave their office and give assistance to the other staff, and the tendency to meet the supplier's sales representatives who walk in without an appointment. In other words, when staff work in a distracting environment, they are used to using the physical stimuli to overcome the effect of other physical stimuli and to remember what to do. This happens through using diaries, notes, memo and so on⁹⁴. In spite of this fact, some physical stimuli may let managers block them out. This takes many forms. Davis (1984) mentioned that managers should quickly know which paper goes to the waste basket, filing cabin, tickler file, or other people. Other stimuli may disturb other staff in the same office, such as telephones ringing, movement, and background noise. The introduction of information technology where a large number of staff sit in front of the VDUs for quite a long time may cause eye strain, and employees are asked to get a regular break to rest their eyes⁹⁵.

The last dimension of the physical settings defined by Davis was *symbolic artifacts*. This was defined as the physical settings that individually or collectively guide the interpretation of social settings. These include type and style of furniture, wall colour, signs inside the office, posters, absence or presence of carpet, and so on. Davis has categorised the impact of this dimension into four aspects. These are professional image cues, status cues, task effectiveness cues, and aesthetic cues.

The professional image cues are apparent when the physical settings in organisation contribute to transferring a certain image about the company. For instance, certain organisations like banks and insurance companies tend to have their offices and furniture in a formal design so as to give more trust to customers, whereas the interiors of advertising companies tend to be very informal, unconventional, and innovative in keeping with the creative product they sell ⁹⁶. The location of the building with respect to the city could also participate in giving the organisation a special image.

Becker (1982) has described the images that offices can convey. His classification is based on the type of activities and functions that take place inside the office ⁹⁷. Three types of offices were identified according to the type of function. These are creative offices, administrative offices, and client-centred offices. The creative offices are needed for creative professionals such as artists, architects, fashion designers, and so on. The physical settings of creative offices should provide the creative professionals with a creative atmosphere that help them to stimulate their imagination and thinking. Administrative offices are mainly for members of organisations that perform business activity. The main issue in these offices is efficiency and the ease of information exchange. The concern about the image that the physical settings could convey is minimal. Client-centred offices are needed for professionals that deal with clients such as lawyers, dentists, bankers, physicians, and so on. Most of these offices try to convey the image of care, confidentiality, comfort, and security.

The status cues were described as differences in the physical settings among different members of staff. The differences in the physical settings perform an important symbolic function that help reinforce the nature of the social order in organisations. The size of workspace, quality of furniture, location, facilities, all could

participate in addressing images that would affirm the differences in hierarchical positions ⁹⁸.

The task effectiveness of cues is related to the task-related messages that offices send to other people. The tidiness of a person's office will tend to have a positive influence on visitor's attribution and perception of the office occupant; whereas a clutter and disarray will tend to produce a negative view of that person ⁹⁹. The image of an office where the paperwork is scattered everywhere in piles could mean that the occupant is totally disorganised, or the amount of work assigned to him is quite high. In the same way, a clean desk could mean that the person has finished all his work, or he does not have enough work to do and needs to be given extra work. The person that stays in his office after working hours could create a certain image about this staff. In fact these symbolic cues are very ambiguous and could be interpreted in different ways. Managers need to be aware of the impression they create and avoid presenting physical cues that can have negative or contradictory connotations ¹⁰⁰.

The last aspect of symbolic artifacts is aesthetic cues. This has to do with the quality of the environment. The colour, the type of furniture, the nature of light, and so on, all generate different images in organisations.

Having reviewed some of the works that investigate the role of physical settings in organisation, it is worthwhile to refer to the definition of 'criticality' in design which makes the study of the people-building relationship quite ambiguous. Duffy (1974a) described 'criticality' as the scale on which the importance of these dimensions can be measured ¹⁰¹. For some people spatial properties are the most critical, for others facilities and amenities are the most critical. Although certain properties seem to be critical to organisations, such as space and facilities, these could be easily valued by designers and surveyors. On the other hand, some properties like

symbolic artifacts have established their criticality from not only the difficulty in measuring them, but also from the unawareness of both designers and users to think about them.

Further studies tried to describe the impact of organisational structure on the physical properties of the workplace. Duffy (1974b) studied two types of organisations and tried to investigate their impact on two types of physical layout in the workplace ¹⁰². Bureaucracy and interaction were the two organisational variables that were studied in conjunction with differentiation and subdivision as two measures that can describe the physical layout of the workplace. Duffy's hypotheses were: 1) highly bureaucratic organisations are positively associated with highly differentiated workplaces. 2) highly interactive organisations are negatively associated with highly subdivided workplaces. Although Duffy's study has increased the concern with the relationship between organisations and physical settings, his classification of organisations into "bureaucratic" vs. "interaction" and the physical layout into "differentiation" vs. "subdivision" is very limited. The findings of this study will be discussed in detail in Chapter 4. Sundstrom (1986) has criticised Duffy's approach. He wrote:

"Duffy's hypothesis apparently used over-inclusive dimensions of organisational structure. The elements of bureaucracy included several important structural dimensions, each of which could be related to different features of the environment".¹⁰³

An alternative hypothesis was developed by Sundstrom (1986) where he referred to eight dimensions of organisational structure (size, technology, configuration, interdependence, specialisation, centralisation, formalisation of roles, and standardisation) and claimed that each structural dimension of an organisation is reflected to one or more physical properties of the workplace in a way that the physical structure is congruent with the organisation ¹⁰⁴. For instance, as size is related to number of people and assets, this could affect space in the amount of floor

space in a building. Technology could affect the proportion of space devoted to machinery and equipment. Configuration i.e. size and number of work units and the hierarchical structure will affect location, enclosure, and physical boundaries in addition to differentiation among different groups according to their status. Interdependence may affect proximity of work units. Specialisation, i.e. number of different jobs, may create designated areas for different tasks. Centralisation, i.e. authority in decision making, might affect the uniformity of workplaces. Formalisation of roles includes role-specification which could affect differentiation among workplaces. Standardisation could influence the rigidity of layout within buildings and work units ¹⁰⁵.

Another study by Trickett (1990), described the physical layout of the offices as a hidden dimension since each organisation should develop the most efficient and effective layout that responds to its needs ¹⁰⁶. Trickett identified three measures of differentiation in organisations. These are authority system (i.e. concentrated vs. dispersed), working procedure (i.e. participative vs. individual), and interpersonal style (i.e. formal vs. informal).

All the previous approaches have identified certain dimensions that describe the role of physical settings in organisations. Although the approaches vary slightly in specifying the key dimensions of the physical settings, all have confirmed the influence of the organisation on shaping the physical settings. The researcher considers that some of these approaches, like the ones by Steele and Pfeffer, are very limited and discrete. As mentioned by Davis (1984) both approaches have described physical settings in terms of the benefits that they provide, rather than identifying aspects and facets of the physical settings that create stimuli which are perceived by their users. In the meantime, the Steele, Pfeffer, and Davis approaches have not expressed these dimensions in the management context. What the researcher thinks is that the effects of physical settings in offices are so complex and interrelated to each other, that a

certain setting could generate conflicting stimuli .In this respect, generating a conceptual framework that explains the process, rather than discrete dimensions, in which the physical settings operate could be worthwhile. Recent studies in facilities management have sought this approach. This will be examined in detail in Chapter 5 with a deep focus on the relationship between physical settings and the social process in organisations in the management context. The aim of this review is to indicate that previous studies have established a connection between physical settings and their influence in offices. It should be kept in mind that this review examined the physical settings in organisational behaviour so as to establish a broad base that enables the researcher to focus in a consistent manner on the problematic area of the research which deals with the impact of the physical settings on interaction activity in organisations.

3.5. The state-of-the-art in Saudi Arabia.

The office industry in Saudi Arabia has passed through a remarkable stage. Over the last two decades changes have created a startling boom in the economy. The government sector has been affected by this boom more than the private sector. This was mainly due to the sudden increase in the country's revenue as oil demand, production, and price were at its peak. This was reflected in the millions of dollars invested in the office industry.

The governmental organisations are classified under a number of different ministries. Each governmental organisation has developed a design team responsible for the provision and management of the required space. This design team consists of a number of architects and engineers whose decisions are always linked with top management. In fact, the team is not always the actual designers, but its main responsibilities lie in three activities: the formulation of a design brief in conjunction with top management; carrying out the bidding process; and practising the "feed-back" process with the actual designers. The team usually makes the bidding and asks

all the capable consultant offices to participate. Most of these consultant offices are in Europe or America; some are local.

As both privacy and interaction are needed, the translation of the need for privacy or interaction into layout is limited to the solution of either the open plan office or conventional plan. The majority of governmental offices are adopting the conventional plan with individual rooms of different sizes for single and multiple occupancy. Figures that represent the percentage of conventional vs. open plan offices in the whole country were unavailable. The researcher took a random sample of 22 offices belonging to seven ministries in the city of Jeddah; 86% of these offices (19 offices) were conventional plans. The reason for adopting the conventional layout has not been found in any of the design briefs. But in an interview with 13 architects in seven different design teams belonging to different governmental organisations they claimed that they believed (along with the top management) that the conventional layouts could provide employees with better privacy and would respond to the differentiation between staff according to the hierarchy of authority structure ¹⁰⁷. Furthermore, the provision of rooms of different sizes will allow staff under similar organisational divisions (i.e. departments) to be accommodated under the same spatial enclosure (i.e. room).

In an inquiry into their view about the need and importance for interaction, they believed (along with the top management) that interaction is vital and worthwhile, but they believe that privacy will not be compromised in favour of interaction, as they believe that it is difficult to achieve the desirable level of interaction and privacy simultaneously. The interview also revealed that designers could only solve the problem of privacy vs. interaction through the physical enclosure of the workspaces. No other design criteria was in the agenda. The researcher investigated in the interview the responses of the members of the design team concerning their perception of the role of spatial morphology of the workplace in effecting informal

contact. The members of teams believe that the spatial morphology could affect the pattern of interaction but they were unaware of how it could happen.

On the other hand, the adoption of an open plan layout was found in three governmental organisations. These are some of the Saudi Telecom offices , SAMA (Saudi Arabian Monetary Agency), and SAUDIA (Saudi Arabian Airlines). These organisations have adopted the open plan layouts based on their expectations that the open plan could cope with any future changes in the physical layout of the workplace. Other important criteria are based on the assumption that an open plan could enhance industrial relations through the ease of communication among staff to support work-related activities and increase organisation effectiveness. Generally speaking, the Saudi organisations' experience with the open plan is not encouraging. This was confirmed when Bin-Ladin, the biggest contracting company in the Middle East constructed the governor building for Makkah province with an open plan layout. Just after six months of occupation almost 70% of the plan was converted to private offices. This happened because staff experienced a high deterioration in the level of privacy. Another experience was with Saudi Telecom, when most of the open areas in their offices were converted into conventional offices.

The adoption of a conventional layout in most of the Saudi organisations has hampered the opportunity of informal interaction among the staff. This was confronted by the pilot study to diagnose the problem by questionnaire, distributed to 87 subjects in four offices (Samarec head quarter, Samarec administrative building, Saudi Telecom headquarters, and the Municipal and Rural Affairs office) ¹⁰⁸. All of these offices are located in Jeddah, except the last office in Makkah. These four offices are conventional offices except, Saudi Telecom where it is an open plan. The questionnaire investigated employees' satisfaction with the level of both informal interaction among each other and the maintained level of privacy. Results were as expected. 85% of the employees in the conventional plan were dissatisfied with their

informal interaction opportunity, whereas 73% reported their satisfaction with the level of privacy. On the other hand, in the Saudi Telecom (an open plan office), 8% of the staff were dissatisfied with the informal interaction opportunity and 68% of the staff were dissatisfied with their level of privacy.

These results showed that staff in the conventional plan are dissatisfied with informal interaction and staff in the open plan are dissatisfied with privacy. The researcher has also investigated the importance of both privacy and interaction to workers. 92% of the staff perceived privacy as an important criterion in workplace, which is required to perform their tasks. 79% perceived interaction as an important feature related to the social atmosphere of the organisation and the formation of friendships. 65% of the staff perceived informal interaction as an important feature in the workplace that would support the process of information exchange and improve organisation performance through the discussion of ideas and opinions.

In brief, conventional layouts were found to hamper the level of interaction among staff, though they provide a satisfactory level of privacy. In the meantime, the open plan in Saudi organisations has not been accepted in some cases, though employees experience better interaction but low privacy. The researcher believes that the need for interaction in Saudi organisations would not be solved by the physical enclosure through the open plan. As Saudi organisations are adopting the conventional layout, it is believed that the level of interaction could be enhanced through the spatial structure of the layout.

3.6. Summary.

Apparently the role of physical environment as a support to human and organisational needs is quite well-reported in the literature. However, the physical features of the workplace have become a significant aspect that contributes to employees' satisfaction and productivity. The chapter aimed to explore the connection

between the physical features of the workplace and the level of interaction, in order to reveal aspects of the physical environment that are important to interaction. The effect of the physical environment is extended beyond the support of the formal processes in organisations. This happens when the physical environment regulates and controls human behaviour in a way that generates informal processes that are not in the agenda of design. Thus, an informal social dimension in organisations is established.

In summary, aspects of the physical environment that are found through the literature to influence the level of interaction are limited to physical enclosure and proximity. However, the study here developed two aspects of physical enclosure that are significant to interaction. These are the visual accessibility property of enclosure, and the level of enclosure (i.e. number of enclosed sides).

The design solution for office layout in Saudi governmental offices was limited to the conventional office type. This is due to the need for privacy and the ability of this kind of layout to express the hierarchical structure of status among staff and the provision of the desirable level of privacy. In the survey, employees express their dissatisfaction with the level of informal contact among each other. The management was aware of the importance of interaction, but they were unaware of other measures in the physical environment to support interaction. As the open plan layouts have not been accepted in some Saudi organisations, the researcher believes that physical enclosure would not respond to Saudi need for interaction. Instead, Saudi organisations could use the potential of spatial structure to support the desired level of interaction without jeopardising the level of privacy.

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- ⁵ Pile, J., 1978, op. cit., p.19.
- ⁶ Ibid. p.19.
- ⁷ Ibid. p.21.
- ⁸ Ibid. p.21.
- ⁹ Ibid. p.21.
- ¹⁰ Ibid. p.21.
- ¹¹ Ibid. p.23.
- ¹² Ibid. pp.23-24.
- ¹³ Landscape office is a large open space characterised by random scrambled layout. Workspaces are arranged in the pool area in irregular patterns with no visual separation at all.
- ¹⁴ Pile, J., 1978, op. cit., p.24, 27.
- ¹⁵ Ibid. p.27, 29.
- ¹⁶ Ibid. p. 29.
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108 See appendix for the questionnaire

CHAPTER: 4

THE SOCIAL DIMENSION OF SPACE

4.1. Overview

The spatial dimension of the workplace is another aspect of the concept of the total workplace. The study is concerned with the spatial dimension in organisations for several reasons: a) Although some research highlighted the importance of the spatial dimension in social organisations, studies that investigate the relationship between the patterns of space and the patterns of society are still limited; b) there is a lack of descriptive technique to evaluate the spatial structure; c) the expectation that the understanding of the nature of the relationship between space and its occupants will provide a potential scope to manage and control the social pattern of staff. Research that is concerned with the investigation of the connection between space and its society have been confronted with several difficulties. The problem is twofold. This is simply because there is no society without space, and no space without society.

The aim of this chapter is to establish a connection between space and social behaviour, as to examine how informal interaction among individuals can be affected by virtue of space. Prior to the creation of space, society tends to dictate its behaviour requirements and then shape space accordingly. But after post-occupancy, space starts to control and regulate the social behaviour of its users; in some cases it meets the targeted social needs, but in most cases social behaviour deviates from what is expected. This occurs mainly because of the failure to understand space in its social pattern and society in its spatial pattern. In offices the society consists of groups, and these groups consist of individual workers. Organisations need space to occupy their staff under certain conditions governed mainly by the structural dimensions of the organisation. This space will therefore reflect one or more aspects of the organisation. In order to investigate how informal interaction could be influenced by virtue of space, the chapter discusses in detail the nature of the connection between spatial and social patterns. This implies the revision of some theories of space and society. The

spatial dimension of the organisation is highlighted. Finally, the theory of space syntax was adopted in this study as a descriptive tool for spatial pattern.

4.2. Social pattern and spatial pattern

The relation between society and its spatial form has always been associated with different difficulties. Theories that try to describe the spatial form in its social pattern and the social form in its spatial pattern have always been confronted with some difficulties. Hillier & Hanson (1984) have described such difficulties in two ways:

"First, there is no consistent descriptive account of the morphological features of 'man-made' space that could be lawfully determined by social processes and structures. Second, there is no descriptive account of the morphological features of societies that could require one kind of spatial embodiment rather than another."¹

Hillier & Hanson have referred this lack of progress to the way space is being conceptualised, specifically to its physical domain where society is embraced. The paradigm of the relation between space and society will be more appreciated if we conceptualise space without social content and society without spatial content, yet one cannot exist without the other ².

An early example of the of the pattern of spatial structure was reported by Alexander (1965). He was concerned with the nature of the spatial structure of cities. His dilemma was focussed on describing natural cities in term of a semi-lattice pattern and artificial cities in term of a tree pattern (Fig. 4.1) ³. Alexander explained that people and especially architects preferred old buildings and ancient squares and piazzas to new buildings and modern cities because of a failure to conceive certain spatial-social structures. He believed that natural cities have the semi-lattice pattern, while the artificial cities have the pattern of a tree. The semi-lattice pattern was defined as when the structure meets certain conditions, whereas the tree pattern was defined as when the structure meets other more restrictive conditions. Further explanations for the two patterns were:

"A collection of sets forms a semi-lattice if and only if, when two overlapping sets belong to the collection, then the set of elements common to both also belong to the collection." "A collection of sets forms a tree if and only if, for any two sets that

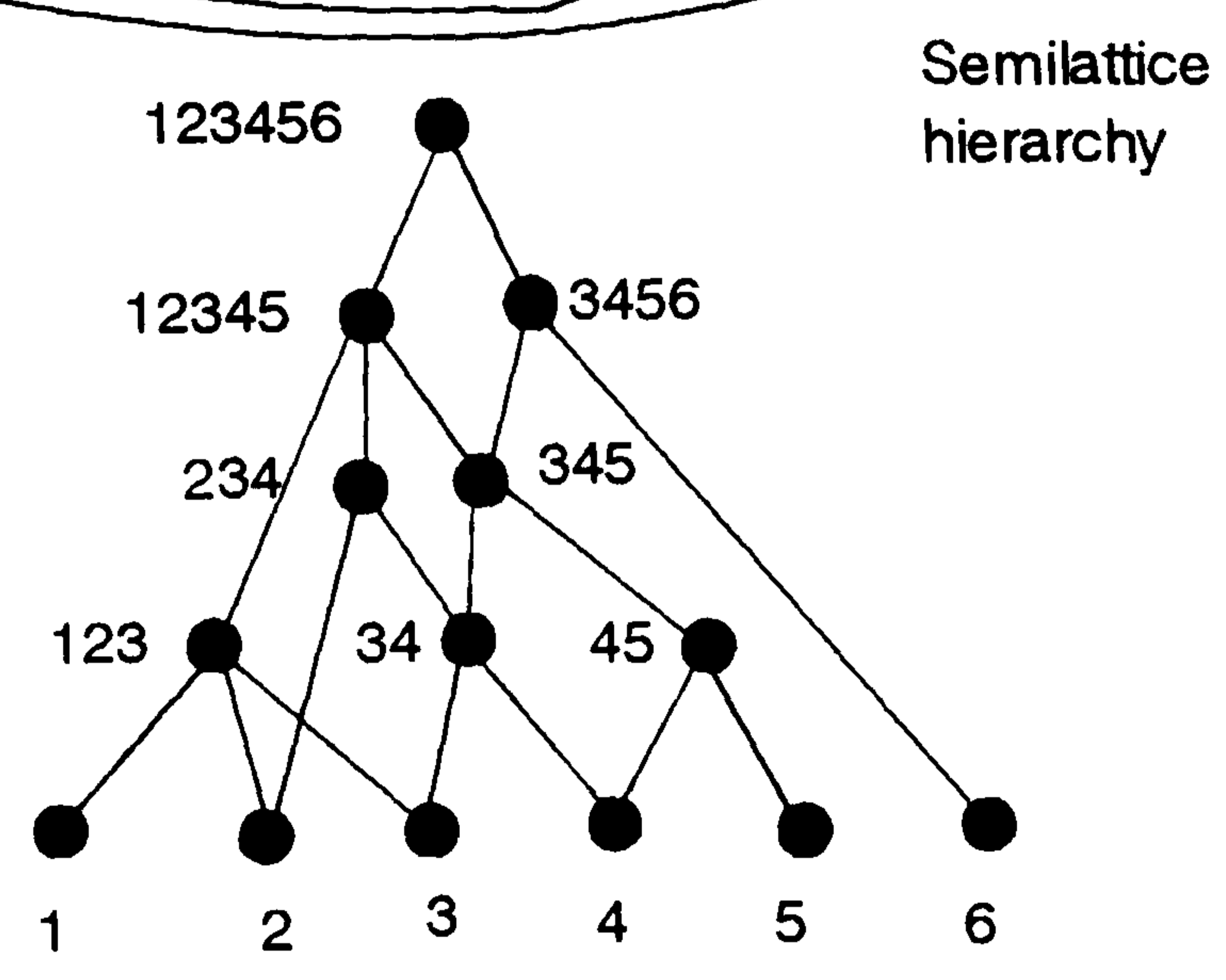
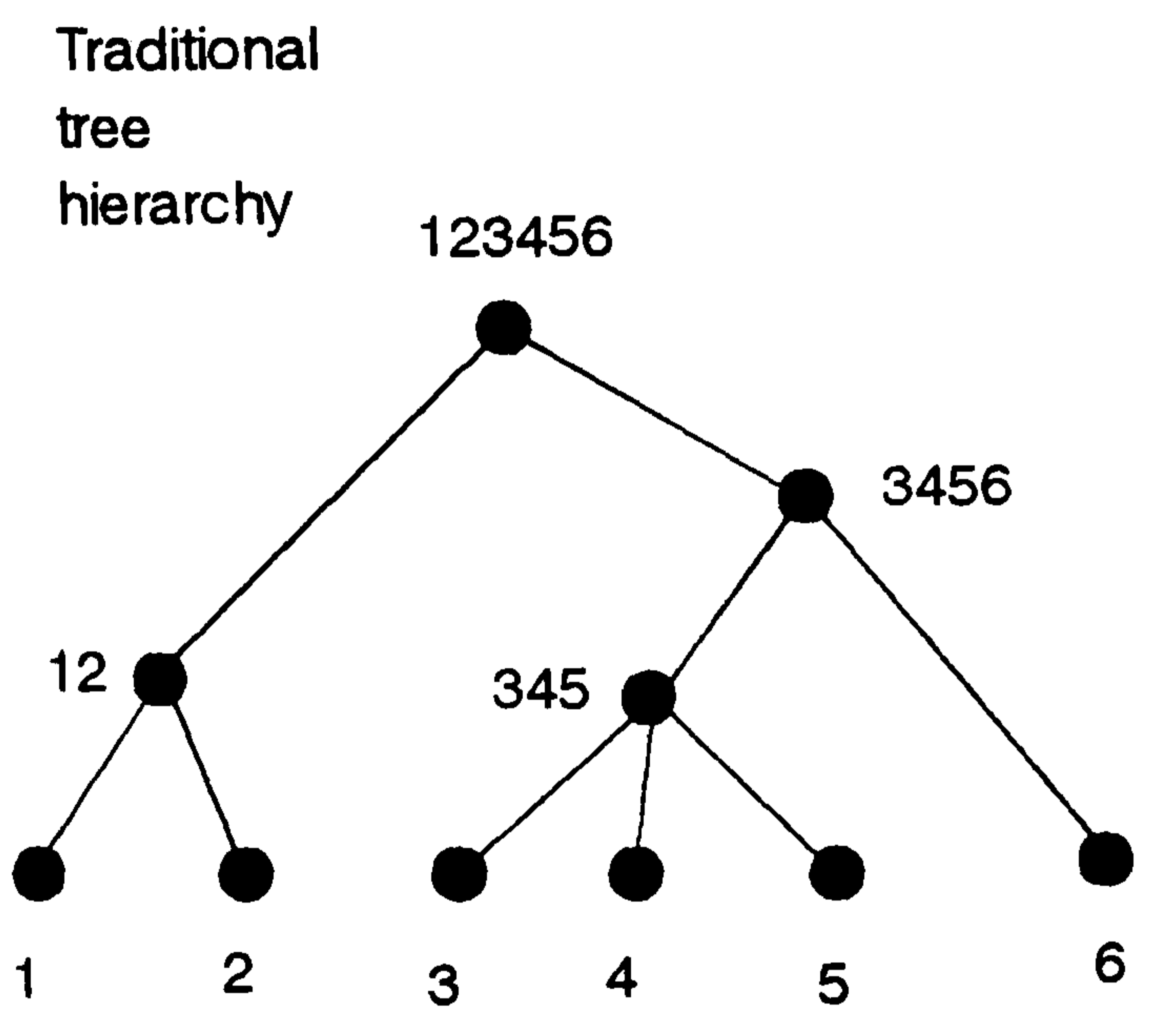
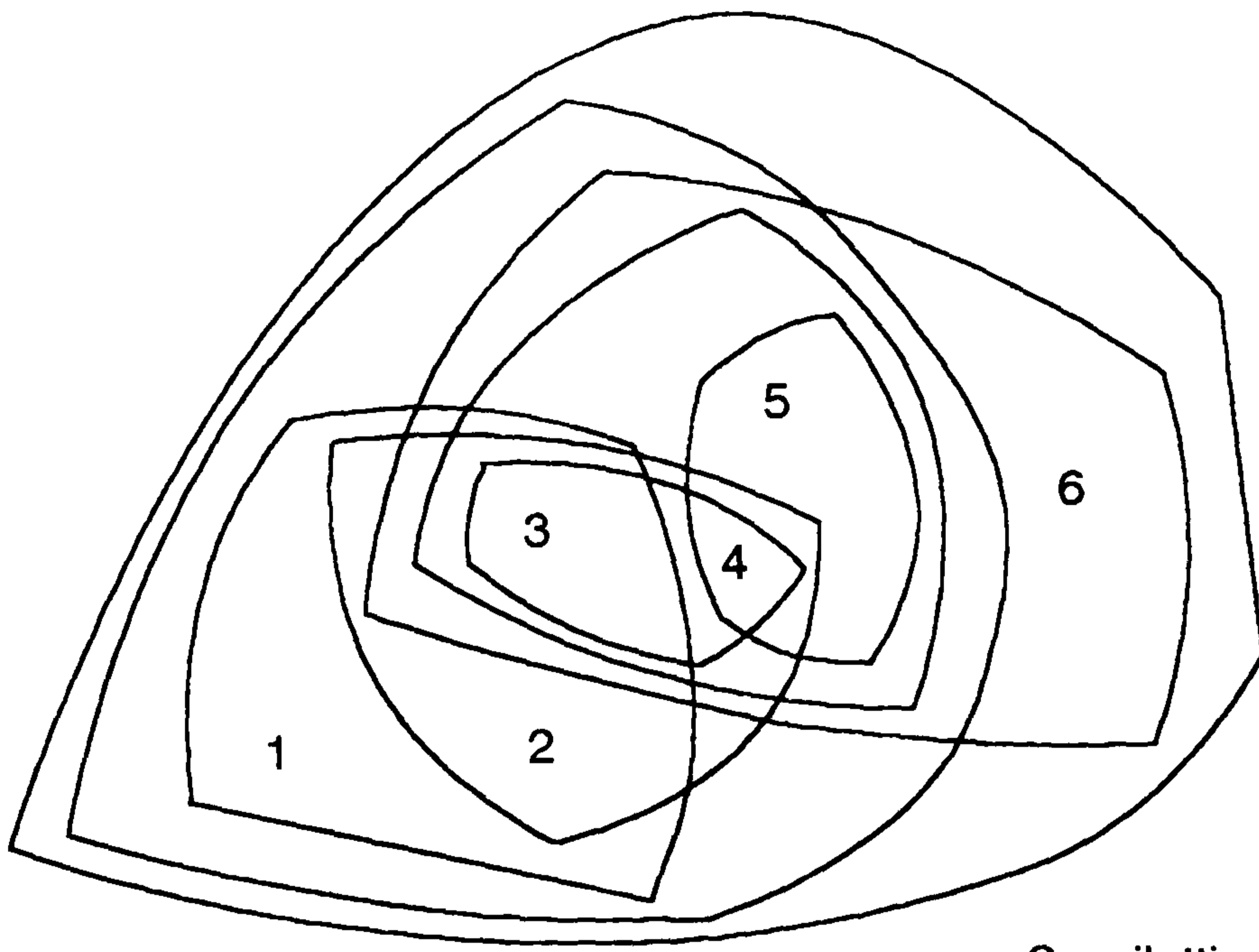
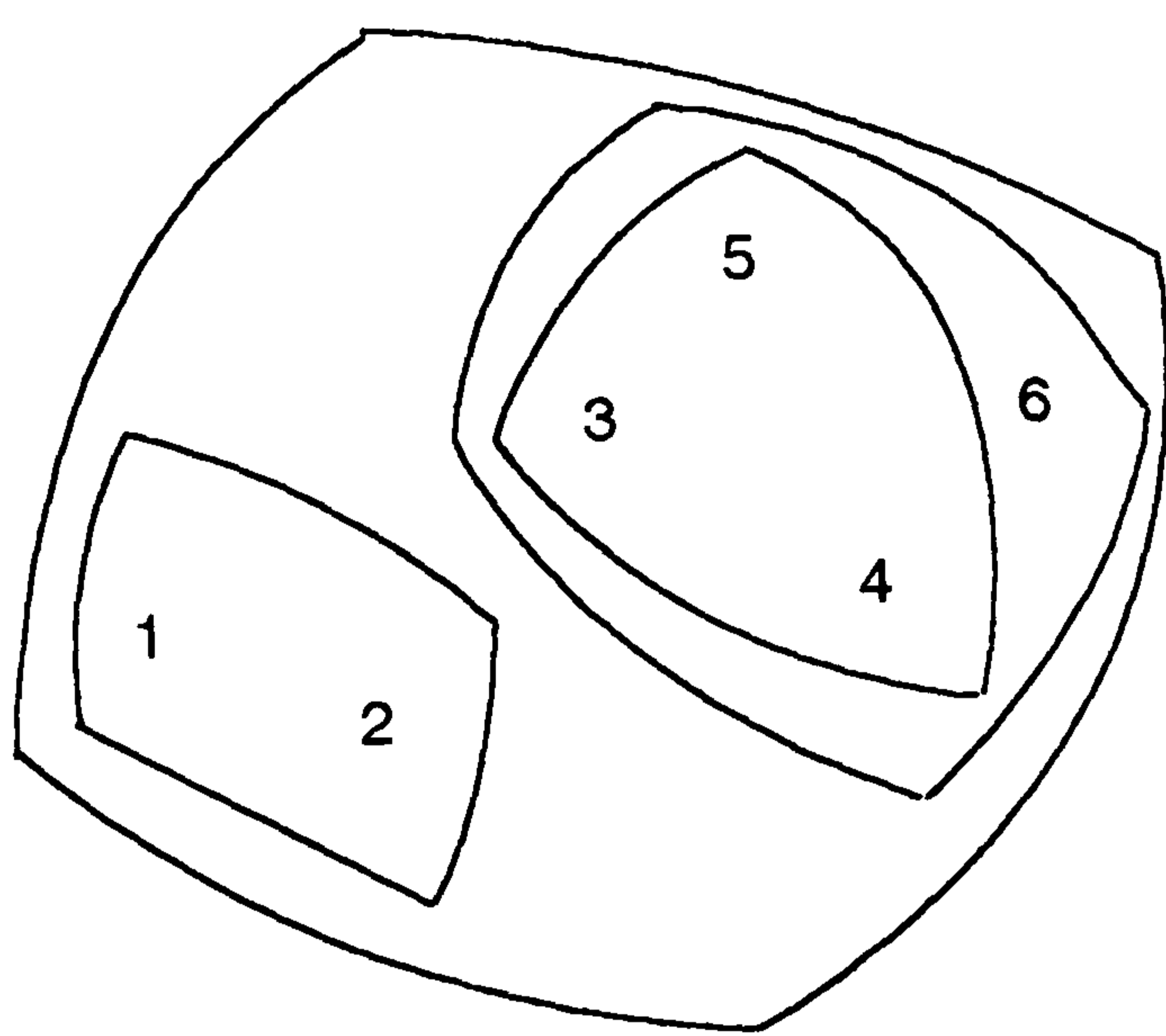


Fig. 4.1. Traditional tree hierarchy and Semilattice hierarchy

Source: Alexander, C., 1965, p.59

belong to the collection, either one is wholly contained in the other, or else they are wholly disjoint."⁴

The researcher thinks that the way in which Alexander criticised the formation of hierarchical spatial structure in design is too inclusive. In other words, his suggestion of conceiving spatial structure in a semi-lattice pattern would eliminate an important facet of space structure i.e. the hierarchical structure. The researcher argues that a compromise is inevitable in this case. This will be clearer once we realise that society is the content of the spatial structure. When the social structure of people adopts the idea of hierarchy, their spatial pattern should be so. Hillier & Hanson's view of Alexander was:

"Alexander's notion of a pattern is too bound to the contingent properties of configurations to be useful for us; while at a more abstract level, his preoccupation with hierarchical forms of spatial arrangements (surprising in view of his earlier attack on hierarchical thinking in 'A city is not a tree') would hinder the formation of non-hierarchical, abstract notions of spatial relations which, in our view, are essential to giving a proper account of spatial organisation."⁵

Stone & Luchetti (1985) have taken Alexander's concept of (*tree vs. semilattice*) to generate a kind of layout in offices that would respond to the complex needs among teams in the organisations. They wrote:

"The translation of the tree and semilattice hierarchies into office layouts is straight forward....when a conventional tree structure is described by a Venn diagram, as on the left, the result is cleanly nested areas and subareas with people located close to their coworkers and supervisors.- a planner's delight. But when a semilattice structure is described by a Venn diagram, as on the right, team overlap is taken for granted and each area assumes a complexity exceeding even that of the Quickborner crazy quilts." ⁶

An early approach by Atkin (1974a,b) focussed on describing the structural pattern in architecture and urban design. His aim was to define the term *structure* and how it can be used in the context of social science. This was undertaken by developing a mathematical based language of structure. The mathematical language is

concerned with the study of relations between finite sets; thus any complex could be described in its relations and this could be represented either as geometrical structure in a multidimensional space or as an algebraic subsystem. The method of describing structure was based on both the local and global properties of various complexes. Such concepts of both *connectivity* and *structural forces* were studied in connection with the *hierarchical system* of the complex ⁷.

Another approach to describing spatial structure is 'shape grammars' by Stiny & Gips (1978). It is concerned with the abstract generative principles of spatial patterns. Rules which govern different geometrical shapes are the basis for generating the whole structure ⁸. This will provide a systematic descriptive approach to analysing the nature of any spatial structure in its basic geometrical forms. The approach could find some difficulties in describing irregular patterns of spaces, as these spaces are refined so that they refer to the closest regular geometrical form. Under this refinement, spaces could lose some of their characters and entity. In this case, spaces will no longer exist in their real morphological patterns, which might cause biases in the understanding of the social pattern.

The problem of space and society could be conceptualised if we start to think of the material realm of physical space, without social content, and an abstract realm of social relations without a spatial dimension. Such thinking would clarify that society can only have lawful relations to space if society already possesses a spatial dimension; at the same time space can only be lawfully related to society if it can carry those social dimensions ⁹.

Four examples by Hillier & Hanson (1984) were used to clarify the logic of discrete systems of space and society. The first example is related to individuals, given by Rene Thom: the cloud of midges. The 'cloud' is the global form and made up of a collection of midges who constitute a cloud that could remain stationary for a certain

period of time. The global form(i.e. the stable cloud) is formed when each midge moves randomly until half its field of vision is clear of midges, then moves in the direction of midges. The global form has risen from these restrictions on individual randomness. Such a model will demonstrate that the global form is composed of discrete individuals and it arises from a relation of implication between the local and global properties of a collection of midges ¹⁰.

The second example is related to space itself. It is concerned with the formation of a spatial complex made up of individual cells under certain rules. The cell is a square, and the whole complex pattern is constructed under one restriction: each cell must retain at least one side of its four 'walls' free from other cells. The process of generating this complex is randomised; the result will be a dense and a continuous aggregate of cells containing a number of void spaces of multiple cell size. The global form in this case is this complex structure of cells. The global form in this case and in the case of the midges follow the same analogy; the global form in both cases has been generated from discrete individuals under some restrictions¹¹.

The third example takes both individuals and space together. This is demonstrated in the children's game of hide-and-seek. This game is spatial to the degree that the enjoyment of the game will depend to some extent on the complication of the spatial milieu in which the game is played. The place where the game is held should have a focal home-base linked to many hidden spaces. The spatial pattern of the place should have a sufficiently wide variety of paths with sufficient interconnections. Once children start the game they are governed by the spatial relations in a network of points and lines. The global form in this case could be described in the spatial relation of spaces and the quantitative aspects of the number of spaces, links, intersections, and children¹².

The fourth example is demonstrated in an 'army camp'. The army are asked every time to erect their tents in a different locations (e.g. on a hill, in a narrow valley, beside a river, etc.). Each time tents of different type and size are placed in certain definite relations including kitchens, sentry posts, flags and fences. The next time the army moves to a different location and they are asked to erect their tents and facilities. Each time they start erecting they have in mind the rules and relations that govern their layout. As locations change, the phenotypes of the camp change, but the genotype remains the same. Although the global description in this example and in the hide-and-seek example both have an abstract relational model governing the spatial pattern, the army model is different from the hide-and-seek model in many ways. First, the hide-and-seek model is a tacit, unconsciously learned structure, while the army model is deliberately spatially structured. Second, the army model carries information about social structure and relationships, patterns of activities, and ideological beliefs.

These four models illustrate the concept of the discrete system in the space-society relationship. The global description of the whole structure is derived from discrete individuals behaving under certain restrictions in the spatial environment ¹³. The elementary generator of space could be referred to by the way space is generated. In this way Hillier & Hanson (1984) have described the example of cells. The example refers to closed and open cells which are made up of two kinds of raw material: a continuous space called *Y* ; and the stuff of which boundaries are made and which has the property of creating discontinuities in space, called *X*. The spaces designed for human purposes are neither *Y* nor *X*. They are simply 'raw' *Y* converted into effective space by means of *X* . If these spaces are to be effective, they must maintain the property of being continuous in spite being transformed by the presence of *X* ¹⁴. The example is the elementary cell representing a space. In this respect, Hillier & Hanson think that the imperfection of the logic of space results largely from this paradoxical need to maintain continuity in a system of space which is actually constructed by

erecting discontinuities. The notion of boundaries under the Y and X spaces was defined by Hillier & Hanson as:

" Now the notion of 'boundaries' can be very easily defined. It is some X that has the property of containing some part of Y: {XoY}. The Y inside X is now transformed in the sense that its relation to the rest of Y has been changed by the intervention of X. It now forms part of a small local system with a definite discontinuity in respect to the large system".¹⁵

The analogy of how we introduce Y space to a closed solid cell will demonstrate the nature of spatial patterns (Fig.4.2). Hillier & Hanson wrote:

"We can consider the case of the simplest nondistributed structure, the closed cell itself; this is the form that results from the conversion of X into a boundary. This conversion, it turns out, can be described in terms of the basic concepts of the language. Consider for example a convex piece of X, one that contains no segment of Y. Now if we wish to deform this X so that it does in some sense contain some Y, we must introduce a concavity into it. This concavity will always have a very definite form in the region where it does the containing. It will appear that the X somehow bifurcates in that region forming two arms, and it is these arms that do the containing. A boundary is simply an X that is bifurcated and then co-ordinated with itself. The two bifurcated arms are in some sense brought together again to form a complete ring. Since all the boundaries in which we are interested will be permeable, we know that the 'co-ordination with itself' will be by virtue of the fact that these two bifurcated arms will have between them a piece of Y, and it is this Y that will complete the circle." ¹⁶

Now, the researcher found that it is worth mentioning the example of Hillier & Hanson (1984) concerning our understanding of the way in which space acts to pattern social relationships¹⁷. In Fig.4.3, when the cell cuts off one part of the surface from the rest, such an elementary *categoric* is generated making a differentiation between the interior of the cell and its external. The cell in this case inherits the logic of spatial boundaries, in which certain relationships will be established. In the first relationship, the cell will define a region of the surface which is adjacent to it, which we call its neighbours (Fig. 4.3b). The second relationship is realised when the cell defines part of its neighbours lying in the threshold (i.e. the transition area from inside

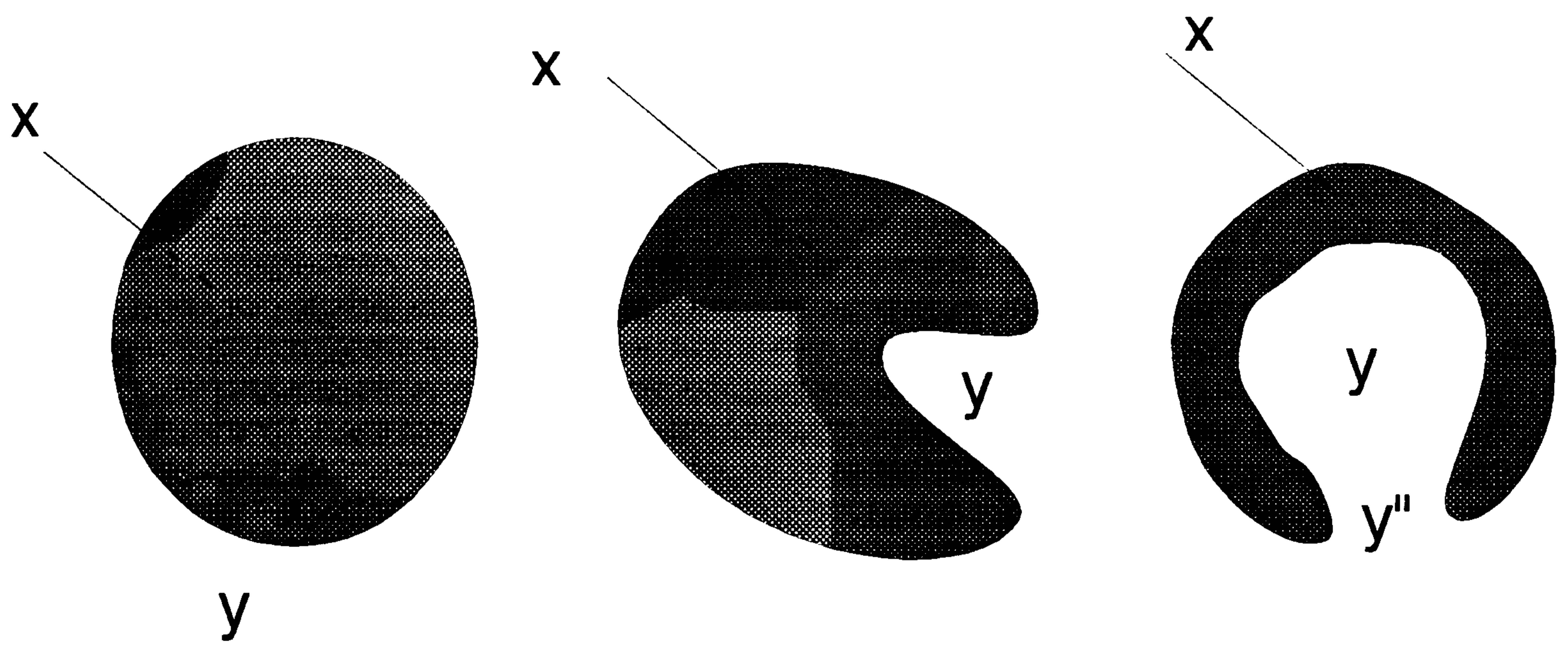
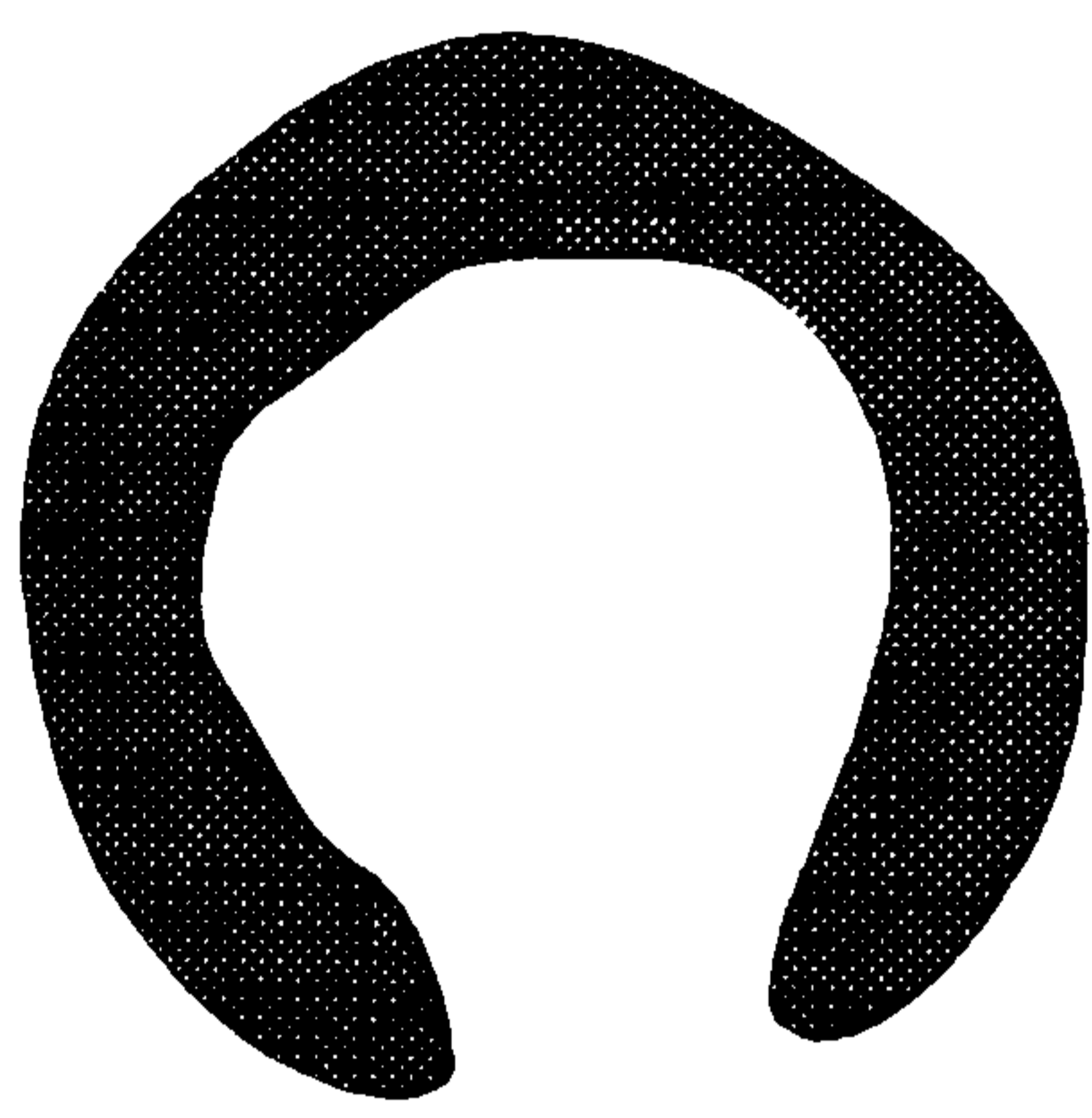
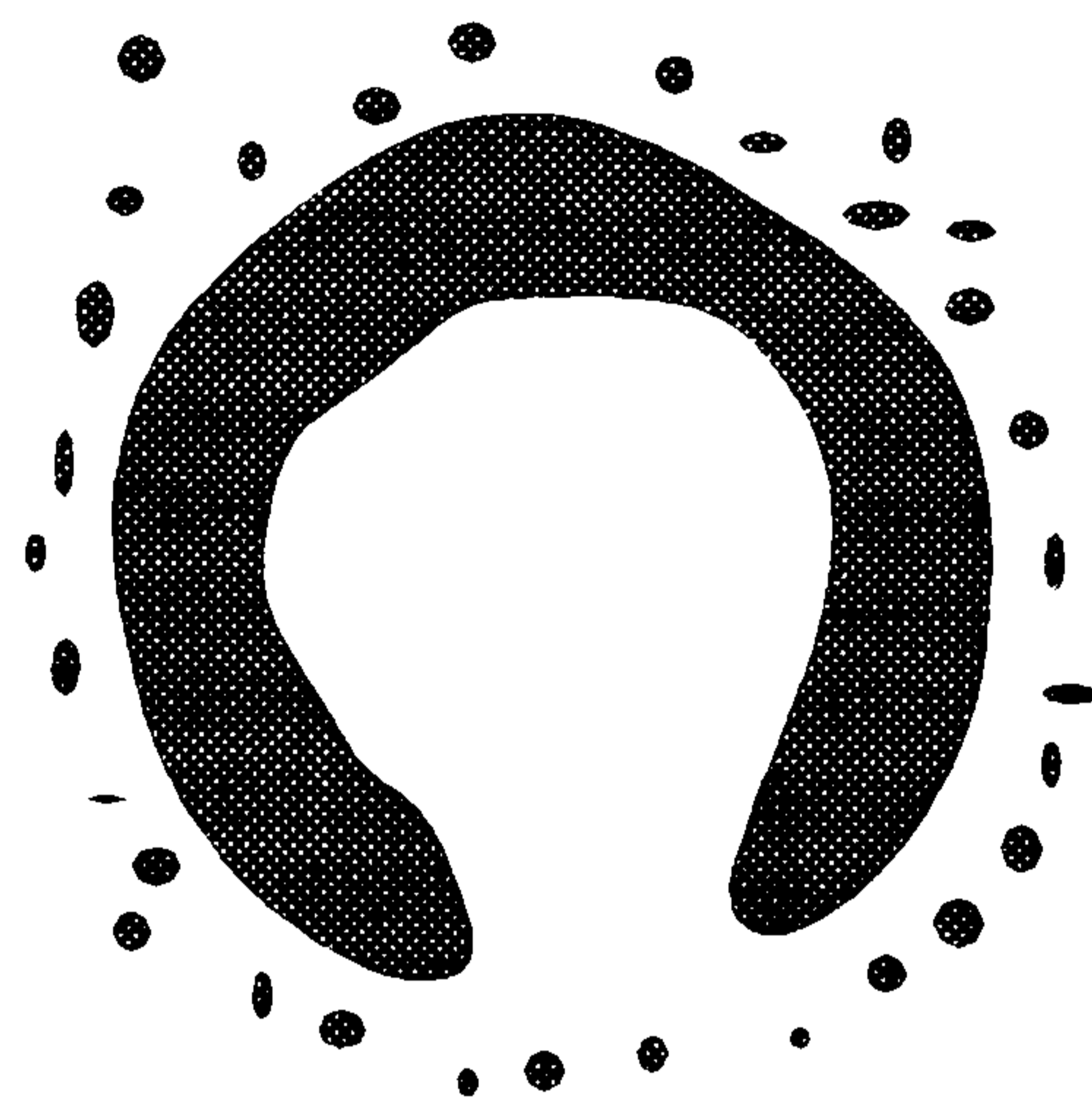


Fig. 4.2. The analogy of introducing y space to a closed solid cell.

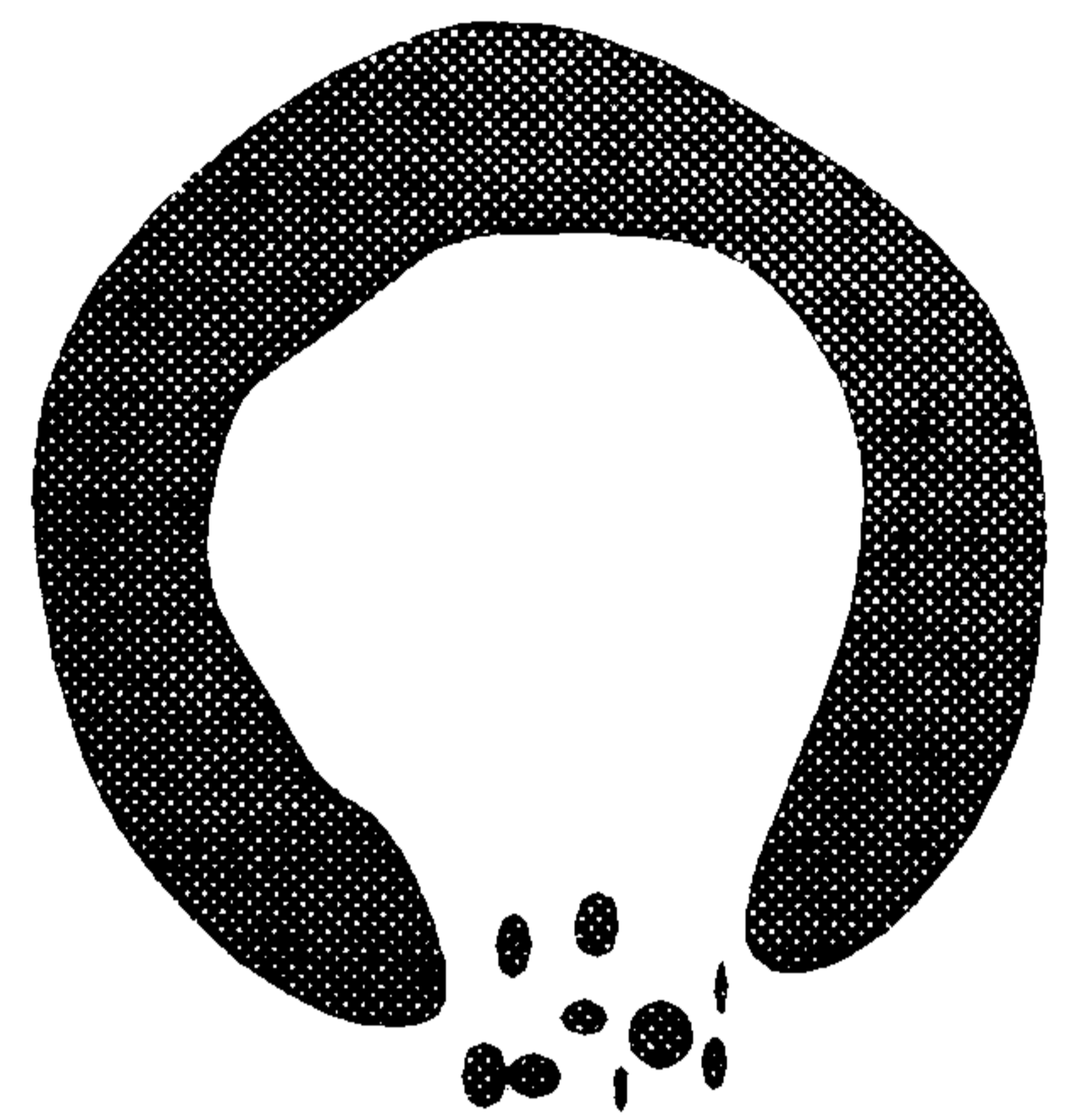
Source: Hillier & Hanson, 1984, *The social Logic of Space*, p.75.



(a)



(b)



(c)

Fig. 4.3. Space acts to pattern social relationships

Source: Peponis, J., 1983, p.39..

to outside) (Fig. 4.3c). This threshold will *control* access to the interior. Two such measures were developed: *category* and *control*. It is these two measures that the theory of space syntax examines. The *category* of spaces refers to the global integration of the spatial system, and the *control* refers to the local connectivity of a particular space to its neighbours. The local and global measures were also the basic descriptive criteria in the mathematical approach developed by Atkin, 1974a, to describe the spatial structure of complexes¹⁸.

Based on the properties of the cell given in the last example, three social groups are involved. Firstly, people who occupy the interior, who are called *inhabitants*. Secondly, people who do not occupy the interior by right, who are called *strangers*. Thirdly, people who interact with inhabitants occasionally in the threshold or inside the cell, who are called *visitors*. Thus, social categories and relationships are built in accordance with spatial categories and relationships¹⁹.

The control of categories:

An important question arises about the impact of layouts on the formation of interaction groups within and between different organisational groups (departments). The problem arises from the link between spatial boundaries and organisational boundaries. Organisations tend to control interaction among members of the same organisational group by virtue of space. Such an approach justifies the provision of different spatial boundaries among different organisational groups. Peponis (1983) cited the study by Burns and Stalker (1961) on industrial firms, which proposed such a concept. These industrial firms decided to introduce a development department to their organisation in order to cope with changes in technology and market. The directors had realised that there were strong differences between the normal production work and ordinary workers. The directors referred to the problem of matching different units which have to interact closely in the interest of product development and manufacture. The decision made by the directors was to isolate

physically and administratively the new department from the rest of the organisation

²⁰. The decision left the new department isolated from the other,

"The only party wall in the whole plant was between the research department and the production shop"²¹.

Such an action will automatically generate categoric differences between groups, since boundaries will regulate and control the interaction pattern in a hierarchical manner. On the other hand, the new approach in today's organisations is to eliminate spatial boundaries among different organisational groups so as to allow more interaction among members of different organisational groups. Such an approach is apparent in the total workplace concept of Becker & Steele (1990) ²². Eliminating spatial boundaries will therefore reduce both *categoric* differences and *control* among groups occupying different spaces.

4.3. The spatial dimension of organisations

The section in Chapter 3 which is concerned with the connection between physical settings and organisations tackled all the attributes of physical settings within the broad context of organisational activities. This section, however, will focus on the spatial settings of organisation in relation to interaction activity. The broad question that this section explores is whether there is a spatial dimension for both formal and informal organisations. The link between organisations and space is the area of concern of several studies. Chadwick (1990) wrote:

" Organisations subtend people who subtend space. Change the organisation and you will change the space".²³

However, the link between organisations and space has become one indicator of building performance ²⁴. An example of a spatially oriented efficiency approach is that of the office landscape (*Burolandschaft*) in Germany. The aim of this approach was to design the spatial layout in a way that reflects the work-flow among the staff. The study of the relationship between each pair of staff and the importance of being in

contact with each other was a key point in shaping the office layout ²⁵. What the researcher believes is that the way in which organisations exchange information among the members of staff (i.e. formal vs. informal) could affect the way the spatial layout is shaped. Empirical work in this area was conducted by Duffy (1974b) investigating a hypothetical model in office design and organisations.

Duffy defined two types of organisations i.e. bureaucratic vs. interactive, and two types of office layouts i.e. differentiation vs. subdivision. Two main hypotheses were tested. Firstly, organisations that are highly bureaucratic are likely to have a layout whose workplaces are highly differentiated from one another. Secondly, organisations that are highly interactive are unlikely to find themselves in office layouts where there is a great deal of physical subdivision ²⁶. The study was conducted on sixteen firms, and the results were unexpected according to Duffy's hypotheses. Two dimensions were adopted to describe office layouts. These were differentiation and subdivision. These two measures were chosen as Duffy claimed that in any layout there will be a number of workplace elements which will either be similar to one another or not, and which will be partitioned from one another or not. Four main bureaucratic variables were incorporated. These were ;centralisation (including participation and hierarchy), formalisation (including job codification, rule observation, and job specificity), complexity (including professional training and professional activity) ,and routinisation. Three main aspects of interaction were included in the study. These were; internal interaction (including daily and weekly communication in addition to frequency and importance of communication), confidentiality (including confidentiality of communication and confidentiality with visitors), and external interaction (including frequency of visitors and importance of visitors). The physical variables were area, expense, work settings, equipment, enclosure, and accessibility. Differentiation was expressed in terms of high variation among these variables, whereas subdivision was expressed in terms of only enclosure and accessibility.

In his first hypothesis, Duffy expected that the bureaucratic variables would correlate negatively with differentiation. He found that both centralisation and complexity as two aspects of bureaucratic variables were significantly correlated to differentiation, but in a positive direction (+.42 and +.45 respectively). The other two bureaucratic variables (formalisation and routine) were in a negative form as expected, but they were below the level of significance ²⁷. Such results confirm the strong correlation between the physical variables and both centralisation and complexity.

In the second hypothesis, Duffy expected no significant relationship between the bureaucratic variables and subdivision. The results were also unexpected. Three bureaucratic variables (centralisation, formalisation, and complexity) showed a strong positive relationship with subdivision (+.57, +.55, and +.55 respectively). The fourth bureaucratic variable (routine) showed a positive relationship, but below the level of significance.

The third finding was that internal interaction and differentiation were found to be unrelated to each other, though the daily contact achieved a correlation of -.39. All the four aspects of internal interaction (daily communication, weekly communication, frequency of communication, and importance of communication) were found in a negative form with differentiation. Duffy therefore concluded that the more widespread, frequent, and important an interaction is, the less physical differentiation will be found in the layout.

The fourth hypothesis correlates interaction with subdivision. Both external interaction and confidentiality achieved no significant correlation, though the direction of the correlation suggests that more confidentiality is found with more subdivision. The percentage of daily and weekly contact was not correlated to subdivision. None of the other internal interaction variables (frequency and importance) show a

significant correlation with subdivision, though they show significance when they are combined together. As a summary of Duffy's findings, he wrote:

"The results of an empirical test of this model in sixteen firms were not entirely as expected. Highly bureaucratic organisations exhibit less . rather than more. physical differentiation .Interaction is not strongly related to subdivision. Subdivision, however, relates strongly to the bureaucratic variables. Moreover, some of the bureaucratic variables are significantly related to interaction- the less bureaucratic the organisation, the less its members speak to one another." ²⁸

The findings of Duffy's study suggest some conclusions about the nature of organisations and their physical layout. Workplaces in bureaucratic organisation show less differentiation among each other. This is a startling result, since some of the bureaucratic variables such as centralisation and complexity, which are key dimensions in bureaucratic organisation, were expected to generate a physical differentiation among workplaces. However, such a result indicates that bureaucratic organisations tend to have more uniformity in workplaces, whereas non-bureaucratic organisations display more differentiation.

One could take this finding in conjunction with other studies so as to reveal the consistency of these results. Sundstrom (1982) studied the relationship between the perceived privacy, job complexity, and the physical features of workplaces among three staff groups (i.e. managers, accountants, and secretaries) . The three groups were characterised with different levels of job complexity. The results show that perceived privacy is positively associated with physical enclosure ²⁹. The second hypothesis, which claims that privacy would become more important for satisfaction with the workspace and job satisfaction with increasingly complex job duties, was not supported ³⁰. Sundstrom could not find a relationship between privacy and job complexity. Instead he suggested that different groups of different job complexity vary in the way they perceive privacy, which is caused by the need for different levels of privacy ³¹. Sundstrom's suggestion of variation in perceived privacy among groups of different job complexity (taking into account that privacy is positively associated

with physical enclosure, which therefore creates workspaces of different levels of enclosures among groups) supports Duffy's where he found that complexity is correlated positively with both differentiation and subdivision ³². This hypothesis is still ambiguous and further study is needed to test its validity.

Another study by Farbstein (1975) compared organisations as users of space. Organisations were classified into three types according to their raw material. These were things processing, information processing, and people processing. Three dimensions were selected for the study. These are organisation, space, and activity. All were studied according to the three levels of the individual, group, and organisation. The sample was studied before and after the change in premises. The broad questions that Farbstein tried to investigate were; firstly, is space assigned on the basis of status or on the basis of nature of task?; and secondly, are the activities and behaviour of individuals determined more by their organisations or by their spatial position?. Three working hypotheses were tested in regard to the first question. Firstly, information processing organisations would allocate space to their individuals on the basis of rank. Secondly, people processing organisations would allocate space to their individuals on the basis of both rank and task. Thirdly, things processing organisations would allocate space to their individuals based on the nature of individual tasks ³³. The rank variable was measured in three ways. This is according to individual position in the organisation, according to a standardised rank, and according a weighted rank. The other variable aimed to make the individual comparable across the organisation with respect to status by allocating them a common scale. The nature and variety of raw materials which individuals deal with (i.e. things, information, or people) was another variable describing task criterion. The spatial variables were: 1) area allocated to each person, 2) number of persons per room, and 3) distance separating each pair. The quality of furniture was another variable. On the other hand, activities were classified as "work at own station", "deliver", "collect", "discussion", and "visit cloakroom". Other variables were also

incorporated, such as number of face-to-face encounters, average distance each individual walked inside the building, and number of activities each person performs.

The results of Farbstein's study showed that organisations differ in the way they allocate spaces to their individuals according to their rank and task. Organisations that deal with information tend to consider both rank and task in allocating individual space. Organisations that deal with people tend to consider rank only. Finally, organisations that deal with things tend to consider task, but less strongly than expected³⁴. In people processing organisations, distance walked was related to the area and number of people with whom one shares. The results on group level showed that both organisations dealing with information and dealing with people have a tendency to allocate groups of greater rank differences at longer distances. People and things organisations tend to allocate people of shared tasks close to each other³⁵. Furthermore, in the three organisations, groups of similar task and rank were highly segregated from each other³⁶. No relationship was found between contacts and distance. Distance has little effect on number of trips between groups³⁷. Results at organisation level suggest that organisations dealing with things are characterised by more area, less privacy, and lower furniture quality. In contrast, organisations dealing with people tend to have less area, more privacy, and higher furniture quality. However, organisations dealing with information were less concerned with manipulating space. Rank was positively associated with time spent in discussion. Organisations characterised by lower rank, less variety, and fewer task bonds were characterised by fewer contacts. Furthermore, the longer the paths in buildings, the more the contact³⁸.

The approaches discussed in the previous chapter were concerned with the connection between the physical settings and organisations which supports the link between the spatial environment and organisations. Gutman (undated) has referred to the impact of the location of facilities and structures on the spatial organisation³⁹.

Steele (1973) described several functions as the role of physical settings in organisations, among them social contact ⁴⁰. Steele has referred to social contact in organisations as the way in which facilities and space are arranged in a way that promotes social interaction. Pfeffer (1982) has also referred to the spatial organisation as the way facilities are laid down ⁴¹. The model developed by Davis (1984) describing the influence of physical settings on organisations reflects the attributes of the spatial environment in organisations ⁴². One of the three dimensions he defined was the physical structures, in terms of the way the building is designed, furniture laid down, and the type of layout i.e. open vs. closed. This in turn influences the level of social interaction among staff.

The importance of building design and physical location lies in the possibility of influencing interaction and relationships among occupants ⁴³. Room arrangement and location were found to be associated with interaction pattern and friendship ⁴⁴. The physical distances separating employees both horizontally and vertically could also influence the level of contact between members of organisations. Even for newcomers location could influence the speed with which they recognise the surrounding settings of the organisation. In brief, aspects of building design and physical location were perceived to be factors that could influence interaction among the staff and the way in which work flow is performed. The role of furniture and seating arrangements was perceived in the impact of comfortable furniture, especially chairs, on back problems and stress. Steele (1973) found that members of organisations tend to leave furniture and seating arrangements in their office exactly the way they find them. Seating arrangements will also affect the level of eye contact with others, as well as with passers-by. Steele has emphasised the importance of *PFF* (*Pseudo-Fixed-Feature*) in the physical environment. *PFF* was defined as:

"those features in man's environment that are relatively simple to change or move, but which are perceived as fixed, even when their configuration is inappropriate for task accomplishment. In most group and organisational settings, there are a great

many changeable features (technically speaking) which are treated as if they were fixed".⁴⁵

One of Steele's suggested measures to improve environmental competence is through the notion of *PFF* so that the created spatial environment affects the interaction pattern⁴⁶. Becker (1982) suggested that managers should zone their offices into different areas according to activities and functions. For instance, spaces for formal discussion, for casual conversation, for materials and photocopying, and so on⁴⁷.

The degree of openness vs. closeness in office layout, was perceived by Davis (1984) as hindering or facilitating interaction, improving communication, and increasing office efficiency and productivity⁴⁸. The degree of openness was also related to the degree of satisfaction with the workplace, especially with regard to the level of noise⁴⁹. Members of organisations may prefer certain types of offices, which really depend on the nature of the organisation and the performed job. Oldham and Brass (1979) found in their study that a move from a conventional office to an office without interior walls or partitions resulted in significant decreases in employee satisfaction and internal motivation⁵⁰. The type of office layout was also associated with the level of productivity. A study by Clearwater (1980), found that the level of communication deteriorated when staff moved to an open plan; the level of disturbance and distraction also increased⁵¹. Another significant aspect relating to the degree of open vs. closed offices is the level of privacy. Sundstrom (1980) found that employees preferred their workspace to be enclosed and visually inaccessible⁵².

Sundstrom (1986), in his alternative hypothesis, described how the physical properties of workplaces could be influenced by organisational structure, reflecting the link between spatial environment and organisations⁵³. Trickett (1990) has established the relationship between organisation and space in the way he defined the measures of differentiation in organisations. The three defined measures (i.e.

interpersonal style, authority system, and working procedure) were hypothesised to shape the type of layout in organisations⁵⁴.

Becker & Steele (1990) in their concept of the *total workplace* have related the need for informal communication among different disciplines to the spatial organisation⁵⁵. In their total workplace approach, taking the Steelecase Corporate Development Centre as a case study, they realised that informal communication among members of different disciplines inevitably supports the process of creativity. Several spatial measures were taken to support the main organisational objective. Among these were bringing all disciplines under one area with no physical barriers; providing work settings of different levels of privacy; creating common areas or nodes inside the office building; and applying the concept of front-stage vs. back-stage, as it refers to eliminating and controlling the front-stage areas (customers' areas) from intruding back-stage areas (staff areas). Peponis (1983) in his study on the impact of spatial morphology on informal interaction in factories, described five measures that affect spatial organisation in factories. These are the relative *adjacency* of machines performing connected operations; the relative *sequencing* of machines according to the flow of production; the *grouping* of machines according to the process of production; and the adjustment of *areas* and *shapes* occupied by mechanical equipment. Peponis considers machines to be the basic design unit in factory design⁵⁶. In offices, the workspace is the basic unit of design. So all the previous five measures are expected to be applicable to office layout.

4.4. The Need for Descriptive Model.

Architects design various types of spatial structures. They have the ability to design complicated spatial patterns, but unfortunately they have not got enough understanding of the implications of different spatial structures for social behaviour. The problem arises again from the dilemma of *spatial* and *social*. As social theories are concerned with understanding the social behaviour of humans, the failure to

establish a consistent theory to describe and analyse spatial structures is one of the main reasons for the gap existing between space and society. The picture will be clearer once we realise that people experience different social behaviours in different spatial patterns. SERC & et al (1983) have reported such problems as a lack architectural knowledge:

"The problem, it must be admitted, is one of *knowledge*-architectural knowledge. There is a substantial gap in our knowledge of the social implications of strictly formal, hence architectural, decisions. There is no adequate description and explanation of why certain types of spatial patterning seem inevitably to lead to that curious feeling of a disembodied architecture, devoid of human contact and activity, and more than there is an understanding of why common-or-garden urban space of the past so easily provided a setting for the life that nowadays seems so often to be missing".⁵⁷

Designers are unable to understand the kinds of spatial orders that exist in their spatial environment due to the lack of concepts and techniques that allow them to describe and analyse the spatial patterns. The failure to develop a proper understanding of spatial logic has left designers unable to understand the social consequences of different physical forms⁵⁸. Hillier, Hanson, and Peponis, (1984) stressing the need for a theory of description of human settlements, have defined two distinct traditions in architectural discourse. These are a critical tradition, which is concerned with the changing of *form* of buildings; and a research tradition, which studiously avoids the issue of form and addresses itself almost exclusively to the matter of *function*. They believed that *function* is scientifically tractable, whereas *form* is not. The need for a consistent theory that describes both *function* and *form* simultaneously has become inevitable in order to understand spatial-social relations. A theory that describes *function* in absence of *form* or describes *form* in absence of *function* will not help us understand the real implications of spatial-social dilemma⁵⁹. Hillier & Hanson have insisted on the need for theory to describe the space-society relation in a more scientific way. They wrote:

"But while academic disciplines may simply deplore the lack of theory, for architects and planners the problem is a more pressing one, since as things stand

there is no way that scientific theory of the society-space relation can either help to understand what has gone wrong with contemporary design or suggest new approaches".⁶⁰

The theory of space syntax has the ability to describe spatial and social relations simultaneously and in a consistent manner.

4.5. Space syntax theory.

Space syntax is a research programme that has been developing since 1975 at the Bartlett School of Architecture and Planning, University College London under the direction of Prof. Bill Hillier. The method was defined by SERC & et al (1983) as:

"Space syntax is a method we have developed at the Bartlett Unit for Architectural Studies 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 description, we can investigate how well environments work, rigorously relating social variables to architectural forms. We can thus simulate the performance of real and hypothetical schemes on the computer, so that it can be used as a suggestive and evaluative design tool."⁶¹

The space syntax was the outcome of the *social logic of space* theory by Hillier & Hanson. The aim of the theory was:

"The aim of the Social Logic of Space is to begin with architecture, and to outline a new theory and method for the investigation of the society-space relation which takes account of these underlying difficulties. First, it attempts to build a conceptual model within which the relation can be investigated on the basis of the social content of spatial patterning and the spatial content of social patterning. Second, it tries to establish, via a new definition of spatial order as restrictions on a random process, a method of analysis of spatial pattern, with emphasis on the relation between local morphological relations and global patterns. It establishes a fundamental descriptive theory of pattern types and then a method of analysis. These are applied to settlements and then to building interiors in order to discover and quantify the presence of different local and global morphological features. On this basis, it establishes a descriptive theory of how spatial pattern can, and does, in itself carry social information and content."⁶²

The space syntax technique was used in this study as a tool to analyse office layout for several reasons. The technique compared to other spatial descriptive approaches was found to be more holistic, systematic, scientific, and realistic. In general, most ideas about spatial order are geometric, while human settlements and buildings are not. In fact, most urban environments appear to be in a kind of disorder. However, spatial order and geometrical order are not necessarily the same ⁶³. For example, the 'shape grammar' approach (as discussed earlier) depends on refining spatial forms. Hillier & Hanson wrote:

"But while conceding their superior mathematical refinement, we have found that shape grammars are in general too over-refined to model the untidy systems which are found in the real world of settlements and buildings. Our notion of 'syntactic generators' is insufficiently formalised for a full mathematical treatment, yet syntactic generators are right for the job that they are intended to do: capturing the formal dimensions of real-world spatial systems in term of the social logic behind them". ⁶⁴

Hillier & Hanson have described the syntactic generators to be shape free; moreover, they are simpler than shape grammars. Hillier & Hanson think that it is unnecessary to specify shape in order to model real-world generative processes, since they think that the concept of shape obscures the fundamental relational notions that underpin human spatial order ⁶⁵. They think that the randomness in shape grammars is limited, while space syntax is based on the notion of randomness. Furthermore, they say that shape grammars tend to over-determine the realities of the spatial form that they are keen to model ⁶⁶.

As the space syntax technique is concerned with the morphological pattern of spaces, it undermines the geographical approach of spatial analysis in two ways: *distance* and *location*. The technique does not take into account distance, it is simply distance-free. The concept of *location* is substituted with the concept of *morphology* in an unconventional way. This method will describe spaces with respect to the whole system of spaces as well as to their immediate neighbours ⁶⁷.

The space syntax technique was used in several studies. Peponis (1983) has used the technique to investigate the impact of spatial morphology on informal interaction in factories. He adopted the technique for the following reasons:

"The theory of syntax is adopted for a number of reasons. Firstly, it is based on a model of the properties of space which have an inherent social logic. Secondly, it deals with the abstract relational properties which characterise a pattern as a whole. This facilitates the task of dealing with space at a level over and above that of its technical determination. Thirdly, it permits the systematic, parametric and quantitative comparison of layouts. This makes it possible to be as specific about the social properties as about technical functions. But further, quantitative parametric comparisons are crucial for a project which seeks to reveal not only underlying similarities but also strategic differences. Quantification allows the precise assessment of the effect of variation in the strength with which a property is realised. The strategic relevance of that property can therefore be tested."⁶⁸

Stansall (1989) has used space syntax technique as a tool to assess spatial layouts in terms of space-use. He has adopted the technique because:

"space syntax was adopted for several reasons. First, it is based on a model of the properties of built space which recognises its underlying social function. Second, it deals with abstract relational properties that describe both the local and global dimensions of spatial patterns and allows the effects of space to be analyzed simultaneously from two objective viewpoints. Third, it allows the comparison of building layouts through the quantification of continuously varying spatial variables and permits systematic comparison beyond elementary, binary classification".⁶⁹

The notions of depth (i.e. *integration*) and control (i.e. *connectivity*), which space syntax has developed, was used as a descriptive tool by Markus (1987) to classify buildings in terms of their spatial properties⁷⁰.

The space syntax theory presents space *intelligibility* in the correlation between *global integration* and *local connectivity*. This means that a large scale of spatial structure is intelligible to people as the information and circumstances they receive from the space that they are occupying -the local measure of connectivity-will

comprehend the structure of the whole. The intelligibility correlation therefore, will indicate the degree to which people can learn about large patterns from their experience of small parts. For example, in urban areas or town , the intelligibility correlation tends to be around 0.45, whereas unintelligible systems will have values of 0.2 or less ⁷¹ .

In summary, space syntax was used as a tool to analyse office layout for various reasons: a) the space syntax theory was able to develop the measures of spatial analysis (i.e. integration and connectivity) from the social nature of human behaviour; thus the theory attaches a social dimension to the spatial structure. b) the theory is based on a mathematical model which will enable researchers to analyse spatial structure in a quantitative and consistent manner. This also will give the opportunity to compare structures of different size with each other. c) its success as a useful tool in the previous research, particularly on urban scale. d) lack of other techniques in the literature which are concerned with the analysis of spatial structure.

Space syntax theory and spatial organisation:

The theory of space syntax was adopted in this study based on the belief that both of the two intelligibility measures of integration and connectivity provide a local and global description of spatial layout in which they directly or indirectly influence social interaction. Therefore, these two measures are key criteria of spatial structure. The study here aims to revise some of the previous approaches that tried to describe the spatial pattern of organisations, and to show how these approaches limited the description of spaces to its physical enclosures and configuration and failed to provide a descriptive criterion for the pattern of spatial structure. Alexander (1965) has urged designers to think of the semi-lattice pattern of design rather than the tree pattern ⁷². Although the tree pattern reflects the hierarchical structure of the organisation, it echoed the category dimension of space syntax theory. On the other hand, the semi-lattice pattern, with its need for the interconnections among spaces, reflects the

control dimension of the theory through the potential of the connectivity. Even Stone & Luchetti (1985), when applying Alexander's approach in offices, did not refer to the problem of *integration* and *connectivity*⁷³. Instead, they limited the concept to the ability of the semi-lattice to increase the interrelationships among staff.

Chadwick (1988) in his model of organisational modelling, limited his concept of space to space standard, space quantity, and the enumeration of four categories of office space (i.e. general office space, managerial office space, low occupancy areas, and high occupancy areas). The only thing mentioned about spatial structure was with regard to inter-departmental interactions and adjacencies⁷⁴. Although he associated changes in organisations (strategic and local) with changes in space, no criteria of spatial layout was developed⁷⁵. However, he did not refer to how these different types of spaces could be structured. Trickett (1990) defined measures of differentiation among organisations that would generate the need for different office layouts. Unfortunately, he did not specify any description of the spatial layout. The only criterion was open vs. closed plan layout⁷⁶. However, Trickett (1992) has referred to the importance of the spatial context to people in offices, especially the relationship of each work position to others⁷⁷. Duffy (1974b) has also limited the description of spatial layouts among bureaucratic and interactive organisations in their degree of subdivision vs. differentiation⁷⁸. Subdivision and differentiation are measures of spatial layout that describe spaces on their own. They do not describe spaces in relation to each other, though they both contribute to shaping the overall structure of spaces.

The researcher believes that these approaches need to specify measures by which spatial layouts in organisations could change and be managed over time. These measures are present in space syntax theory. The two intelligible measures of *integration* and *connectivity* of the adopted theory will provide the opportunity to describe the pattern of spatial structure in a consistent language.

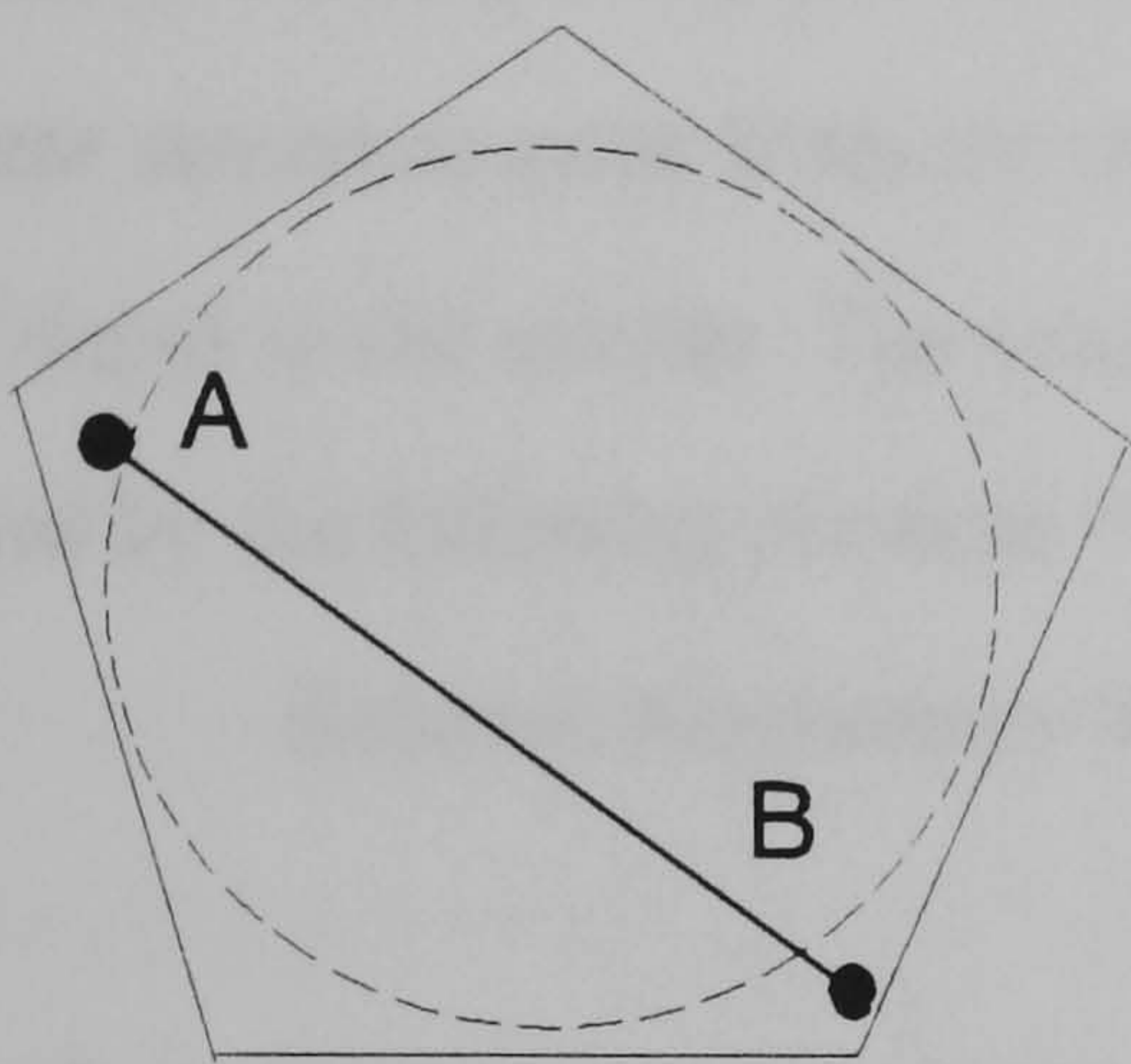
4.6. Describing the technique.

The technique started by breaking up the whole plan into the fattest possible convex spaces until the whole plan is divided. The mathematical definition of convexity is that:

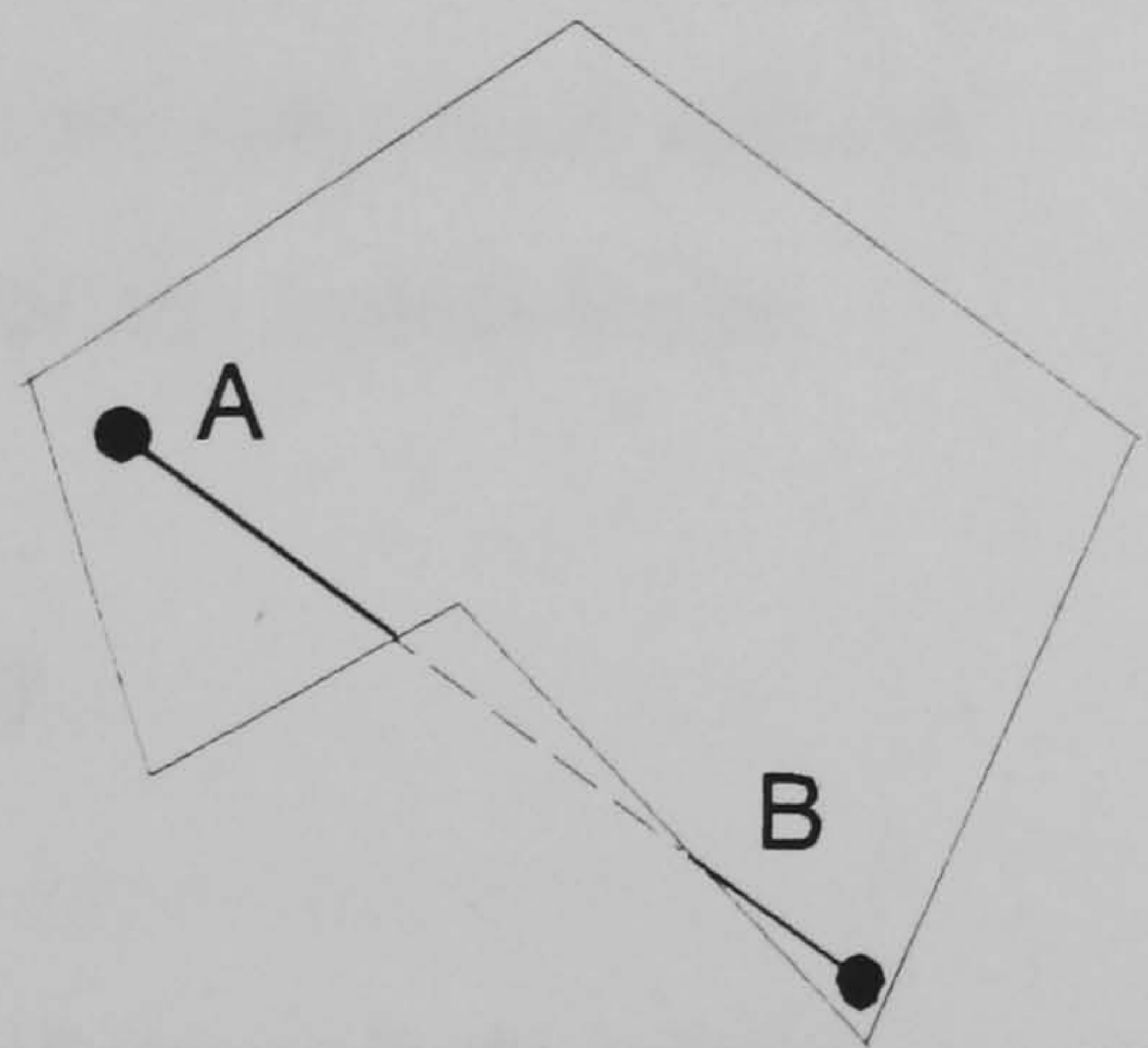
" no tangent drawn on the perimeter passes through the space at any point. It might be easier to think of convexity as existing when straight lines can be drawn from any point in the space to any other point in the space without going outside the boundary of the space itself". ⁷⁹

The difference between the convex space and concave space is illustrated in (Fig. 4.4). It should be noted that the largest convex space should be drawn first, then the next largest, and so on until the whole plan is covered ⁸⁰. The next step is to transfer the convex map onto a graph in which convex spaces are represented by small circles and relations between them by lines joining circles. Lines linking circles are drawn whenever the convex spaces share a face or part of a face ,but not when they only share a vertex . In order to carry out the mathematical analysis, each convex space should be labelled with a number. The syntactic description of spaces is undertaken in two ways: first, the global measure of *integration* or the real relative asymmetry; secondly, the local measure of *connectivity* or control value.

The first measure (i.e. the global measure of *integration*) deals with the notion of depth in a way that any space could be either symmetric with respect to other spaces (having the same relation to them as they do to it); or asymmetrical (not having the same relation , in the sense of one controlling the way to another with respect to the third) ⁸¹. The mean depth "MD" is mainly the number of steps a space is deep from the carrier (i.e. the shallowest point in the system) or from the original space. This measure could differentiate between spaces in their level of symmetry vs. asymmetry, since spaces can only be deep from other spaces and it is necessary to pass through intervening spaces to arrive at them. The depth map (for example from the carrier) could be drawn by placing the carrier at the bottom (level 0), and then the



(a) A convex space



(b) A concave space

Fig. 4.4. The concept of Convex space and Concave space

Source: Hillier & Hanson, 1984, The social Logic of Space, p.98..

spaces which are linked to the carrier are drawn above it in another level (level 1), and so on until the whole system of spaces is placed in a justified map of a 'diamond shape' pattern. The MD is calculated by assigning a depth value to each space according to how many spaces it is away from the original space, summing these values and dividing them by the number of spaces in the system less one (the original space). The mean depth MD will enable us to develop the measure of the relative asymmetry "RA", which compares how deep the system is from a particular point with how deep or shallow it theoretically could be. The least depth exists when all spaces are directly connected to the original space, and the most depth occurs when spaces are arranged in unlinear sequence away from the original space; in this case every space adds one level of depth to the system. The relative asymmetry RA for any system can be calculated by the following formula ⁸²:

$$\text{Relative Asymmetry 'RA'} = 2(\text{MD}-1)/(\text{k}-2)$$

where MD is the mean depth and k is the number of spaces in the system. Now, this measure of RA will not enable us to make comparisons across systems which differ significantly in size ⁸³. In this case, we need to compare the RA value we have with the RA value for the root (the space at the bottom of a justified map of a 'diamond shape' pattern), so the measure of real relative asymmetry or *integration* was developed, enabling us to compare systems that differ in size with each other. The *integration* formula is:

$$\text{Global Integration} = \text{RA}/\text{D}_k$$

where D_k is the relative asymmetry value for the 'root' (the space at the bottom of a justified map of a 'diamond shape'). The greater the value of integration, the deeper the system; whereas the lower the value, the shallower the system.

In order to make it easier for the reader to understand the notion of integration vs. segregation (i.e. depth of spaces), it is worthwhile here to refer to a

simple example. The four simple structures in Fig. 4.5 could be easily described in terms of their level of integration ⁸⁴. Although the four structures are similar in their geometry and number of spaces, they are entirely different in their syntactic composition. The level of integration for each structure could be easily conceptualised when each structure is drawn in a justified map starting with the shallowest space in the system (i.e. the least in depth), then the next in depth and so on until all the spaces are drawn. The more the spaces are lined up in a vertical pattern, the more the system becomes deep and therefore more segregated. On the other hand, the more the spaces spread horizontally, the more the system becomes shallow and therefore more integrated. Consequently, one could easily say that *a* and *c* structures are more integrated than *b* and *d*.

The second syntactical measure is the connectivity value. This is a local measure, which takes into account only spaces with their intermediate neighbours, unlike integration which is a global measure, since it takes into account the relation of a space to every other space in the system. Each space has *n* number of neighbours, and therefore each space gives to its intermediate neighbour $1/n$. The *connectivity* value for each space therefore is $\Sigma 1/n$. Spaces with *connectivity* value greater than 1 will have strong control, those below 1 are weak control spaces ⁸⁵.

Space syntax technique can be used as a good tool to describe the spatial composition of spaces. The implication of the technique for the real world is that it would enable researchers to conduct further research on the spatial environment in a more credible way. For instance, in the study by Weisman (1981), in which he investigated the relationship between five criteria of plan configuration and ease of way-finding ⁸⁶, the space syntax could become an effective descriptive mechanism to describe the degree of complexity of the spatial system. The local and global measures of integration for the whole system of spaces could be expressed in terms of complexity vs. simplicity of the spatial pattern.

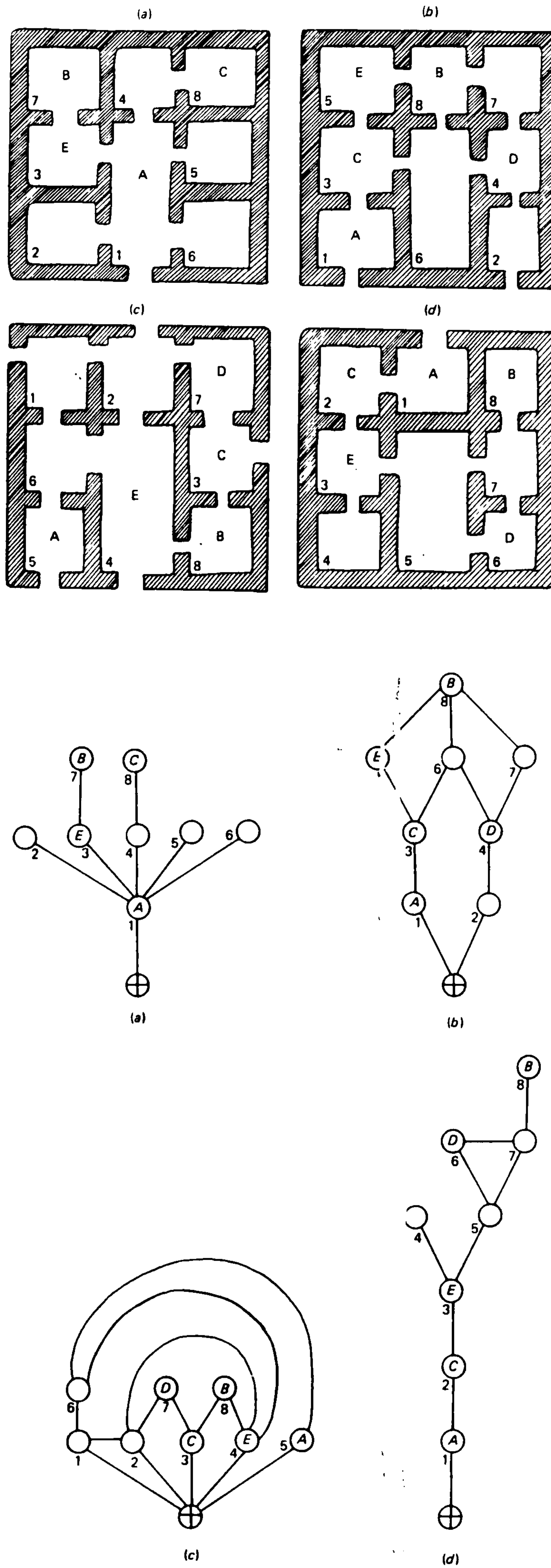


Fig. 4.5 The concept of integration vs. segregation.

Source: Hillier & Hanson, 1984, *The Social Logic of Space*, p.150.

4.7. Summary.

The review has established a connection between space and its social contents. The investigation was taken further to explore the spatial dimension in organisations, specifically the way organisations consider space as a design criterion that responds to different structural components of organisations. It was realised that one of the problems that hinder the understanding of the nature of the relationship between space and its social behavioural is the lack of theory to describe space in its social pattern and society in its spatial pattern. However, the social logic of space theory (the space syntax) was adopted in this work due to its explicit approach and its implicit understanding of the spatial-social implications in the real world. The space syntax theory assesses spatial patterns with two different measures. Firstly, there is the problem of *integration* or category, which is a global measure, and refers to the degree of integration of a single space compared to the whole system of spaces. Secondly, there is the problem of *connectivity* or control, which is a local measure and refers to the level of connectivity of a single space to its immediate neighbours. In this respect, a space would be intelligible to its users in terms of its local measure, of *connectivity* and global measure of *integration*. Future studies on spatial organisation should refer to the pattern of spatial structure rather than be confined to the description of the spatial organisation according to the degree of openness vs. closeness.

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CHAPTER 5

FACILITIES MANAGEMENT AND THE INTERACTION ACTIVITY

5.1. Overview

Chapters 3 and 4 were concerned with the physical and spatial environment of the total workplace . However, this chapter is concerned with the management aspect. Managing the social dimension in organisations has become a significant criteria of successful workplaces. The dynamic nature of organisations has increased the need for facilities management to control not only the physical assets but also social issues. The 'churn' which describes changes occurring in organisations necessitates constant reconsideration of the way facilities are being managed. Interaction is one of the activities that could pass through minor or major changes to cope with changes in strategic objectives.

This chapter aims to describe approaches to manage interaction in organisations. In order to do so, several issues must be investigated. This is related to decisions of creating and selecting the physical settings to cope with the selected level of interaction. In this respect several models are to be discussed, especially their responsiveness to the needs of organisations and their understanding of the broad field of facilities management. Identifying the social processes in organisations has become important. This would enable facility managers to understand where and how interaction among individuals occurs, so as to establish guidelines and policies to control it in a way that would respond positively to the basic needs of organisations. The chapter also aims to explore some models in facilities management with regard to social activities. These issues will be discussed in the context of people needs. This will increase the responsibility of facility managers to incorporate the social dimension in management. This includes people's reaction to their workplaces, level of control, and response to changes.

5.2. Selecting physical settings

The broad question here is how physical settings are constructed from the beginning. In fact, the answer to this question demands that we explain in depth the design process from the inception stage. It is apparent that many factors influence the shaping of physical settings in organisations such as, social, psychological, economical, and cultural factors. Becker (1981) stressed the importance of the information transformation process during the design stages ¹. He claimed that as the design process is concerned with transferring information throughout the design process stages, ambiguity in transferring the necessary information will create physical settings that cause constant problems to organisations. He wrote:

"Physical settings are created through a series of attention cycles characterised by such information transformation. At each stage of the design process, different parties transform available information into its opposite state in order to make sense of and act on it. These processes become problematic for an organisation when the transformations do not occur at what are considered appropriate places or times, or are stunted in some way".²

Such an approach necessitates a clear understanding of the client needs by the design team. Organisations should specify clearly the significance of informal exchange among members of staff, as this will be incorporated in the list of their strategic objectives, and will be translated into real policies that enable organisations to achieve the desirable level of interaction. The design team should develop the design guidelines that serve the main strategic objectives of the organisations.

Sims (1978) has described six approaches for generating user-oriented design requirements for physical settings ³. He claimed that the weakness of one approach is a strength of another. *User characteristics* is the approach that is concerned with actual behavioural patterns and environmental needs. The *Social functions* approach is concerned with social, psychological and physiological functions. It refers to the ability of the physical settings to support the desired level of interaction within the social atmosphere. The *Behavioural circuit* approach refers to design requirements

that support or discourage behaviour at certain settings. It extends to following the individual as a chain of behaviour. *Behaviour settings* are the overt patterns of behaviour within a setting or area which are systematically desegregated, and behaviour attributes are specified which will provide a specific level of support to selected behaviour. *Post-occupancy evaluation* refers to the assessment of the performance of the physical settings and the degree to which these settings provide users with environmental needs. Such a process involves conducting a survey and analysing the gathered data. The post-occupancy evaluation is very important when organisations are planning for a new set of activities within the existing environment. The last approach is *user participation*, which is concerned with giving users the opportunity to participate in decisions related to their basic requirements and the evaluation of their satisfaction with existing settings. Users are also required to contribute their opinions and views for any future changes.

The interaction process within the domain of Sims' concept will fall within all six approaches. That is why the interaction activity is not a single approach decision. Organisations that adopt informal interaction as a basic requirement in their strategic objectives should go through the user-oriented approach process so as to ensure that the achieved level of interaction meets individual needs.

But the researcher found that it is worth referring to the Markus & et al (1972) model of designing for people⁴. The model was developed in the Unit of Building Performance at Strathclyde University. Five systems were introduced in the model. These are building systems, environmental systems, activity systems, and objective systems, and resources systems. Each system consists of subsystems, and the five systems in total make a complex system open to the influence of economics, culture, climate, social, and business context. The objective system is the only system that exists alone (no hardware). All the other systems work in complex interrelations to serve the objectives system. An unoccupied building is regarded as hardware (an

empty shell) with no organisation. The interaction activity falls under the activity system, where an organisation is supposed to develop policies derived from the objective system so as to enable staff to maintain the desired level of interaction. As the model was developed mainly to serve people's needs, the researcher thinks that the model undermines the understanding of the complexity of human relations. In other words, in order to develop a responsive model for people, one should investigate the implications of these five systems for different levels of users (i.e. individual, group, and organisation).

The researcher refers to the model developed by Mortensen (1972), where he developed a multidimensional approach describing systems of human communication⁵. His approach was based on understanding the type of communication system and the analysis of its implications for sociocultural, interpersonal, and intrapersonal systems. Another approach by Sundstrom (1986) developed a framework concerned with understanding people in their physical settings⁶. The emphasis was to generate three levels of analysis. These are the individual, interpersonal, and organisation levels. The outcome at the individual level of analysis is satisfaction and performance; at the interpersonal level it is communication, privacy, and formation of groups; and at the organisational level it is organisational effectiveness. This is why it was thought appropriate to modify the Markus' model by adding another dimension describing users' levels. The researcher realises that the level of analysis of any system will have a different facet once it is examined at different users' levels. For example, the extent to which organisations give the opportunity to the individual worker to isolate himself or interact with small groups, large groups, or the whole organisation staff will vary. In fact, each level of interaction will have either a direct or an indirect effect on the other systems. The modified model is illustrated in (Fig. 5.1).

5.3. Physical settings and social structure

Chapter 5: workplace environment

organisations in general. This chapter

explores the physical and social

environment of the workplace.

It discusses the importance of

designing the physical environment to support

the needs of the organisation and its

employees. It also discusses the

importance of creating a positive

social environment in the workplace.

This chapter is divided into two

sections. The first section discusses

the physical environment of the

workplace, and the second section

discusses the social environment.

The physical environment of the

workplace includes the design of

the building, the furniture, and the

lighting. The social environment

includes the relationships between

employees and between employees

and the organisation.

Both the physical and social

environments of the workplace

can have a significant impact on

employee health and well-being.

Therefore, it is important for

organisations to design their

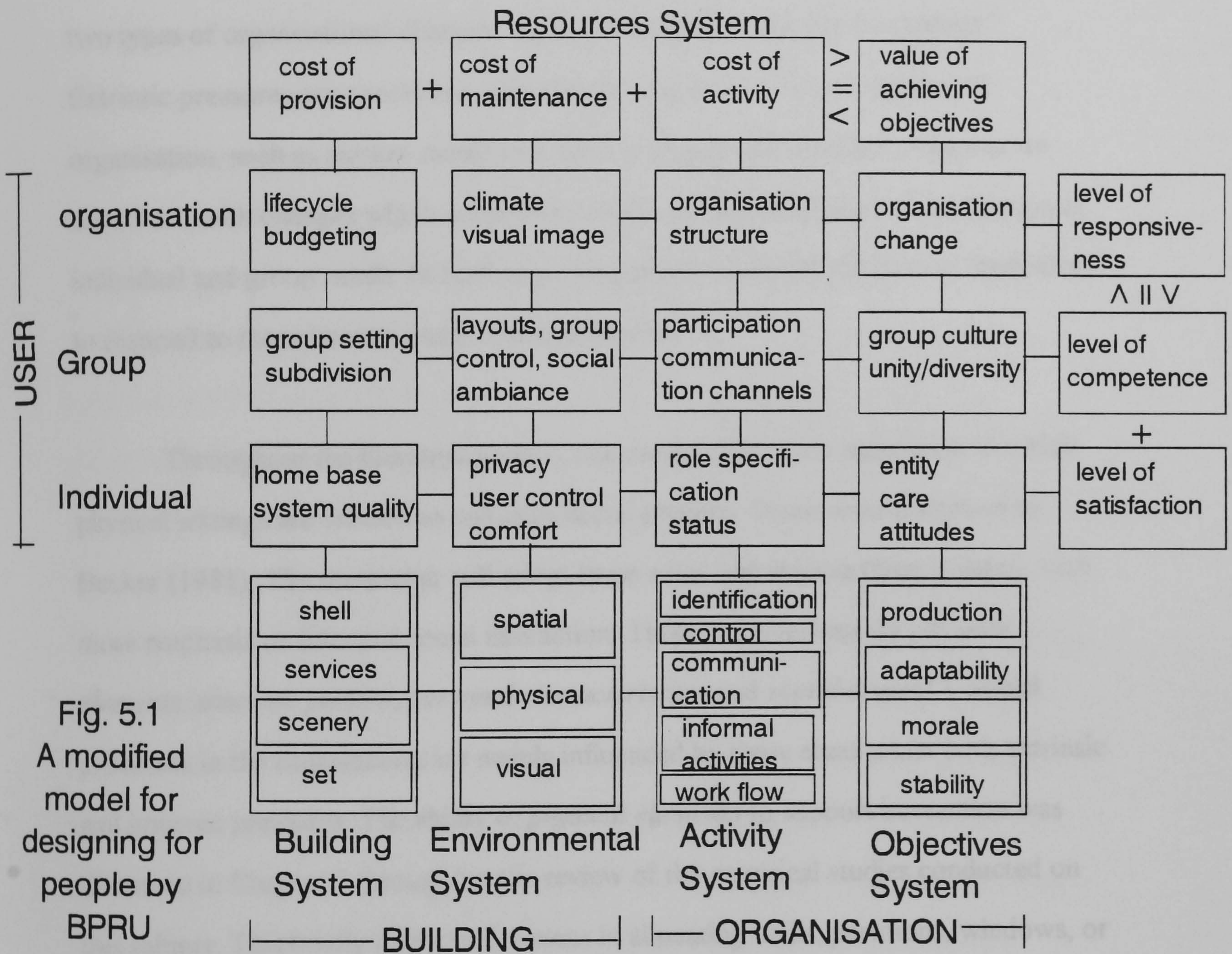


Fig. 5.1
A modified
model for
designing for
people by
BPRU

5.3. Physical settings and social processes.

Chapter 3 established a connection between physical settings and organisations in general. This section, however, highlights areas where physical settings could affect the social behaviour of members of organisations. What seems to be important here is the course of changes that organisations might experience. There will be no need for management if there are no changes. Ellis (1991) has described two types of organisational changes; these are extrinsic and intrinsic changes⁷. Extrinsic pressures are concerned with changes which come from outside the organisation, such as market conditions. On the other hand, intrinsic pressures are concerned with changes which come from inside the organisation, such as changes in individual and group needs. In both cases organisations should restructure themselves to respond to these internal and external pressures.

Throughout the literature review, one can establish four main areas in which physical settings are created to influence social process. These were discussed by Becker (1981). The researcher will adopt these areas and discuss them in detail, with more emphasis on informal social interaction. These are *selecting the physical elements; time/use pattern; personal characteristics; and social context*⁸. Social processes in the organisation are mainly influenced by these areas under both extrinsic and intrinsic pressures. The ability of *physical elements* to support interaction was discussed in Chapter 3 throughout the review of the empirical studies conducted on this subject. This briefly refers to decisions in allocating walls, partitions, windows, or size and location of workspace. The review has established a growing body of evidence of the impact of physical elements (enclosure, proximity, spatial potential, and facilities) on social behaviour (i.e. interaction). Physical elements could reflect the degree to which an organisation emphasises the differences among different individuals in the workplace through size of office and quality of furnishings⁹. In this respect, the physical elements could be used as a tool to control the social differences among the staff.

The second issue relating to social processes and the physical settings deals with the way in which management schedule the *time/use pattern* of both facilities and activities. This mainly involves decisions regarding the use of space and equipment. The issue of space utilisation, which is concerned with managing space over time, has been accepted in big organisations as it increases organisation efficiency in making maximum use of its facilities. The physical setting is always affected by the time/use mechanism. The level of mobility (i.e. movement) of each member of an organisation is dictated by the type of task he or she pursues and is a determining factor that can highly influence the pattern of physical settings. Time/use pattern has become a criterion that determines the success of effective organisations. Recent approaches in managing facilities have described successful workplaces as the ones that promote facilities' sharing and unfixed positions for staff¹⁰. Such approaches increase the opportunity for informal exchanges among the staff, and therefore support the process of information exchange.

Relating time to settings always elicits the question "*What Time Is This Place?*"¹¹. This approach urges designers to pay attention to the form of time as they deal with the form of space. Management could either support face-to-face contact among staff by increasing the length of overlapped working-time among individuals or groups, or discourage it by avoiding any overlapped working-time. In this way work will be performed as a pattern of serial activities rather than as overlapped activities. This becomes apparent when organisations introduce the notion of flexible time, where staff can work any time within a specified range of time. The extreme range is that staff can work at any time of the day, any day of the week. In this respect, as the flexibility of working-time increases, the opportunity for staff to maintain informal contact among each other decreases. On the other hand, providing pleasant and comfortable settings could retain staff in these settings for a longer time, and subsequently these settings will act as a focal and attractive point in the workplace

and provide a good opportunity for staff to meet each other informally¹². In contrast, unpleasant settings can always be seen as vacant and act as a repellent for staff.

Lynch (1972) has described seven characteristics of time. These are *grain*, *period*, *amplitude*, *rate*, *synchronization*, *regularity*, and *orientation*¹³. It is worthwhile to think carefully how each character involved in the management of the physical settings could influence the level of interaction in organisations. *Grain* refers to the time unit in which the working-time is divided. Basically, the grain in most organisations is an eight-hour module i.e. the module is the hour. The smaller the unit, the more the organisation is keen on time. Some organisations adopt a five or ten minute module for the whole working programme i.e. all meetings, conferences, or any formal events could take place at 9:10, 9:20, 9:30, etc. The more the grain tends to be coarse, the more organisations tend to perform less activities, whereas the more the grain tends to be fine, the more the organisation tends to be active and busy. The issue of grain will also affect the working program, such as taking a break on a certain time interval basis. Secretaries and managers can vary dramatically in their tighter-grained time texture.

Period refers to the length of time within which events occur. Individuals with different tasks and hierarchical status may experience a different time structure. Stimuli in the physical settings that cause staff to leave their workspaces can vary according to their position in the organisation. In other words, managers can be more sensitive to any disturbing stimuli than secretaries. In this case a manager may leave his workspace as a behavioural reaction to stop that stimuli, so the manager will have the chance to talk to others. Generally speaking, as individuals vary in their physical settings, the degree to which they are influenced by physical stimuli will also vary. The frequency of any event followed by a certain behaviour may provide a person with the opportunity for informal contact with others.

Amplitude refers to the degree of change within a cycle. For secretaries, the number of different activities they perform could be telephoning, typing, filing, etc. Assigning these activities to different people will decrease the amplitude of work. As the size of the amplitude determines the way in which activities are performed (i.e. serial or parallel), this in turn will influence the number of individuals and groups that are involved in each activity. The approach of the *total workplace*, by Becker & Steele (1990), described this approach with *Rugby vs. Relay race models*, in which activities should be performed all at once in a parallel way rather than finishing each activity and starting the next one¹⁴. In Becker & Steele's view this will increase informal communication among the involved members. The approach was regarded as a key support for the information exchange mechanism.

Rate refers to the speed with which changes occur. Changes in the settings such as a change in layout and furniture will influence the opportunity for staff to talk to each other. Changes in an information technology system might lead staff to converse and inquire about any ambiguity regarding the new changes, and express their own opinions and views. The rate of making changes in the physical settings should be undertaken gradually as this could disturb the flow of work.

Synchronisation is the degree to which certain events occur in the same phase. A fire alarm could cause a large gathering of staff outside an office building. Synchronisation also deals with the time/use frames of the setting, i.e. what time are most of the staff present in their workspaces?. Is the office vacant at lunch time?. When are lounges, cafeterias, and spaces provided for informal exchange most busy?.

Regularity refers to the degree to which the previous characteristics remain steady. Changes in these characteristics will create a hectic day for staff, whereas their stability will create a feeling of a slow day. The degree of regularity can affect

the degree of work stress on the staff so that individuals might need informal contact to relieve their stress.

Finally, *orientation* is the degree to which attention is focussed on the past, present, or future. Creating settings that can draw staff attention to the past (such as old ornaments or antiques) or to the future (such as high sophisticated facilities) can act as an attractive feature to attract people and therefore converse informally.

The third area that can influence the social process is *personal characteristics*. This refers to race, sex, income, age, qualification, ability, human relation skills, previous work experience etc. ¹⁵. All of these characteristics could have an impact on shaping the social atmosphere in organisations. The study by Walden, T. et al (1981) on the perception of crowding on 16 male and 35 female incoming freshmen at the University of Florida showed that the perception of crowding was different among males and females. Staff of similar age and race could show more tendency to converse and make friendship ¹⁶. Facility managers should personalise employee's workspaces. This is in terms of employees' reaction to their workspaces, the level of control they possess, their expectations, their views, etc. All of these issues will influence the way facility managers manage the social dimension in organisations.

Furthermore, staff that change in their personal status may start to change the way they perceive and look at the surrounding settings. The rate of changes occurring in the hierarchical structure of organisations will affect the rate of change in the physical settings. This can generate a constant changeable image of the social organisation. An organisation whose staff tend to have less variation in their hierarchical structure (i.e. horizontal structure) can maintain a different social atmosphere from the one of longer depth of span among staff status (i.e. vertical structure). The latter type of organisation is an example of bureaucratic organisation.

Duffy (1974b) has found a relationship between some bureaucratic variables and interaction:

Moreover, some of the bureaucratic variables are significantly related to interaction- the less bureaucratic the organisation, the less its members speak to one another."¹⁷

On the other hand, employees who spend a longer time in organisations may perceive the surrounding physical environment differently from those of shorter time. Those who are newly employed could take a week or a month to accept their physical settings and to experience their social activities. Personal characteristics also refers to the type of office layout staff prefer. New staff may prefer a private office to an open plan. Riland and Falk (1971) found that employees with five years' service or less have more intention to move to an open landscaped office than those who have been longer ¹⁸ . The type of office layout will provide staff with different interaction potential opportunities.

The last area that can affect the social process is the *social context* of the organisation. The essence is that the relationship between environment and behaviour as described by Becker (1981) is an indirect relationship (i.e. environment as a catalyst-second order effect) ¹⁹. Salancik and Pfeffer (1978) argued that the conventional approaches to understanding peoples' attitude at work fail to take into account the social context in which the work occurs ²⁰. Therefore, understanding the social context is worthwhile because it helps organisations to understand their staff's attitudes. Becker (1981) has described the link between physical settings and social behaviour as:

"For any individual, the enacted physical environment is both social product and process perceived in particular ways. We respond not only to the physical elements, like the color, size, and arrangement of the office, on the basis of our own personal experience and circumstances, job requirements, and role responsibilities, but respond as these are , in turn , subjected to influence processes initiated by our friends, family and colleagues"....."If we accept that behavior is influenced by

information provided by others. the physical setting is the most immediate and visible sign of the social process and of communication in any setting." ²¹

The organisation's intention to provide separate lounges for staff of different status will encourage interaction within the same status class and discourage interaction between different classes ²². The presence of sharing facilities among staff and creating gathering focal points will promote informal contact among staff. This is all part of the social processes in the organisation ²³.

Becker & Steele have described certain design elements in their developed concept of the total workplace as supporting the informal exchange mechanism among members of the organisation (in this case at Steelecase Corporate Development Centre SCDC)²⁴. The informal communication among the staff was found to be a key issue in enhancing the creativity of products. Eight design features were adopted in the SCDC building. The first was *multiple work areas*, which aim to provide work areas with different characteristics and purpose. The concept was developed since the researchers realised that neither an open plan office nor a closed office would be appropriate to carry out different organisational activities. Instead, work settings that are characterised by different levels of privacy and physical elements are expected to be more responsive to the organisations. The concept will generate private, project, and shared spaces. In this case, individuals will move and select their work areas in the way they think is more appropriate to the performed task.

The second design feature is to provide *neighbourhoods with mixed disciplines*. This refers to accommodating different disciplines in one area so as to encourage informal communication and create working relationships based on trust and understanding of the diversity of tasks.

The Director's cluster, allocates managers to the middle of the building, so they are accessible to all staff. The concept rejects the notion of allocating managers to separate or isolated areas. By allocating managers to the hub of the working areas, informal communication is facilitated between managers and their subordinates.

The fourth feature is creating *activity generators*, which refers to creating common areas and nodes inside the building such as cafeterias, coffee break, atrium, lounges, etc., with attractive physical elements such as comfortable seats, colour, and furniture quality, which will increase the likelihood of unplanned informal contact.

Corner commons, refers to providing areas with flexible furniture and facilities, so employees can manipulate these physical elements by themselves to create workspaces that support different tasks. For example, employees can arrange screen barriers to create workspaces with a high level of privacy for tasks which require a high level of concentration. The aim behind this design measure is to enable employees to have an appropriate workspace at any time for any task.

Escalators & stairs means the vertical circulation inside the office was meant to be exposed to the staff and not hidden behind walls. Escalators were adopted in the building, instead of stairs hidden behind the walls, as they provide a high level of visual accessibility and encourage staff to have better informal contact.

Adjacencies, or critical areas such as a conference room, break areas, laboratories, and so on, are heavily used by all the staff. Distributing these areas all over the building will increase the level of mobility among the staff, which can increase the opportunity for staff to bump into each other. The approach is developed from the functional inconvenience concept which abandons the conventional method of allocating highly-related functions close to each other to minimise the travelling distance.

The final design measure is the *front-stage and back-stage concept*. Front-stage refers to areas where customers and guests can meet with staff, whereas back-stage refers to areas allocated for staff only. The approach tries to restrict customers and guests to a few front-stage areas, so as to avoid any intervention in back-stage areas which might disturb the staff. More concern about back-stage rather than front-stage will minimise the chance of the building looking like a show room, and in the meantime give the staff a better chance to carry out their work more effectively, especially with regard to functional diversity.

5.4. Models for managing interaction in facilities management.

The way in which facilities management differs from the conventional method of designing building for interaction is by introducing supporting services and management aspects to the problem of interaction. Before we revise some models that show interaction activity in the context of facilities management, it is important to look in depth at the nature of interaction in management.

Managing interaction and workplace intelligibility

Is interaction a manageable activity?. If we succeeded in defining the parameters of managing the problem of interaction then our workplace is more intelligible. Nutt Bev (1992) has raised the question of what is manageable. He argued that:

"The nature and quality of facilities are determined by the initial planning, design, engineering and construction of the development, through post-occupancy management by a series of users, by the prevailing business climate, and by external factors of an economic, social and environmental kind. Within the typical life cycles of buildings and their facilities we must identify those aspects of facility performance that are manageable through time, in that they may be changed, regulated and improved by management decision and action. On the other hand, we must determine which facility issues are not susceptible to management, in that management decisions can have no material effect." ²⁵

Nutt also thinks that between these two extremes of manageable and unmanageable issues, there is an array of partially manageable issues. In brief, separating manageable from unmanageable issues is complicated, but in theory Nutt has developed three characteristics that can help us understand whether or not an issue can be resolved through management. These are *predictable* or *unpredictable*, *controllable* or *uncontrollable*, and *reversible* or *irreversible*. Some features in organisations are very rigid and cannot be modified. Such features, called irreversible, include location and building shell. On the other hand, some other features are flexible and adaptable. These are called reversible; examples of these are space utilisation and the scenery (interior division) of the space. Of the reversible features some are controllable, whereas others are not. Examples of controllable features are the level of temperature and air quality. Of the controllable and uncontrollable features some will be predictable while others are not. Examples of predictable features could be the use of information technology and therefore the level of automation. Unpredictable features could be like the change in business, and the change in the way people prefer to perform work.

Now, the broad question is 'how can interaction be described in the light of these three characteristics?'. The answer to the question emerges from the time organisations take to look at the importance of interaction, and measures taken to support these objectives. Evidence that connects informal interaction to the physical environment is well-established (see Chapter 2, The Role of the Physical Environment). Therefore, measures (i.e. design guidelines) taken by organisations to support informal interaction through the physical environment should be examined against the three characteristics of manageability. This in turn will determine the level of *intelligibility* of the workplace. An organisation will have an intelligible workplace of informal interaction according to the following criteria: 1) to the degree that the interior layout, equipment, and physical facilities are *reversible* to respond to any changes in the informal interaction policy; 2) to the degree that employees have

control over their workspaces so as to isolate themselves to maintain privacy or integrate themselves to maintain participation; 3) to the degree that organisations *predict* the work styles of the future that dictate the importance of informal exchange so as to take early decisions at strategic levels.

The mission of facility management is quite complex because it deals with the physical facilities and supported services which serve organisational objectives.

Becker (1981) wrote:

"Facility management is concerned with decisions about the use of an existing environment or facility on an ongoing basis: decisions about which group can use the conference room; where the file cabinet can be located; how often the office landscape should be changed ,by whom, and on what basis; when the corridor needs to be repainted , and in what colours; whether secretaries should be allowed in the staff dining room, or the dining room should be separated into areas used by specific groups . And it deals with how these decisions are reached"²⁶.

Becker (1981) has also summarised the attributes of facility settings that facility planners and managers are concern with. These are the *spatial form of settings*, including size, shape, location, circulation paths, partitions around workspaces. *Patterns of activity*, including location, intensity, type, flow, and scheduling of activities within and between settings, in addition to decisions concerning sharing facilities. *Communication* refers to all aspects (i.e. verbal or non verbal) of communication, level of using information technology, use of memos and signs, and degree of incorporating formal vs. informal communication. Finally, *ambience* refers to the quality of the micro climate of the organisation including light, sound, texture, selecting type of lighting, colours, etc. ²⁷. These four attributes defined by Becker imply very bounded and limited responsibilities for facility managers. Even the model developed by Trickett (1990) has the same shortcoming ²⁸. Trickett's model described the creation and maintenance of physical settings in offices as a hidden dimension in organisation design. His focus was on managing office layout in a way that contributes to the success of the organisation. His model of

measuring the differentiation among organisations consists of three dimensions. These are interpersonal style (formal vs. informal); the authority system (concentrated vs. dispersed); and the working procedure (participative vs. individual). Trickett's model seems to be very inclusive in viewing measures of differentiation in organisations. Specifically, the three dimensions in his model represent the three different dimensions of organisational structure. But organisational structures that are expected to influence the physical settings of organisations and therefore the interaction level are beyond those described by Trickett's three dimensions ²⁹. Duffy (1974b) has also confined organisational dimensions to bureaucracy and interaction, an approach that was criticised by Sundstrom, where Sundstrom hypothesised that each organisational structure could be reflected in one or more physical criteria in the workplace ³⁰. These approaches were discussed in Chapter, 2 which tried to establish a connection between organisations and physical settings.

However, the approach of facilities management should be different from the previous approaches. Managing physical settings is more complex and resistant to being figured out in discrete dimensions. The shortcoming of the previous approaches occurs when an array of issues fall between discrete dimensions which could have an influence on physical settings. In facilities management we do not only describe dimensions of organisations that can influence the physical settings, but we also describe all the internal and external forces that embrace the problem of creating the physical settings, such as users' expectations and needs, market conditions, and churn over time. An example for this approach is the model developed by Alexander (1992) describing five dimensions reflecting the concept of facilities management ³¹. The model describes the interface between people and their environment, in addition the services provided to support organisational effectiveness. The dimensions of the model are user groups (e.g. individual, operational units and corporate); facilities (e.g. service and place); processes (e.g. socio-psychological and managerial); context (e.g. business); and time (e.g. life cycle). The model was an adaptation of the model

developed by the Environmental Design Research Association (EDRA) developed to serve environmental design research. However, Alexander's model provides facility managers with more comprehensive concepts about the implications of managing physical settings in organisations to support their basic objectives. Furthermore, the concept of total workplace by Becker (1990) incorporated the physical, social and management dimensions as a framework for facility managers to provide responsive workplaces and a comprehensive, integrated model for managing successful workplaces ³².

5.5. Examples in managing interaction.

The issue of enhancing communication among members of organisations has become critical because some organisations are starting to rethink the way in which work is performed. Recent approaches that describe successful workplaces have insisted on a full understanding of the context of working lives that comprises the design elements, social, and organisational networks. Becker & Steele (1990) wrote:

"The concept of the total workplace includes physical facilities - but it goes beyond them to take account of the whole network of social, organisational and design elements that constitute the context in which we spend our working lives" ³³.

The approach of the total workplace focuses on the organisational ecology in which work is undertaken. The aim behind developing this concept is to enable organisations to effectively create, maintain, and change their work settings. This necessitates broad thinking about social, physical and management issues operating as one system to create the total workplace. The Steelex Corporation Development Centre in Michigan, the world's largest furniture manufacturer, was an example with which the authors illustrated the idea of the total workplace. Two main criteria were required to improve the product development process. These were enhancing creativity and innovation, and secondly a reduction in the time required for the product development cycle. The response to these needs was demonstrated in a

workplace that takes all work stages as one process and encourages all formal and informal communication across discipline and team lines. Becker & Steele wrote:

"In order to serve the goals of enhanced creativity and greater speed in the development process, two anchoring themes were selected, based on the premise that innovative product development required that at all stages of the process, members should be sharing large amounts of information about technology, markets, design, and manufacturing processes. Formal and informal communication across discipline and team lines to stimulate creativity and connections was at the heart of what we came to call the 'advanced work culture'. These anchoring themes were the 'Rugby v Relay' model, and the critical need for communication".³⁴

The Rugby model was compared with the Relay model. The former model was suggested to the organisation as it implies several shifts; firstly, a move from individual to team work; secondly, a move from sequential to interactive work flow; thirdly, a move from static to dynamic positions; fourthly, a move from preplanned to serendipitous activities; and finally, a move from autocratic to democratic style. The Rugby model emphasises the need for informal communication, as the authors claimed that communication which stimulates creativity is less predictable and is informal. The concept of the total workplace refers to the potential of informal communication for the physical arrangement of office space³⁵. Six measures were adopted to convey the concept of the Rugby model, which emphasises not only informal face-to-face interaction, but also other related organisational concepts which in totality will enhance the process of creativity.

The first measure was *functional inconvenience*. This refers to the promotion of accidental contacts through the provision of common area rather than through the spatial proximity. Secondly, *functional diversity* refers to bringing different disciplines in contact with each other. This is of a great importance since groups of different disciplines find difficulty in understanding each other's work style, attitudes, and values. Bringing them close to each other will help groups to understand the nature of

each other's work and will enhance creativity through better co-operation and communication between groups. Thirdly, *strategic leadership* refers to management decisions regarding goals and objectives, completion dates, and staff autonomy represented in their intentions in getting work done in their own way. *Spatial mobility* refers to the abandonment of the idea of fixed workspace. As work changes over time, so the optimal physical settings that support that work should vary as well. Spatial mobility will increase the opportunity of staff to bump into each other during the activity of moving inside the office building when alternating activities and workspaces. The fifth measure is *All time-in*, an expression which describes the time when staff are present in lounges or coffee break areas to socialise, exchange information, discuss ideas, and so on, as a time when informal communication is prompted and staff are still plugged in work. The final measure is the concept of *front-stage and back-stage*. Front-stage refers to lobbies, cafeterias, and public areas, which are areas that are mostly occupied by non-employees. On the other hand, back-stage refers to areas where staff spend most of the day, and where functional diversity takes place. Treating the entire workplace as front-stage areas could weaken group ties and decrease individual identities. In contrast, treating the entire workplace as back-stages will have a more positive impact on staff³⁶.

Earlier Stone & Luchetti (1985) developed the concept of "activity settings". The concept has arisen as a response to the change in the way office work is performed. "Activity setting" enables each employee to have a private home base supplemented by access to quiet spaces, rooms housing shared facilities, and other public areas³⁷. Stone & Luchetti suggested that neither the open plan office nor closed office could respond fully to staff needs, but "activity settings" could. The introduction of technology, the change in work style, the need for interdependencies among staff, and the need for privacy and participation were the main incentives for the development of the concept. They argued that :

"managers can integrate the physical layout, design, and communications to support organisational objectives that emphasize informal exchange; reassign

people to different work teams and study groups; provide many employees access to specialised equipment; value individual initiative and mobility; derive payoffs from serendipity; attract talented employees, and increase productivity while reducing office costs." ³⁸

The study by BRE & DEGW (1992) of the responsible workplace revealed some basic trends in the future of the workplace ³⁹. These include more flexibility and control for users; accommodating more diverse technologies; more work locations used by an organisation; more natural environment; and more user choice with higher expectations. These trends were embodied in some design guidelines. These include workplaces with greater flexibility in the use of space and time so as to ensure more rapid response to market needs; and workplaces to satisfy rising employees expectations of office quality. Other considerations were: systems of managing workplaces should enhance the quality of life and improve productivity; and thinking of workplace as an asset where spaces should be efficiently utilised and allow shared facilities among individuals. As organisations are restructured over time with regard to hierarchy, the physical settings should be adjusted in term of space allocation, acceptance of open plan and common workstations. Information technology will allow working from multiple workstations. Furthermore, more integration between design, construction, and management as to eliminate the gap between shell and scenery. Regulations will increasingly shape office form and use.

5.6. Summary.

Facilities management has become more vital as organisations experience changes in their basic structural components dictated by external and internal pressures. No organisation is static. In fact, every organisation experiences some sort of change, and this is where the management aspect of the total workplace concept arises. However, interaction is an activity that can pass through a course of changes, as organisations may make changes in their interaction policy for any reason. The chapter has focussed on many issues. Firstly, after been exposed to the nature of

organisations, it was the aim to investigate in detail the process of selecting physical settings to support organisational needs. Secondly, the chapter set out to explore the role of physical settings and facilities in influencing the social processes in organisations. This is a vital issue, since facility managers can intervene through these processes to control the level of interaction among employees. Thirdly, models for managing interaction were reviewed. This concluded with the argument that previous approaches tend to describe managing physical settings in discrete organisational dimensions, whereas it is thought that managing physical settings should incorporate users of different levels, facilities, and all the formal and informal processes in organisations.

The broad mission of facility managers should be to personalise employees' workplaces. This is in terms of control over the workspace, workspaces that meet employees expectations and workspaces that support productivity. Finally, as far as managing interaction is concerned, three measures of workplace intelligibility were developed. The workplace is intelligible to its users if a) the physical settings, layout, and facilities are *reversible* in the way that they respond to any changes in the interaction policy b) people in their workspaces are able to *control* their level of interaction so as to isolate and participate themselves whenever it is necessary c) organisations are able to *predict* future changes, especially with regard to work style and therefore the importance of interaction.

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Summing up the problem and the research hypothesis

Organisations have accepted interaction as a means to increase productivity and meet employees expectations of their workplaces. However, organisations vary dramatically in the way they look at the need for interaction to support their strategic objectives. The level of participation vs. bureaucracy is one of the key dimensions that shapes the structure of the organisation⁴⁰. Saudi organisations form the context of this study. Although Saudi organisations are bureaucratic, they perceive participation within and among different organisation levels as a key dimension to support productivity in the organisations.

The role of the physical environment in influencing the level of interaction was the richest in the literature. The study reviewed some of the previous research that claimed a congruence between the physical properties of the workplace and organisation structure. The impact of physical proximity and physical enclosure on interaction was the research area of several studies. The majority of Saudi organisations have adopted the conventional plan layouts of rooms of different sizes due to the belief that they would respond to the hierarchical structure of the organisation as well as provide a better level of privacy. Another reason was due to the possibility of accommodating similar organisational groups under one spatial boundary (i.e. room). The level of participation was severely hampered by virtue of the conventional layout through the high level of enclosure. Although open plan layouts were not accepted by some Saudi organisations, the researcher believes that the high level of physical enclosure will not solve the Saudi organisations' problem. Instead the spatial potential of layouts is another design measure that Saudi organisations should adopt in their layout in order to support participation and interaction without hindering the level of privacy.

The study aims to explore the connection between the spatial layout and the pattern of social structure in office environments. It should be noted that this study

does not examine the efficacy of the space syntax concept though it has some limitations. The space syntax theory is used in this study as a tool to describe spatial layouts of offices. The reason for adopting space syntax concept as a method to analyse spatial structure is due to its ability to attach a social logic to space in a way that the two spatial measures of the theory (i.e. global integration and local connectivity) correspond to the social dimension of human behaviour ⁴¹. Another justification for the use of space syntax technique is realised in its ability to describe spatial layouts in a more consistent and scientific approach, in a way that allows quantitative comparison of different layouts ⁴². Exploring the connection between the spatial pattern and informal interaction by using the concept of space syntax theory will enable us to generate norms and standards of different spatial environmental quality that could respond to different organisation and user requirements.

The central research area of this study consists of two parts:

A. Investigating the relationship between spatial structure and social structure in office environment.

This study explores the potential of the spatial structure of office layout in a way that implies typological choices which affect the level of informal interaction. The study adopted space syntax theory as a tool to describe and analyse the spatial structure of layouts. This theory describes the spatial pattern with two intelligibility measures. These are the problem of spatial integration (global measure); and the problem of connectivity (local measure). The working hypothesis of this study is that **the spatial structure of layout in terms of its global measure of integration and local measure of connectivity will be associated with the level of informal interaction.**

The hypothesis will be tested on three levels. These are individual (level 1), small group (level 2), and large group (level 3). At an individual level, the impact of

both the level of integration and the level connectivity of each employee on his level of informal interaction will be investigated.

In order to make the research hypothesis clearer for small groups (level 2), the researcher has developed a conceptual model which demonstrates four different spatial layouts that are expected to be associated with different levels of interaction. The hypothetical model is based on the notion of the depth (i.e. integration) of the spatial structure. This intelligible measure of spatial structure (i.e. spatial integration) is expected to regulate and control human interaction through the notion that certain spaces are only accessible through other spaces. Spaces in highly integrated systems are independent from each other (i.e. more route choice). On the other hand, spaces in highly segregated systems are dependent on each other and there are fewer route choice to move between spaces (Fig. 5.2). Therefore, it is hypothesised that society in deep structure (more segregated than integrated) will maintain higher interaction than society in shallow structure (more integrated than segregated). The hypothetical model illustrates a typical office layout of individual rooms (Fig. 5.3). Each room is subdivided into individual workspaces. Thus, spatial groups were developed (i.e. staff within the same room).

Following the way that organisations accommodate staff of similar organisational divisions (i.e. departments) under the same spatial boundary (i.e. room), four different possible layouts can be generated with respect to the notion of spatial integration and interaction within and between spatial groups. Fig. (5.3a) is a shallow structure (i.e. more integrated) within the spatial groups (i.e. staff in the same room) and deep structure (i.e. more segregated) between spatial groups which will create low interaction within the spatial groups and high interaction between the spatial groups. Fig. (5.3b) is a deep structure (more segregated) both within the spatial groups as well as between the spatial groups. This is expected to generate a high level of interaction both within and between the spatial groups. Fig. (5.3c) shows

that the spatial groups are accommodated in a shallow structure (more integrated) within each other as well as between each other. This is expected to generate low interaction within the spatial groups as well as between spatial groups. Fig. (5.3d) is a deep structure (i.e. more segregated) within the spatial groups and a shallow structure (i.e. more integrated) between spatial groups which is expected to generate high interaction within the spatial groups and low interaction between the spatial groups.

At large group level (level 3), the impact of the two spatial measures (i.e. global integration and local connectivity) on the level of informal interaction among staff on the whole organisational scale will be explored. This will be investigated by comparing the spatial and social quality of different organisations with each other.

The potential of spatial structure is believed to provide organisations with another scope, additional to physical enclosure, as a design solution to support the level of participation and interaction among members of organisations. This will be an approach recommended to Saudi organisations to resolve the problem of interaction.

B. Identifying the significant predictors of informal interaction:

The study will also develop an overall model describing the strongest physical, spatial, and organisational predictors of informal interaction. Physical variables refer to the level of visual accessibility, physical enclosure, and proximity. Spatial variables refer to the global measure of spatial integration of each space with respect to the whole system of spaces in addition to the local measure of connectivity. Variables related to organisation are organisational division with respect to function (i.e. departments), level of mobility (i.e. to which extent staff are mobile), and task characteristics (i.e. managerial vs. clerical). These three groups of variables (i.e. physical, spatial, and organisational) will be treated statistically at an individual level of analysis so as to identify the strongest predictors of informal interaction. This will

help to formulate design guidelines that will assist designers and managers to control the problem of interaction in workplaces.

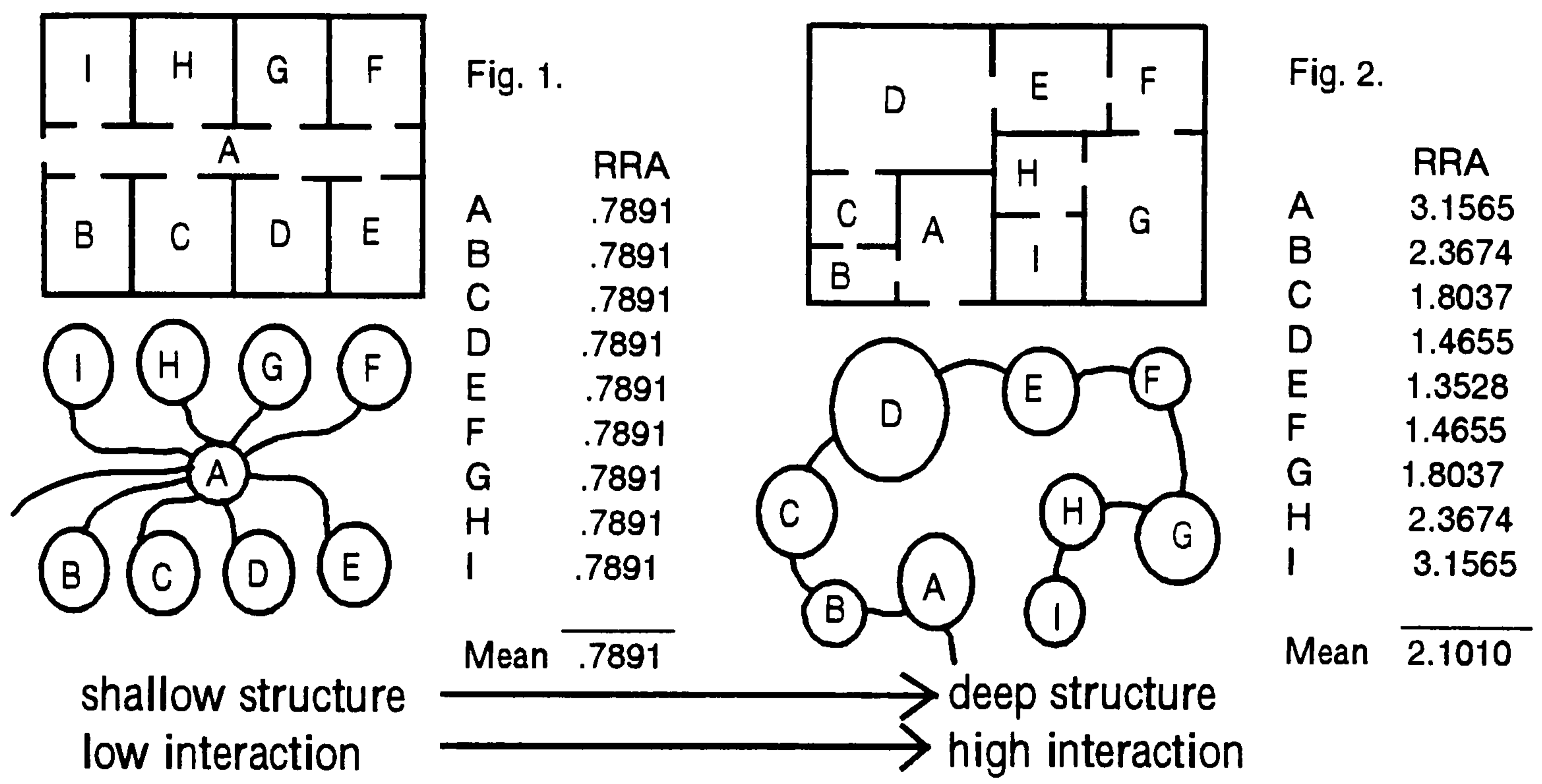
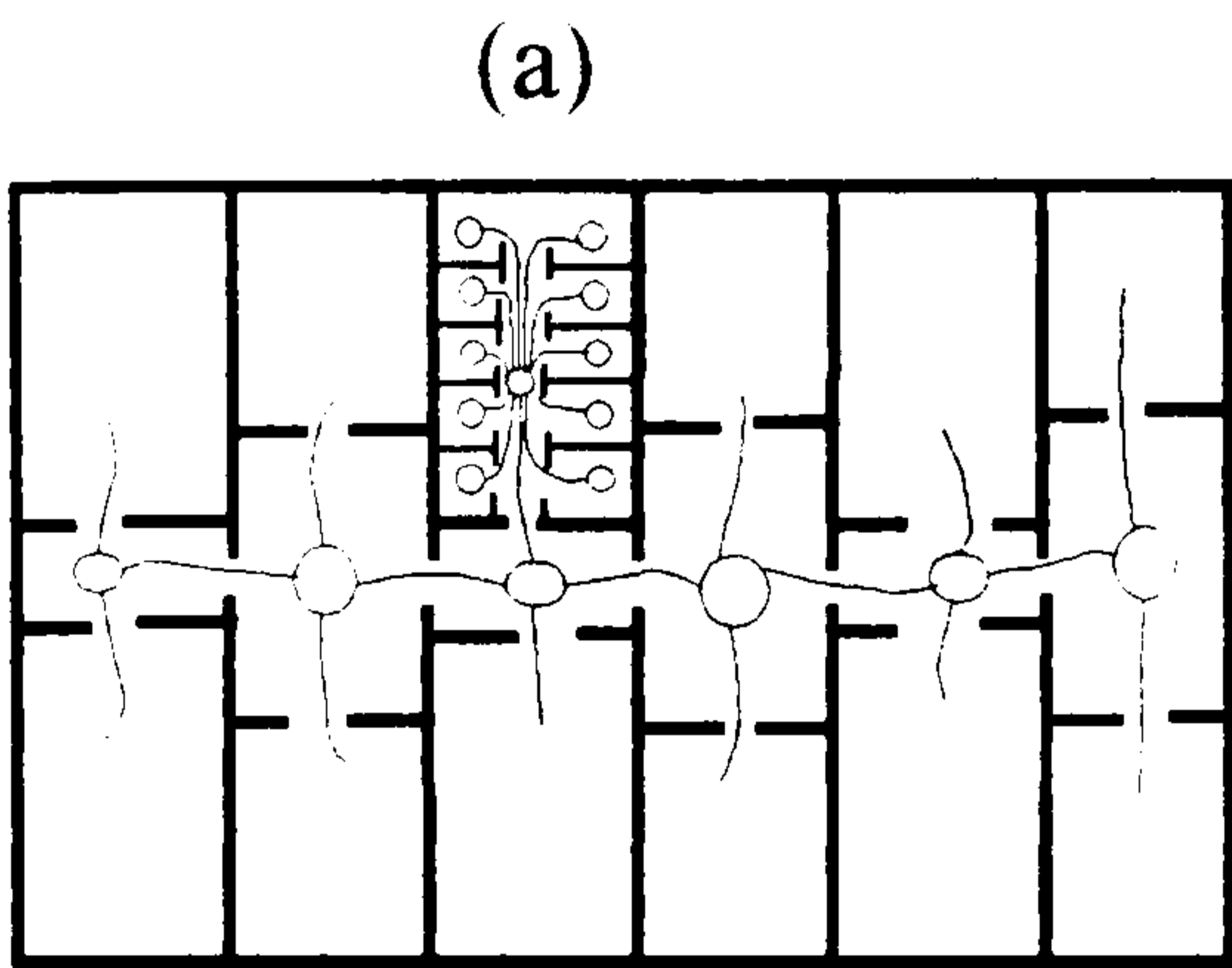
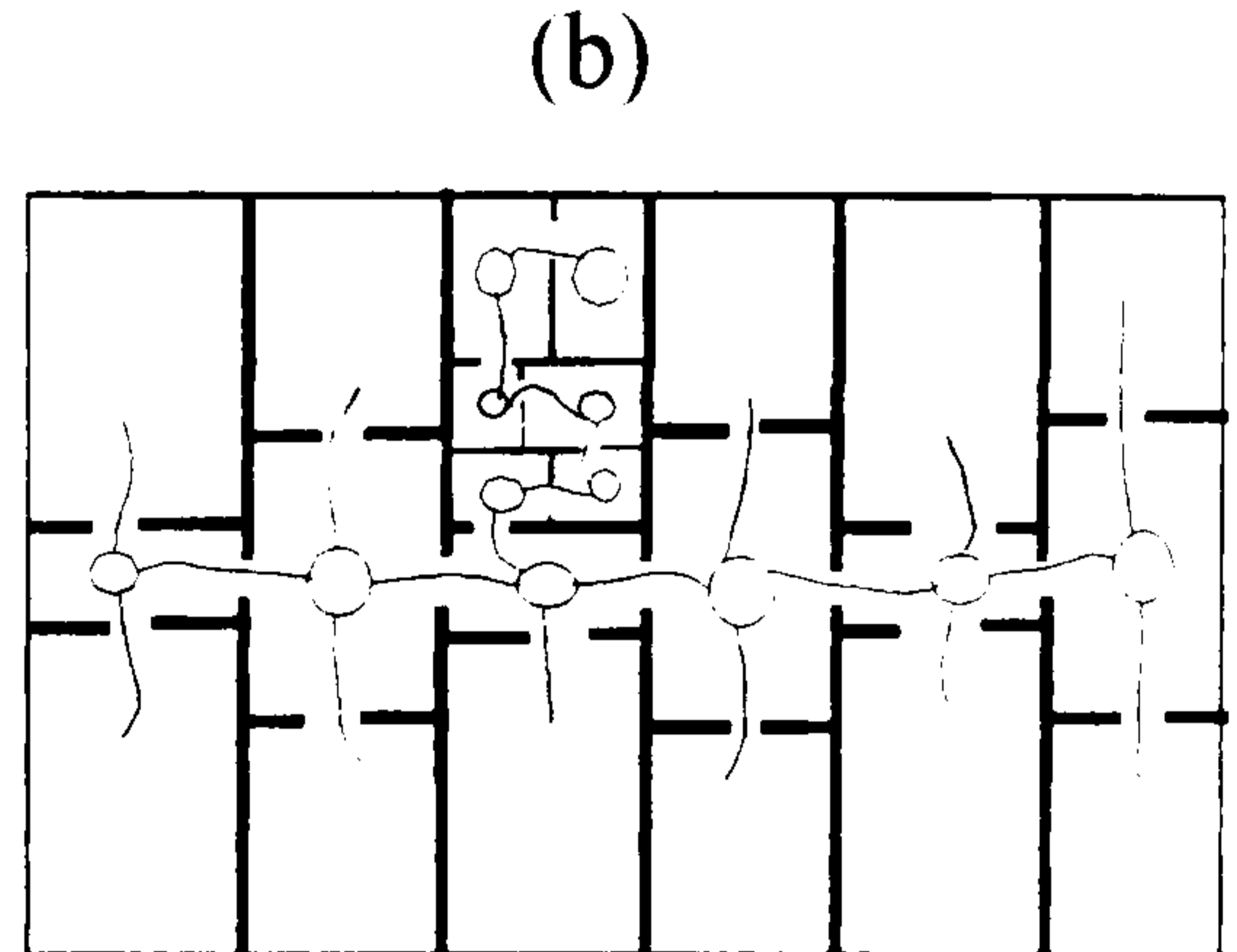


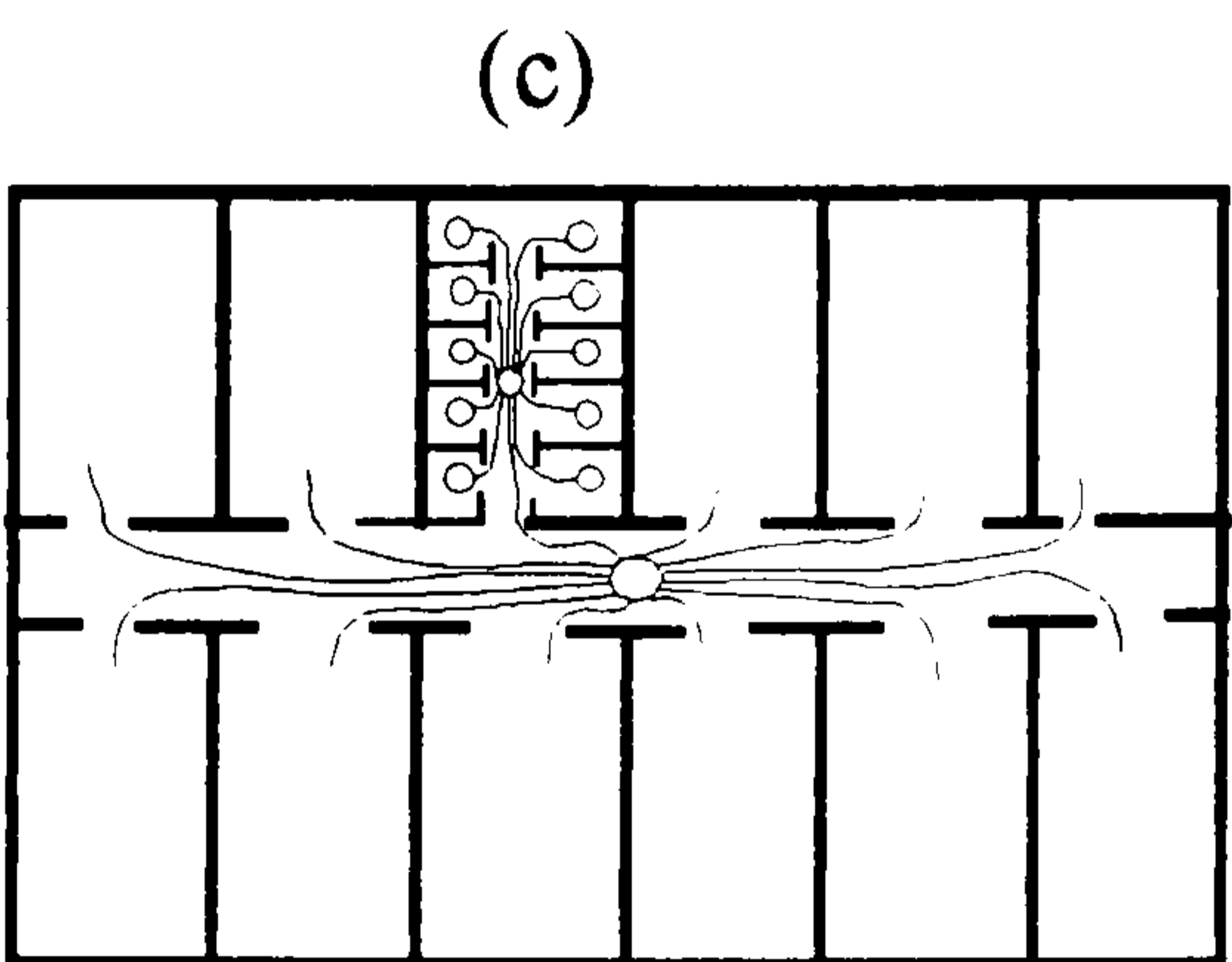
Fig. 5.2. The hypothesised relationship between the global measure of space integration and the level of interaction.



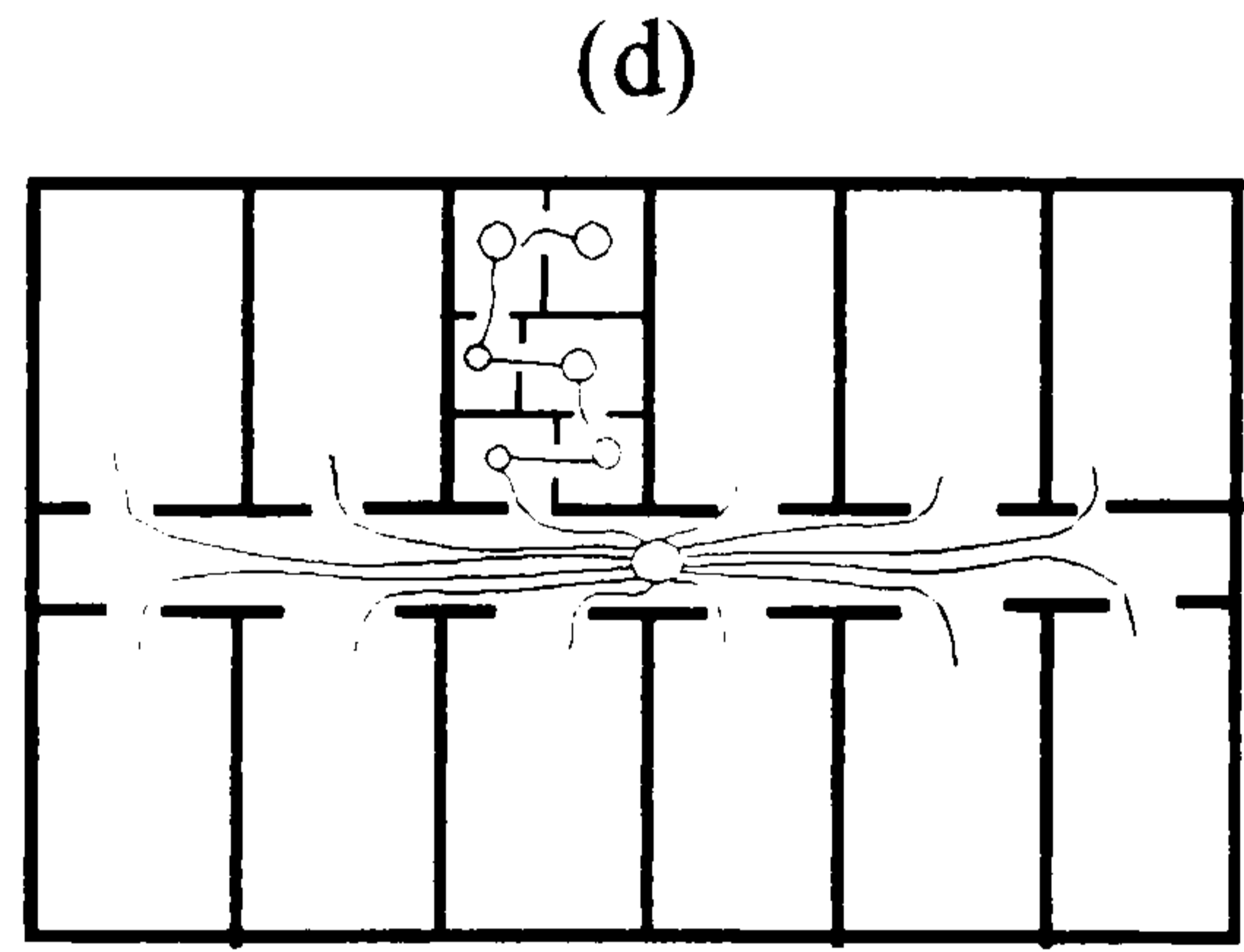
Low interaction within groups
High interaction between groups



High interaction within groups
High interaction between groups



Low interaction within groups
Low interaction between groups



High interaction within groups
Low interaction between groups

Fig.5.3 The hypothetical model - Four different layouts demonstrate the expected impact of the global measure of space integration RRA on interaction

Notes and References

⁴⁰ Bureaucracy in Saudi organisations is defined in terms of centralisation in decision making, formalisation, and complexity of work. Staff are structured in a hierarchical pattern with the ability of high status staff to highly influence the decision-making process. Staff at higher positions have more complex work than staff at the lower positions. The nature of work in Saudi organisations is characterised by being very complicated with a high level of routinisations. Most of the processes in Saudi organisations are formal and there is heavily reliance on formal communication channels. For further reading on bureaucratic organisations see pp.62-67. On the other hand, participation in Saudi organisations reflects one aspect of bureaucracy which is the level of participation in the decision-making process. In this study the participation dimension is found in the nature of organisational and social contexts of Saudi organisations. For further reading about the participative dimension in Saudi organisations see pp.64-66.

⁴¹ See p.133.

⁴²For further reasons see pp.147-150.

CHAPTER 6

RESEARCH DESIGN, METHODOLOGY AND DATA COLLECTION

6.1. Overview:

This chapter is concerned with laying down the guidelines and the framework of the research. It starts by giving an idea about the scope of the research and the parameters of the problematic area. The chapter gives a brief idea about the considerations that were taken into account while selecting the research samples. Also it gives a clear demonstration of the research design and methods adopted to test the research hypothesis.

Six office buildings in Saudi Arabia were selected to test the research hypothesis. These were Saudi Telecom Headquarters Office in Makkah, Saudi Telecom Western Province Headquarters Office in Jeddah, Samarec (Saudi Arabian Mining and Refinery Company) Headquarters Office in Jeddah, Samarec Corporate Engineering Office in Jeddah, Dallah Headquarters Office in Jeddah, and Jaffali Headquarters Office in Jeddah. These six case studies were adopted based on the assumption that they meet the expectation of Saudi organisations. These six organisations are described in terms of the nature of work in these organisations, aims and strategic objectives, organisational structures, in addition to a brief highlight of their spatial and physical settings. The research hypothesis which associates the pattern of spatial structure with informal interaction will be tested on three levels. These are based on the density of interaction of the individual, small group, and large group.

The next four sections deal with describing the methods and techniques followed to measure the incorporated variables in this study. It first starts with measuring the main dependent variable, which is the level of informal interaction. The social science technique of questionnaire was used to measure the density of interaction for each individual. *Spatial variables* were measured through the software computer program of

space syntax theory. Later, methods to measure the *physical variables* and the *organisational variables* were also discussed.

In all six cases, the researcher ensured that they provide a wide range of variations in their spatial structure so as to test the significance of the spatial typology on interaction. The sample was also ensured to provide variation in their physical settings. These were level of *enclosure*, level of *visual accessibility*, and *proximity*. In each case, the study incorporated three different groups of staff- managers, administrators, and secretaries, so as to investigate the spatial and social dimensions of different groups. The last section is concerned with showing the profile of the variables in the six case studies so as to ensure that the sample covers all the necessary variations. The section also highlighted some critical points that were taken into account in selecting the case studies with special regard to organisational culture and ecology.

6.2. Research parameters and design

Having defined the research problem, the aim of this section is to define the scope of the research. In other words, in designing the research plan to test the research hypothesis, should the research tackle the problem area solely, or in conjunction with other related areas?. This is why defining the parameters of the research is of a great importance, especially when some related problems could hardly be isolated from the main research problem. The researcher's intention in laying down the dimensions of the problem is to incorporate aspects of the physical environment that can contribute to an understanding of the nature of the main research problem (i.e. interaction). The researcher's aim in selecting samples was to eliminate and freeze the unwanted variables by making them constant in order to focus on the targeted variables. For instance, all the staff included in the study was ensured to have the same cultural, sex, race, social, religious belief, language, and almost the same time spent in the organisation since they were appointed. All subjects participating in the study were male. This is due to the Saudi culture, where male and female are always isolated from each other. Other considerations were also taken into account, such as the nature of work, level of using information technology, organisational structure, organisational culture, organisational objectives and policies (especially with regard to informal contact) and time since the layout was last changed. As discussed in Chapter 2, these could have an effect on the social pattern as well as the physical pattern of organisations. More about research parameters and considerations is discussed in the last section under case studies profile.

In order to make understanding the research design easier, the researcher has developed a diagram (Fig. 6.1) illustrating the process of conducting the problem area. The research deals with one dependent variable which is the *interaction activity* and three groups of independent variables. These are the *spatial* variables, which describe the nature of the spatial structure of layouts; the *physical variables*, which have to do with

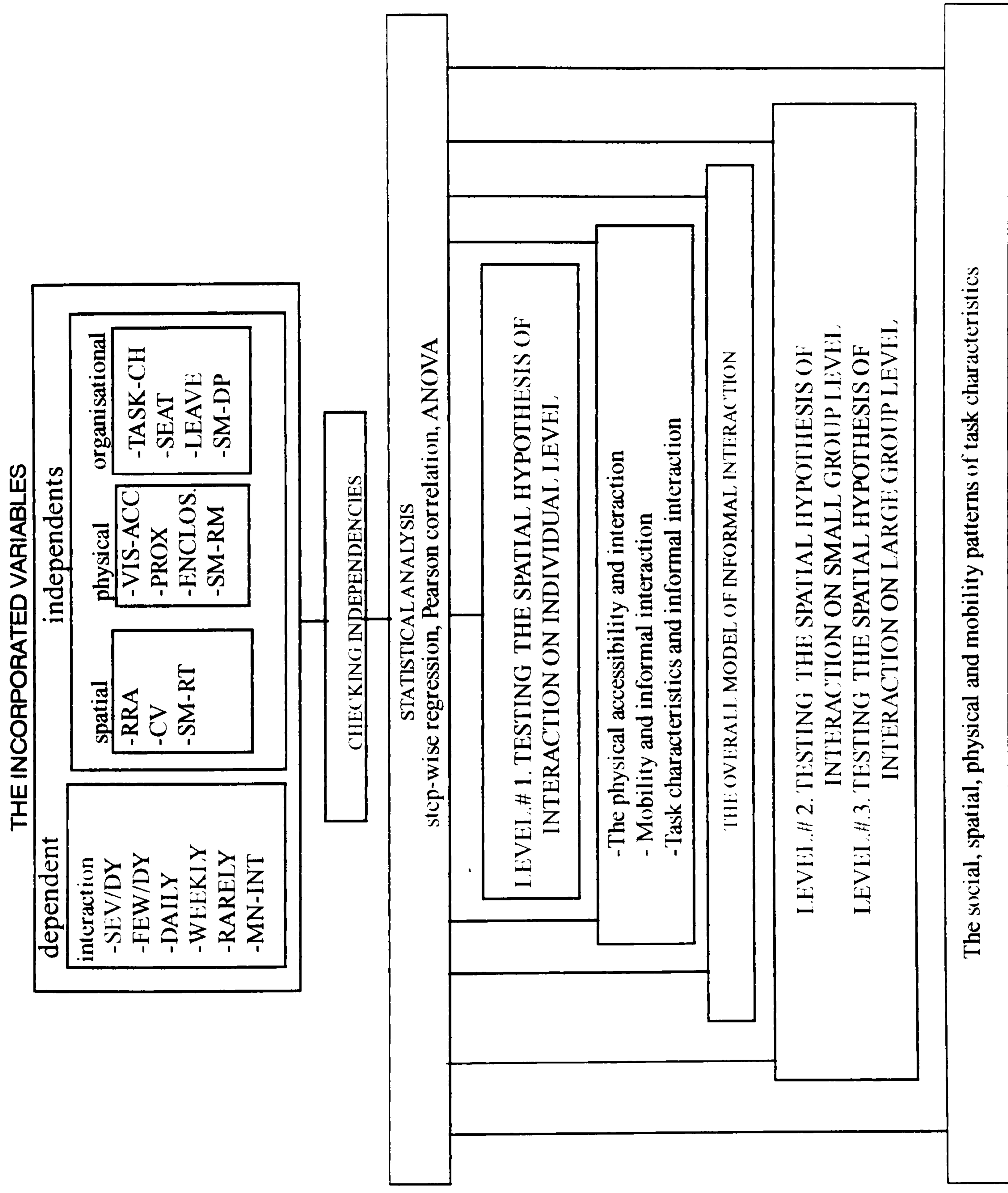


Fig. 6.1. RESEARCH DESIGN

the physical settings of workplace; and finally the *organisational variables*, which are related to the nature of work and variation in organisational divisions (i.e. departments). The research starts by defining methods and techniques which measure both the dependent and independent variables. The next step is to check the independence of the incorporated variables between each other, so as to eliminate the highly correlated variables and to ensure that all the incorporated variables are almost independent. The third step is to go through the statistical analysis and perform all the necessary computational analysis to test the research hypothesis. Several statistical operations are used such as regression, correlation, and analysis of variance (ANOVA). It should be noted that the research has relied on the regression analysis more than correlation analysis because of two main reasons: a) regression analysis will measure how much each variable contributes in explaining the variation in the main dependent variable through the value of *R-sq*; b) in the case of correlation analysis, in some cases even when the two variables show a high correlation with each other this could be so because a third variable is actually highly correlated to these two.

The spatial hypothesis of interaction will be tested on three levels. These are a) by focussing on the interpersonal relations for each individual with regard to the other subjects under different spatial, physical, and organisational conditions (level 1); b) by focussing on the interpersonal relations for each small group with other small groups under different spatial conditions (testing the hypothetical model) (level 2)¹; c) by investigating the relationship between the overall density of interaction of large groups (i.e. the whole organisation's members) and their spatial pattern (level 3).

The first level of analysis will test the spatial hypothesis of interaction based on the density of interaction of each individual. The interaction model for each case study as well as for all cases is to be developed as this will enable us firstly to test the spatial

hypothesis of interaction; secondly, to explore the impact of the physical variables on interaction; thirdly, to explore the impact of organisational variables on interaction. Later, the final model of interaction will be developed.

The second level of the analysis is to test the hypothetical model, which consists of four different layouts of different structural depth in connection with the level of interaction. This is mainly on a small group level. Two kinds of groups were defined. These are the *spatial group* (i.e. sharing the same room) and the *organisational group* (i.e. sharing the same organisational department). The third level of analysis is to test the spatial hypothesis of interaction on a large group scale. This is by investigating and comparing the relationships in the six case studies between the density of interaction of each organisation and its pattern of spatial structure.

The next task is to use the data to investigate the differentiation in social, spatial, physical, and organisational aspects among staff with different jobs (i.e. managers, administrators, and secretaries). The importance of recognising the physical potential of workspaces occupied by staff with different jobs would enable us to identify the interaction opportunity each level of status possesses. In this respect Keller & Holland (1983) have tested the hypothesis which argues that staff members which could be described as communicators and innovators would have distinctive individual characteristics and information processing habits². The hypothesis was proved. Results have suggested that communicators and innovators have an innovative orientation whereby they want to "do things differently", a low need for clarity, and high self-esteem. They are also found to be in a superior position and to be more central in communication networks. Such a finding draws a clear line for the significance of type of task performed and position in the hierarchical structure, and for informal communication opportunity in

organisations. For further explanation of the impact of *task characteristics* on interaction see Chapter 2.

6.3. Describing the case studies:

Two studies were conducted, a pilot study and the main study:

A. The pilot study:

The aim of the pilot study was to investigate employee satisfaction with the informal interaction opportunity they possess in conventional vs. open plan offices as to explore the impact of physical enclosure on both the level of informal interaction and privacy³. The need for the pilot study was to strengthen the argument that physical enclosure through the open plan solution will not solve the interaction problem in Saudi workplaces since such a solution will raise the problem of privacy, an option that has not been accepted by most governmental organisations⁴. A successful demonstration that staff in open plan will experience more satisfaction with informal interaction than with privacy and in conventional plan more satisfaction with privacy than informal interaction will substantiate the role of spatial structure to solve the problem of interaction vs. privacy. Another aim for the pilot study was to assess staff perception of the importance of both informal interaction and privacy at work.

There were several criteria that governed the selection of the pilot study. As the intention was to evaluate the impact of physical enclosure on both interaction and privacy, there are three criteria: the organisational aspects, personal aspects, and the physical aspects. With regard to organisational aspects, staff participating in the survey should perform the same type of task in terms of its complexity and their need for interaction vs. privacy. The need to eliminate the impact of the variation in tasks on the perception of privacy is drawn from Sundstrom (1982). His findings suggested that staff

with different tasks would perceive privacy differently ⁵. Participants should also have the same level of power to participate in the decision-making process. Another organisational criterion is with respect to the management style and culture. This is in terms of organisation concern with formal and informal communication and level of automation.

The personal aspects are concerned with sex, race, age, and belief. These personal characteristics have an impact on shaping the social organisation ⁶. Criteria which are concerned with the physical aspects were summarised as follows: a) a variation in the level of physical enclosure among the selected samples. b) eliminating the impact of the change in the layout. c) eliminating the impact of visual accessibility.

Based on these pre-mentioned criteria, four offices in Saudi Arabia were selected. These are Samarec Headquarters in Jeddah, Samarec Administrative Office in Jeddah, Saudi Telecom Headquarters in Jeddah, and Municipal and Rural Affairs Office in Makkah. These are about the same in size and they are all purpose-built buildings. Now it is worthwhile to review how these selected four samples comply with the survey requirements in terms of organisational, personal, and physical aspects.

In terms of organisational requirements, 35 participants were selected from each office whose work classified them as administrators. These are staff who usually are supervised by managers and who perform the bulk of the work. Their participation in the decision-making process is relatively low. The other dimension of the organisational requirements is the compliance of these four offices with the same management style and culture. The four selected samples do not belong to the same organisation. Although the researcher was keen to eliminate the management and cultural variables by selecting offices which belong to the same organisation, that could not be achieved since most of the offices under the same organisation maintain the same physical enclosure level which

means that it was difficult to maintain a variation in the level of physical enclosure. This is considered as a limitation in the pilot study. However, the researcher ensured that these selected four offices maintained a similar management style. In these offices, organisations rely mainly on formal communication channels. Staff always conduct formal meetings and discussion. Informal interaction is perceived as a means to support formal communication and enhancing work efficiency. Not all the processes and transactions in these organisations are computerised. The level of information technology is limited to mainly to personal computers and there is no computer network that connects all staff together.

The compliance of the selected offices with the personal characteristics requirements was accomplished by selecting male participants with an age range from 25-40 years. Participants were all Muslims and have the same belief and motivations for interaction⁷. Furthermore, they all speak the same language.

Finally the physical aspects of these four offices were ensured to comply with the survey criteria through the following: a) both Samarec offices and the Municipal and Rural Affairs office are conventional plan whereas only Saudi Telecom is an open plan office. Although the intention was to select two conventional offices and two open plan offices, it was quite difficult to find another open plan office among governmental organisations that have the same management style. This is considered to be another limitation in the selecting of the samples. The conventional vs. open plan vary dramatically in the level of physical enclosure; therefore this will comply with the survey requirements. The four offices are purpose-built buildings and the layout has not been changed for the last five years. The need to eliminate the visual accessibility variable was ensured through the nature of walls and partition materials (i.e. glass vs. solid). All walls in the conventional offices were solid.

Out of the 140 questionnaires distributed over the four offices 87 were returned. Results was as expected. 85% of employees in the conventional offices were dissatisfied with their informal interaction opportunity, whereas 73% of staff were satisfied with their level of privacy. In contrast, in the open plan office only 8% of staff were dissatisfied with informal interaction opportunity, and 68% were dissatisfied with privacy.

The findings of the survey support the role of the physical enclosure in affecting both informal interaction and privacy. As the pilot study was launched to support the argument which claims that the level of physical enclosure in Saudi offices will not solve the tension between privacy and interaction, this increases the concern to find another design solution (i.e. the spatial structure).

B. The Main Study:

The aim of the main case studies is to provide a program of variation among the targeted variables. As this study aims to explore: a) the impact of the spatial structure on social structure, and b) the significant organisational, physical, and spatial predictors of informal interaction, it becomes necessary to ensure that the adopted case studies provide the necessary variations. Although most of the criteria that governed the selection of the main case studies were similar to the ones in the pilot study, the study will discuss these criteria in more details.

1. The organisational criteria:

Several criteria were developed with regard to organisations. These will shape the culture of the organisations. In such research it is important to eliminate the cultural differences from the selected samples. All the adopted samples should be of the same type. This is in terms of kind of business and industry. The need to ensure similarities in

the kind of industry lies in the fact that different kinds of industry could establish different industrial relations and therefore different interaction patterns. Case studies should also meet the general expectations of staff and organisations. In other words, the adopted samples should represent a typical Saudi organisational style. The size of organisations is also an important aspect to be controlled. The difference in size could develop different cultures. This happens when large organisations provide their staff with better care, quality, and motivation than small organisations. In the meantime, large organisations tend to have clearer policies and objectives.

There is also a need to eliminate the management style factor. This is in terms of level of bureaucracy vs. participation. These two types of organisations will perceive the need for informal interaction differently ⁸. Issues related to these types of organisations are position in the hierarchical structure of the organisation, ability to influence the decision-making process (i.e. centralisation), and work complexity and routinisation. Furthermore, there is the impact of organisational divisions (i.e. departments). Participants in the study should cover the wide spectrum in terms of position in the hierarchical structure, level of work complexity and formalism, and location under different organisational departments. The way organisations look at the need for informal communication through staff interaction should be considered. More important is the need to ensure that the adopted organisations maintain the same policy in regard to the way they allocate spaces of different quality to different staff according to their status.

The level of automation in organisations should be also controlled. This is in terms of the level of incorporated information technology. The notion that information technology has a social dimension in organisation raises the need to eliminate the impact of level of automation on the interaction pattern ⁹. Therefore, it is suggested that the

adopted samples should maintain the same level of automation. Participants' work should also vary dramatically in their level of mobility inside the office building.

2. The personal criteria:

Sex, age, race, religion, language, culture and belief of staff participating in the study should be controlled. Others, like time spent in the organisation since appointment, should also be taken into account.

3. The physical criteria:

These are criteria describing the physical conditions of the layouts. There are six main physical criteria that should be taken into account while selecting the research samples. These are: a) nature of office layout. The kind of office layout should represent the current office trend type in Saudi Arabia; b) samples should vary dramatically in the level of physical enclosure of workspaces; c) workspaces should possess different levels of visual accessibility; d) ensure variation in the average distance among participants' workspace; e) participants' workspace should be scattered between different rooms; f) the adopted offices should maintain the same level of services and facilities (i.e. activities generators). This is in terms of cafeterias, lounges, and attraction areas.

4. The spatial criteria:

Since the research focus area is to measure the ability of different spatial structures to support different interaction levels, it is necessary that the adopted layouts vary dramatically in their spatial structure. Spatial structure in this study refers to the relationships which govern any single space compared to the whole system of spaces. In this respect, the adopted workspaces should show different values of the two measures of space syntax theory (i.e. level of global *integration* and level of local *connectivity*).

Applications and Limitations of the case studies:

Based on the previous criteria, six organisations in Saudi Arabia were selected. These are two offices for Saudi Telecom, two offices for Samarec, one office for Dallah, and one office for Jaffali. These offices will be discussed in detail in order to show their compliance and limitation with the previous criteria. In fact, most of the limitations in these samples occurred in the organisational dimension. This is mainly due to certain constraints which will be fully explored.

Although governmental organisations have the same organisational hierarchical structure, they vary dramatically in the managerial aspect. Some governmental organisations showed more concern with management style than others. For example, Saudi Telecom and Samarec are two governmental organisations in which both organisational performance and productivity are the main objectives in their agenda. Consequently, they developed a very distinctive management style and policies to control employees and organisation performance. This was with regard to work flow (maximum time to finish a certain task), more open management (managers are accessible to all staff), ability of some subordinates to communicate to other managers apart from the direct manager, training programs, level of incorporating information technology, and personal motivation (i.e. salaries, pensions and allowances). Saudi Telecom is a highly customer-care oriented organisation, though there is no other competitive organisation providing the same service. The need to increase its revenue was a determining issue that reflected its management style.

On the other hand, Samarec , a leading international organisation in oil products, both marketing and refinery world-wide, has developed its management style from the need to increase its profit, to satisfy market needs, and to build a good image and reputation. Work in these organisations is more organised, more disciplined, and more

systematic compared to other governmental organisations. Both Saudi Telecom and Samarec have provided their staff with high-quality workplaces in the expectation that the conditions of workplace will assist management in pursuit of their objectives with regard to productivity. The success of these two organisations has increased the enthusiasm and the expectation that many governmental organisations will adopt the same trend in management. These offices were adopted as they represent the future trend of Saudi organisations. There was a requirement to find other governmental organisations that maintain similar management style, so it was decided to adopt two organisations from the private sector. Dallah and Jaffali are two private organisations with a similar management style to Saudi Telecom and Samarec. In fact, the intention was to select all the case studies from the governmental sector, but there was no other governmental organisation with a similar management style to Saudi Telecom and Samarec. As four organisations belong to the government sector and two belong to the private sector, this acts as one of the research limitations in this study.

The six case studies represent nearly the same type of work. This is administrative office work, where all staff are assigned workspaces inside the office building. Although these six organisations pursue administrative work, they are different in another respect. For instance Saudi Telecom is concerned with Telecom business, Samarec with the oil industry, Dallah with the banking industry, and Jaffali with marketing. This is in fact represents another limitation in the samples. As far as the size of these organisations are concerned, the six organisations are almost of equal size, except Samarec headquarters offices. All these organisations have a staff of 50-75 employees, except Samarec headquarters with 120 employees. In terms of amount of facilities and equipment they are almost identical. For instance, they have a similar number of staff per photocopying machine, telephone, etc.

The six case studies maintain a bureaucratic style of management. For instance, all staff are structured in a hierarchical pattern with managers at the top of the pyramid and secretaries at the bottom. These organisations are characterised by centralisation in decision-making where managers at the top are the powerful and most involved people in the decision-making process. Managers at the top of the hierarchical structure have more complex tasks compared to staff in the lower positions. Staff in the lower positions are also characterised by more routine tasks than staff in the higher positions. Employees in these organisations rely mainly on formal communication through telephones, conferences, regular meetings, and discussion. In the meantime, they look at informal communication as an important support to formal communication. Management in these organisations do not share the notion of shared facilities. Every employee has his own workspace that no other employee can use. The six organisations differentiate among their staff through workspace quality. According to the management policy, the higher in the hierarchical structure, the better in the workspace quality. Quality is mainly perceived in terms of amount of space, furniture quality, and number of staff per room. High status staff are usually allocated a private office¹⁰. The impact of information technology was controlled by enquiring if these organisations incorporate the same level of information technology. The level of automation in these organisations is limited to personal computers and internal departmental networks. There was no large network on the organisational scale that combines the whole organisation's members.

Staff in these case studies are Muslims with similar beliefs, motivations, and restrictions. All the staff in these premises are men. They all have Arabic mother tongue. Among the staff there are some staff from other Arabic countries such as Egypt and Sudan, but they still have the same religious and cultural beliefs. Although the staff age in these organisations ranges from 21-58, it was decided to involve only staff ranging

between 25-40. This is important so as to eliminate the impact of the age variable. It was ensured that all the participants had spent not less than 5 years in the organisation.

Not all of the governmental organisations have purpose-built buildings. Some occupy rented premises. Others are accommodated in highly luxurious buildings. Generally speaking, governmental organisations are keen to provide buildings that not only accommodate their staff, but that give the image of luxury and that facilitate work-related activities and increase employees' productivity and creativity. All the six offices are purpose-built buildings except Samarec Corporate Engineering Office. Although this office has not been built specifically for Samarec, it was designed to meet workspaces of a high standard. In this respect, Samarec adjusted the layout of the office to meet their requirements.

The layout of the six offices reflects the prevalent trend of Saudi organisations. This is characterised by accommodating different groups of staff under different conditions. Workspaces in these rooms are of a different level of enclosure. The level of physical enclosure refers to numbers of enclosed sides around the chair. It was of a great importance to ensure that the layout of these offices has not been changed for at least the last 3 years. This is to ensure that the perceived level of informal interaction developed by the existing layout. Samples also provide a wide range of visual accessibility opportunity among staff. As far as the level of services and activities are concerned, all of these organisations have a main cafeteria to serve the whole staff. There are no common coffee corners where both tea and coffee are served by waiters. Furthermore, there are no lounges which are meant to be used as a place to exchange ideas and opinions.

The compliance of these six offices with the spatial criteria was in terms of space variation in their level of global *integration* and local *connectivity* (i.e. space syntax).

This was ensured by applying the computer analysis to the six types of spatial structure. Spaces obviously have different values in terms of these two measures. The need to control the size of different spatial structures was fully considered in the space syntax analysis in the way that spatial structure of different sizes could be compared ¹¹. The impact of the size of the group was controlled through making the analysis for different group sizes.

There are several limitations to space syntax theory in such a kind of research. The theory describes the syntactical relations among spaces with no regard to distance. This means that two spatial structures with the same size (i.e. number of convex spaces) and with the same syntactical relations will be treated similarly even when their convex spaces vary in their actual size (i.e. area). This has raised the question that the theory does not take into account how big or small each convex space is. As the literature showed that distance is a strong predictor of interaction ¹², the omission of the impact of distance in the space syntax theory is a clear limitation of such research.

The space syntax concept is concerned with the morphology (i.e. the shape of each spatial structure with respect to each other) of spatial structure, but not with location. This occurred due to the absence of distance in the theory. The notion of location which implies physical adjacencies is absent. The only adjacencies criterion is based on the level of the connectivity of each space to other spaces. Moreover, space syntax theory does not consider the geometrical shape of spaces, where it is based on the notion of randomness. For instance, no matter what geometrical shape a convex space is, it eliminates the impact of the geometrical shape of spaces. For instance, a circle and a rectangle are both convex spaces that are treated similarly in the theory. But is the impact of the circular and rectangular spaces on human behaviour the same? If we realise that a circular space will promote the notion of centralisation through creating a focal point in

the centre with radial and concentric lines, and a rectangular space will promote the notion of directionality and longitudinal axis, both the circular and rectangular spaces might have different impacts on human behaviour.

There are also other limitations in the use of space syntax as a tool to analyse spatial layouts. These are with respect to the way the theory omits some of the space quality. For instance, the theory does not differentiate between the different activities of spaces. Working and non-working spaces, spaces that represent the focal and gathering points in the building such as services, cafeterias, lounges, staircase, etc. are all treated similarly. These spaces are activity generators, since they can influence human behaviour. The failure of the theory to differentiate space activities is another limitation as an analytical tool. That is why it was the intention in this study to minimise the number of different activities. For instance, in the adopted case studies, spaces are either classified as working or non-working areas. There were no spaces assigned as lounges or focal points in the case studies.

The problem of the omission of the theory of the functional varieties of spaces arises from the way the theory looks at the way space is generated. Since the theory considers any spatial structure is made up of two kinds of raw materials: a continuous space, and a stuff space¹³. The continuous space is the one that is used for variety of activities. In this respect the theory does not make any further category to the continuous space.

Another limitation in the space syntax concept with regard to space quality is the level of physical enclosure of the convex spaces. Any convex space should have a minimum of three enclosed sides. In this respect, convex spaces with three enclosed sides and one side open will be treated similar to convex spaces with four enclosed sides. The

level of physical enclosure has a significant effect on the level of interaction¹⁴. Therefore, the space syntax concept also omits an important space criteria (i.e. enclosure). This is considered as another limitation of space syntax theory.

Office :1. Saudi Telecom Headquarters in Makkah.

Saudi Telecom is a governmental organisation belonging directly to the Ministry of P.T.T. (Fig. 6.2). The building is located in the peripheral north part of Makkah near the industrial zone. It was the organisation's policy to construct this building away from the city centre for mainly economical reason. Another reason was in connection with the need to move away from the high load of traffic in the city of Makkah. The office represents the headquarters of Saudi Telecom in the city of Makkah, and through this office the organisation runs and supervises all P.T.T. affairs in the city. The need to construct this building started when Saudi Telecom realised the shortage in amount of space to accommodate their staff. Prior to the construction of this building, staff were accommodated in a non-purpose built building with lower workspace standards than both users and organisation expected. The management has become conscious of the need to provide their staff with workspaces of high quality.

This building was constructed in 1980 by a Canadian company. The management of the Saudi Telecom was very keen to design their buildings in a way that could accommodate future changes. Furthermore, the management was eager to develop a kind of office that is similar to western offices in terms of their physical conditions. This mainly refers to the openness of the plan. The design brief of this office was to design an office building that would meet the expectations of both users and the organisation. Organisation expectations were defined in terms of the ability of the office building to meet the change in the organisation's requirements. Users expectation referred to the ability of the physical condition of the workplace to provide a creative environment.

The building was designed as a pool open plan area with a limited level of subdivisions. Services, staircase, and lifts were located in the hub of the building. The building is almost square in shape and has an inner wall-to-wall dimension of 30m x 36m, making a floor area of 1080 sq-m. The adoption of a deep shell rather than a shallow shell was due to the need to provide an ample open area where different groups of staff and activities could be accommodated in an interrelated pattern. Such a solution will support industrial relations among staff within and across departments. In spite of this, the structural module of the building was 6m x 6m, which created an enormous number of columns in the open plan. The design team adopted a small module structure based on their belief that columns in the pooled open plan would help to define groups territoriality. This design solution was adopted as both management and the design team believed that it would correspond to the design requirements.

Three years after the occupation, the management realised that the current office layout does not support both the users and organisation. The staff started to complain about deterioration in the level of privacy and security. The problem got worse when customers kept moving inside the open plan, intruding on employees privacy. Many of the staff were dissatisfied with the existing layout. The design team which belonged to the Saudi Telecom was asked to redesign the open plan. Another solution was suggested and has been accepted by the staff. This is concerned with the need to accommodate each department's member under one physical enclosure (i.e. room). The layout was adjusted and staff experienced a better level of satisfaction with privacy. The building is three storeys high, including departments of billing, contracts, planning, information, finance, and personnel affairs. The researcher selected the third floor to conduct the survey, where the last six departments are located.

Work processes in these six departments are related to each other. Work is usually accomplished in a serial manner. This means once a certain activity is finished in a certain department, another activity is resumed in other department. Staff always need to be in contact with each other. Although staff use written forms of communication, many of them rely on informal communication. This is mainly through discussion after prayer or while moving inside the office building. Departments of billing, finance, personnel affairs, and information are the highest in incorporating information technology. However, the internal networks in these departments are limited to members of the same department only.

Office:2. Saudi Telecom Headquarters Office in Jeddah.

This office, like Office 1 belongs to Saudi Telecom. It is the headquarters for the western province of the kingdom. The building is located within a large complex belonging to Saudi Telecom in the south-east part of the city of Jeddah. Saudi Telecom realised the need to establish a headquarters as a regional centre to run all the organisation affairs on a western region scale. This was due to the heavy load of work on this regional headquarters where it runs the Telecom business for other main cities such as Taif, Makkah, Madinah, Tabuk, and Jeddah.

The organisation used to rent several non-purpose built buildings to accommodate their staff. This affected organisation performance where work delays always occurred due to the weak communication channels between different offices. The need to establish this building was realised in 1975. Saudi Telecom thereafter developed a design brief for its headquarters regional office. The design brief for this building is similar to Office 1. The organisation was keen to maintain physical flexibility in the layout over time as well as maintaining a working environment that meets user expectation. It is one of the main organisational policies to provide good care services for both customers

and staff. The Saudi Telecom offices tend to be very distinctive from other governmental offices, due to the provision of high quality workplaces.

The building was designed as three storeys. Each floor consists of two wards with an approximate floor area of *1900* sq.m. for each ward in each floor . The building is an open plan office with internal subdivisions. The proposal of the office was approved by the design team in Saudi Telecom where they believed that such a design will respond to the organisational requirements. The same Canadian company which built Office 1 has constructed this office. After the construction and thereafter the occupation, the organisation realised the need to provide more subdivisions in the layout. In fact the current office layout is more subdivided than Office 1 (Fig. 6.3). The reason behind this is due to the wide variation in the hierarchical status among the staff in this office since it is on a regional scale and therefore a higher level of subdivision is required. Consequently, the layout was adapted as required, with more subdivisions creating individual rooms of multiple sizes for single and group occupancy.

The study focussed on the ward on the second floor, which comprises the department of private services, department of telex, and department of real estate. The building consists of rooms of different sizes for different departments. Staff in this office maintain the same hierarchical structure as in Office 1 with more variation among staff in the hierarchical positions. Managers are allocated private offices with each managers supervising a group of subordinates. Members of different departments always need to be in contact with each other. Like Office 1, staff rely on the formal communication in the written modality, but they perceive informal interaction as an important means of communication.

The level of automation is also at the same level as Office 1 where there are mainly internal networks that link members of the same department together. Most of the staff have personal computers although top managers have an access to a mainframe network that is connected with other regional and local offices.

Office: 3. Samarec Headquarters in Jeddah.

This mining and refinery office belongs to the Ministry of Oil and Mineral Resources (Fig. 6.4). The building was constructed in 1982. The design brief of this office was to provide staff with high quality workspaces in terms of their physical condition. Furthermore, there was the need for this building to reflect the power of the organisation through the image of luxury. The first proposal of this office (not much different than the final proposal) consists of numbers of individual rooms of different sizes. It is a huge building, the biggest in area compared to the other cases, consisting of four wards in each floor with a huge lobby centralising the four wards in the hub of the building. The building has a floor area of 4020 sq.m. After the construction the office has not experienced any changes in physical layout. Management in this organisation did not receive any complaints from staff about the physical condition of the workplace. Thus, the management believed that the staff in this office were probably satisfied. However, there was no survey conducted to examine staff satisfaction with the current physical environment.

The study was conducted on the second floor, which accommodates the departments of administration, operation, aviation, and finance. The office is a conventional office plan with most high status employees (mainly managers) occupying private offices. Other employees share rooms with an average rate of 2.6 persons/room. Samarec is a newly established company practising the sale and marketing of Saudi petrochemicals all over the world. It is like Saudi Telecom, a fast expanding company

that has a different system of management from the Ministry of Oil and Mineral Resources. The company, like other Saudi organisations, faces churn in their facilities caused by changes in their strategic policies. Just recently the company established a huge corporate engineering team to follow up and manage the dramatic changes in the company premises.

The company maintains a hierarchical system in management and administration with high status staff who are fully involved in the decision-making process with some participation from other staff. The company's main objective is to compete with other products all over the world. Such an objective has led the company to realise the need to not only improve the physical condition of workspace, but also a more efficient way of management. Staff in this organisation is more motivated, more trained, and more committed to the organisation.

Staff in this organisation also rely on a written form of communication, but they also view informal interaction as a support to formal communication. The level of incorporation of information technology is the same as in the Saudi Telecom offices. There is no a large network frame that connects all members of the organisation.

Office: 4. Samarec Corporate Engineering Office in Jeddah.

This is in fact a speculative building that was previously occupied by one of the biggest architectural firms in the Middle East (Fig. 6.5). Samarec rented this office to accommodate staff dealing with the technical affairs of the organisation. The building belongs to a real estate investment company. It was mainly designed to suit different organisational needs with particular reference to flexibility in layouts. Other important physical criterion of this office is the need to provide a healthy and pleasant working environment that will attract market attention.

Samarec decided to rent this office based on their belief that this office could be easily adapted to their requirements. This is mainly because the office was designed as an open plan with high flexibility in the provision of the necessary services to each workspace. Once the building was rented, the design team of Samarec started to develop several design alternatives. The current layout is characterised by high subdivisions with rooms of different sizes and a pool office area in the middle. Since the layout was redesigned in 1987 it has not been changed thereafter. According to the management opinion, staff are satisfied with the existing layout, and no serious complaints have been reported. However, some individual staff have complained about the loss of privacy that is necessary for concentration.

The building is three storeys high. The study focussed on the lower floor, where both Departments of Technology & Development, and the Department of Engineering & Services are located. The office has a floor area of 1200 sq.m. This office belongs to the same organisation as in Office 3. Therefore, the staff in this office maintain the same hierarchical system of work, the same level of information technology, in addition to being liable to the same organisational policies and objectives. But unlike Office 3, the variation in the hierarchical positions among staff is less, since Office 3 accommodates the top executives and managers.

Office: 5. Dallah Headquarters in Jeddah.

The building belongs to one of the biggest private companies in Saudi Arabia (Fig. 6.6). The company is involved in many private industries such as real estate, construction, consultation, banking, and general services. The building is fourteen storeys high and accommodates more than one thousand employees. It is situated in the eastern part of the city and it acts as a landmark since it is surrounded by vacant lots of land and low-rise developments.

The building is designed by Al-Faiz, the biggest architectural office in the Middle East. This organisation was keen to accommodate its one thousand staff involved in a variety of business in one building. In this respect, the top management will be able to run and supervise the whole team. In 1975 the organisation was able to develop its design brief for the office of the future. The building was designed to respond to the current and future needs of the organisation. There was more concern about the need to create an adaptable layout. The organisation was also keen to provide high standard workspaces. Al-Faiz architectural team responded to these needs by developing an open plan office to allow any changes in the layout. Services and vertical connections were allocated right to the edges of the building.

In the early 80's the building was occupied with the top management right at the top of the building. The other thirteen floors were occupied by different businesses belonging to the same organisation. Due to the current economic situation, the organisation shrank and many jobs were lost. As a consequence, many floors have become unoccupied. Recently, the management started to let the vacant office space to other companies. Some private and public organisations rented some of these premises. As a result, the building acquired the image of a speculative building.

The study focussed on the twelfth floor, where the company runs one of the most active banking systems in the country, entitled Al-barakh . It is a branch of the company that pursues its business in banking. The company gained tremendous support from the public due to the high standard of service and care it provides to customers as well as the staff. The office is an open pooled area with rooms on the edges and high subdivisions by partitions right in the centre. As reported by the manager of personnel affairs of the company, the layout is under the pressure of change as the company realises the need to adjust their facilities to cope with future changes. The office has a floor area of 1870

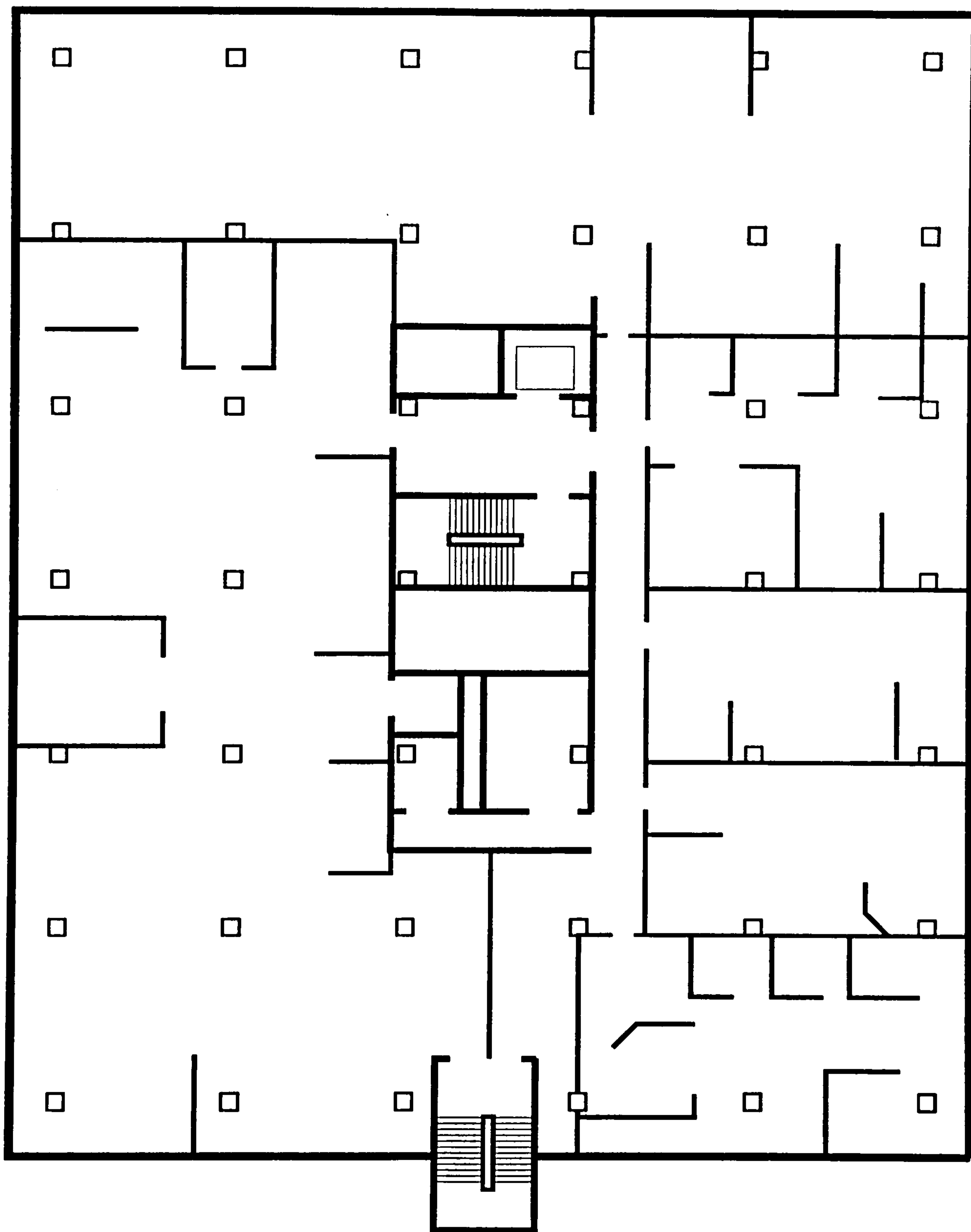
sq.m. and accommodates the departments of Accounting, Foreign Exchange, Exchange co-ordination investment, Banking, Administration, Printing, and Finance. The hierarchical system dominates this organisation, with higher status staff taking care of most of the decisions based on some participation from other staff.

Office: 6. Al-Jaffali Headquarters in Jeddah.

This is again one of the leading private companies in Saudi Arabia, which pursues its business in all IT products, car sales, electrical appliances, and air conditioning (Fig. 6.7). The building is considered to be one of the most sophisticated buildings in the country and regarded as a successful building. The organisation dictated its design requirements for an office building with a high level of workspace quality that would support employee creativity and productivity. There was also concern from this organisation that its building convey the image of luxury and power.

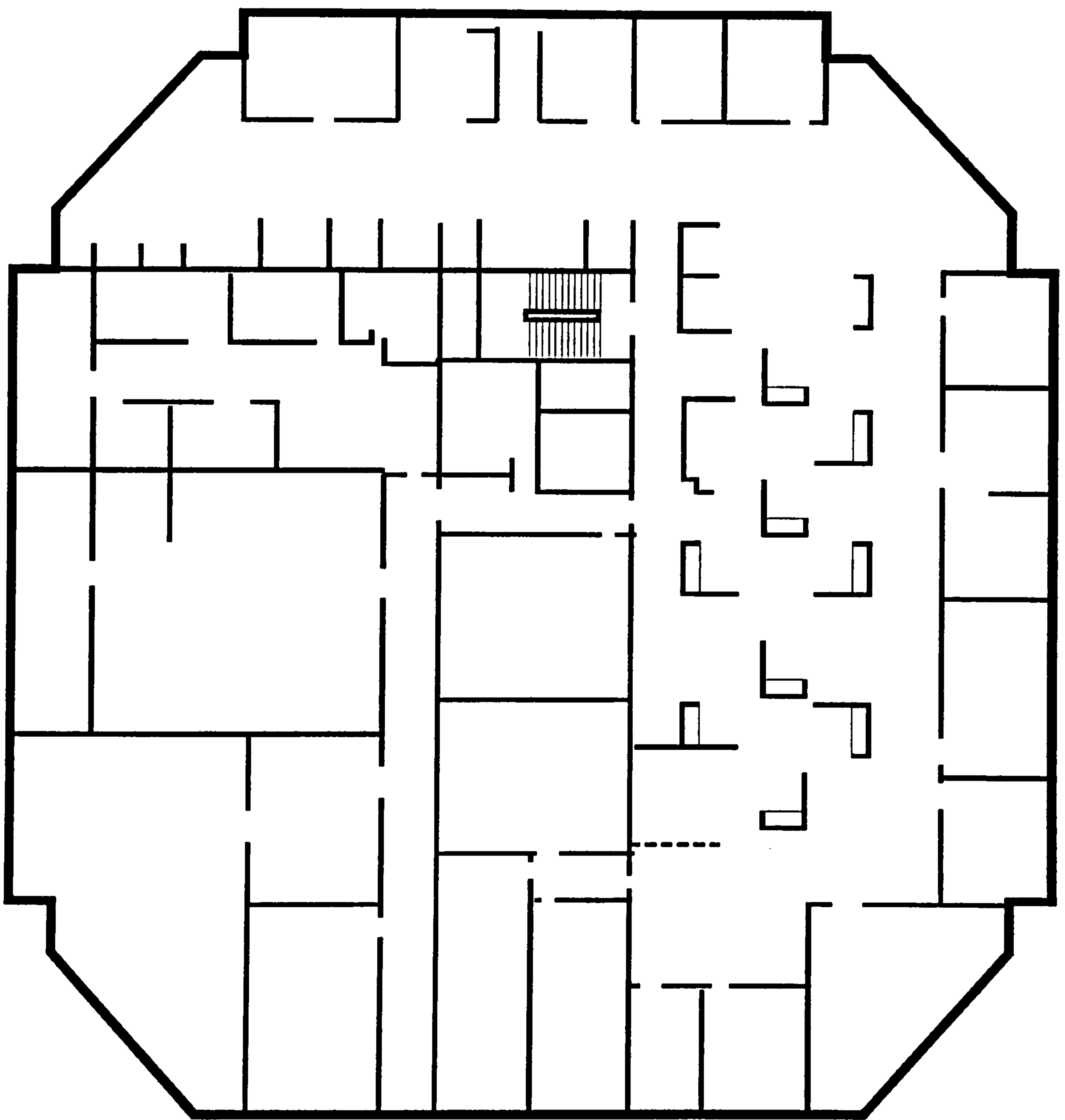
The building was constructed in the mid 70's with highly flexible walls that could be adjusted for different types of layout. All the external facade of the building was made of glass which has given the building the image of western office. The concern about the quality of the working environment inside the office was reflected in the way the design team increased the level of indirect daylight and the creation of internal fountains and plants.

The building is seven storeys high with two basements, and it was constructed as two masses linked by a flying corridor on each floor. The organisation is experiencing the same organisational changes as in Dallah (Office 5). Such a change was caused by the economical recession in the market which led to the reduction of staff. Management also realised the need to let the unoccupied space to other organisations.



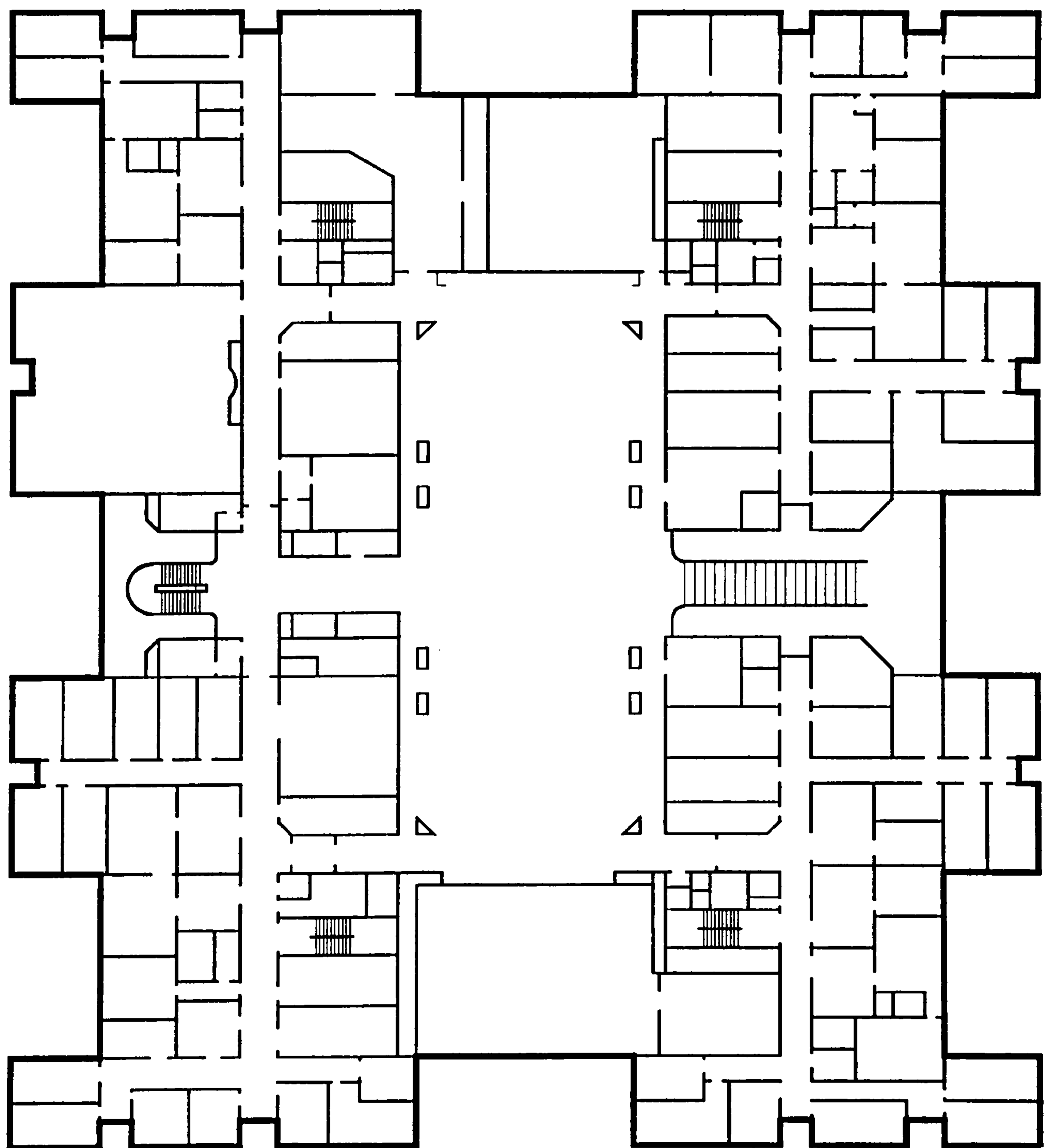
OFFICE ONE: SAUDI TELECOM OFFICE IN MAKKAH

FIGURE 6.2



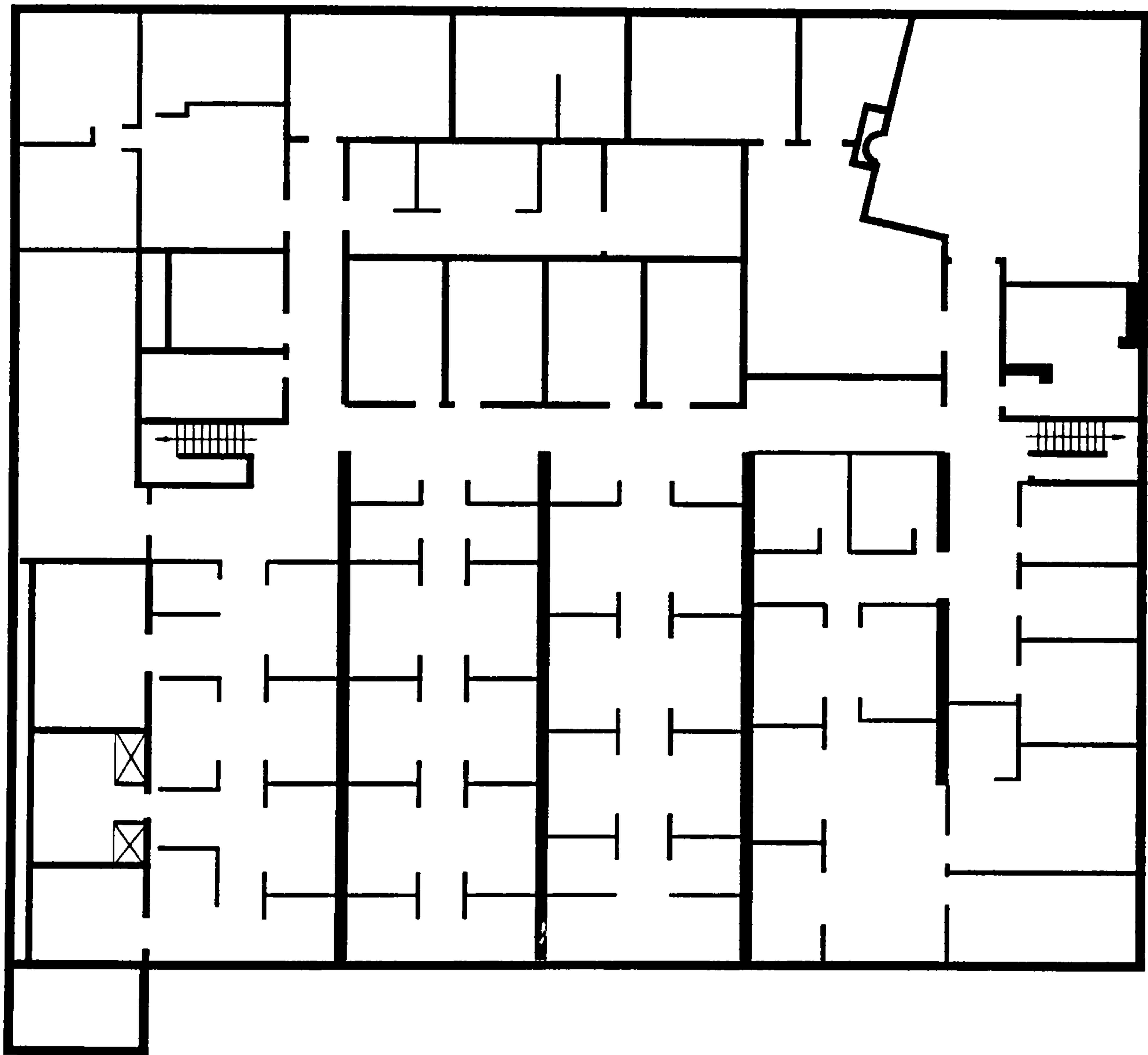
OFFICE TWO: SAUDI TELECOM HEAD QUARTER OFFICE IN JEDDAH

FIGURE 6.3



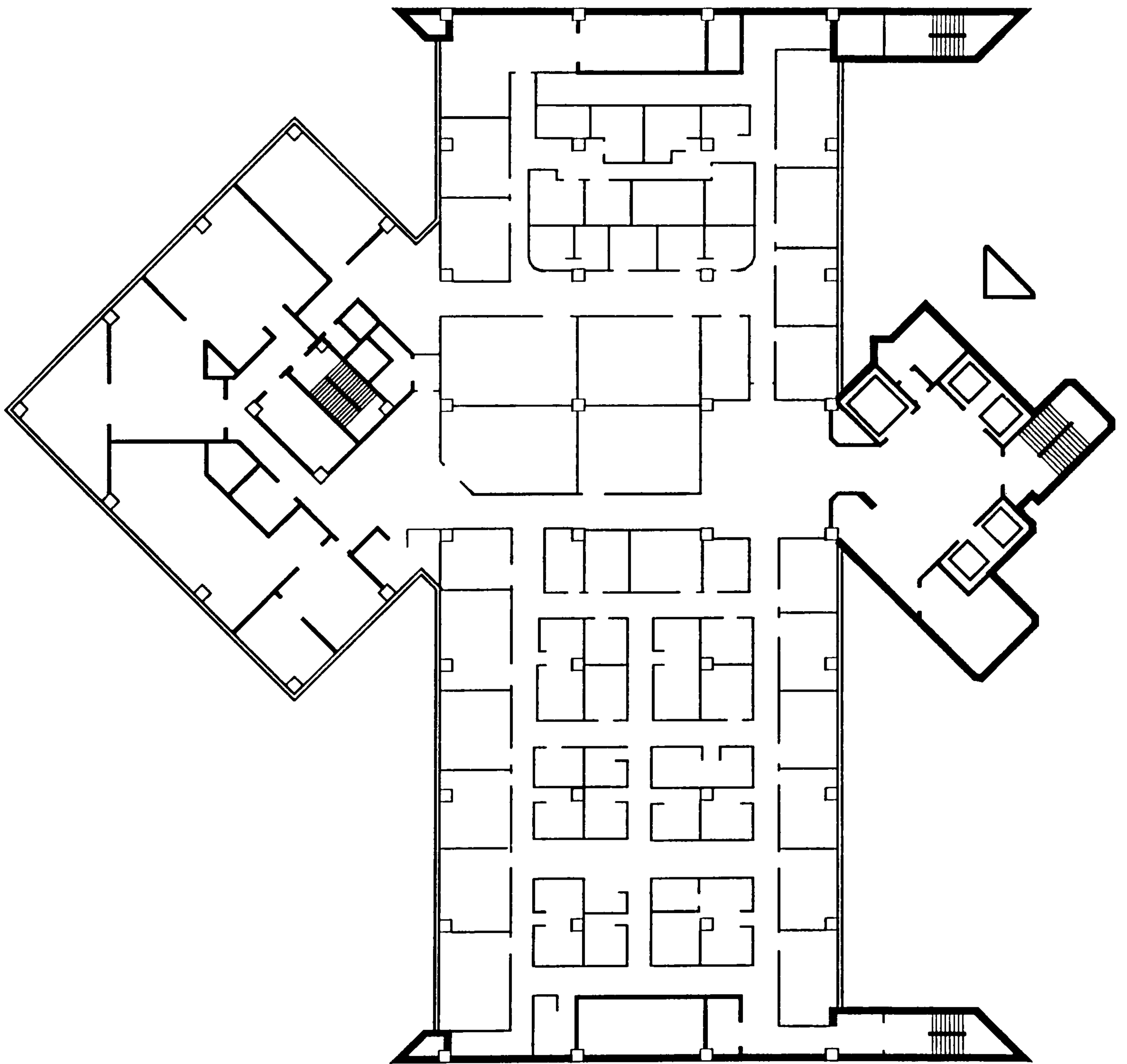
OFFICE THREE: SAMEREC HEAD QUARTER OFFICE

FIGURE 6.4



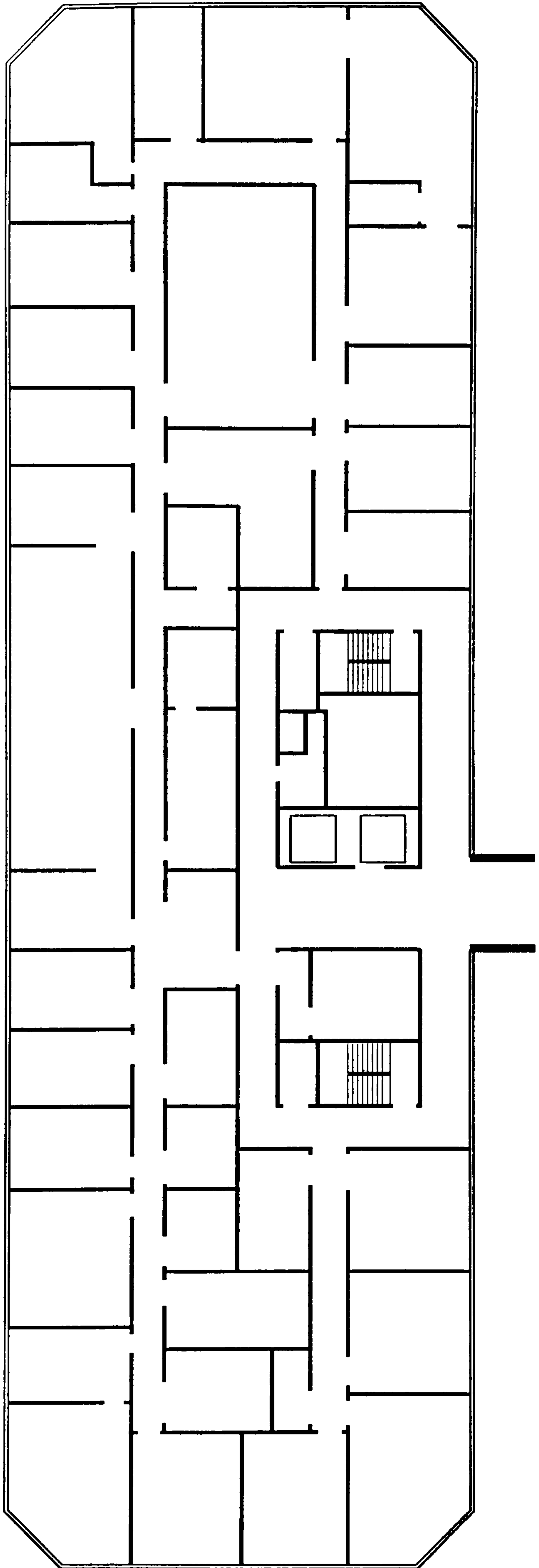
OFFICE FOUR: SAMAREC CORPORATE ENGINEERING OFFICE

FIGURE 6.5



OFFICE FIVE: DALLAH HEAD QUARTER OFFICE

FIGURE 6.6



OFFICE SIX: JAFFALI HEADQUARTER OFFICE

FIGURE 6.7

The researcher selected one ward of the second floor to implement the study. The selected office belongs to the air conditioning branch and it is laid on a floor area of about 1090 sq.m., accommodating the Departments of Accounting, Evaluation, Commerce, Drafting, Contracting, Administration, Implementation, and Staff affairs. The office consists of individual rooms of different size. Some offices have glass walls so as to give employees the opportunity to access visually to the rest of the staff. The organisation's aim is to create a special image for customers about their organisation. The standard of care and services being offered to the staff in their workplaces is quite remarkable.

Staff in this organisation also experience the hierarchical structure with minor participation in the decision-making process from lower positions. Staff always appreciate the need for informal interaction where they believe that most of the formal transactions have to be discussed informally first. There are no large computer networks that connect each member of staff. Staff have only personal computers for personal use.

6.4. Measuring informal interaction.

The degree of informal interaction (the main dependent in the study) for each employee was measured through a questionnaire. The researcher decided to conduct a pilot study in order to receive employees' criticism and comments about any ambiguity regarding the clarity of the questionnaire. The questionnaires were distributed to all employees occupying the same floor, inquired about all the verbal and non-verbal forms of informal interaction. All the names of employees were listed in a table and each one of those was asked "Would you please indicate how frequently you interact informally with the people listed in the table below". Informal interaction was defined in three ways: firstly, if you exchange nod, smile, or a gesture to any of these staff.; secondly, if you exchange a few words including greetings; thirdly, if you exchange a conversation. In all

the three levels, a 1-5 scale was provided for each employee to determine the frequency of each level i.e. at least once an hour ,at least once every couple of hours ,at least once a day, at least once a week, and rarely or never.

The researcher conducted a pilot study on four buildings to test the clarity of the questionnaire. These were the Municipal and Rural Affairs Head Office in Makkah, Saudi Telecom Head Office in Jeddah, Saudi Telecom Western Province in Jeddah, and Saudi Telecom Head Office in Makkah ¹⁵. The study revealed some weak points in the questionnaire and respondents provided copious comments. The study shows the following: 1) most of the staff were unaware of non-verbal interaction such as nodding, smiling ,or gesturing. In contrast, some reported that such interaction was unlikely to be experienced in their organisation and the majority left spaces allocated to non-verbal form of interaction blank and did not answer. 2) the questionnaire was very long and tedious. In some cases more than 100 employees were incorporated in the study ,which meant that every employee was supposed to tick 297 answers in all the three levels. In fact, very few completed the questionnaire. Other comments were also reported by the staff such as "sorry I do not know the person" and "I feel isolated from the rest of the staff". Therefore ,the researcher decided to make some changes to the questionnaire as follows: 1) focus on the verbal interaction only, 2) incorporate only 50-60% of the total staff occupying the same floor with a maximum of 50 employees in each case.

The final questionnaire asks the staff the following question "Would you please indicate how frequently you talk informally -face to face -(all the formal and regular meetings are excluded) to the people listed in the table below ¹⁶. This question refers to all the face-to-face conversation on any subject, even if it is trivial and includes greeting". The questionnaire has a 1-5 scale to measure the frequency of interaction as *several times*

a day, a few times a day, once a day (daily) , once a week (weekly) , and rarely or never.

The frequency scale used by Marsden & Campbell (1984) to measure tie strength in cities was limited to the range from "rarely" to "more than once a week". Such a scale does not incorporate daily or part of the day increments as people in cities do not often meet each other in smaller increments of time ¹⁷. The measuring scale was intended to be precise about small increments, like Duffy's scale, which was "several times daily", "daily", "2-3 times weekly", etc. ¹⁸. Each employee was asked to tick one answer in front of each of his colleagues. Such a question was similar to the one used by both Peponis and Duffy ¹⁹. The measurement scale, unlike both (i.e. Duffy and Peponis), has incorporated *a few times a day (a few/dy)* level so as to have a more precise scale. The work in this study, unlike Duffy, has not attempted to focus on duration, purpose, confidentiality, and importance of interaction.

The Quickborner team in their interaction survey also ignored the content, duration, and importance of communication, based on the theory that only the simple fact that the communication took place is significant ²⁰. Tie strength among members, as suggested by Marsden & Campbell (1984), would be best measured in terms of *time spent* and *closeness* i.e. (acquainted friend, good friend, or very close friend) ²¹. Although Marsden & Campbell have described frequency and duration as having some difficulties as indicators of tie strength, it should be noted that the informal interaction in this study will be measured only in term of frequency (i.e. the density of interaction) rather than in terms of tie strength. Frequency was found to be the strongest measure of interaction ²². However, the concern of environmental designers is to control and manage (i.e. increase or decrease) the opportunity for informal contact.

Table (6.1) shows the number of employees who participated in the study in the six case studies and the total number of questionnaires distributed. Only 77% of the questionnaires were returned and some staff apologised for not participating in the study. The technique used in this questionnaire investigates the degree of interaction of each employee with the rest of the staff. The number of actual relationships in each case study is 435 (Office 1), 528 (Office 2), 1081 (Office 3), 780 (Office 4), 990 (Office 5), and 171 (Office 6) with a total of 3985 relationships (Table 6.1). But the number of relationships investigated by the questionnaire was in fact double this number (7970 relationships). This is mainly because each relationship between two employees is reported twice. For instance, employee A reported his interaction with employee B and in the meantime employee B reported his interaction with employee A. This has resulted, in some cases, in each pair of staff have reporting two different levels of interaction. The researcher decided to select interaction at its highest score, based on the following two reasons: most of the staff were reluctant to report trivial interaction, and for the sake of consistency of the analysis. The mean interaction for each building is calculated based on the five increments with a minimum value 1 and maximum value 5. Office 1 scored the highest level of interaction among the six cases (3.3621) while Office 3 scored the lowest (2.3215). Offices vary dramatically in interaction levels. For example, the highest in *weekly*, *daily*, and *several times a day* levels are Office 3, Office 5, and Office 1, respectively. Table (6.2) shows density of interaction in each building at different time intervals.

6.5. Measuring the spatial properties of layouts.

As discussed in Chapter 4, the technique adopted to measure the spatial properties of layouts is "space syntax". The reason for adopting space syntax theory as a descriptive tool for spatial analysis was also explained in Chapter 4. The validity of this technique in the real world has been explored on the urban settlements scale, where in

Office	Number of staff included in the study	Number of distributed questionnaires	Number of returned questionnaires	Number of actual relationships
Office 1	30	30	27	435
Office 2	33	33	29	528
Office 3	47	47	33	1081
Office 4	40	40	28	780
Office 5	45	45	32	990
Office 6	19	19	15	171
Total	214	214	164	3985

Table 6.1 Number of staff included in the survey, number of distributed questionnaires, number of returned questionnaires, and number of relationships in the six offices.

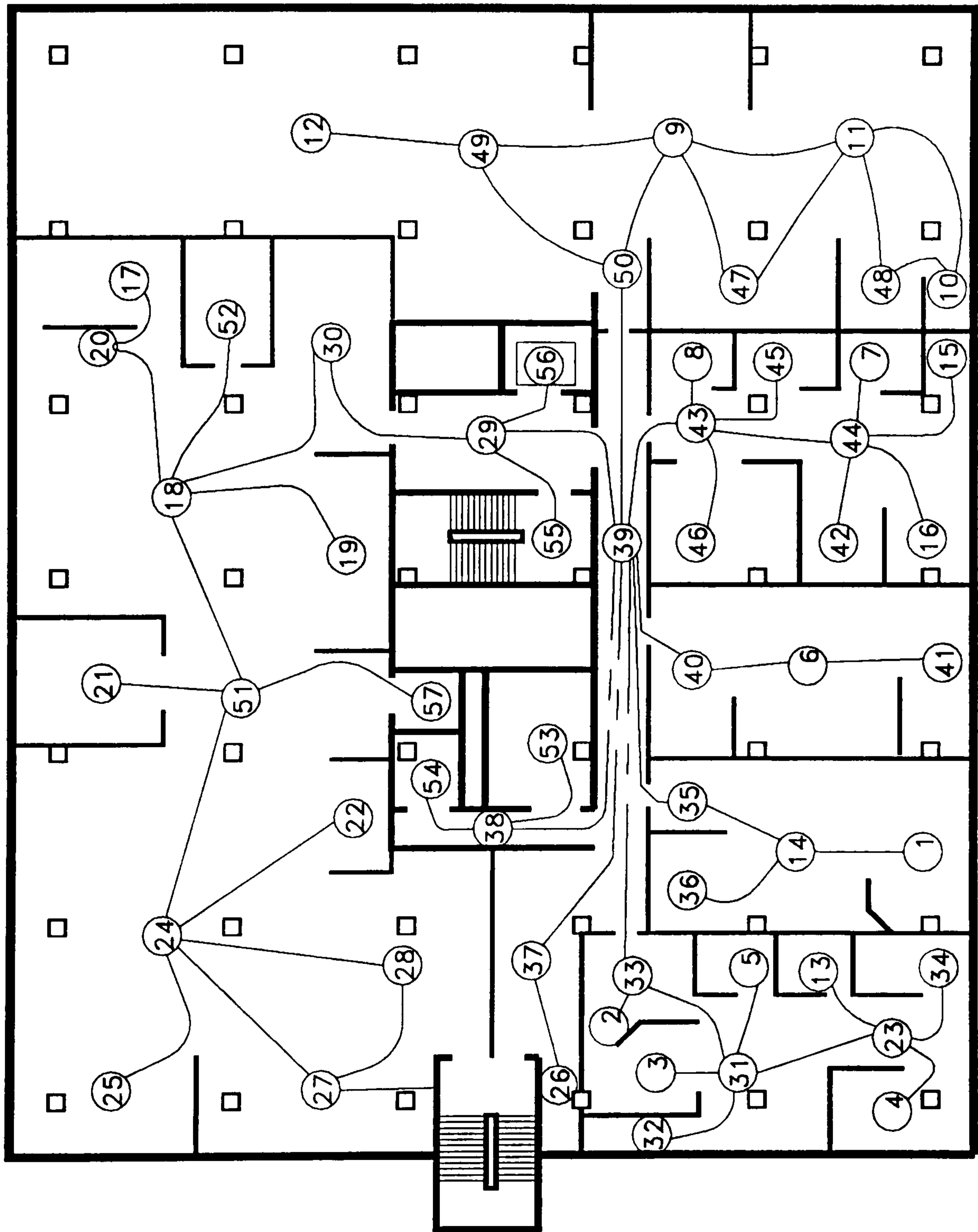
Office	<i>Rarely</i>	<i>Weekly</i>	<i>Daily</i>	<i>Few times a day "a few/dy"</i>	<i>Several times a day "sev/dy"</i>	<i>Mean In- teraction "mn-int"</i>
Office 1	0.1238	0.1231	0.3368	0.0997	0.3166	3.3621
Office 2	0.2093	0.1124	0.1860	0.2063	0.2859	3.2473
Office 3	0.4402	0.1923	0.1104	0.1200	0.1371	2.3215
Office 4	0.3671	0.1491	0.2282	0.1314	0.1243	2.4976
Office 5	0.1747	0.0963	0.3626	0.1755	0.1909	3.1119
Office 6	0.3923	0.1338	0.1477	0.1755	0.1507	2.558

Table 6.2 Density of interaction levels in the six offices.

urban areas or towns, the intelligibility correlation of both category and control tends to be around 0.45, whereas unintelligible systems will have values of 0.2 or less ²³.

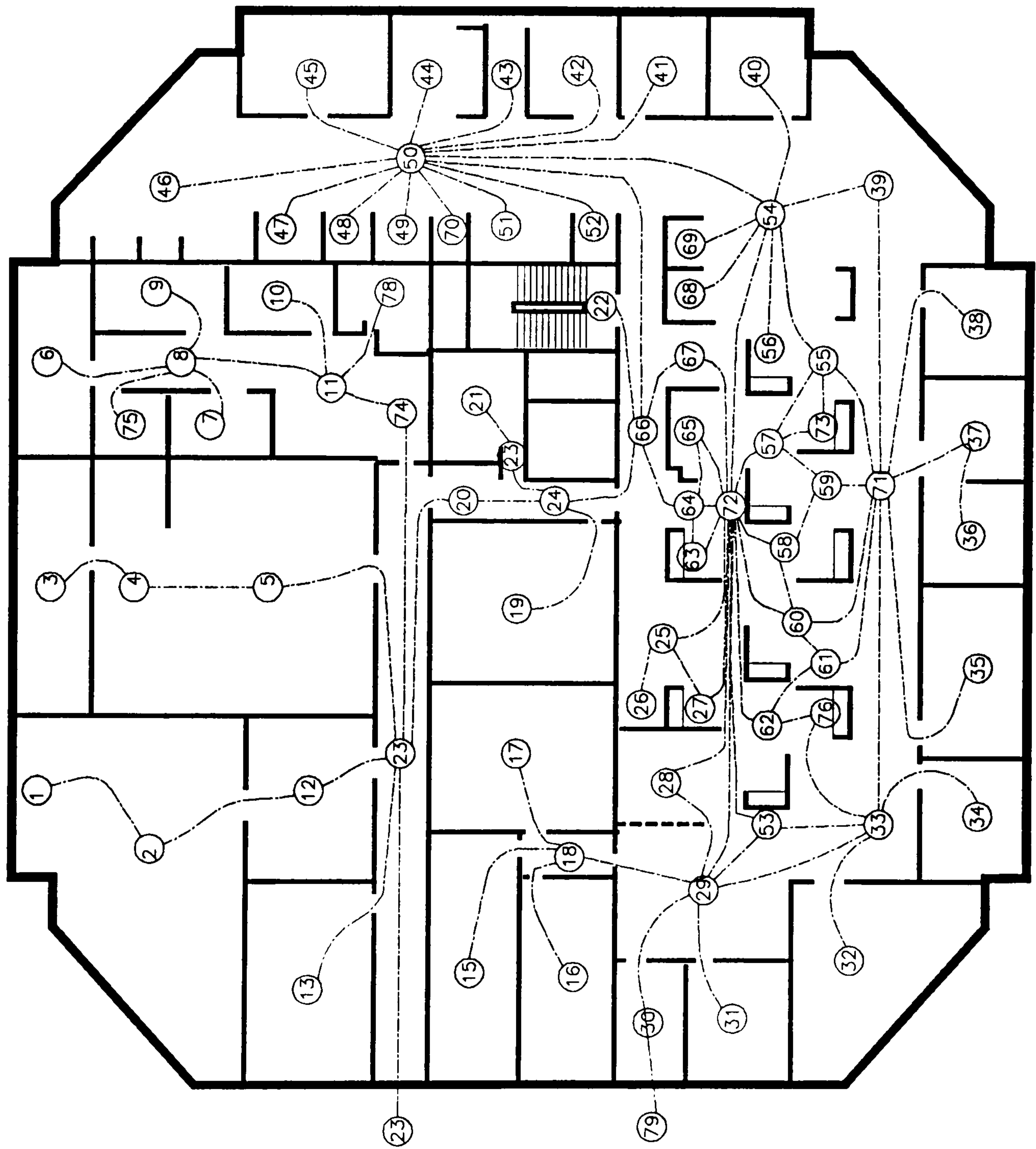
However, the application of the technique to building scales has not been fully explored. This is due to the diversity and complexity of spatial dimensions within organisations. For example, Peponis (1983) used space syntax as a descriptive tool to establish a relationship between spatial typology and interaction pattern ²⁴. Others like Stansall (1989) used the technique to establish a connection between spatial pattern and space-use ²⁵. These two studies on building scale used the space syntax tool and they were able to establish relationships between spatial quality and both the social pattern and activities pattern. Based on the fact that these previous studies have supported the use of space syntax technique, and that it has been used in the real world successfully without showing any critical or major defects, the researcher chose the space syntax technique as a reliable tool to analyse the spatial morphology of office layouts.

The researcher determined all the staff participating in the study on architectural plans, and through this technique the local and global measures of each space were calculated. The process started by dividing the whole plan into convex spaces and then connecting these spaces with lines ²⁶. These lines represented the actual connections among spaces (Fig. 6.8-6.13). Computer software developed by the Department of Architecture at University College London was used to get the local and global measures of spaces. The procedure starts with inserting the number of space, then spaces that this particular space is connected to, and so on till all spaces are described. The final computer outcome shows space number, number of connected spaces to that particular space, degree of *connectivity* (local measure), degree of *integration* (global measure), and degree of integration from three steps depth.



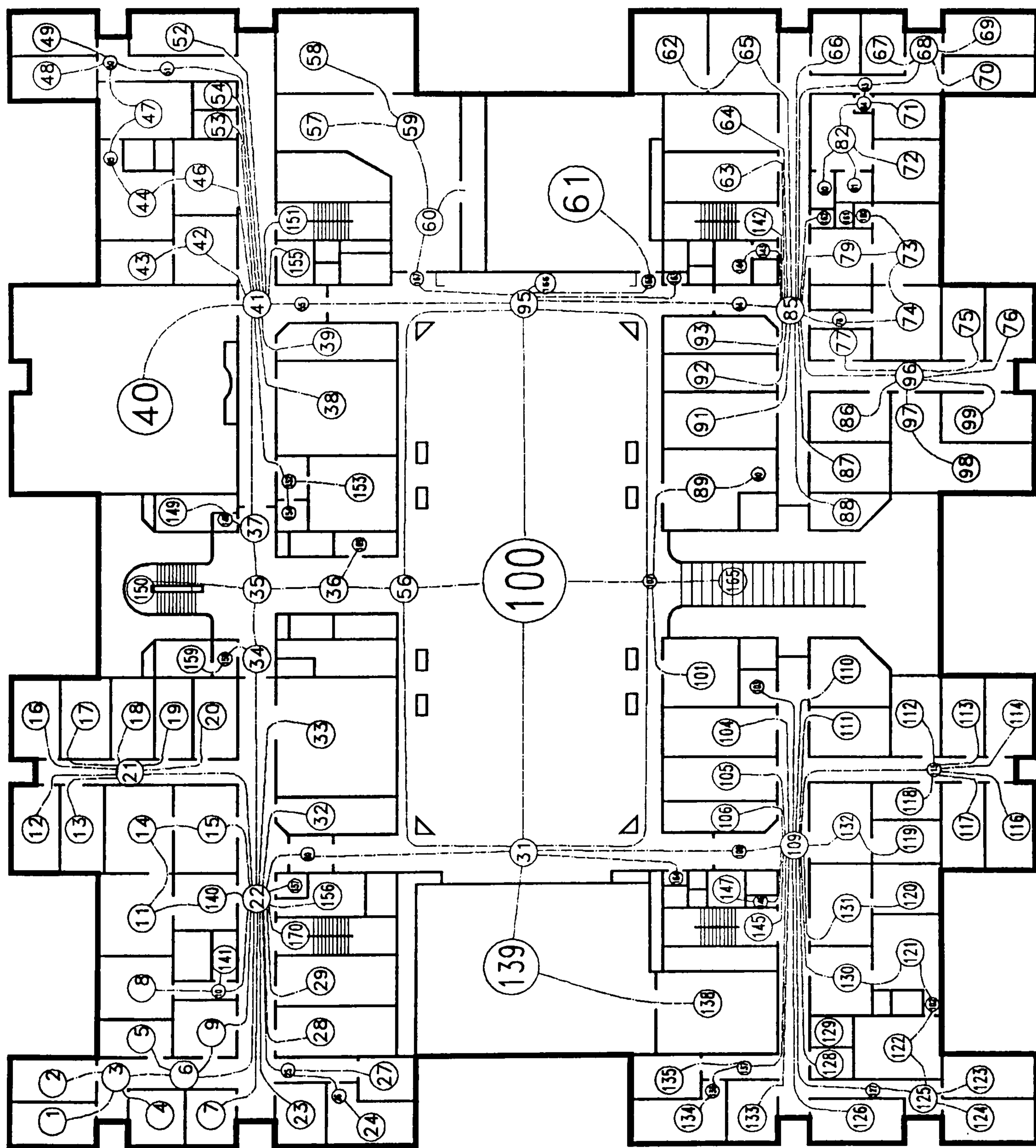
OFFICE ONE: SAUDI TELECOM OFFICE IN MAKKAH

FIGURE 6.8



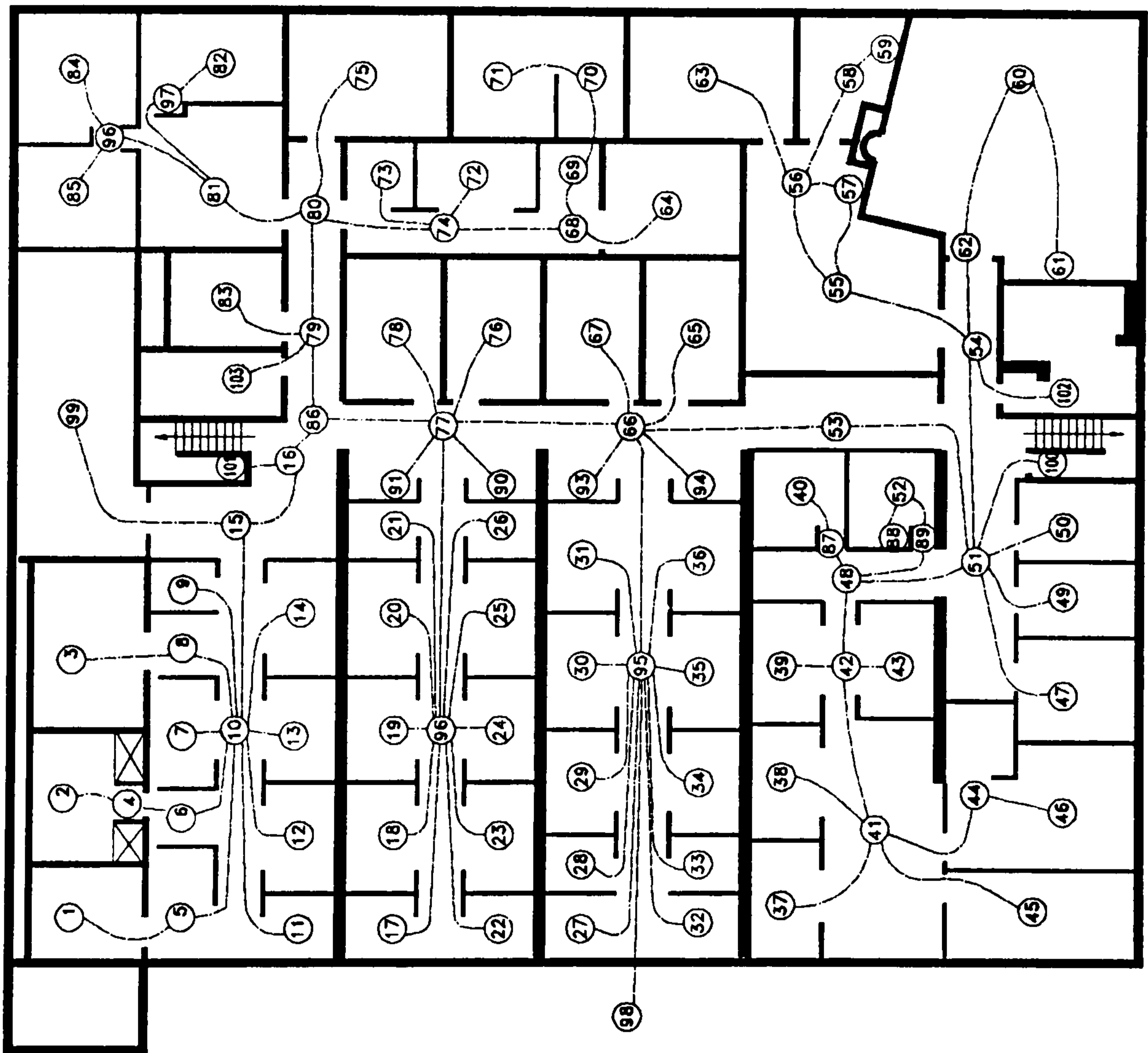
OFFICE TWO: SAUDI TELECOM HEAD QUARTER OFFICE IN JEDDAH

FIGURE 6.9



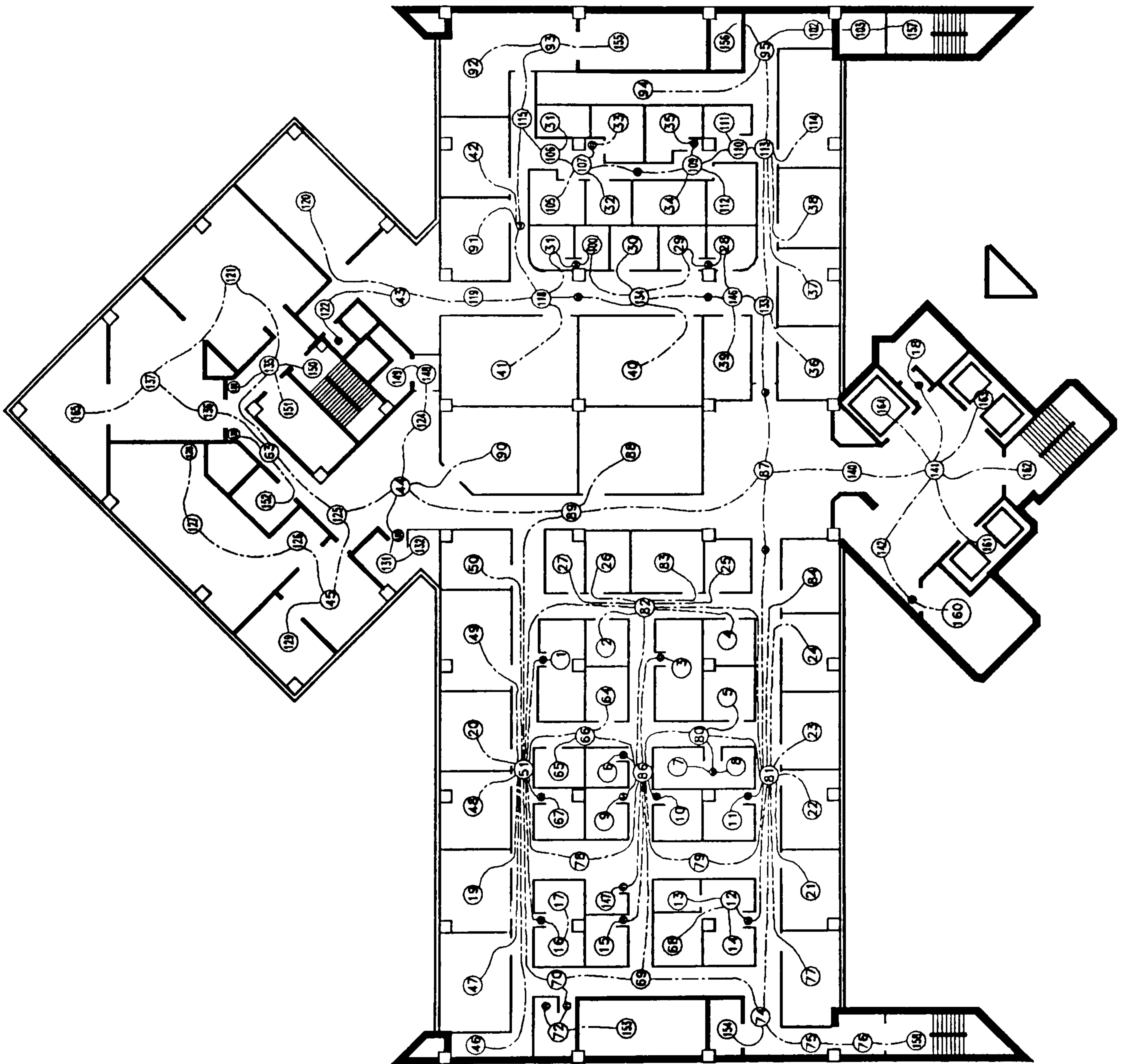
OFFICE THREE: SAMEREC HEAD QUARTER OFFICE

FIGURE 6.10

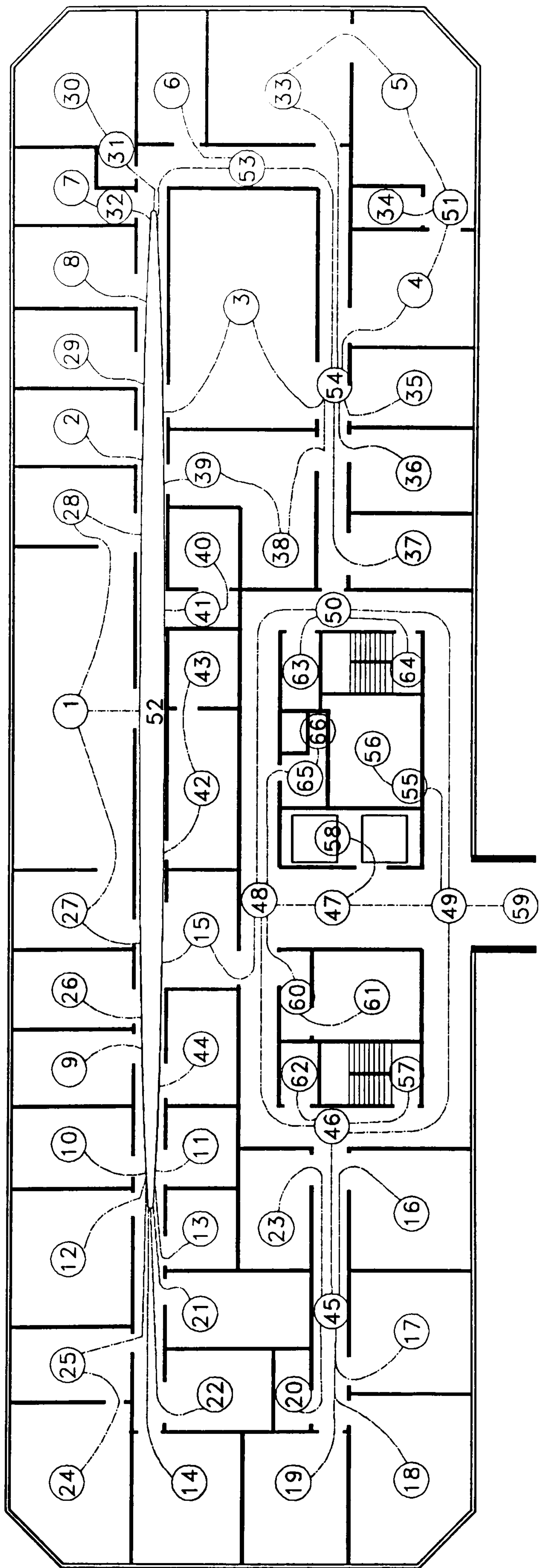


OFFICE FOUR: SAMAREC CORPORATE ENGINEERING OFFICE

FIGURE 6.11



OFFICE FIVE: DALLAH HEAD QUARTER OFFICE
 FIGURE 6.12



OFFICE SIX: JAFFALI HEADQUARTER OFFICE

Table (6.3) shows the local and global measures for all spaces in all the six cases²⁷. Office 4 has the highest *integration* value while Office 6 has the lowest value. The reader is reminded that a high integration value indicates deeper spaces in the system, while low value indicates shallower spaces in the system. If offices are arranged according to their integration values in a decreasing order, from higher to lower, they will be Office 4, Office 1, Office 5, Office 3, Office 2, and Office 6 respectively. The variation in the integration value among the offices from 1.4688 in Office 4 to 0.8902 in Office 6, indicates that the six offices vary in their spatial layouts as far as the integration measure is concerned. On the other hand, a high *connectivity* value in the system indicates well-connected spaces and a low value indicates poorly-connected spaces. The six offices can be arranged from well-connected to poorly-connected as follows: Office 1, Office 2, Office 4, Office 5, Office 3, and Office 6. The difference in control values from 0.991 in Office 1 and 0.2331 in Office 6 ensures the variation in the level of connectivity among the six cases.

Another important variable was whether employees are allocated to the same route or not. The researcher believed that an index for the number of employees allocated to the same route must be developed. Therefore, the researcher filled in a worksheet which manipulated employees' names against each other and marked "1" for staff on the same route and "0" for staff on different routes. The mean for all values represents an index for *same route* variable with "1" indicating that this employee is sharing the same route with the whole staff and "0" indicates that not one of the staff shares a route with this particular staff, where $0 \leq \text{same route} \leq 1$. The need for this variable is generated from the failure of local and global measures of spaces to describe spaces in their route allocations. In other words, two spaces could have the same control and integration values but they are allocated in different routes. As an assumption, all routes were assumed to lead to the shallowest point in the system of spaces (the lowest integration

Office	Mean <i>Integration</i> Value	Mean Connectivity Value	Mean <i>Same Route</i> Index
Office 1	1.3681	0.991	0.2680
Office 2	1.1165	0.696	0.5560
Office 3	1.2427	0.3234	0.1770
Office 4	1.4688	0.584	0.4669
Office 5	1.3190	0.519	0.1970
Office 6	0.8902	0.2331	0.3860

Table 6.3 Mean *integration* value, mean *connectivity* value, and the *same route* index for the six offices.

value), which is almost the carrier. In case there is more than one choice to the carrier, the shortest route is selected.

Table 6.3 shows the index of *same route* for all six cases. If we compare the six offices with each other, we find that Office 2 has the highest *same route* value which subsequently means that number of staff allocated in the same route in this office is the highest among the six offices. Office 3 has the lowest *same route* value, which means that number of staff allocated in the same route in this office is the lowest among the other cases. Layouts allocating a larger number of employees in the same route in decreasing order are: Office 2, Office 4, Office 6, Office 1, Office 5, and Office 3, respectively.

6.6. Measuring the physical variables

Throughout the study every workspace was inspected to measure the physical variables incorporated in the study. The researcher enumerated a checklist to measure the degree of enclosure for each workspace. Enclosure is defined as any physical barrier surrounding the workspace. This could be a wall or a partition. It should be noted that only barriers above eye level are included in the study. The checklist investigates the number of enclosed sides for each workspace i.e. 1,2,3, or 4. Such a study is similar to the one used by Sundstrom (1982) where he measured the number of enclosed sides through the numbers of walls, panels, or partitions, which were at least 6 ft. high around a work-surface and chair, with no thoroughfare or workspace intervening²⁸. All types of barriers, i.e. transparent or opaque, were counted in the study as an index of the degree of *visual accessibility* was developed.

The six cases vary explicitly in their level of enclosure. The highest value was found in Office 6 (3.421) and the lowest value is in Office 5 (1.791). These values are the average values of enclosure among the whole staff with a maximum value of 4 and

minimum value of 0. The order of enclosure level among the six cases from higher to lower is: Office 6, Office 3, Office 4, Office 2, Office 1, and Office 5, respectively.

The degree of visual accessibility was defined as the ability of staff to see each other while they are seated in their own workspaces. The researcher enumerated a worksheet for each case with employees' names against each other, and visited every workspace belonging to employees participating in the study and identified employees that are visible to each other. The researcher marked "1" for staff who are visible to that particular person and "0" for invisible staff. Thereafter an index for the degree of visual accessibility for every employee is calculated with "1" indicating that the employee is visible to all the staff and "0" indicating that this employee is invisible to the whole staff, where $0 \leq \text{visual accessibility} \leq 1$. Visual accessibility in the work of Sundstrom (1982) was measured in terms of the number of co-workers visible from the participant's primary work position with door open, if any²⁹. Office 1 has the highest visual accessibility value (0.2045), which means that staff have the lowest intervening barriers among each other, while Office 3 has the lowest value "0" which means that staff have the highest intervening barriers among each other. In fact, in this case staff are entirely invisible to each other. The visual accessibility in the six offices in decreasing order are: Office 1, Office 2, Office 5, Office 6, Office 4, and Office 3.

Proximity is another variable which was measured. As part of the survey, the researcher with the help of one of his colleagues used a metre-tape to measure the distance separating every employee from the rest of the staff. The measurement was taken from chair to chair and it was the actual shorter walking distance. Steele (1986) has defined two forms of physical distances. These are the "actual distance" and "functional distance", that is the amount of difficulty involved in getting from point A to point B³⁰. Allen (1977) in his work on "the effect of indirect travel routes on communication

probability" has developed an index of difficulty called "nuisance factor" which is the difference between the straight line and the actual travel distance ³¹. It should be noted that only the actual distance of travel is the area of concern in this study. However, for each employee, the researcher developed an index for the average distance from the rest of the staff. Office 3 has the highest *proximity* value, which means that staff participating in the study are more dispersed from each other compared to the other offices. Office 4 has the lowest value, and this subsequently means that staff are closer to each other than in other cases. The order of offices according to their index of proximity in decreasing order is: Office 3, Office 1, Office 6, Office 5, Office 2, and Office 4.

Another variable that was taken into account is percentage of employees (participating in the study) sharing the *same room*. The room was defined exactly as in Sundstrom's work to have structural walls up to the ceiling ³². It should be noted that this measure does not represent the crowding situation since it does not count all the occupants in the room, but in fact it is only concerned with employees participating in the study. With the same method as explained in developing the indices for visual accessibility and same route, the researcher filled in the worksheet with "1" indicating that employees are in the same room and "0" indicating that employees are in different rooms, where the *same room* index for every employee is $0 \leq \text{same room} \leq 1$. Office 1 has the highest *same room* value (0.2865), which means most of the staff selected in the study are allocated the same rooms compared to the other cases, while Office 3 and Office 6 have the lowest value "0" which means all the staff participating in the study are allocated different rooms.

The number of relationships investigated to measure *visual accessibility*, *proximity*, *same route*, and *same room* in all cases was equal to the number of informal interaction relationships investigated among the staff i.e. 3985 relationships for each

variable. Table (6.4) shows the degree of *enclosure*, and index of *visual accessibility*, *proximity*, and *same room* for all cases.

6.7. Measuring the organisational variables.

Two aspects under organisation variables were taken into account: firstly, variables related to job characteristics; secondly, variables related to organisational grouping (i.e. departments). Job characteristics focussed on the status and nature of work. These were measured through a questionnaire³³. All the staff included in the study were asked to identify their status, whether they were managers, administrators, or secretaries. Staff were also asked to indicate the percentage of the total time spent seated, standing and walking. In both Offices 4 and 6 staff tend to be seated most of the time (76% of the total time spent seated), while staff in Office 5 have the lowest seated percentage (61%) compared to the rest of the cases. The walking percentage is the highest in Office 2 and lowest in Office 6. Another variable also investigated through the questionnaire was the degree of movement i.e. number of times employees leave their workplaces for both work and personal purposes. Respondents to the questionnaire were given a 1-5 scale i.e. at least once every 15 minutes, at least once every 30 minutes, at least once an hour, at least once every 2 hours, at least once a day. The frequency of leaving the workspace for each office is shown in table 6, where Office 5 reported the highest level and Office 1 reported the lowest level. Tables (6.5) and (6.6) show the numbers of each group of employees (managers, administrators, and secretaries), times spent (seated, standing, and walking), and frequency of leaving the workspace for every office.

The second variable which is related to departments was obtained from the management of each firm, where the whole staff is classified in their hierarchical and

grouping structure. The index for percentage of employees in the *same department* was obtained in the same method discussed with visual accessibility, same route, and same room as $0 \leq \textit{same department} \leq 1$, where "1" means this employee is in the same department with the rest of the staff, and "0" means this employee has no partner in his department. Most of the staff selected in Office 4 (the highest value among the cases) are in the same department, while most of the staff in Office 5 (the lowest value among the cases) belong to different departments (Table 6.6).

6.8. Case studies profile.

It was the researcher's intention to ensure that the selected case studies provide a wide range of variety among all the incorporated variables. All the case studies have the same nature of work, which is of an office type with a variation in the degree of desk-work to non-desk-work. The six organisations have almost the same policies in operating their business. For instance, they all provide high quality care and services to their employees, the same workspace quality, and have almost the same facilities and services in their office buildings. On the other hand, the cultural issue was one of the most important issues to deal with. The researcher tried hard to eliminate any effect that could be caused by organisational culture differences. Therefore, it was essential for the researcher to investigate that the six organisations had almost similar social and organisational attitudes and expectations.

Other factors including whether all the staff performed their work inside the office building i.e. no people working at home, were also important. To ensure the compatibility of the six case studies with regard to organisational culture and ecology, the researcher referred to Becker's definition where he mentioned the degree of "acceptability" in an organisation as a significant index³⁴. It takes many forms: the amount of money allocated to personal computers and their servicing, the level of office

Office	Mean Enclosure	Mean Proximity	Mean Visual Accessibility	Mean Same Room Index
Office 1	1.900	30.068	0.2045	0.2865
Office 2	2.455	27.317	0.1872	0.1336
Office 3	3.348	52.83	0	0
Office 4	2.700	25.15	0.0825	0.1765
Office 5	1.791	28.274	0.1337	0.1718
Office 6	3.421	28.97	0.1008	0

Table 6.4 Mean enclosure, mean proximity ,and indices for both visual accessibility and same room for the six offices.

Office	Number of <i>Managers</i>	Number of <i>Administrators</i>	Number of <i>Secretaries</i>
Office 1	4	21	2
Office 2	13	13	3
Office 3	15	15	3
Office 4	7	16	5
Office 5	12	17	3
Office 6	3	6	6
Total	54	88	22

Table 6.5 Number of each staff group participated in the study (These numbers represent the actual number of staff returned the questionnaires).

Office	% Seat	% Stand	% Walk	Leaving the work- space	Same Department
Office 1	70.3	16.48	13.22	1.96	0.2865
Office 2	62.76	13.79	23.45	2.897	0.5064
Office 3	70.09	13.03	15.73	2.485	0.3823
Office 4	76.30	12.89	10.81	2.654	0.6046
Office 5	61.45	16.66	22.24	3.00	0.06508
Office 6	76.43	11.93	11.64	2.00	0.1249

Table 6.6 Percentage of time spent seated, standing, and walking .The fourth column shows frequency of staff leaving their workspaces daily.The last column is an index for percentage of staff fall under the same department.

automation to produce a paperless office , amount of time and money that the organisation is willing to commit to an employee's training , and so on. All of these aspects were taken into account and were held constant as far as possible in all case studies.

Another significant factor as determined by Becker (1990) also is "what people do and value". This is defined as "shared patterns of thought, belief , feelings and values that result from shared experience and common learning" ³⁵. As mentioned earlier, all the staff involved in the study have almost the same cultural , social and religious beliefs, sex (i.e. male), time spent in the organisation since they were appointed , and the same language. The level of performing team-work vs. individual-work was also important. In all the six cases , employees experienced the same level of individual vs. group type of work to ensure that the incentives for performing participative vs. private work are almost the same . Another significant point was the organisations assumptions about how to structure spaces as well as staff and management relations. In all the six cases, the organisations maintained the same hierarchical policy in allocating spaces to different staff groups i.e. managers, administrators, and secretaries. This is mainly in terms of the physical quality of workspaces assigned to each group.

The organisational structure was also a factor to be kept constant. In all cases, organisations maintained a hierarchical system of management with higher status at the top of the pyramid and lower status at the bottom. The decision-making process in these organisations is mostly devoted to higher status staff, with some participation from the lower status staff.

As far as variables incorporated in the empirical work are concerned, it was the intention that the sample cover all the spectrum . The spatial layouts in the case studies

were ensured to vary dramatically in their level of depth and connectivity and in the way the whole system of spaces was structured. The architectural plans that were used to develop the spatial measures represented the most difficult task to the researcher since none of the existing plans were up-to-date . All plans were modified to coincide with the existing layouts. The sample was also well spread along different independent variables, such as level of visual accessibility, proximity, being allocated in the same room, and being in the same department.

6.9. Summary

The chapter is concerned with research design and methodology . It starts by explaining the parameters of the working problem .The research design was summarised in a systematic diagram to facilitate the understanding of the research design. Six offices were selected to conduct the study. These are organisations that mostly maintain the hierarchical structure in management with managers who are mostly involved in the process of decision-making with some participation from the other staff. These organisations have adopted a managerial style that has become very distinctive. The success of the performance of these organisations has increased the expectation that other Saudi organisations will adopt the same management style. The chapter described the nature of the organisations in these case studies , their policies, objectives , in addition to a brief description of the physical settings of the layouts. The study ensured that these six samples provided the necessary data to test the research hypothesis. The spatial hypothesis of interaction will be tested on three levels: a) the relationship between the density of interaction of each individual with his spatial properties; b) the relationship between the density of interaction of each small group and its spatial properties; c) the relationship between the density of interaction of each large group (i.e. the whole organisation's members) and its spatial properties.

Five levels of interaction were developed. These are *several times a day (sev/dy)*, *a few times a day (a few/dy)*, *daily*, *weekly*, and *rarely*, in addition to the *mean interaction (mn-int)*. The independent variables were divided into three parts. Firstly, there are the spatial variables, which include the global level of *integration*, the local measure of *connectivity*, and the *same route* index . Secondly, there are the physical variables, which include the level of *visual accessibility*, *proximity*, and the *same room* index . Thirdly, there are the organisational variables, which are mainly concerned with identifying three groups of staff i.e. managers, administrators, and secretaries. These are

different in nature of tasks performed . Staff were also described in their level of mobility, this is in terms of percentage of time spent seated, in addition to the frequency of leaving the workspace. The other measure of organisational variables is the organisational groups i.e. different departments in the organisation. The variable was the *same department index* .

The method to measure each independent variable was explained in detail. In the previous pages the final data was also presented and briefly the researcher reviewed variations and differences in both the dependent and independent variables. Finally , the chapter concluded with the case studies profile by showing the considerations that were taken into account while selecting these samples, and the variables that were meant to be frozen constant while allowing variation among the targeted variables.

Notes and References

¹ See p. 191.

² Keller, R. & Holland, W., 1983, Communicators and Innovators in Research and Development Organisations, *Academy of Management Journal*, Vol.26, No.4, p.746.

³ Conventional office is defined as a space surrounded by full-height, fixed partitions or walls (i.e. room). This space is occupied by one or more persons. The Saudi conventional office consists of rooms of different sizes for single and multiple occupancy. In the case of multiple occupancy the room is subdivided by partitions. On the other hand, open plan office is a large open space with light and movable head-high partitions surrounding workspaces.

⁴ See p.114.

⁵ Sundstrom, E., Town, J., Brown, D., Forman, A., McGee, C., 1982: Physical Enclosure, Type of Job, and Privacy in Offices. *Environment and Behavior*, vol.14, No.5, Sept. 1982, p.556.

⁶ See p.173.

⁷ See pp.67-70.

⁸ See pp.138-140.

⁹ See pp.58-61.

¹⁰ Private office is defined as a space surrounded by full-height fixed walls (i.e. room) and occupied by one employee only.

¹¹ See p.154.

¹² See pp.92-93.

¹³ See p.132.

¹⁴ See pp.94-98.

¹⁵ These are different offices from those selected for the final study.

¹⁶ See Appendix.

- ¹⁷ Marsden, P. & Campbell, K., 1984, Measuring Tie Strength, *Social Forces*, Vol. 63:2, December, 1984, p.488.
- ¹⁸ Duffy, F., 1974b, Office Design and Organisations: 2-The testing of hypothetical model, *Environment and Planning B*, 1974, vol.1, p.225.
- ¹⁹ Peponis, J., 1983, *Typology and Social Functions of Factory space*, Ph.D. thesis submitted to Bartlett School of Architecture & Planning, University College, University of London, p.106.
- ²⁰ Pile, J., 1978, *Open Office Planning*, Whitney Library of Design, New York, p.64.
- ²¹ Marsden, P. & Campbell, K., 1984, op. cit., p.482.
- ²² See pp.54-55.
- ²³ SERC; Hillier, B., Hanson, J., Peponis, J., Hudson, J., Burdett, R., 1983, Space Syntax, : A different urban perspective, *Architectural Journal*, November, 1983, p.63.
- ²⁴ Peponis, J., 1983, op. cit., p.207.
- ²⁵ Stansall, P., 1989, *Office Space and Productivity: The layout talks back*. Unpublished paper.
- ²⁶ See p.152.
- ²⁷ For the local and global measures of each employee's space see Appendix.
- ²⁸ Sundstrom, E., Town, J., Brown, D., Forman, A., McGee, C., 1982, Physical Enclosure, Type of Job, and Privacy in the Office. *Environment and Behavior*, vol.14, No.5, Sept. 1982, p.548.
- ²⁹ Ibid. p. 548.
- ³⁰ Steele, F. 1986, *Making and Managing High-Quality Workplaces*, Teacher college, Columbia University. p.91.
- ³¹ Allen, T. 1977, *Managing the Flow of Technology*, The Massachusetts Institute of Technology, p. 266.
- ³² Sundstrom, E. & et al, 1982, op. cit. p.550.
- ³³ See Appendix.

³⁴ Becker, F., 1990, *The Total Workplace*, Van Nostrand Reinhold, New York , p. 228.

³⁵ Ibid. p.229.

CHAPTER 7

THE PHYSICAL SETTINGS AND THE INFORMAL INTERACTION MODELS

7.1. Overview

The aim of this chapter is to test the spatial hypothesis of interaction based on the relationship between the density of interaction of each individual and his syntactic position (level 1). In the meantime, all the incorporated variables will be used to generate an overall model describing the role of physical settings in supporting informal interaction in workplaces. Throughout the development of the models, three other areas will be investigated. These are the impact of physical accessibility, mobility, and task characteristics on informal interaction.

The correlation values for all the incorporated variables were worked out so as to ensure that all of these variables are truly independent so that they will be ready to be treated statistically. It should be noted that interaction models will be developed for the five interaction levels. These are *several times a day (sev/dy)*, *a few times a day (a few/dy)*, *once a day (daily)*, *once a week (weekly)*, and *rarely*, in addition to the *mean interaction (mn-int)*. The spatial structure of the layout is being described in both the global measure of *integration* and the local measure of *connectivity*. This is in addition to the *same route* opportunity.

Physical accessibility was defined in terms of both the *visual accessibility* and *proximity*. The level of mobility is defined in terms of time spent seated, walking, or standing, in addition to frequency of leaving the workplace. The task characteristics are described in term of managerial vs. clerical work. The interaction model for every case study will be developed individually. The purpose of this section is to test whether all case studies develop the same models of interaction or not . The final section is focussed on generating the overall model of interaction by combining all the case studies together. This was mainly developed to provide a single and comprehensive model that can

describe the role of the physical environment in supporting informal interaction in organisations.

7.2. The incorporated variables.

In the previous chapter the independent variables were classified into three categories. Firstly, there are the spatial variables, which include the level of *integration*, the level of *connectivity*, and level of allocating in the *same route*. Secondly, there are the physical variables, which include the level of *enclosure*, *proximity*, level of *visual accessibility*, and level of being in the *same room*. Thirdly, there are the organisational variables, which include the three organisational groups (managers, administrators, and secretaries), degree of mobility, and level of being in the *same department*.

The informal interaction in its five levels with all the independent variables are matched against each other to test their correlation. Among all, there are some variables which were shown to be highly correlated with each other. As the mobility level of the staff was measured in the percentage of time spent seated '*seat*', standing '*stand*', and walking '*walk*'. The percentage of '*stand*' was the lowest and in all cases it shows a high correlation with the percentage of '*seat*'. The researcher, therefore, decided to drop the '*stand*' variable. On the other hand, '*walk*' and '*seat*' variables in most cases were found to be highly correlated with each other too. Therefore, through all the regression analyses the '*walk*' variable was dropped from the regression equations. Only '*seat*' and '*leave*' variables, therefore will describe the level of mobility. It should be noted that only variables that are found to be highly correlated with other variables are eliminated. Tables (7.1-7.7) are full of information¹. They show the correlation values among variables for each case study and for the overall cases.

In fact, the six cases have shown different relationships among variables. The spatial measures of layouts i.e. the *integration* value, the *connectivity* value, and the *same route*, have only shown significant relationships in some case studies with interaction. The level of *integration* has shown a negative relationship with *a few times a day* level of

interaction in Office 6 and also a negative relationship with the *mean interaction* in Office 2. The level of *Connectivity*, on the other hand, has not shown any direct correlation with any interaction levels. The *same route* index has shown a high correlation with the *mean interaction* in some cases. It shows a positive relationship in Offices 1,2,3,and 6. The correlation values were at their highest in both *a few times a day* and *several times a day* levels of interaction. The *mean interaction* has shown a positive relationship with the *visual accessibility* in Office 1 and 2 only, and in all the cases the highest correlation value was found to be with both *a few times a day* and *several times a day* levels of interaction. Proximity has also shown a negative relationship with the *mean interaction* in Office 1 and 3.

Task characteristics was found to have a positive relationship with the level of *enclosure* in Offices 1,2,3,4,and 6, which highlights the hypothesis that associates *enclosure* with status. The level of *integration* also was found to have a positive relationship with *task characteristics*. This was only in Offices 2 and 6, which indicates that managers in these offices occupy deeper spaces in the system than secretaries². In all cases the local *connectivity* and the global measures of *integration* of spaces did not show any significant correlation with each other, which means that these two measures are truly independent of each other. The *mean interaction*, which was calculated from the five interaction levels, showed a significant correlation with both *several times a day* and *'rarely'* levels (these are the two extremes of the interaction scale) in all cases, which means that the *mean interaction* could replace the interaction levels. This is of a great importance in order to develop a single and comprehensive model describing interaction.

Statistical analysis and the efficacy of the predictive power:

The variables in Tables (7.1-7.7) show some significant interrelated correlation with each other. Significance level in these tables is $r = .59$ at 1%, $r = .48$ at 5%, and r

=.41 at 10%. In this study, any correlation value above .35 is considered to be a significant moderate relationship. It is difficult to draw a solid conclusion from these correlation values since most of these variables have interrelated correlation among each other. That is why the regression analysis was recommended. For each case the regression analysis is carried out at the five interaction levels and by using 'stepwise' regression to determine the significant predictors among these variables in steps according to their significance and their influence on interaction. It should be noted that in some cases the statistical analysis could not develop regression models for some individual cases simply because the data are not large enough to develop the model, which sometimes resulted in a high *p-value* for the overall test. Although the data were not large enough to develop models on an individual case basis, when they were combined with other cases' data to develop the overall model, the regression test was successful and the results were meaningful.

Tables (7.8-7.14) shows *R-sq* value for each case and *p-value* for each independent ³. The *R-sq* value indicates how much the independent variables explain the variation in the dependent variable (i.e. interaction). Therefore, the higher the *R-sq* value, the stronger the predictive power of the variable to explain the main dependent i.e. interaction. The *P*-value indicates how significant the variable is, as well as the overall test. It is concerned with the percentage of the probability of the coefficient of the predictor being not equal to 0. As the *P*-value tends to 0 value, the significance of the variable increases and as it becomes bigger its confidence starts to diminish. In all the developed models, predictors are chosen on a significance level of $p < .1$ unless it is indicated. In some cases, though the *p-value* of some predictors is high, they were adopted in the model since they contain data that contribute to explaining the main dependent. This is in fact a statistical problem which is caused by two or more variables being correlated to each other. A statistical analysis was undertaken for all the five levels

of interaction for every case. Throughout the regression analysis dummy variables of 0 and 1 were introduced when dealing with the pool data (i.e. the six case studies) so as to eliminate the impact of any differences occurring in the untargeted variables throughout the six case studies.

7.3. Testing the spatial hypothesis of informal interaction at the individual level.

The working spatial hypothesis of interaction in this study consists of three parts. Firstly, there should be a relationship between the level of *integration* (the global measure) and the level of informal interaction. Secondly, there should be a relationship between the level of *connectivity* (the local measure of control) and the level of informal interaction. Thirdly, staff whose workspaces share the same route opportunity would experience better interaction. Referring to the interaction models generated by the regression analysis, the following results are reported (Tables 7.15-7.20) ⁴:

The global measure of *integration* and informal interaction:

The level of *integration* was positively significant with *several times a day* level in Office 5 , positively significant with *a few times a day* level in Office 2 , negatively significant with *daily* level in Office 3 , positively significant with *weekly* level in Office 6 , negatively significant with *rarely* level in Offices 1,3,5, and 6, and negatively significant with the *mean interaction* in Office 5 . It is clear that under the same interaction level , no more than one office could show the significance of the global *integration*, except at *rarely* level, where four offices have incorporated the level of *integration* in their models. That is why the global *integration* did not appear as a significant predictor in the overall models for the four remaining levels .

In the case of *rarely* level , the global *integration* was shown to be negatively significant in Office 1 where *R-sq* increased from 41.18 to 55.57, but at a low level of confidence $p = .255$; in Office 3 *R-sq* increased from 44.96 to 52.49 and $p < 0.05$; in Office 5 where *R-sq* scored 3.29 and $p < 0.05$; and in Office 6 where *R-sq* increased from 66.08 to 66.27 with $p < .1$. The level of *integration* was also shown in the overall model which described the significant predictors at the *rarely* level in a negative relationship. It means that the spatial hypothesis that associates the level of interaction with informal interaction has only been supported at the *rarely* level . The reader is reminded that a high value of *integration* means deeper spaces in the system and a low value means shallower spaces in the system. Therefore a negative relationship between the level of *integration* and *rarely* level of interaction means that as spaces get deeper ,the *rarely* encountering decreases and as the spaces become more shallower , the *rarely* encountering increases. The hypothesis was supported on *rarely* level when the global *integration* appeared in the overall model of the pool data of *rarely* level and *R-sq* jumped from 41.53 to 48.32 once the level of *integration* entered the model with $P < 0.05$. The hypothesis, therefore, has not been supported on other interaction levels nor on the *mean interaction*.

Although the global *integration* has appeared in individual cases to be significant, it did not appear in the overall model of the other four levels. However, the correlation values (Tables 7.1-7.7) could only find one significant negative relationship with *mean interaction* in Office 2 ($r = -.451$). Such a strong relationship was established as the level of *integration* was found to have strong relationship with proximity (a strong predictor of interaction). This happened when staff in shallower spaces were allocated closer to each other (more compact) than staff in deeper spaces. This was confirmed by a strong correlation value between the level of *integration* and *proximity* ($r = .408$).

If we review the trend of the level of *integration* where it was shown to be significant in individual cases under the four remaining levels i.e. *several times a day*, *a few times a day*, *daily*, and *weekly*, some conclusions might be drawn . The level of *integration* was found to be significant in four cases as mentioned earlier . Firstly, the level of *integration* was positively significant in Office 5, with *several times a day* level . Secondly, it was also positively significant with *a few times a day* level in Office 2. Thirdly, it was negatively significant with *daily* level in Office 3 .Fourthly, it was positively significant with *weekly* level in Office 6. The *p-values* were 0.071, 0.013, 0.003, and 0.067, respectively . Although these results are not enough to draw any conclusion , they could give a clue as to the impact of the level of *integration* on interaction.

In the first ,second and the third cases already mentioned, one can easily see that the global *integration* has a positive relationship with both *several times a day* and *a few times a day*, and a negative relationship with *daily* level of encountering. This means that deeper spaces do encourage encountering on an almost *hourly* basis (both *several times a day* and *a few times a day* levels were counted to be interaction on an almost *hourly* basis) and discourage encountering on a *daily* basis, as shallower spaces discourage encountering on an *hourly* basis and encourage encountering on a *daily* basis. Such results go hand in hand with the supported hypothesis which associates '*rarely*' level with the level of *integration*. The only contradiction occurred in the fourth case where the level of *integration* was found to be positively significant with '*weekly*' level in Office 6 . One interpretation to justify this result is that the level of *integration* in the fourth case has a high *p-value* which exceeded 0.05 and which could weaken the confidence of the relationship. Secondly, the level of *integration* in Office 6 was found to be highly correlated to *same route* ($r = 0.634$) and that was the main reason for having a high *p-value* for the level of *integration*. Another contradicting result for the first, second, and

third cases appeared in the model of the *mean interaction* for Office 5 where the level of *integration* shows a negative significant correlation. One possible interpretation for this result is that although $p < 0.05$, *R-sq* did not show a big increase once the *integration* entered the model (from 5.99 to 6.09), which means that this relationship only explains 0.1% of the *mean interaction*, which is far too low to enable the researcher to draw any conclusion.

Generally speaking, the level of *integration* has not shown a direct and clear influence on *several times a day*, *few times a day*, *daily*, *weekly*, and the *mean interaction* levels. The final conclusion is that the hypothesis that associates the level of *integration* with *several times a day*, *few times a day*, *daily*, *weekly*, and the *mean interaction* levels has not been supported in this study. It was only supported at the 'rarely' level of encountering.

The local measure of control and informal interaction:

The second part of the working hypothesis deals with the local measure of spaces which associates the level of *connectivity* with the level of interaction. The reader is reminded that high control value means that the space is well-connected to its neighbours, whereas low control value means that the space is poorly connected to its neighbours. If we revise the models that were developed for the five interaction levels, *connectivity* does not appear in *several times a day* level. However, *connectivity* draws attention in eight cases. Firstly, under *a few times a day* level it appeared in Office 2 to be positively significant. Secondly, in Office 4 it was negatively significant with *a few times a day* level as well, but it did not appear in the overall model of *a few times a day*. Thirdly, at the third level (i.e. *daily*), it was positively significant in Offices 3, 4, and 5, but not significant in the overall model of *daily* level. Fourthly, at the fourth interaction level 'weekly', it was negatively significant in Offices 3 and 6 but not in the overall model of

this level. Fifthly, at the '*rarely*' level, it was negatively significant in Office 5. Sixthly, it was negatively significant in the overall '*rarely*' level of all cases. Seventhly, it was positively significant in the mean interaction model in Office 5. Eighthly, it was positively significant in the mean interaction of all cases.

From these eight cases, one can easily see that *connectivity* associates positively with the higher levels of interaction (i.e. *several times a day* and *a few times a day*) and negatively with the lower levels (i.e. '*weekly*' and '*rarely*') except for *a few times a day* in Office 4. In spite of this fact, *connectivity* was not shown to be directly significant at the overall *several times a day*, *a few times a day*, *daily*, and '*weekly*' levels for all cases. However, a clear relationship was drawn between *connectivity* and the overall '*rarely*' level for all cases in a negative relationship; *R-sq* increased from 48.32 to 51.28, which indicates that *connectivity* explains that much of '*rarely*' encountering. Therefore, the spatial hypothesis which associates the level of local *connectivity* of spaces with interaction was supported at the '*rarely*' level. The hypothesis has also been supported by the overall model of the *mean interaction* for all cases, where the model adopted *connectivity* in a positive relationship. *R-sq* jumped from 50.28 to 52.06 with $p = 0.011$. The spatial hypothesis of control value therefore was supported at a '*rarely*' level with a negative relationship, and on the overall *mean interaction* for all cases with a positive relationship. Such arguments suggest that as spaces tend to be well-connected, the level of interactions among members of staff increases.

The confirmation of the *connectivity* hypothesis fits with the Peponis result where he found a positive relationship between *connectivity* and encountering density⁵. In his empirical work Peponis tried to find a relationship between the two spatial measures of space (i.e. *integration* and *connectivity*) and the informal interaction in six factories after he calculated the *integration* and *connectivity* values for all systems of spaces. His results

showed that spatial *integration*, with respect to the overall pattern of integration as well as with respect to immediate neighbours, is positively associated with encounter density. Of the limited number of studies on offices, one was undertaken by Stansall (1989) where he tried to describe space-use in terms of their global and local measures of *integration*⁶. Space-use was classified to be characterised by employees working, talking, or moving. It should be noted that Stansall's study did not aim to focus on the impact of spatial properties of layouts on informal interaction. It was only concerned with describing the genotype of layout in terms of the space-use.

In summary, the level of *connectivity* of spaces was found to have a significant relationship with only '*rarely*' and *mean interaction* levels. Furthermore, *Connectivity* was regarded as the third strongest predictor of interaction.

The same route opportunity and informal interaction:

The *same route* variables were significant variables in almost all offices except in Office 4 and Office 5. This was seen in the correlation values between *mean interaction* for the five levels and *same route* index. The correlation values for the six cases were $r = .681, .572, .607, .292, .300,$ and $.660$, in order (Tables 7.1-7.7). Such results support the argument that staff whose workspaces are allocated in the same routes will experience more informal interaction with each other. These results were confirmed by correlation values with the five interaction levels, where the *same route* index showed a strong positive correlation with both *several times a day* and *a few times a day* levels and strong negative relationships with '*rarely*' level in most cases. The overall *mean interaction* for all cases only revealed a comparatively low value ($r = .334$). That was the reason why the *same route* index was not shown in the final regression model of interaction. Another significant reason was because the *same route* index was found to be strongly associated with *visual accessibility* and *proximity* in almost all cases ($r = .419,$ and $-.455$). These

two variables are the strongest predictors of interaction (see Table 7.20) and that is why the regression analysis overrides and eliminates the effect of *same route* index as a significant interaction predictor.

The overriding conclusion is that the *same route* index did not contribute in explaining any variance in the *mean interaction* level. Therefore it was not considered as a significant predictor of interaction.

7.4. The impact of physical accessibility on informal interaction.

In this study physical accessibility refers to both visual accessibility and proximity. Two areas are to be investigated in this section. Firstly, there will be a relationship between the level of visual accessibility and the level of informal interaction. Secondly, there will be a relationship between proximity and the level of informal interaction. Such relationships have been fully explored in the final model of the mean interaction for all cases where both the *visual accessibility* and *proximity* were incorporated in the model, but under this section more light will be focussed on the impact of physical accessibility on different interaction levels.

Visual accessibility and interaction:

The regression analysis revealed that *visual accessibility* is positively significant under *several times a day* in Office 2 and in the overall model of *several times a day* level for all cases (Tables 7.15-7.20). Under *daily* level, *visual accessibility* was positively significant in Office 5, negatively significant in Office 4, and negatively significant in the overall model. Under '*rarely*' level, *visual accessibility* was negatively significant in Office 1 only. Under the *mean interaction*, *visual accessibility* was positively significant in Offices 1, 2, and in the overall *mean interaction* for all cases. *Visual accessibility* has no significance at *a few times a day* and '*weekly*' levels.

In all cases where *visual accessibility* was shown to be significant, it is quite obvious that *visual accessibility* does support interaction. The only contradictory results appeared at *daily* level, where Office 4 exhibited a negative relationship while Office 5 exhibited a positive relationship and in the overall model for the same level, *visual accessibility* was found to have a negative relationship. One interpretation is that it could be due to the preponderance of *daily* interaction in Office 5 since *daily* interaction was the highest compared to the other four levels, though most of the staff occupy the pooled office area and they experience a high level of visual accessibility (the third office in the highest visual accessibility value, see Table 6.4).

Visual accessibility was supported at the overall *several times a day* level with a positive relationship, as it appears to be the most significant predictor with $R\text{-sq} = 52.92$ and $p = 0$. At the *a few times a day* level, the overall model does not adopt the *visual accessibility* where $p = 0.430$. At *daily* level, the overall model shows *visual accessibility* in a positive relationship with $p = 0.008$, and it appeared in the sixth level of the model with $R\text{-sq}$ increased from 51.85 to 53.48. *Visual accessibility* did not appear in 'weekly' and 'rarely' levels since $p\text{-values}$ were 0.804 and 0.474, respectively. The overall model for the *mean interaction* for all the six cases has shown *visual accessibility* in a positive relationship and it comes in the first step of the model with $p\text{-value} = 0.005$ and $R\text{-sq} = 39.47$. Therefore, the association between the visual accessibility and the level of informal interaction is strongly supported in the study.

It should be noted that although enclosure has scored three significant relationships (with *several times a day* in case of Office 1, with *daily* in Office 6, and with *mean interaction* in all cases, $r = -.499, .484, \text{ and } -.319$ respectively), it does not appear as a significant predictor in the *mean interaction* model for all cases because

enclosure was found in three offices (Office 1, Office 4, Office 5) to be highly correlated with *visual accessibility* ($r = -.589, -.520, \text{ and } -.881$). In this case, the effect of *visual accessibility* overrode the effect of enclosure. Office 2 and Office 6 have developed low correlation values between enclosure and *visual accessibility* because some of the interior walls and partitions are made of glass. Thus, the significance of enclosure as an influence on interaction is always perceived in its visual accessibility capabilities. The study could also conclude that what is vital to interaction is visual accessibility rather than enclosure. This argument is supported where four offices develop a negative relationship between *mean interaction* and enclosure, except Office 6 where a positive relationship was established. This was mainly because the enclosure in Office 6 allows visual accessibility (glass walls and partitions), whereas in the other four offices it does not.

In brief, *visual accessibility* was found to have a strong significant relationship with *mean interaction*. Moreover, it was shown to be the strongest predictor of interaction.

Proximity and informal interaction:

The second working task, is that physical *proximity* would be correlated to the level of interaction. *Proximity* was found to be significant in the following cases. Firstly, at the *several times a day* level, *proximity* was negatively significant in Office 5 and positively significant in Office 6. Secondly, at the *a few times a day* level, it was negatively significant in all cases. Thirdly, at *daily* level, it was positively significant in Offices 3,4,5, and in the overall model. Fourthly, at a *'weekly'* level, it was positively significant in Offices 1,3, and in the overall model. Fifthly, at *'rarely'* level, it was positively significant in Offices 3, 5, and in the overall model. Sixthly, on the mean interaction, it was negatively significant in Office 1,5, and in the overall model.

If we examine the previous six cases where *proximity* is shown to be significant, such a relationship between proximity and interaction could be easily established. On the overall model for all cases, only *several times a day* level has not shown any significance with proximity, whereas all the other four levels, in addition to the *mean interaction*, show proximity as a significant predictor with a negative relationship at *a few times a day*, *daily*, and the *mean interaction*, and a positive relationship at *'weekly'* and *'rarely'* levels. Therefore, the correlation between physical proximity and interaction was not supported on *several times a day* level. But it was supported on *a few times a day* with $p = 0$ and $R\text{-sq}=9.23$; on *'daily'* with $p = 0$ and $R\text{-sq}= 14.30$; on *'weekly'* with $p=0.398$ and $R\text{-sq}=8.16$; on *'rarely'* with $p = 0$ and $R\text{-sq}= 41.53$; and finally at the *mean interaction* with $p = 0$ and $R\text{-sq}$ showing an increase from 39.47 to 50.2. At *a few times a day*, *'daily'*, *'weekly'*, and *'rarely'* levels for the overall cases, *proximity* was shown to be the most significant predictor as it comes in the first step of the models. In the case of the *mean interaction* for all cases, *proximity* comes just after *visual accessibility* with a negative relationship. Such a negative relationship with interaction indicates that as distance separating employees from each other increases, the level of informal interaction decreases. All the results in the previous models go hand in hand with this conclusion, except at *several times a day* level in Office 6 where *proximity* shows a positive relationship. The researcher assumes that this result is caused by a relatively high correlation between *proximity* and other key predictors. In fact, in Office 6 *proximity* was found to be correlated to *task characteristics*, *'leave'*, *global integration*, and *same route* (0.610, 0.467, 0.780, and -0.392, respectively).

Generally speaking, *proximity* was found to be significantly associated with the *mean interaction*. It was also regarded as the second strongest predictor of interaction after *visual accessibility*.

7.5. Mobility and informal interaction.

The argument which claims that staff in motion would experience more informal contact is to be tested in this section. Four measures of mobility were developed (% walking '*walk*', % standing '*stand*', % seated '*seat*', and numbers of times leaving the workspace '*leave*'). The first two measures were dropped since they showed a high correlation with the '*seat*'.

Throughout the developed regression models (Tables 7.15-7.20), '*seat*' was a significant predictor in *several times a day* level in three cases. The strongest was in Office 4 ($p < .05$), which means that the seated feature in this office is influencing the encountering at the *several times a day* level. The second strongest was in Office 2 ($p < .05$), and the third was in Office 6 ($p < .05$). The surprising result is that the '*seat*' predictor was in negative relationships in both Office 4, and Office 6, but it was in a positive relationship in Office 2, which means that as staff remain seated their interaction on *several times a day* increases. Such a result could be interpreted as being due to the openness and better level of visual accessibility of the plan in Office 2, whereas Office 6 and Office 4 maintain the lowest *visual accessibility* opportunity compared to the other four offices. Therefore, when staff remain seated in Office 2, the one with high visual accessibility, the level of encountering on *several times a day* increases. Whereas when staff remain seated in highly enclosed offices, the ones with low visual accessibility, their encountering on *several times a day* decreases. Such a trend highlights the dilemma that connects mobility with openness. In other words, staff could maintain a high level of frequent encountering if they occupy workplaces of high visual accessibility, even if their level of mobility is low. At the same time, staff occupying workplaces of low visual accessibility can only maintain a high level of frequent encountering if their level of mobility is high. The effect of '*seat*' on *several times a day* level was quite strong since it appears as the second strongest predictor that affects the overall *several times a day* level

in all cases in a negative relationship ($p < .05$). On the other hand, 'leave' has only appeared in Office 1 ($p < .1$), and Office 2 ($p < .05$) as a significant predictor in a positive form. This explains that in these two offices the frequency of leaving the workspace is associated with *several times a day* level of interaction.

At the *a few times a day* level, 'seat' was only significant in Office 2 ($p < .05$). No other significant relationships were found in other offices, not even in the overall *a few times a day* level for all cases. 'leave' comes into view as the strongest predictor in Office 4 ($p < .05$) in a positive relationship. But it also arose in Office 2 ($p < .05$) in a negative form. The overall model for *a few times a day* incorporated 'leave' as the third strongest predictor to influence encountering at this level ($p < .05$).

The daily interaction 'daily', adopted 'seat' in Office 3 ($p < .05$) as a third significant predictor and in Office 5 as the most powerful predictor ($p < .05$), both in positive forms. 'seat' was also a powerful predictor in the overall model for *daily* interaction in positive form ($p < .05$). This could explain that staff who spend most of their time seated are mainly experiencing interaction with their colleagues on a daily basis. In contrast, 'leave' has not shown any significance at this level of interaction. The weekly encountering 'weekly' models incorporated 'seat' in Office 6 only ($p < .05$). 'leave' was much stronger where it was shown in Office 3 as the most powerful predictor ($p < .05$), in Office 6 as the weakest predictor ($p < .1$), and in the overall model for all cases in a negative form ($p < .05$).

In the last interaction level 'rarely', two significant cases for 'seat' emerged; in Office 1 in a negative form ($p < .05$), and in Office 6 in a positive form ($p < .05$). 'leave' was the only significant predictor to influence the *rarely* encountering in Office 4 ($p < .1$).

Office 3 has also included 'leave' ($p < .1$), but it was not as strong as in the case of Office 4.

The *mean interaction* models for all five levels did not establish any significance for 'seat' in any office. However, the overall mean interaction for all cases revealed 'seat' as the fourth significant predictor that could affect interaction in general ($p < .05$). The reason why 'seat' failed to appear in the model for any individual office is because of the amount of data. This happens when the data for the six offices are combined and treated simultaneously. This has affected the significance of the test, and a better connection between the two variables was established. Such a result supports the relationship between 'seat' as one aspect of the level of mobility, and informal interaction. On the other hand, 'leave' as a significant predictor was found in Office 1 (test significance was quite low i.e. $p = .155$, but the predictor has contributed to explaining the variation in the mean interaction since $\Delta R-sq = 69.35 - 57.78 = 11.57$), and Office 5 ($p < .05$) in positive relationships. However, 'leave' has not appeared in the overall *mean interaction* for all cases, which means that the only significant relationship between 'leave' and interaction was found in Office 1.

In summary, the level of mobility in terms of percentage of time spent seated 'seat' was found to have a significant relationship with the *mean interaction*. In fact, 'seat' variable was regarded as the fourth strongest predictor of interaction. On the other hand, the frequency of leaving the workspace 'leave' was not found as a significant predictor of interaction.

7.6. Task characteristics and informal interaction.

Task characteristics in this study refers to the degree of performing managerial vs. clerical work. In this respect, three groups of staff were defined; these are managers, administrators, and secretaries. The aim of this section is to investigate the kind of

relationship between task characteristics and frequency of informal interaction. The developed regression models have shown *task characteristics* to be a significant predictor of interaction in several cases (Tables 7.15-7.20). At *several times a day* level, only Office 6 regarded *task characteristics* as a significant positive predictor ($p < .1$). This confirms that the difference in nature of work among staff in this office caused a significant effect on the frequency of *several times a day* encountering. This means that managers' nature of work initiates more encountering on *several times a day* basis than secretaries'. None of the offices have found *task characteristics* to be a significant predictor at the *a few times a day* level. At daily interaction '*daily*', it appeared in Office 3 in a positive form, whereas in Office 5 in a negative relationship ($p < .05$ in both cases). An interpretation of these two different trends in these two offices could be that managers in Office 5 are occupying private offices in the peripheral sides of the office, whereas secretaries are accommodated in the pooled office area in the centre with high occupancy. The case in Office 3 was different where all the three groups of staff are accommodated in conventional rooms with a different level of occupancy (i.e. number of staff sharing the room).

The weekly interaction '*weekly*' in Office 1 has considered *task characteristics* to be the most powerful predictor in influencing interaction at this level ($p < .05$). The overall *weekly* interaction model for all offices has also regarded *task characteristics* as the third strongest predictor ($p < .1$). The last interaction level '*rarely*' revealed two significant cases with regard to *task characteristics*. First, in Office 1 it is the first predictor ($p < .05$) in a positive relationship. This means that managers in Office 1 are experiencing more '*rarely*' encountering than secretaries. Secondly, in the overall '*rarely*' model for the six offices it is in a negative relationship ($p < .05$). This result confirms that in the overall '*rarely*' encountering for all cases, managers experience less '*rarely*' interaction than secretaries. The relationship was not proved at all interaction levels.

However, the *mean interaction* for all five levels found that only Office 5 established a significant relationship with *task characteristics* ($p < .05$). No other significant relationship was found on the *mean interaction* for individual offices, nor on the *mean interaction* model for the six cases. Such a result indicates that the association was only supported in Office 5 in a positive relationship, which means that interaction increases as the task tends to be more managerial. However, the relationship was disproved on the *mean interaction* for all cases.

The overriding conclusion is that *task characteristics* did not contribute in explaining any variance in the *mean interaction*. Such a result indicates that *task characteristics* was not regarded as a significant predictor of interaction in this study.

7.7. The interaction models for each case study.

The aim of this section is to generate a model to describe interaction in every case and at every level. Although the researcher has ensured the compatibility of the six cases i.e. all case studies vary only in the targeted variables, we should not be surprised if the six models for the six cases are not identical i.e. the regression equations for the six cases are not the same. This has to do with various reasons. Firstly, variables in the six cases have not shown the same correlation values among each other. Secondly, although the six offices were selected on the basis that they have almost similar cultures, the data has shown that some of these organisations vary slightly from the others e.g. the organisational culture in allocating spaces to different groups, although in all the six cases the organisational policies were to provide workplaces with a high level of privacy through private offices to the higher group of staff, Office 5 did not show this trend. Another difference was found in the variation in the level of *integration* and *connectivity* values among the same group of staff in the six cases. Thirdly, some cases have more

data than others, which causes some differences in the level of confidence and reliability of the statistical analysis.

The interaction models for *several times a day* level of interaction:

At the *several times a day* level, *visual accessibility* has shown a high significance. It comes in the first step of the model in case of Office 2 with a positive relationship. *Same room* was a significant predictor in Offices 1 and 5 with positive relationship. The degree of mobility represented in '*seat*' and '*leave*' predictors appeared in Offices' 1 and 2 models in a positive relationship with '*leave*', while in Offices 4 and 6 '*seat*' appeared in a negative relationship at *several times a day* level. *Same department* was also a significant predictor in Office 4. The spatial predictors have only shown significance in Offices 5 and 6. The global *integration* appeared in Office 5 model with a positive relationship and *same route* has also appeared in the Office 6 model with a positive relationship as well. *proximity* was only significant in Office 5 in a negative relationship to *several times a day*. Office 5 also exhibited *enclosure* in a positive relationship. *Task characteristics* showed a positive relationship in Office 6. The model for Office 3 under *several times a day* level could not be developed since none of the predictors fall within the reasonable level of *p-value*. The lowest was *connectivity* which had a *p-value* of 0.096, and showed a very low *R-sq* value once forced to enter the model. Generally speaking, the most significant predictors that affect the *several times a day* level of interaction in Offices 1,2,4,5, and 6 are *same room*, *visual accessibility*, '*seat*', *same room*, and *same route* respectively.

The overall model for *several times a day* level exhibited *visual accessibility* as the most significant predictor in the first step with a positive relationship. '*seat*' comes next in the model with a negative relationship, and finally *same room* with a positive

relationship . The *p-values* for each of these predictors were 0.000, 0.019, and 0.007 respectively. *R-sq* showed a dramatic increase each time the next predictor entered the model by 52.95, 55.49, and 57.32 (Table 7.15).

In brief, three variables (*visual accessibility*, '*seat*', and *same room*) are considered to be the main predictors that affect interaction at the *several times a day* level.

The interaction models for *a few times a day* level of interaction:

The second interaction level *a few times a day* was supported by organisational grouping (i.e. *same department*) in Offices 2 and 4 . The degree of leaving the workspace '*leave*' was a significant predictor in Office 4 . The spatial measure of *connectivity* showed two different trends in both Offices. *connectivity* was positively associated with *a few times a day* level in Office 2, whereas in Office 4 it has been exhibited in a negative relationship. The level of *integration* has appeared only in Office 2 with a positive relationship. The *a few times a day* level was the most critical level of interaction where the regression analysis could not develop models for the other four Offices, since they showed no significance when they were treated individually.

The overall model for *a few times a day* level adopted *proximity* with a negative relationship , then *same room* with also a negative relationship , and finally a positive relationship with '*leave*'. P-values were 0.000, 0.003, and 0.005 respectively and the overall *R-sq* increased by 9.23, 20.78, and 26.51 (Table 7.16). Therefore variables which significantly influence *a few times a day* level of interaction are *proximity*, *same room*, and '*leave*'.

The interaction models for *daily* interaction:

In the third interaction level '*daily*', only three models were developed. These are Offices 3, 4, and 5. *Proximity* was highly significant in Office 3. It shows a positive relationship, while in Offices 4, and 5 it shows a negative relationship. *Proximity* was the most significant predictor at this level since the highest increase in *R-sq* value always appeared when it was introduced to the model. The degree of being seated '*seat*' has shown a positive relationship in both Offices 3 and 5. *Enclosure* showed in Offices 3 and 5 in two opposite trends. It appeared in Office 3 with a negative relationship and in Office 5 with a positive relationship. *Task characteristics* was also negative in Office 5 and positive in Office 3. *Visual accessibility* appeared in Office 5 with a positive relationship and in Office 4 with a negative relationship. As far as spatial predictors are concerned, *connectivity* appeared in the models of three offices with a positive relationship. On the other hand, the level of *integration* was only significant in Office 3 with a negative relationship. The *same route* predictor was exhibited in Office 4 in a positive relationship and in Office 3 with a negative relationship. As a summary, the strongest predictors that affect daily level of interaction '*daily*' in Offices 3, 4, and 5 are *same department*, *connectivity*, and '*seat*' respectively.

The overall model of the daily level of interaction '*daily*' consists of seven predictors including *proximity*, *same route*, *same department*, *visual accessibility*, and *enclosure* in a negative relationship; and *same room*, and '*seat*' in a positive relationship (Table 7.17).

The interaction models for *weekly* interaction:

The weekly interaction model '*weekly*' was developed for Offices 1, 2, 3, 4, and 6. *Same department* was significant in Offices 2, 3, 4, and 6 with a negative relationship, except for Office 3 where it was positive. *Proximity* with a positive relationship was

significant in Offices 1 and 3 . Offices 3 and 6 show a negative relationship with *connectivity* and with *'leave'* as well . *'seat'* was only exhibited in Office 6. *Enclosure* appeared in Office 2 with a positive relationship and finally *task characteristics* was positively significant in Office 1 .Office 6 shows a positive significance with the level of *integration*.

The overall model for the weekly interaction consists of only three predictors. These are *proximity* in a positive relationship, *'leave'* in a negative relationship, and *task characteristics* in a positive relationship (Table 7.18).

The interaction models for *rarely* level of interaction:

At the last interaction level *'rarely'* (Table 7.19), Office 1 shows a positive relationship with *task characteristics* and a negative relationship with *'seat'* , global *integration*, *visual accessibility*, and *enclosure* .Such a negative relationship with *'seat'* could be interpreted as being due to a high level of visual accessibility maintained by employees so the more they are seated ,the more they are present and *'rarely'* encountering decreases . The *'rarely'* model in Office 3 has adopted *proximity*, *enclosure*, and *'leave'* in a positive relationship and both the level of *integration* and *same route* in a negative relationship . Office 4 has only shown a negative relationship with *'leave'*. Office 5 exhibited the *integration* and *connectivity*, both in negative relationships, while with *proximity* and *same department* in a positive form. The last model at this level belongs to Office 6, where *same route* ,*enclosure* , and the level of *integration* are negatively significant while *'seat'* is positively significant. However, we saw clearly that the *'rarely'* level is affected by different predictors in different offices. In Office 1 it is affected mostly by *task characteristics*; Office 3 with *proximity* ; Office 4 with *'leave'*; Office 5 with the level of *integration*; Office 6 with *same route*.

In brief, the overall model for the '*rarely*' level adopted *proximity* in a positive relationship, then the level of *integration*, *connectivity*, and *task characteristics*, all in a negative form to '*rarely*' level. It is very clear that *proximity* is the most influencing predictor at a '*rarely*' level since it shows the highest increase in *R-sq* value. Fig. 7.1 shows predictors that affect the five interaction levels for all cases.

7.8. The overall informal interaction model.

Having constructed five different models describing interaction under the five levels *several times a day*, *a few times a day*, '*daily*', '*weekly*', and '*rarely*', the researcher's aim is to develop an overall model that could describe interaction in general. In order to achieve that, it was decided to create a sixth level which describes the *mean interaction* for all the previous five levels. As explained in the previous chapter the mean interaction for each employee is calculated out of the five interaction levels' density. It should be noted that the mean interaction models have been developed only to give guidance to conceive and understand the interaction activity in a more comprehensive manner.

The mean interaction model for Office 1 (Table 7.20) has incorporated *same room* predictor in a positive relationship, as well as '*leave*' and *visual accessibility*. *proximity* and *same route* were in a negative relationship to the mean interaction. Office 2 has only expressed *visual accessibility* in a positive relationship, which means that in this office the visual accessibility is the only significant predictor that affects the mean interaction. Office 3 has a positive relationship with *same route* and a negative relationship with *enclosure*. Office 4 has not got a model since the overall test was not significant. Office 5 shows *connectivity*, '*leave*' and *task characteristics* in a positive relationship, and *integration* and *proximity* in a negative relationship. Office 6 has only shown a positive relationship with *same route*.

	<i>sev/dy</i>	<i>few/dy</i>	<i>daily</i>	<i>weekly</i>	<i>rarely</i>	<i>mean</i>
1st step	<i>vis-acc</i>	<i>prox</i>	<i>prox</i>	<i>prox</i>	<i>prox</i>	<i>vis-acc</i>
2nd step	<i>seat</i>	<i>sm-rm</i>	<i>sm-rt</i>	<i>leave</i>	RRA	<i>prox</i>
3rd step	<i>sm-rm</i>	<i>leave</i>	<i>sm-rm</i>	<i>task-ch</i>	CV	CV
4th step			<i>seat</i>		<i>task-ch</i>	<i>seat</i>
5th step			<i>sm-dp</i>			
6th step			<i>vis-acc</i>			
7th step			<i>enclos</i>			

Fig. 7.1 Significant predictors of interaction levels for the six offices (arranged according to their strength to affect interaction)

The final interaction model that describes the mean interaction in general for all the case studies, is a four-step model which starts with the most significant predictor, which is *visual accessibility* with a positive relationship to the mean interaction, then *proximity* with a negative relationship. The third significant predictor is *connectivity* with a positive relationship and finally a negative relationship with '*seat*'. The overall *p-value* is 0 and *R-sq* increased constantly each time the next predictor was entered in the model by 39.47, 50.28, 52.06, and 53.75. The four predictors adopted in the final model are worth discussion so as to compare with similar studies, as the reviewed studies in the literature go along with the results of this study. As the first two predictors in the model have been the object of much attention from researchers, very few have conducted empirical work on the other two predictors, which are the local measure of spatial layout (i.e. *connectivity*) and the degree of mobility '*seat*'. As mentioned earlier, the work of Peponis is among the limited number found to study the impact of the local and global measures of space on informal social interaction in factories. In contrast, the impact of mobility on interaction was mainly based on the assumption that staff will bump into each other while they are in motion.

The fourth predictor in the model '*seat*' was the issue of concern for both Stone & Luchetti (1985). Their idea is concerned with providing a new concept to today's workplaces as a shift from traditional workplaces characterised by individual workstations, to an 'activity setting' approach where the whole team works as one group in a way that position no longer means place. The authors also wrote:

"Today's office desk is a node in a communication network. Being 'away from one's desk' often means that a person is not at that moment plugged into the network. But once we abandon the position equals place tradition, we need to consider how people can easily stay in the network when they are on the move."⁷

It is clear that one of the main policies mentioned in this article in order to increase office productivity through employees' informal exchange is to abandon the desk-work idea and move toward mobility. This argument is fully supported in this work where the degree of being seated '*seat*' was found to be negatively correlated to informal interaction and comes as the fourth significant predictor. Therefore, the concept of today's office characterised by a fixed position is no longer valid if informal exchange among workers is a key point in the agenda of office productivity.

In summary, four variables were found to have a significant relationship with *mean interaction* for all case studies. These are *visual accessibility*, *proximity*, *connectivity*, and '*seat*'. These variables were also regarded as the strongest predictors of interaction.

7.9. Summary.

This chapter is concerned with testing the spatial hypothesis of interaction at the individual level (level 1). The argument was that the level of global *integration* of spaces has to do with the level of informal interaction. Secondly, the level of control of spaces (i.e. *connectivity*) has to do with the level of interaction. The overriding conclusion for statistical findings for all case studies is that: a) the hypothesis which associates the level of global *integration* of spaces and *mean interaction* is not proven. b) the hypothesis which associates the level of local *connectivity* of spaces and *mean interaction* is proven. The third spatial criteria, which is the same route opportunity for the all case studies was not found to be correlated to *mean interaction*.

Findings showed that *physical accessibility* is highly associated with *mean interaction*. In fact, *visual accessibility* was found to be the strongest predictor of interaction. The second issue under physical accessibility is proximity. Proximity was

also found to be highly correlated to the *mean interaction* where it was regarded as the second strongest predictor of interaction.

The two aspects of mobility (*seat* and *leave*) were tested against the frequency of informal interaction. The results showed that *seat* is significantly associated with the *mean interaction* for all cases. In fact the *mean interaction* model for all cases has recognised *seat* as the fourth strongest predictor of interaction. On the other hand, no significance occurs between *leave* and *mean interaction* for all cases. The relationship between task characteristics and interaction revealed different results. This deals with the impact of the type of job on interaction. The relationship was not significant for all case studies.

The study afterward developed models describing significant predictors of different interaction levels i.e. *several times a day*, *a few times a day*, *'daily'*, *'weekly'*, and *'rarely'*, in addition to the *mean interaction* for all levels. Variables that are significant in each level for every case study were identified. The *mean interaction* was introduced so as to deal with a single level that describes the overall interaction activity.

One should bear in mind that the reason why the six cases have not adopted the same predictors under the same interaction level models is that these predictors vary dramatically in their correlations with each other in every case study. Secondly, the dependents (i.e. the five interaction levels) also vary in their correlation value among each other and therefore would have different correlation values with the predictors. The second reason is caused by employees' variation in conceiving the actual density of interaction and therefore reporting the exact density of interaction in the questionnaire. Thirdly, employees in the six organisations vary dramatically in their density of interaction levels i.e. some offices experience more *several times a day* interaction than

others. Fourthly, the six cases vary in the amount of data generated to undertake the statistical analysis. The researcher, therefore, suggested dealing with the *mean interaction* so as to focus on a single model describing the activity of interaction.

The final model of interaction has adopted four predictors, as these were found to be the most significant predictors that affect interaction. These are, arranged according to their significance and effect on interaction, *visual accessibility*, *proximity*, the *connectivity* value, and one aspect of the mobility level i.e. the degree of being seated '*seat*'.

Notes and References

¹ See appendix, Tables 7.1-7.7.

² The spatial and physical dimensions of different groups will be discussed in more detail in chapter 9.

³ See appendix, Tables 7.8-7.14.

⁴ See appendix, Tables 7.15-7.20.

⁵ Peponis, J., 1983, Typology and Social Functions of Factory space, Ph.D. thesis submitted to Bartlett School of Architecture & Planning, University College, University of London, p.288, 314.

⁶ Stansall, P., 1989, Office Space and Productivity: The layout talks back. Unpublished paper.

⁷ Stone, P.& Luchetti, R. Your Office Is Where You Are. Harvard Business Review , Mar-Apr, 1985, p.108.

CHAPTER 8

TESTING THE SPATIAL HYPOTHESIS OF INTERACTION ON SMALL GROUP AND LARGE GROUP LEVELS

8.1. Overview

The previous chapter focussed on the interpersonal relations for each individual under different physical conditions. This chapter, however, will investigate the impact of the typology of spatial structure on interaction at small group level (level.2) as well as on large group level (level.3). The hypothetical model of the study will be examined at the second level of the analysis ¹. At the level of small group two conditions were defined. These conditions are applied by organisations in order to possess sort of control over groups. These are control through the physical enclosure of space; secondly, control through the organisational hierarchical divisions of staff (i.e. departments). These two conditions will generate two types of small groups, the spatial group and the organisational group. The study suggests that these two conditions will influence the pattern of informal interaction among the staff within and between the context of these conditions. These two groups were adopted in the study as it is hypothesised that these two small groups will always be realised in a boundary. A boundary is defined as the ratio of the density of interaction within the group to the density of interaction across the group. On the other hand, the large group refers to all members of an organisation.

8.2. The small groups: spatial groups and organisational groups.

Two kinds of small groups are adopted in the study. These are the spatial group and organisational group. The spatial group is defined as employees occupying the same room. The room still has the same definition used to develop the *same room* index, as structural walls up to the ceiling. On the other hand, the organisational group is defined as employees under the same hierarchical divisions, in other words, department. The reason for adopting these two types of groups has two dimensions. Firstly, spatial control and organisational control are two measures of controlling social interaction². Secondly, Wilson (1978) concluded that the unity of small groups emerges naturally, while the unity of large groups emerges through official and formal rules and duties³. Since the natural preferences of an individual to form groups is related to the physical properties of the environment, space could develop social groups. On the other hand, the formal hierarchical structure of the organisation through the official rules and formal roles can create another social group.

It should be noted that the spatial group used here is different from the spatial group in Peponis' work conducted on factories⁴. In the case of his work, the spatial group was defined as employees occupying the same convex space. The reason for describing spatial groups in this work as employees occupying the same room rather than the same convex space is because the nature of the office layout characterised by individual workspaces is to assign one employee to each convex space. This is unlike factories, where each group of employees occupies the same convex space.

The study here claims that these two kinds of groups should be incorporated in the study. This argument is based on the hypothesis that both organisational and spatial groups will create an interaction boundary. A boundary is defined as having the density of interaction within the group higher than the density of interaction between groups. The

working hypothesis in this section is that both spatial and organisational groups will be realised in an interaction boundary. Therefore, the definition of both groups is the ratio of the density of interaction within the boundary to the density of interaction across the boundary. Sommer (1969) has described the imaginary boundary among human interaction ⁵. The concept of the interaction boundary was also explored by Peponis (1983). Other studies established a connection between the degree of permeability of group boundary and group size ⁶.

For the sake of the consistency of the analysis, the researcher tried to eliminate the effect of the size of the group by only incorporating groups of almost the same size. The size of a small group was considered to be 3-7 persons. In all the six cases, the researcher worked out the density of interaction of both groups. Tables (8.1/8.2) shows the density of interaction of both kinds of groups for each office at all interaction levels (i.e. '*rarely*', '*weekly*', '*daily*', '*a few times a day*', '*several times a day*', and '*mean interaction*'). The definition of both groups was investigated by the ratio of within groups interaction density to between groups interaction density (W/B). Tables (8.1/8.2) show that the values of the definition of groups (i.e. W/B) on the *mean interaction* level in all case studies are greater than one, which means that the definition of groups is always realised in a boundary. The strength of the boundary is at its highest at *several times a day* level in most case studies, and at its lowest at '*rarely*' level. This result indicates that the definition of the group is more apparent and distinctive at the two ends of interaction scale.

As the ratio of within to between group density on *several times a day* level was found to be greater than one, this means that in all case studies and in all spatial and organisational groups, the density of interaction within the group is higher than the density of interaction between groups. On the other hand, as the ratio of within groups to

Office 1		<i>rarely</i>	<i>weekly</i>	<i>daily</i>	<i>few/dy</i>	<i>sev/dy</i>	<i>hourly</i>	<i>all day</i>	<i>mn-int.</i>
<i>within</i>									
	DP.1	0	0	0	0	1	1	1	5
	DP.2	0	0	0	.0387	.9613	1	1	4.96
	DP.3	0	0	.3333	.6667	0	.6667	1	3.66
	DP.4	0	0	0	0	1	1	1	5
	DP.5	0	0	0	0	1	1	1	5
<i>between</i>									
	DP.1	.1637	.2023	.4717	.1086	.0535	.1622	.6339	2.686
	DP.2	.1629	.1721	.4524	.1547	.0579	.21269	.6651	2.773
	DP.3	.3281	.1728	.4240	.0626	.01233	.075	.4990	2.258
	DP.4	.17855	.1250	.3214	.23215	.14285	.375	.6940	3.035
	DP.5	.0179	.1607	.6786	.1428	0	.1429	.82145	2.946
<i>w/b</i>									
	DP.1	0	0	0	0	18.666	6.165	1.577	1.8615
	DP.2	0	0	0	.25	16.599	4.7016	1.5035	1.789
	DP.3	0	0	.786	10.638	0	8.888	2.0039	1.6236
	DP.4	0	0	0	0	7.0003	2.666	1.435	1.6470
	DP.5	0	0	0	0	-E	7.0004	1.2173	1.6969
Office 2									
<i>within</i>									
	DP.1	0	0	0	0	1	1	1	5
	DP.2	0	0	0	.2222	.6889	.9111	.9999	4.6
	DP.3	.0137	0	.2341	.3349	.41714	.75211	.9862	4.14
<i>between</i>									
	DP.1	.3811	.2411	.2013	.0967	.0797	.1764	.3777	2.236
	DP.2	.4188	.19813	.1934	.11074	.0789	.1897	.3830	2.233
	DP.3	.4724	.2579	.14376	.0918	.0340	.1258	.269	1.963
<i>w/b</i>									
	DP.1	0	0	0	0	12.54	5.6673	2.647	2.236
	DP.2	0	0	0	2.0067	8.724	4.8029	2.6105	2.06
	DP.3	.0291	0	1.628	3.646	12.254	5.974	3.65	2.109
Office.3									
<i>within</i>									
	DP.1	.1098	.1401	.2619	.246	.241	.487	.75	3.369
	DP.2	.134	.1428	.2315	.1678	.323	.491	.722	3.40
	DP.3	.103	.067	.099	.317	.412	.729	.829	3.868
	DP.4	.2333	0	.1	.113	.55	.663	.763	3.75
<i>between</i>									
	DP.1	.550	.2955	.0608	.077	.016	.093	.154	1.713
	DP.2	.5996	.2675	.0607	.054	.017	.072	.133	1.622
	DP.3	.898	.0933	0	0	.0076	.0077	.0077	1.48
	DP.4	.6326	.218	.0508	.0330	.06572	.0987	.149	1.682
<i>w/b</i>									
	DP.1	.1997	.474	4.302	3.186	14.97	5.222	4.861	1.966
	DP.2	.2235	.5339	3.81	3.066	18.68	6.818	5.44	2.098
	DP.3	.1149	.72	-E	-E	53.63	94.89	107.85	2.602
	DP.4	.3688	0	1.968	3.409	8.368	6.710	5.099	2.230

Continued..

Office 4		<i>rarely</i>	<i>weekly</i>	<i>daily</i>	<i>few/dy</i>	<i>sev/dy</i>	<i>hourly</i>	<i>all day</i>	<i>mn-int.</i>
<i>within</i>	DP.1	.348	.1501	.1255	.1672	.208	.376	.5017	2.555
	DP.2	.1815	.0831	.3065	.2097	.2114	.42111	.7276	3.002
<i>between</i>	DP.1	.463	.179	.225	.0534	.0785	.1319	.357	2.112
	DP.2	.503	.195	.188	.056	.066	.1223	.300	1.972
<i>w/b</i>	DP.1	.7515	.8375	.557	3.128	2.661	2.85	1.404	1.209
	DP.2	.360	.424	1.624	3.737	3.190	3.441	2.339	1.522
Office 5									
<i>within</i>	DP.1	0	0	.391	.26666	.341	.608	1	3.95
	DP.2	0	0	.4	.6	0	.6	1	3.6
	DP.3	0	0	0	.35	.65	1	1	4.65
	DP.4	.0625	0	0	.145	.792	.937	.937	4.833
	DP.5	0	0	0	0	1	1	1	5
	DP.6	0	0	0	0	1	1	1	5
<i>between</i>	DP.1	.1999	.0925	.311	.193	.201	.394	.706	3.108
	DP.2	.150	.084	.411	.190	.163	.353	.764	3.13
	DP.3	.231	.1233	.480	.104	.059	.164	.644	2.636
	DP.4	.167	.1117	.380	.184	.156	.340	.720	3.04
	DP.5	.0867	.094	.468	.209	.140	.35	.818	3.22
	DP.6	.0981	.162	.383	.130	.225	.356	.739	3.223
<i>w/b</i>	DP.1	0	0	1.255	1.378	1.698	1.541	1.415	1.270
	DP.2	0	0	.973	3.145	0	1.695	1.307	1.149
	DP.3	0	0	0	3.353	10.87	6.092	1.551	1.763
	DP.4	.372	0	0	.7913	5.066	2.75	1.300	1.584
	DP.5	0	0	0	0	7.137	2.856	1.221	1.551
	DP.6	0	0	0	0	4.4307	2.80	1.352	1.551
Office 6									
<i>within</i>	DP.1	0	0	.1	.5	.4	.9	.1	4.3
	DP.2	0	0	0	.208	.791	1	1	4.79
	DP.3	0	0	0	0	1	1	1	5
	DP.4	0	0	0	1	0	1	1	4
	DP.5	0	0	0	0	1	1	1	5
<i>between</i>	DP.1	.496	.087	.247	.168	0	.1689	.416	2.088
	DP.2	.6906	.2267	.0634	.0192	0	.0192	.082	1.411
	DP.3	.4059	.088	.1088	.229	.167	.397	.506	2.665
	DP.4	.411	.029	.088	.294	.176	.471	.558	2.794
	DP.5	.115	.309	.251	.088	.235	.323	.574	3.018
<i>w/b</i>	DP.1	0	0	.404	2.959	-E	5.326	2.403	2.058
	DP.2	0	0	0	10.835	-E	52.015	12.096	3.393
	DP.3	0	0	0	0	5.965	2.518	1.977	1.876
	DP.4	0	0	0	3.3996	0	2.1249	1.789	1.431
	DP.5	0	0	0	0	4.249	3.0907	1.7402	1.656

Table 8.1 *Within and Between Organisational groups interaction density.*

		<i>Rarely</i>	<i>Weekly</i>	<i>Daily</i>	<i>F:dy</i>	<i>S:dy</i>	<i>Hourly</i>	<i>All day</i>	<i>Mn-int.</i>
Office 2									
within									
	GP.1	0	0	0	0	1	1	1	5
	GP.2	0	0	0	0	1	1	1	5
	GP.3	0	0	0	0	1	1	1	5
	GP.4	0	0	0	0	1	1	1	5
	GP.5	.0387	0	.110	.297	.553	.851	.961	4.32
	GP.6	0	0	.5666	.4333	0	.4333	1	3.43
between									
	GP.1	.313	.298	.210	.094	.083	.177	.388	2.71
	GP.2	.186	.138	.218	.164	.292	.456	.674	3.41
	GP.3	.326	.106	.126	.149	.290	.439	.566	3.265
	GP.4	.059	.136	.291	.378	.133	.511	.803	3.44
	GP.5	.272	.084	.156	.267	.219	.487	.644	3.317
	GP.6	.1710	.094	.314	.247	.175	.423	.737	3.114
w/b									
	GP.1	0	0	0	0	12.004	5.624	2.572	1.838
	GP.2	0	0	0	0	3.421	2.19	1.48	1.46
	GP.3	0	0	0	0	3.442	2.275	1.766	1.531
	GP.4	0	0	0	0	7.465	1.953	1.244	1.453
	GP.5	.142	0	.703	1.111	2.519	1.745	1.492	1.303
	GP.6	0	0	1.801	1.748	0	1.024	1.355	1.102
Office 4									
within									
	GP.1	0	0	0	0	1	1	1	5
	GP.2	.226	0	.321	0	.452	.452	.773	3.452
	GP.3	.2405	.071	.276	.359	.052	.411	.688	2.911
	GP.4	0	0	0	0	1	1	1	5
between									
	GP.1	.291	.202	.259	.1888	.058	.247	.506	2.906
	GP.2	.290	.2268	.1976	.174	.111	.285	.483	2.849
	GP.3	.396	.131	.3013	.094	.075	.170	.471	1.82
	GP.4	.295	.276	.309	.1175	0	.1175	.427	2.04
w/b									
	GP.1	0	0	0	0	17.08	4.04	1.97	1.72
	GP.2	.779	0	1.626	0	4.07	1.58	1.60	1.211
	GP.3	.606	.542	.916	3.79	.694	2.420	1.459	1.595
	GP.4	0	0	0	0	-E	8.510	2.340	2.449
Office 5									
within									
	GP.1	.0705	.028	.356	.201	.343	.545	.901	3.71
	GP.2	0	0	.296	.319	.384	.703	1	4.08
between									
	GP.1	.238	.115	.354	.133	.204	.338	.692	2.151
	GP.2	.184	.119	.343	.153	.198	.351	.695	2.15
w/b									
	GP.1	.295	.243	1.006	1.506	1.681	1.612	1.301	1.728
	GP.2	0	0	.863	2.083	1.939	2.002	1.439	1.899

Table 8.2 *Within and Between Spatial groups interaction density.*

between groups at the *rarely* level was found in all groups to be less than one, it means that in all groups the density of *rarely* interaction within groups is less than the density of '*rarely*' interaction between groups. Therefore, the hypothesis which describes the spatial and organisational groups in a form of an interaction boundary is supported. However, individuals within the same spatial groups were found to be associated with the level of interaction where the *same room* index was found to have an overall correlation of $r = .439$ with the overall *mean interaction* level. On the other hand, individuals within the same organisational groups were only found to be associated with some levels of interaction in some cases, but there was no significant association on the overall interaction level for all case studies ($r = .029$). It should be noted that these two indices for both organisational and spatial groups (i.e. *same room* and *same department*) were introduced in the regression analysis in Chapter 7 to develop interaction models at the individual level. This chapter tests the spatial hypothesis of interaction within the context of these two boundaries at group level.

In summary, the hypothesis which claims that both the spatial and organisational groups will be realised in a form of an interaction boundary is supported.

8.3. The relationship between the small group interaction and the syntactic position in organisational groups.

The importance of this section lies in the possibility of the syntactical position of layouts supporting staff under the same organisational division to interact with each other as well as with other departments. It was found in Chapter 7 that the *connectivity* value was regarded as one of the significant predictors that affect interaction at the individual level. In this section, the study aims to test the impact of the two intelligibility measures of space on interaction within departments as well as between departments. The

researcher expected different trends for the level of global *integration* and local *connectivity* within and between departmental interaction.

A. Within organisational groups

The density of interaction within each department was calculated and in the meantime, the mean values for both the level of global *integration* and the level of local *connectivity* for each organisational group were developed. The correlation between all interaction levels within departments and the two measures of space were worked out. The researcher decided to rely on the overall values for all departments in the six case studies so as to develop reliable results. Table (8.3) shows that only one moderate relationship between the level of *integration* and *a few times a day* level was found ($r = -.498$), which means that as employees within the same department occupy shallower spaces, their interaction on *a few times a day* level increases. On the other hand, *connectivity* was also found to have a moderate relationship with both *a few times a day* level ($r = -.380$) and *several times a day* level ($r = .376$). But overall, no significant correlation was found. Therefore, within the same departments, both the levels of *connectivity* and *integration* were not found to have a significant effect on interaction.

B. Between organisational groups

The second part of this section aims to find out the effect of both *connectivity* and *integration* on interaction between different departments. In each department, the density of interaction with other departments is worked out, then the mean values of both *connectivity* and *integration* is calculated. Table (8.4) shows the correlation between all interaction levels between departments and the two intelligibility measures of *connectivity* and *integration*. The overall correlation values for all departments show only one significant relationship, between *a few times a day* level and the level of *integration*, $r = -.477$. On the other hand, *connectivity* has only two moderate relationships with both

		<i>rarely</i>	<i>weekly</i>	<i>daily</i>	<i>few/dy</i>	<i>sev/dy</i>	<i>hourly</i>	<i>all day</i>	<i>mn-int.</i>
Office 3									
ORG.	RRA	.018	-.389	-.710	.182	.530	.705	.559	.725
	CV	.905	-.719	-.570	-.799	.857	.339	-.162	.386
Office 4									
SP.	RRA	-.850	-.787	-.790	-.787	.913	.852	.896	.893
	CV	-.144	.694	-.290	.694	-.173	.137	-.034	-.019
Overall									
ORG.	RRA	.274	.228	.135	-.498	.187	-.259	-.274	-.095
	CV	-.041	-.093	-.266	-.380	.376	.192	.062	.239
SP.	RRA	-.125	-.218	-.354	-.426	.416	.335	.151	.367
	CV	-.176	.078	-.595	-.338	.477	.516	.134	.461

Table 8.3 Correlation values between interaction levels and the two syntactical measures of space *within* Organisational and Spatial groups.

		Rarely	Weekly	Daily	F/dy	S/dy	Hourly	All day	Mn-int.
Office 1									
ORG	RRA	.014	.219	-.058	-.137	.104	-.034	-.094	-.024
&SP.	CV	-.710	.672	.720	-.067	-.144	-.101	.408	.222
OFF.2									
ORG.	RRA	-.997	-.296	.931	.270	.884	.765	.856	.882
	CV	-.273	.995	.542	.997	.633	.782	.676	.637
SP.	RRA	.055	.743	.005	-.559	-.099	-.539	-.446	-.286
	CV	.375	.240	-.673	-.01	-.081	-.065	-.393	.012
OFF.3									
ORG.	RRA	.814	-.825	-.733	-.895	-.091	-.761	-.765	-.876
	CV	-.050	-.090	.131	-.307	.835	.285	.226	.094
OFF.4									
SP.	RRA	-.757	.925	.183	.208	-.757	-.340	-.489	.143
	CV	.716	-.523	.885	-.668	-.456	-.677	-.174	-.716
OFF.5									
ORG.	RRA	.214	.155	-.425	-.196	.312	.119	-.289	.002
	CV	.460	.303	.637	-.768	-.741	-.910	-.594	-.813
OFF.6									
ORG.	RRA	-.021	.942	.051	-.934	-.067	-.602	-.518	-.335
	CV	-.843	.734	.419	-.275	.752	.285	.445	.615
Overall									
ORG.	RRA	-.135	.342	.282	-.477	-.06	-.301	.014	-.015
	CV	-.277	.358	.368	-.209	-.118	-.182	.137	.084
SP.	RRA	.012	.608	.148	-.290	-.415	-.410	-.208	-.222
	CV	.039	.305	-.239	.010	-.056	-.027	-.131	-.050

Table 8.4 Correlation values between interaction levels and the two syntactical measures of space *between* Organisational and Spatial groups (in case of Office 1 oOrganisational groups and Spatial groups are the same).

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

'weekly' and 'daily' levels with $r = .358$ and $r = .368$, respectively. But generally speaking, no significant relationship was found.

If we compare the trend of the level of *integration*, within and between departments, we find that in the case of both within and between departments, it has a moderate negative relationship with *a few times a day* level. This means that the level of *integration* impact on interaction within and between departments has the same trend. However, *connectivity* has a clearer trend. In the case of within departments, it has a moderate positive relationship with *several times a day*, which means that as spaces within departments become well-connected, the *several times a day* level of interaction increases. In contrast, in the case of between departments, *connectivity* was found to have a moderate positive relationship with both 'weekly' and 'daily' levels, which means that as departments become well-connected to each other, their 'weekly' and 'daily' encountering increases. The researcher realised that the trend of the level of *integration* in the case of organisational groups is inconsistent and no clear relationship could be established with interaction. Such a result suggests that the spatial criteria of spatial structure have no effect on the interaction pattern within formal communication. The researcher expects a clearer trend for the spatial structure with spatial groups rather than organisational groups, which is the area of concern of the next section.

8.4. The relationship between the small group interaction and the syntactic position in spatial groups

Spatial groups are the second type of small groups. The research aim was to investigate the impact of the spatial structure on the pattern of interaction under the boundary of space. This is achieved by testing the hypothetical model which consists of four types of office layout that have different spatial structures within and between the spatial groups. The hypothetical model demonstrates that deep structure both within and

between spatial groups will encourage interaction. Several considerations were taken into account to generate spatial groups. Firstly, the effect of group size was eliminated by incorporating groups ranging from 3 to 7 persons. Secondly, groups maintain the same physical conditions (e.g. enclosure and proximity) so as to eliminate the effect of other physical variables. Thirdly, groups were selected to occupy spaces of different spatial structure (i.e. levels of *integration* and *connectivity*). Fourthly, members of the groups were selected to perform the same task (e.g. administrators). Other variables that were kept constant were with regard to age, sex, and culture. These considerations were intended to be kept constant so as to focus only on the differences in the spatial structure of groups. It should be noted that only Office 1, Office 2, Office 4, and Office 5 were able to generate spatial groups that would comply with the previous considerations.

A. Within spatial groups

In each case study, groups of different staff occupying the same room were adopted. The density of interaction of each group within itself was counted as well as the average *connectivity* and integration values. A correlation analysis was carried out for all interaction levels against *connectivity* and *integration* (Tables 8.3/8.4). As far as the level of *integration* is concerned, four relationships are established. Two relationships are moderate and the other two are significant (Fig. 8.1-8.4) ⁷. Firstly, at '*daily*' level, although all the offices have exhibited the relationship in a negative form, Office 4 showed the strongest relationship. The weakest relationship was found in Office 1 which means that in Office 4, the level of *integration* could highly influence the pattern of '*daily*' interaction within spatial groups, whereas it showed no influence on the '*daily*' encountering in Office 1. The effect of global *integration* on the overall '*daily*' interaction in all case studies is found to have a correlation of $r = -.354$ and $R-sq = .12$, which indicates that the variance in *integration* value could explain up to 12% of the variance in the '*daily*' interaction. Secondly, at *several times a day* level all offices showed a positive

relationship. Office 5 exhibited the strongest correlation and Office1 exhibited the weakest relationship. The overall correlation for all cases showed a positive relationship between the level of *integration* and *several times a day* level of interaction with $r = .416$ and $R-sq = .18$. Thirdly, at the *a few times a day* level of interaction, Office 5 is the only office which exhibited the opposite trend compared to the other offices. The overall relationship was in a negative form with $r = -.426$ and $R-sq = .20$. Fourthly, at the *mean interaction* level all offices except Office1 are shown to be affected with the level of *integration*.

The overall relationship for all cases indicated that the interaction pattern within spatial groups is affected by the notion of depth (i.e. level of *integration*) by $r = .367$ and $R-sq = .09$. Such results indicate that as spatial groups tend to be structured in a deep system of spaces their level of interaction increases. Therefore, the effect of global *integration* (i.e. depth of spatial structure) on interaction within spatial groups was in the same trend as was expected from the hypothetical model.

Three relationships were found with regard to spatial *connectivity* (Fig. 8.5-8.7) ⁸. Firstly, at a '*daily*' level, it showed a clear effect on the deterioration of '*daily*' interaction in Office1. *Connectivity* encouraged '*daily*' interaction only in Office 5. However, the impact of *connectivity* on the '*daily*' interaction for all offices was proved by $r = -.595$ and $R-sq = .36$. Secondly, at *several times a day* level, although *connectivity* did not show the same significance as in '*daily*' interaction, it still affected the *several times a day* interaction with $r = .477$ and $R-sq = .05$. Thirdly, the overall effect of the level of *connectivity* on the *mean interaction* within spatial groups was strongly supported by a positive relationship. This indicates that as members in the spatial groups tend to be well-connected to each other, their interaction is highly increased. *Connectivity* values could explain up to 40% of the variance in the mean interaction.

In summary, the level of *integration* as well as *connectivity* of spaces within spatial groups were found to be significantly associated with the *mean interaction*. It is important to simplify these findings so that they can be used as design guidelines. In this case the notion of the intelligibility of the spatial system should be introduced. A spatial system is defined as to be intelligible to its users if it supports not less than *daily* interaction. By referring to Fig. 8.4 & Fig. 8.7, three design measures could be developed: a) employees will experience *several time per day* level of interaction if their spatial system maintains a global *integration* of not less than 1.7 and a local *connectivity* of not less than 0.7; b) employees will experience a *daily* interaction if their spatial system maintains a global *integration* of not less than 1.2 and a local connectivity of not less than 0.4; c) however, spatial systems below global *integration* of 1.2 and a local *connectivity* of 0.4 are considered to be unintelligible.

B. Between spatial groups

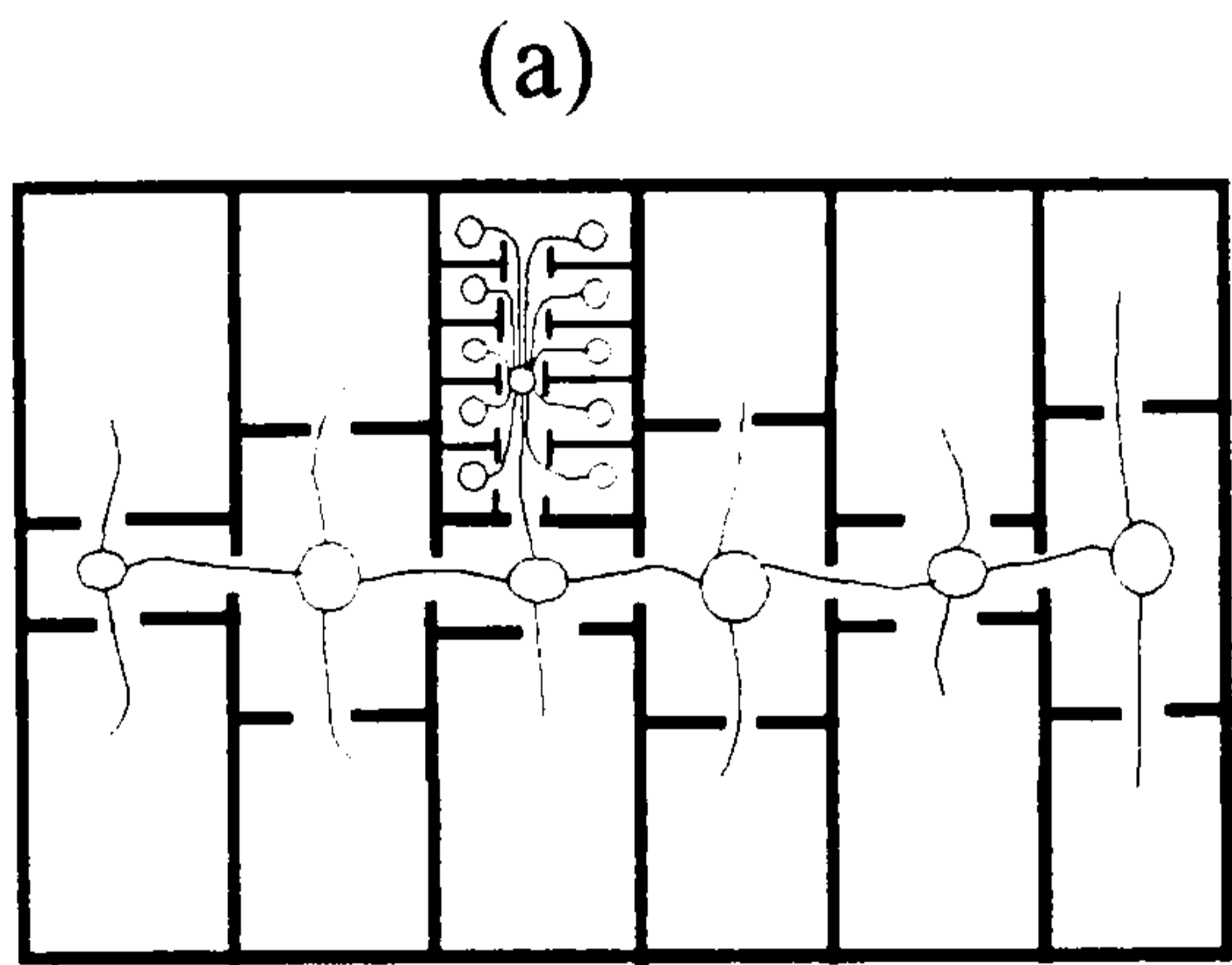
The density of interaction for each spatial group with other spatial groups was counted and the mean *integration* and *connectivity* were worked out as well. This part of the section is concerned with the impact of both measures of spatial structure on interaction between spatial groups (Tables 8.3-8.4). With regard to the level of *integration*, both the '*weekly*' and *several times a day* levels of interaction showed significant relationships (Fig. 8.8/8.9)⁹. At the '*weekly*' level, Office 4 showed the strongest positive relationship, whereas in Office 1 it was the weakest. The overall relationship between the '*weekly*' interaction and the level of *integration* between spatial groups revealed a significant positive correlation of $r = .608$ and $R-sq = .57$, which indicated that deeper spatial groups will maintain higher '*weekly*' interactions between each other. On the other hand, at the *several times a day* level, *integration* showed a strong negative relationship in Office 4, and Office 5. The relationship was quite weak in the case of Office 1 and Office 2. However, the overall impact of the global *integration*

on *several times a day* level between spatial groups was supported in a negative relationship, with $r = -.415$ and $R\text{-sq} = .21$. Such a result contradicts what was expected from the hypothetical model. In the case of *connectivity*, no significant relationship was found at any interaction level between spatial groups.

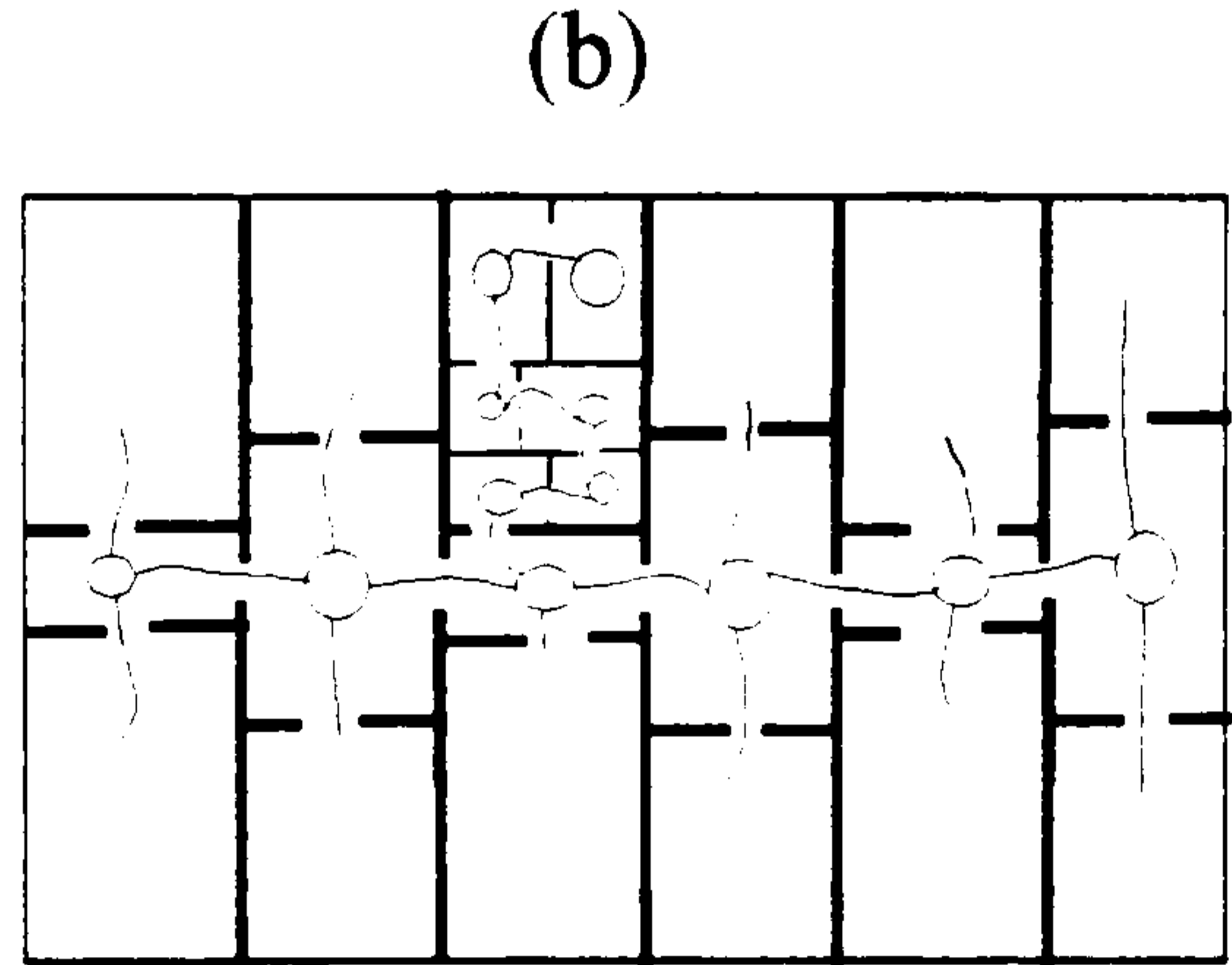
In brief, the intelligibility of spatial systems (i.e. systems that support not less than *daily* interaction) with regard to between spatial groups will be called intelligible as they tend to be more integrated than segregated.

As expected, results obtained from the spatial groups were more consistent than from organisational groups. In the case of within the spatial groups, as spaces become deeper, they encourage interaction at the *several times a day* level, whereas in case of between spatial groups, as spaces tend to be deeper, they discourage interaction at *several times a day*, which is exactly the opposite trend. On the other hand, *connectivity* was only found to have significance within spatial groups. This would enable us to develop guidelines for workplaces that are concerned with the increase of informal interaction in three dimensions. Firstly, organisational groups are to be realised in spatial groups. Secondly, spatial groups should be deep in their own (more segregated than integrated) and shallow with respect to other spatial groups (more integrated than segregated). Thirdly, spatial groups should be well connected within their own group. Therefore the hypothetical model could be modified as in Fig (8.10).

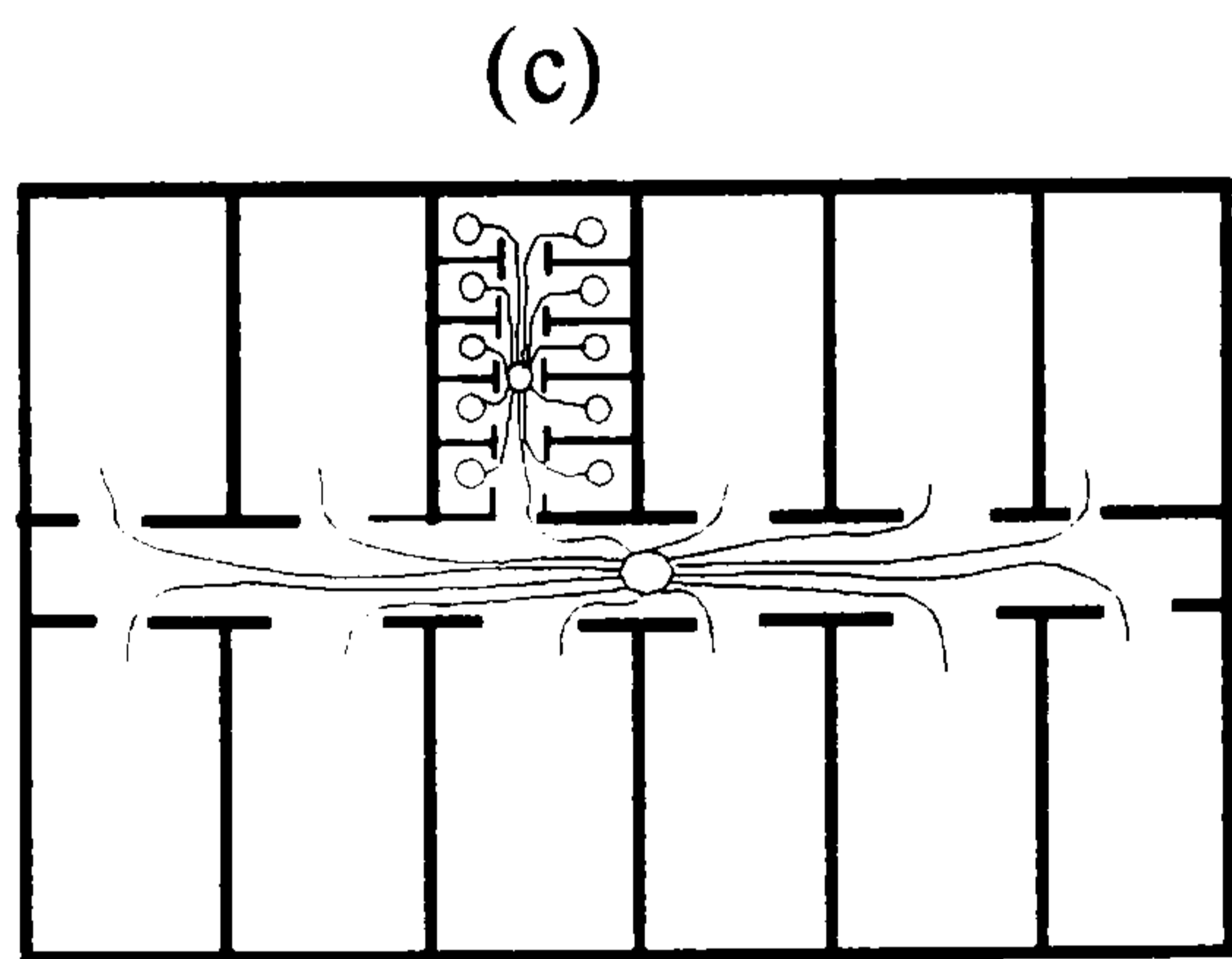
It is worthwhile here to compare these findings with Peponis' results. Peponis found that spatial *integration* in factories, both with respect to the whole complex and with respect to the immediate neighbours, is positively associated with encounter density both overall and external (between) to spatial groups¹⁰. Such a finding contradicts the result in this work where the level of *integration* is found to be negatively associated with



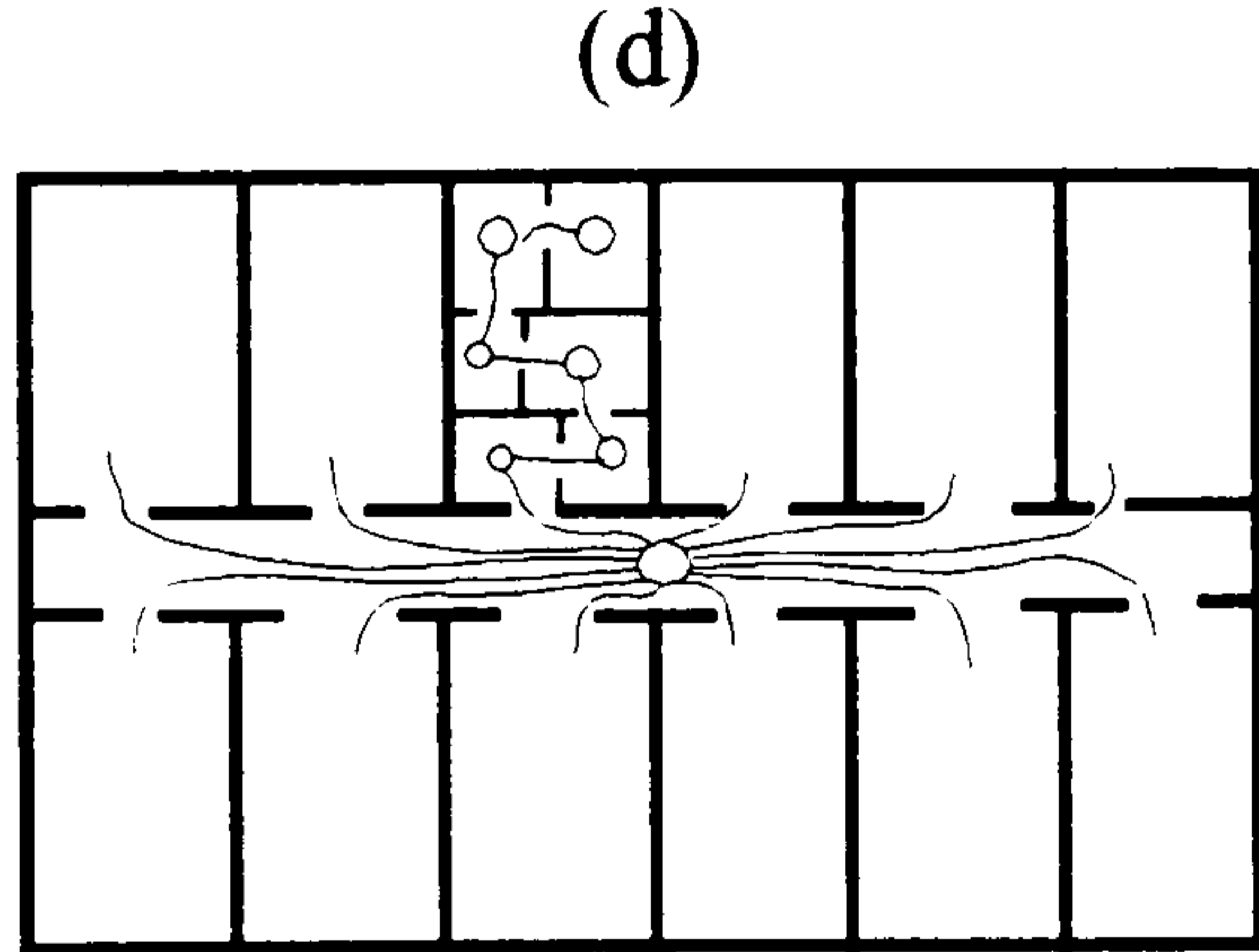
Low interaction within groups
 Low interaction between groups



High interaction within groups
 Low interaction between groups



Low interaction within groups
 High interaction between groups



High interaction within groups
 High interaction between groups

Fig.8.10. Four suggested models -The impact of the global measure of space integration RRA on interaction

the *several times a day* level of interaction in the case of between spatial group interaction. However, such a comparison seems unlikely to be valid since the definitions of the spatial group in both works are not identical.

8.5. The relationship between informal interaction and spatial structure in large group.

This section will focus on testing the spatial structure hypothesis of interaction at large group level (level 3). This is in terms of the impact of both the levels of *connectivity* and *integration* on large group interaction. This is mainly by comparing the spatial layouts of the six offices with each other. The question here is whether the overall pattern of spatial layouts on the scale of the whole office plan affects the level of interaction among the staff in the whole organisation. This is the working theme in this section. The mean values for the overall interaction density for all levels of each office is calculated as well as the mean values for both *connectivity* and *integration*. The issue here is to try to reveal the impact of the two syntactical criteria of space on the level of interaction on the whole plan scale of the six offices.

In order to control other physical and organisational variables, only staff that have similar physical conditions were adopted. This is in terms of the level of enclosure and visual accessibility. Other organisational aspects such as task characteristics were also considered where only administrative staff are involved.

Table (8.5) shows the relationships between the two spatial criteria and all interaction levels. The global measure of space *integration* was found to have substantial relationships of $r = .548$ and $R-sq = .30$ with '*daily*' interaction (Fig. 8.12) ¹¹. Interaction on *a few times a day* level also developed a negative relationship with *integration* ($r = -.588$ and $R-sq = .35$, Fig.8.11) ¹². The *mean interaction* could not develop any significant

	RRA	CV
<i>rarely</i>	-.283	-.813
<i>weekly</i>	.058	-.426
<i>daily</i>	.548	.648
<i>few/dy</i>	-.588	-.303
<i>sev/dy</i>	.040	.827
<i>mn-int</i>	.126	.792

**Table 8.5 Correlation values between interaction levels
and the two syntactical measures of space in large groups**

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

relationship. Therefore, offices that tend to be deeper in the overall system of space are positively associated with '*daily*' interaction and negatively associated with *a few times a day* level of interaction.

On the other hand, *connectivity* was found to have a very strong relationship with almost all interaction levels (Fig. 8.13-8.17) ¹³. At both '*rarely*' and '*weekly*' levels of interaction, *connectivity* exhibited a substantial negative relationship with $r = -.813$ and $-.426$, and $R-sq = .66$ and $.18$, respectively. This indicates that the degree to which the overall system of space is well-connected is negatively associated with the levels of '*rarely*' and '*weekly*' interaction. On the other hand, at both '*daily*' and *several times a day* levels of interaction *connectivity* also revealed substantial relationships. These were found to be in a positive form with $r = .648$ and $.827$, and $R-sq = .42$ and $.68$, respectively. These findings confirm the positive association between level of *connectivity* and both '*daily*' and *several times a day* interaction, which is also in consistent with the previous one with regard to '*rarely*' and '*weekly*' interaction. The *mean interaction* also supported the relationship, with $r = .827$ and $R-sq = .68$.

In brief, the level of *integration* did not show a significant relationship with the *mean interaction* although it showed some significant relationships with other interaction levels. In contrast, the level of *connectivity* was highly associated with the *mean interaction*. The results of this section carry an important message for office designers , as the attention to spatial layout should not only focus on individual workspaces. It was found that layout is equally important to the overall system of the spaces of the whole office plan.

8.6. Summary

This chapter is a continuation of the previous ones. The aim here was to investigate the impact of the spatial structure on the two syntactical measures of space at the level of interaction on the macro scale. The spatial hypothesis of interaction in Chapter 7 was studied at the individual level, but this chapter aims to focus on testing the hypothesis at group level. Two kinds of group were identified. These are the small group and the large group. The small groups were studied in terms of spatial groups and organisational groups. A spatial group was defined as employees occupying the same room, whereas an organisational group was defined as employees in the same department. The first step to test the spatial hypothesis on the two groups was to check the definition of both groups. Both groups were defined as creating an interaction boundary.

In both types of small groups (i.e. the spatial groups and organisational groups) the interaction densities for all interaction levels within and between groups were calculated. The results showed that the impact of spatial structure on interaction is more consistent in spatial groups than organisational groups. The spatial structure in terms of its depth (i.e. *integration*) and control (i.e. *connectivity*) did not reflect any significant impact on interaction within the formal communication channels (i.e. organisational groups). In contrast, the spatial structure has a strong effect on interaction within and between spatial groups.

The results obtained from this chapter could have a significant influence on shaping office layout. If the interaction activity is on the agenda of any organisation, facilities managers should think of the spatial group on its own as well as in conjunction with other spatial groups. The findings of this work could develop design criteria that could be applied with regard to spatial structure to influence the level of interaction

within and between spatial groups. The chapter has developed the notion of the intelligibility of spatial systems. A spatial system is defined to be intelligible to its users if it supports not less than *daily* interaction. In this regard, and as far as within spatial groups is concerned, three design measures are developed: a) if interaction is to be encouraged on *several times per day* level, the spatial system should maintain a global *integration* of not less than 1.7 and a local *connectivity* of not less than 0.7; b) if interaction is to be encouraged on *daily* level of interaction, the spatial system should maintain a global *integration* of not less than 1.2 and a local *connectivity* of not less than 0.4; c) systems below a global *integration* of 1.2 and a local *connectivity* of 0.4 are considered to be unintelligible. On the other hand, and as far as between spatial groups is concerned, as the level of *integration* in the spatial systems approaches 0, interaction on *several times per day* is encouraged.

The last attempt was to test the spatial hypothesis of interaction on large groups (level 3). This referred to the whole office plan. The six case studies were compared with each other in terms of their average interaction density as well as in terms of their type of spatial system. The results showed that *connectivity* is positively associated with all levels of interaction. On the other hand, the level of *integration* has not shown a significant association with the *mean interaction*.

Notes and References

¹ See pp.190-192.

² Hillier, B. & Hanson, J., 1984, *The Social Logic of Space*, Cambridge University Press.

See Peponis, J.,1983, Typology and social functions of factory space, Ph.D. thesis submitted at the Bartlett School of Architecture and Planning , University College, University of London .

See also Wilson, S., 1978, *Informal groups* , Prentice-Hall, Inc., Englewood Cliffs, N.J. p.17.

³ Wilson, S., 1978, op. cit., p.17.

⁴ Peponis, J.,1983, op. cit., p.280.

⁵ See p.53.

⁶ See p.54.

⁷ See appendix, Fig.8.1-8.4.

⁸ See appendix, Fig.8.5-8.7.

⁹ See appendix, Fig.8.8-8.9.

¹⁰ Peponis, J.,1983, op. cit. p.288.

¹¹ See appendix, Fig.8.12.

¹² See appendix, Fig.8.11.

¹³ See appendix, Fig.8.13-8.17.

CHAPTER 9

THE SOCIAL, SPATIAL, PHYSICAL, AND MOBILITY PATTERNS OF STATUS

9.1. Overview

This chapter aims to focus on the differentiation in the physical settings that could be caused by virtue of the nature of task characteristics and status among the staff¹. The point is that different groups i.e. *managers*, *administrators*, and *secretaries* differ in their nature of work and therefore status, which is dictated by organisational hierarchical structure. This is expected to create a different social, spatial, and physical pattern for each group. The aim of this chapter is to argue that as some features of the physical settings of workplaces (i.e. both the spatial and physical criteria) are found to be associated with informal interaction, the variation of these criteria among different groups of staff must be identified in order to reveal the social attributes of each group.

Under the spatial dimension, the syntactical position of each group will be investigated. This is in terms of the two intelligibility criteria, which are the global measure of integration and the local measure of control . It is expected that as groups vary in their work nature and hierarchical position , the syntactical criteria of space will contribute to express such differentiation among different groups. The spatial measures can be used as a tool to analyse and understand the organisational policies and culture in terms of allocating workspaces of different spatial potential to different groups of staff.

The second section deals with the second dimension, which is the physical criterion of the workspace . This is mainly the level of *enclosure*, level of *occupancy* i.e. level of *crowd*, level of *visual accessibility*, and level of *proximity*. Referring to others' work, Sundstrom (1982) has found that privacy is associated with job complexity, and privacy is also associated with both level of *enclosure* and level of *crowd*² . The researcher is investigating the way in which organisations use physical settings as a means to differentiate among different groups. It is expected that staff with different roles will experience variation in their physical settings. In a typical bureaucratic organisation, this

is a deep and rooted aspect of their culture, where the physical settings are used to express how important the employee is. Four working themes are tested under this issue. Firstly, different groups who have different kinds of tasks will vary in their level of *enclosure*. Secondly, there will be a variation between different groups and the level of *crowd*. Thirdly, different groups will vary in their level of *visual accessibility*. Fourthly, different groups will vary in the level of average *proximity* to the rest of staff (i.e. compactness vs. dispersion) .

The third section is focussed on the differentiation in the level of mobility among the three groups of staff. The level of variation will be tested in terms of percentage of the total time spent seated '*seat*' , and the frequency of times each group leaves their workspaces '*leave*' . The importance of recognising the degree of mobility of each group will contribute to managing the level of interaction among different group members.

Lastly, the third section focusses on the social dimensions of different groups. The social dimension is defined as the density of informal interaction each group experiences. It is expected that as staff with different kinds of tasks are allocated to different physical settings, their social pattern will also reflect such differences.

9.2. Status and the spatial differentiation.

Status in this study is defined as employees' positions in the organisational hierarchical structure, which is reflected in the nature of tasks they pursue. Three different groups of staff were adopted in this study . These are *managers* who are in charge of controlling and supervision in addition to the decision-making process. They always represent the higher group in rank. The nature of their job is the highest in complexity and it always necessitates high concentration. *Administrators* come next in rank. These are employees who are normally professionals and undertake detailed work. Their participation in the decision-making process is less than *managers*. The last group is *secretaries*, the lowest in rank. They are always in charge of clerical work, which does not need high concentration, and their work is characterised by being tedious and repetitive, with no power to participate the in the decision-making process.

In this section the study aims to reveal the spatial syntactical differences caused by different groups. The broad question is " Does the differences caused by the nature of work and positions in the hierarchical pyramid of an organisation's structure generate spatial differences between groups of different work and position ?". Three working areas are to be tested . Firstly, as far as the level global *integration* is concerned , there should be a variation in the level of global *integration* among the three groups. Secondly, there should be a variation in the level of local *connectivity* among the three groups. Thirdly, there should be a variation in the level of route allocation opportunity among the three groups.

Differentiation in integration values

The level of global *integration* among the three groups does not show the same trend in every case study. In some offices *managers* got the highest numerical value, which means that they are the most segregated group; while in some cases they got the

lowest value, which means that they are the most integrated group. Such differences, as mentioned earlier, have to do with organisational policy and culture in allocating spaces of different spatial potential to different groups. This is conceived by some organisations as giving *managers* the "back-stage" of the office, and both *administrators* and *secretaries* the "front-stage", or vice versa. It is worth mentioning that although the researcher tried to ensure that in all case studies the organisations had almost the same culture and policies, the six offices did not show the same trend with regard to status vs. syntactical positions. Although the syntactical characteristics of layouts is expected to reflect the social and organisational structure of occupants³, this was not the case in all six offices. The reason could be that the syntactical position of spaces is so critical that it is inconceivable by organisations where physical features such as workplace fixtures (i.e. *enclosure*) are the only visible and conceivable criteria, and differentiation among groups is limited to this level.

Managers in Office 2, Office 3, and Office 6 occupy the most segregated spaces compared to the other two groups, since they have the highest numerical value; while *secretaries* in Office 1, Office 3, and Office 6 occupy the shallowest spaces, and therefore they are the most integrated group (Table 9.2). Only *secretaries* in Office 5 are found to occupy more segregated spaces than the other two groups. *Administrators* are the most segregated group in Office 1, and Office 4, while they are the most integrated in Office 2. It is clear that it is not always the case that *managers* have the highest numerical value, and therefore they are the most segregated group. As mentioned earlier only three offices (Office 2, Office 3, and Office 6) have shown this trend. The *mean* value of the level of *integration* for all cases shows that *managers* are the highest in segregation (1.280), then *administrators* with (1.267) and finally *secretaries* with (1.166). Such figures suggest that *managers* tend to occupy the deepest spaces, and therefore they are the most segregated groups, while *secretaries* tend to occupy the shallowest spaces and therefore

they are the most integrated group. Such a conclusion could hardly be generalised since the *mean* values do not always reveal the real variations among groups. Therefore, the researcher decided to carry out an analysis of variance (ANOVA) for all the case studies.

A "One way" analysis of variance was carried out for every variable against the three groups (Table 9.1). The results showed that not all the six offices express variations in *integration* values among the three groups. Only Office 2 and Office 6 have shown that there is a variation in *integration* values among the three groups. This finding was drawn at a significance level of $p < 0.05$. The other four offices did not show any significance in the level of variations. It is quite remarkable that although Office 1 and Office 2 belong to the same organisation, Office 1 does not show any variation in *integration* values among the groups as in Office 2. In fact the test was far beyond being significant ($p = 0.822$). One interpretation for why they have not shown the same trend could be that Office 2 is an office that runs the organisation on a regional scale, where the depth of span of *status* is much wider than Office 1, which runs the organisation on a local scale. The results obtained from the analysis enables us to describe both Office 2 and Office 6 as typical bureaucratic organisations where the three groups were spatially differentiated; while in the other four offices, organisations do not differentiate between groups spatially, and they intend to eliminate the spatial differences among groups to support their strategic objectives, though they are bureaucratic organisations.

The correlation values (Table 9.3) support the ANOVA test, where only Office 2 and Office 6 were found to have positive relationships between *status* and the level of *integration*. Such results indicate that as staff status increases, the level of segregation increases and therefore staff tend to be more segregated. No other correlation was found to be significant. The overall ANOVA test for all cases did not support the argument of

	RRA				CV				<i>sm-rt</i>			
	SS	MS	F	P	SS	MS	F	P	SS	MS	F	P
office 1	0.0308	0.0154	0.20	0.822	0.99	0.5000	0.38	0.689	0.1205	0.0603	2.37	0.115
office 2	1.1359	0.5680	9.98	0.001	2.344	1.1720	1.54	0.233	0.4064	0.2032	8.03	0.002
office 3	0.0543	0.0272	1.03	0.369	0.111	0.0556	0.86	0.435	0.0133	0.0066	0.54	0.590
office 4	0.6270	0.3140	1.98	0.160	4.72	2.3600	1.80	0.187	0.0798	0.0399	0.50	0.613
office 5	0.0196	0.009	0.12	0.883	1.646	0.8230	2.37	0.111	0.0637	0.0318	1.05	0.364
office 6	0.6397	0.3198	9.56	0.003	0.176	0.0880	0.88	0.441	0.1076	0.0538	3.06	0.084
overall	0.1850	0.093	0.87	0.422	3.107	1.5530	2.25	0.109	0.1146	0.0573	1.08	0.343

Table 9.1 ANOVA for the spatial properties among the three staff groups.

	staff	N	RRA		CV		<i>sm-rt</i>	
			Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
office 1	sec.	2	1.312	0.6511	0.325	0.1770	0.4310	0.0244
	adm.	21	1.4061	0.2601	0.931	1.2300	0.2715	0.1549
	mngr	4	1.3322	0.1690	0.571	0.6220	0.138	0.2088
office2	sec.	3	1.235	0.000	2.200	0.000	0.2143	0.000
	adm.	13	0.925	0.1149	0.733	1.1350	0.6567	0.0825
	mngr	13	1.328	0.3073	0.619	0.5555	0.4490	0.2030
office 3	sec.	3	1.0631	0.000	0.5714	0.000	0.1600	0.000
	adm.	15	1.215	0.1640	0.2687	0.3107	0.2128	0.1071
	mngr	15	1.269	0.1602	0.2307	0.1701	0.1737	0.1156
office 4	sec.	5	1.548	0.4393	1.425	1.9210	0.466	0.3035
	adm.	16	1.559	0.4239	0.516	1.0970	0.4539	0.2136
	mngr	7	1.210	0.2884	0.1854	0.0760	0.580	0.3971
office 5	sec.	3	1.346	0.4448	1.178	1.2479	0.1139	0.1579
	adm.	17	1.273	0.2640	0.375	0.4577	0.2442	0.1772
	mngr	12	1.2568	0.2572	0.487	0.5722	0.1725	0.1731
office 6	sec.	6	0.714	0.1554	0.332	0.3856	0.4741	0.1550
	adm.	6	0.867	0.2354	0.1269	0.1675	0.3461	0.0949
	mngr	3	1.278	0.0423	0.373	0.3986	0.2540	0.1512
overall	sec.	22	1.1660	0.4741	0.893	1.2043	0.3750	0.2329
	adm.	88	1.2665	0.3406	0.5448	0.9193	0.3483	0.2123
	mngr	54	1.2799	0.2368	0.4159	0.4574	0.2997	0.2573

Table 9.2 Means and standard deviations for the spatial properties in the three staff groups.

	RRA	CV	<i>sm-rt</i>
office1	-0.022	-0.002	-0.405
office 2	0.541	-0.214	-0.305
office 3	0.236	-0.167	-0.133
office 4	-0.299	-0.333	0.152
office 5	-0.080	-0.175	-0.034
office 6	0.748	-0.029	-0.578
overall	0.083	-0.154	-0.113

Table 9.3 Correlation values between status and the spatial variables.

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

variations among groups. This is simply because not all the six organisations were found to deal with the spatial allocation of workspaces to different groups in the same way.

In summary, although *managers* were found to occupy deeper spaces (i.e. more segregated than integrated) than the other two groups, no significant variations were found among the three groups in terms of their level of integration.

Differentiation in connectivity values

On the other hand, the level of local *connectivity* among the three groups has a clearer trend. The *mean* values for *connectivity* show that *secretaries* in Office 2, Office 3, Office 4, and Office 5 have the highest control value, which means that they are located in the best connected spaces; while they have the lowest control value in Office 1. *Managers* in Office 2, Office 3, and Office 4 have the lowest control value, which means that they are located in the poorest connected spaces. *Managers* in Office 6, unlike the last three offices (Office 2, Office 3, and Office 4), have the highest control value. *Administrators* in Office 5 and Office 6 have the lowest *connectivity* compared to the other groups, while they have the highest value in Office 1.

Again as happened in the global level of *integration*, offices did not show the same trend with regard to the level of control on a *mean* value basis. As mentioned earlier, four offices (Office 2, Office 3, Office 4, and Office 5) allocated *secretaries* at better connected spaces than the other groups, and at the same time, *managers* in the first three offices (Office 2, Office 3, and Office 4) are poorly connected space-wise compared to the other groups. This means that organisations in these offices have provided *secretaries* with the highest level of control and supervision. It also indicates that given the nature of their work they are always called in conjunction with the other groups. In contrast, *managers* in these offices (Office 2, Office 3, and Office 4) have less

control and supervision and their workspaces tend to be less accessible, less connected, and have less route choices. The reason why Office 1, and Office 6 did not show a similar trend could be due to the variation among organisations in the level of making *managers* accessible to the rest of staff. Another reason could be due to the variation in the work nature of the same group in different offices i.e. *secretaries'* nature of work might be limited, with a small number of co-workers, and *managers* might have a much wider network; or the opposite. However, the *mean* values for control values for the six cases showed that *secretaries* are allocated to the best connected spaces (0.893), then *administrators* (0.5448), and finally *managers*, who are allocated to the poorest connected spaces (0.4159).

Although such variations among groups could be easily seen on the *mean* value analysis, the ANOVA analysis did not find any significant test in all cases at the $p < 0.05$ level. The only remarkable tests were found in Office 5 at the $p = 0.111$ level, and in the overall test for the six cases at $p = 0.109$. If only tests of $p < 0.05$ are adopted, it means none of the tests are significant and therefore the argument that claims variations of *connectivity* values among different groups has not been supported by this study. Such a conclusion was proved by the correlation values (Table 9.3) where none of the six offices showed a significant relationship between status and *connectivity*.

Generally speaking, *secretaries* were found to occupy spaces with higher level of connectivity than the other two groups. *Managers* were also found to occupy spaces with the lowest level of *connectivity*. However, no significant variations were found among the three groups in terms of their level of *connectivity*.

Differentiation in same route opportunity

The third spatial criteria is the route opportunity defined in the *same route* index. Groups are expected to vary in their *same route* values. In both Office 1 and Office 6, the *mean* values indicate that *secretaries* have the highest *same route* values, which means that their workspaces have a better chance of sharing the same route with the other two groups' workspaces; whereas *managers* have the lowest value, which means that their workspaces have less chance of sharing the same route with the other two groups. *Administrators* in Office 2, Office 3, and Office 5 are found to have the highest *same route* value, while *secretaries* in the same offices are found to have the lowest value. In Office 4, unlike others, *managers* have the highest value, while *administrators* have the lowest value. Three offices (Office 2, Office 3, and Office 5) have given *administrators* the highest opportunity to be in the same route with more employees than the other two groups, while *secretaries* in the same offices have been given the lowest opportunity to be in the same route with more employees than the other two groups. Such results could be justified as *administrators* are the group members of the organisation whose kind of work obliges them to be in contact with most of the staff, while *secretaries'* work is characterised by being more independent from the rest of the staff and almost limited to a small number of people. This interpretation could be only true in the previous three offices. But in Office 1, and Office 6 the situation is different, as *secretaries* have the highest opportunity to be in the same route with more employees, while *managers* have the lowest opportunity.

Unexpectedly, no single group shows the same trend in *same route* value over all the six case studies. The *mean* value for *same route* index of the three groups shows that *secretaries* have the highest value compared to the other two groups, which means they have the highest opportunity to share the same route with the rest of the staff.

Administrators come next in rank; and finally, *managers* have the lowest value, which means they have the lowest opportunity for sharing the same route with the rest of staff.

The correlation values showed only one significant value in the case of Office 6 in a negative relationship, which means that in this office as staff tend to be higher in *status* their opportunity to share the same route with the rest of the staff decreases. No other correlation was found to be significant. The ANOVA analysis of the *same route* values shows significance in the case of Office 1 with $P < 0.05$, and in the case of Office 6 with $p < 0.1$. No other significance was found in the other four offices, nor in the overall test for all the six cases. Therefore, the hypothesis which claims variation in the same route opportunity among different groups has only been supported in Office 2 and Office 6.

The overriding conclusion is that although secretaries' workspaces were the highest allocated to the same route with other staff, and managers were the opposite, the significance of the variation among the three groups in terms of their same route allocation was disproved.

9.3. Status and physical differentiation.

As in the previous section, the spatial differences between groups were investigated. The aim here is to focus on the physical differences of workspaces among the different groups. The focal point is four physical variables that contribute to shaping the physical settings of office layout. These are the level of *enclosure*, level of *crowd* i.e. number of people occupying the same room, level of *visual accessibility*, and *proximity*. As mentioned earlier, in Chapter 5, *enclosure* is defined as number of enclosed sides. These could be walls or partitions. Only partitions above eye level are counted. Moreover, all types of physical barriers are counted regardless of their nature of materials (i.e. degree of transparency). The task that will be investigated in connection with

enclosure is "there will be a variation between the level of *enclosure* among the three groups". In all the six cases, *managers* were the highest group in the level of *enclosure* compared to the other two groups. *Secretaries* have the lowest *enclosure* value in Office 1, Office 3, Office 5, and Office 6.

Five offices (Office 1, Office 2, Office 3, Office 4, and Office 6) have shown a direct relationship between *status* and level of *enclosure* i.e. as *status* increases, *enclosure* increases. Table (9.4) shows the correlation between *status* and *enclosure*. All offices have shown a significant positive relationship except Office 5. The correlation values for the six cases are $r = 0.544, 0.654, 0.821, 0.512, 0.358,$ and 0.580 , respectively. The overall correlation between *status* and *enclosure* for all cases was moderately significant ($r = 0.435$). In both Office 2, and Office 4, though *managers* have the highest *mean enclosure* value, *administrators* have the lowest *enclosure* value. This means that management in these two offices have allocated *managers* to highly enclosed spaces and *administrators* to less enclosed spaces. On the other hand, *secretaries* were allocated to more highly enclosed spaces than *administrators*, due to their connection with *managers* work-wise.

Among the six cases, some offices exhibited the differentiation in *enclosure* among the three groups more than others (Table 9.5). Office 3 was the clearest in this respect, where the *mean enclosure* value among *secretaries* is 1.00 , *administrators* have an average of 3.1 , and *managers* have an average of 4.00 . *Managers* in Office 3, and Office 6 have the highest *enclosure* value among all cases, where they occupy a private office. The *mean* value for all the six cases shows that *secretaries* have an average of 2.17 , *administrators* have an average of 2.21 , and *managers* have an average *enclosure* value of 3.48 .

	<i>enclosure</i>	<i>crowd</i>	<i>visual accessibility</i>	<i>proximity</i>
office1	0.544	-0.402	-0.281	0.198
office 2	0.654	-0.621	-0.138	0.474
office 3	0.821	-0.821	-----	-0.008
office 4	0.512	-0.291	-0.222	-0.226
office 5	0.358	-0.040	-0.002	0.003
office 6	0.580	-0.611	-0.243	0.610
overall	0.435	-0.216	-0.104	0.175

Table 9.4 Correlation values between status and the four physical variables.

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

	staff	N	<i>enclosure</i>		<i>crowd</i>		<i>visual accessibility</i>		<i>proximity</i>	
			Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
office 1	sec.	2	1.000	0.000	28.00	0.000	0.2931	0.0244	27.500	7.876
	adm.	21	1.8095	0.8729	21.476	9.993	0.2137	0.1539	30.278	5.074
	mnggr	4	3.000	0.000	11.250	11.206	0.1121	0.2018	32.069	5.478
office2	sec.	3	2.000	0.000	5.000	0.000	0.1429	0.000	23.357	0.000
	adm.	13	1.7692	0.4385	10.385	3.070	0.2274	0.1149	24.752	6.044
	mnggr	13	3.2000	0.944	3.600	2.971	0.1786	0.1152	30.375	4.845
office 3	sec.	3	1.0000	0.000	4.000	0.000	-----	-----	54.84	0.000
	adm.	15	3.0588	0.5557	1.9412	0.5557	-----	-----	51.41	11.38
	mnggr	15	4.000	0.000	1.000	0.000	-----	-----	51.80	10.71
office 4	sec.	5	2.8000	1.0954	5.600	3.578	0.0306	0.0372	31.126	10.741
	adm.	16	2.1875	0.4031	11.375	5.123	0.1144	0.0830	23.093	5.668
	mnggr	7	4.000	0.000	1.857	2.268	0.000	0.000	25.489	6.228
office 5	sec.	3	1.333	0.577	5.330	5.860	0.000	0.000	29.140	3.687
	adm.	17	1.647	1.656	14.24	11.90	0.1667	0.1871	28.373	6.407
	mnggr	12	2.917	1.782	9.25	10.88	0.0914	0.1684	28.747	4.885
office 6	sec.	6	2.6667	1.2111	2.6667	1.2111	0.0833	0.0978	27.154	5.318
	adm.	6	3.8333	0.4082	1.333	0.8165	0.1438	0.0547	28.341	4.397
	mnggr	3	4.000	0.000	1.000	0.000	0.000	0.000	37.68	2.767
overall	sec.	22	1.150	1.150	6.944	8.235	0.0783	0.1040	29.95	9.15
	adm.	88	1.107	1.107	11.678	10.158	0.1441	0.1453	31.70	12.07
	mnggr	54	1.044	1.044	4.304	6.830	0.0754	0.1301	35.55	12.23

Table 9.5 Means and Standard Deviations for the physical variables in the three staff groups.

As five offices (Office 1, Office 2, Office 3, Office 4, and Office 6) were found to have a significant positive relationship between status and *enclosure*, which means the hypothesis that associates status with *enclosure* is supported only in these five offices, the results of the ANOVA analysis support the variation of *enclosure* among these groups. The ANOVA analysis has found that in all cases the tests are significant, except in Office 5. The *P*-value for the six cases were 0.013, 0, 0, 0, 0.107, and 0.047, respectively. The overall test for all cases was also significant with $p = 0$. Such a result supports the argument which claims a variation between level of *enclosure* among the three groups (Table 9.6).

The next physical aspect is the level of *occupancy* or *crowd*. It should be noted that this measure is different from the *same room* index, which was developed in the previous chapters to develop the interaction models, since the last index is only concerned with people included in the study, whereas the level of '*crowd*' concerns all the actual employees occupying the same room. The mean values for the three groups showed that *secretaries* in Office 1, Office 3, and Office 6 have the highest occupancy rate, while *managers* in all offices except in Office 5 have the lowest occupancy rate. *Administrators* in Office 2, Office 4, and Office 5 have the highest rate. The most startling result is that *secretaries* in Office 5 have the lowest rate of *occupancy*. The *mean* value for all cases found that *managers* are the lowest in *occupancy* rate with an average of 4.3 *persons/room*, whereas *administrators* are the highest with an average rate of 11.7 *persons/room*. It is quite surprising that it is not *secretaries* who have the highest *occupancy* rate, but in fact the *administrators*. This indicates that *administrators* as mentioned earlier are the members of organisations whose work calls them to relate to each other, and since they are always the highest group in numbers, they are allocated to workspaces of higher occupancy rate. *Managers*, on the other hand, as found in all cases except in Office 5, have the lowest rate. This reflects how keen organisations are to

	<i>enclosure</i>				<i>crowd</i>				<i>visual accessibility</i>			
		MS	F	P	SS	MS	F	P	SS	MS	F	P
office 1	6.614	3.307	5.21	0.013	474.7	237.3	2.40	0.112	0.0517	0.026	1.04	0.369
office 2	14.534	7.267	12.85	0.000	323.53	161.76	17.77	0.000	0.0198	0.009	0.75	0.482
office 3	13.119	6.560	39.83	0.000	13.119	6.560	39.83	0.000	-----	-----	-----	-----
office 4	16.013	8.006	27.66	0.000	475.2	237.6	12.48	0.000	0.0715	0.0358	8.22	0.002
office 5	13.25	6.63	2.42	0.107	302	151	1.20	0.315	0.0897	0.045	1.49	0.242
office 6	5.433	2.717	3.99	0.047	7.733	3.867	4.35	0.038	0.0419	0.021	4.00	0.047
overall	60.30	30.15	25.35	0.000	1935.3	967.7	12.07	0.000	0.1877	0.094	5.05	0.007

	<i>proximity</i>			
	SS	MS	F	P
office 1	28.2	14.1	0.51	0.609
office 2	239.0	119.5	4.05	0.029
office 3	11.00	6.00	0.05	0.959
office 4	247.0	123.50	2.61	0.095
office 5	2.00	1.00	0.03	0.970
office 6	240.8	120.40	5.70	0.018
overall	764.0	382.0	2.72	0.069

Table 9.6 ANOVA for the physical variables among the three staff groups.

provide *managers* with workspaces of low occupancy rate, due to various reasons such as communication privacy or personalisation of space.

The correlation between *status* and *crowd* reveals that only three offices exhibited a significant negative relationship. These are Office2, Office3, and Office6 with $r = -0.621$, -0.821 , and -0.611 , respectively. None of the other three offices showed a significant relationship. The overall correlation for the six cases was not significant as well ($r = -0.216$). Such results, therefore, indicate that the relationship between *status* and *crowd* was only supported in Office 2, Office 3, and Office 6. The argument was not supported in other offices, nor in the overall cases. However, the variation among the three groups was significant in all cases, except in Office 1, and Office 5. Among these four offices the variation was at its maximum in Office3 and at its minimum in the case of Office6. The overall ANOVA test for all cases shows a significance in variation in level of *crowd* between the three groups with $p=0.000$. Therefore, the argument which claims variation in the level of *crowd* among the three groups is supported.

The third physical variable is the level of *visual accessibility*. The issue here is to investigate to which extent organisations hide or show different groups of staff. As was revealed from the interaction model, the degree of *visual accessibility* among the staff was found to be the most significant predictor in supporting informal interaction. One aspect of the importance of investigating the level of *visual accessibility* of different groups is to recognise the informal interaction opportunity each group possesses, and therefore the role of each group in carrying out individual vs. teamwork. The mean value for *visual accessibility* shows that *managers* in Office 1, Office 4, and Office 6 have the lowest *visual accessibility* value, while it is *secretaries* in Office 2 and Office 5 who have the lowest value. *Administrators* in Office 2, Office 4, Office 5, and Office 6 have the highest *visual accessibility* value, whereas only *secretaries* in Office 1 have the highest

value. Groups in Office 3 could not develop any *visual accessibility* values where all the selected staff in the study were invisible to each other. The previous results indicate that the organisations with Office 1, Office 4, and Office 6 intend to hide *managers* from the rest of the staff, since they got the lowest value among the groups and therefore their role in supervision and interaction is somewhat limited. In contrast *managers* in Office 2 and Office 5 experience a better level of *visual accessibility* than *secretaries* (but less than *administrators*) and therefore their opportunity for participating in the process of supervision, control and interaction activities could be better.

It is quite obvious that none of the five offices have given *managers* the highest level of *visual accessibility*, and this is what differentiates between these types of organisations and the ones which are characterised by strong teamwork and collaboration among co-workers, in which organisations tend to spread horizontally rather than vertically by reducing the depth of span in their hierarchical structure. The latter type of organisations tends to provide all members of staff with a high level of *visual accessibility*, as it is assumed to support teamwork. In general, the *mean* values for all cases shows that *managers* are the lowest in *visual accessibility* value and *administrators* are the highest. Such results are supported by the previous results in the previous section which indicate that *administrators* in these organisations are the key member group because their workspaces are provided with a high level of *occupancy* and *visual accessibility* so as to promote the work flow process among them.

The correlation between *status* and *visual accessibility* has not shown any significance in all cases. This means in this work the relationship between status and *visual accessibility* is not proven. On the other hand, the ANOVA test exhibited some startling results. Office 4 and Office 6 show a significant variation among the three groups, with $p=0.002$ and 0.047 , respectively. The other three offices have not shown

any significance. The overall test was significant with $p=0.007$. Therefore in this study it is proved that there is a variation in the level of *visual accessibility* among the three groups.

The last physical variable is *proximity*. This is of great importance since it has to do with the density of occupation. As found in the regression model of interaction, *proximity* is the second factor that could affect informal interaction. However, a layout that is characterised by a low *proximity* index among workers could show that this is a very dense and compact layout, whereas the ones that have a high *proximity* index indicate that the layout is more disperse and less dense. The main issue here is to see how the three groups vary in that respect and consequently how their role of informal interaction could be affected.

The correlation values between status and *proximity* have only shown one significant correlation ($r = 0.610$). This is in case of Office 6. It is quite remarkable that two offices (Office 3 and Office 4) exhibited the relationship in a negative form, whereas the other four offices exhibited a positive relationship, though they were not significant. This suggests that offices which show a negative relationship tend to bring *managers* in contact with other staff by eliminating the distance separating them from the rest of the staff; in the meantime, the lower group i.e. *secretaries*, tend to be isolated distance wise from the rest of the staff. In contrast, those who show a positive relationship tend to keep *managers* away and *secretaries* in more contact. As mentioned before, Office 6 is the only office that shows a significant correlation in a positive relationship, which indicates that as status increases, distance separating the staff increases. Office 6 therefore intended to keep their *managers* distant, and *secretaries* in more contact. Such a result has a significant implication for bureaucratic organisations that are keen to differentiate among their staff by virtue of physical distance. However, only Office 6 has shown this trend,

which is why this argument which correlates *status* with distance in bureaucratic organisations cannot be generalised.

The *mean* values of the three groups have shown two different patterns . Firstly, in Office 1, Office 2, and Office 6 *managers* are the most separated group distance-wise, whereas *secretaries* are the most consolidated group. Secondly, in Office 3, Office 4, and Office 5 *secretaries* are the most separated group, whereas *administrators* are the most consolidated group. These two patterns illustrate two different trends in organisations. In the first pattern ,organisations are keen to hide *managers* and expose *secretaries* while in the second pattern they are more keen to hide *secretaries* and expose *administrators*. The *mean* value for all cases supports the first pattern, where *managers* are the most separated group and *secretaries* are the most integrated or consolidated group. The ANOVA tests were carried out to investigate the variation in level of *proximity* among the three groups. Results showed three significant tests. These are in the case of Office 2, Office 4, and Office 6 ($p=0.029$, 0.095 , 0.018 , respectively). The overall test was also significant with $p=0.069$. Such a result supports the argument which claims variation in level of *proximity* among different groups.

In summary, the three groups of staff showed more differentiation among each other in the physical features of their workspaces than in their spatial features. *Managers* were found to occupy the highest enclosed and separated (distance wise) spaces, while *secretaries* were the opposite. Managers were also found to have the lowest level of *crowd* and *visual accessibility*, while administrators were the opposite. The three groups of staff showed a clear and significant variation among each other in the four physical features of workplace (i.e. *enclosure*, *crowd*, *visual accessibility*, and *proximity*).

9.4. Status and differentiation in mobility.

In fact, the nature of the task assigned to staff members in the organisation varies in different aspects. As mentioned earlier, the three groups were classified in terms of the nature of tasks they pursue i.e. managerial, administrative, or secretarial. Another aspect that was taken into account while classifying the groups was task complexity, where the higher group i.e. *managers* are assumed to be the higher in task complexity since they are the group most involved in the decision-making process. But groups do not only vary in this respect. One significant dimension is the degree of *mobility*, especially once it comes to the problem of interaction. It was found in the interaction model developed in the previous chapter that the degree of *mobility* represented by the degree of being *seated* is negatively associated with the level of informal interaction. Therefore, studying the pattern of mobility among different groups of staff is important in order to control informal contact among staff. Organisations therefore, should recognise the nature of the staff's tasks in all of its aspects. Degree of mobility is a criterion that most organisations are not aware of. So by recognising the pattern of movement of staff, organisations should be able to manage interaction activities, and that what this section is about.

The concern will focus on firstly, the variation in the total time each group spends seated; and secondly, on the variation in the frequency of number of times each group leaves their workspaces for any purpose. The mean values for the three groups showed that *secretaries* spend the lowest percentage of time spent seated in Office 1, Office 2, Office 3, and Office 5 compared to the other two groups, while *managers* in Office 2, Office 5, and Office 6 spent the highest percentage seated among the groups (Table 9.7). *Administrators* in Office 1 and Office 3 got the highest percentage, while in Office 4 and Office 6 they got the lowest percentage. Only *secretaries* in Office 4 have the highest percentage. The overall mean values for the six cases showed that *secretaries* are the highest in the time spent seated, while *administrators* are the lowest in the time

	<i>seat</i>				<i>leave</i>			
	SS	MS	F	P	SS	MS	F	P
office 1	0.0476	0.0238	1.10	0.348	2.21	1.11	0.76	0.477
office 2	0.0602	0.0301	1.08	0.353	7.26	3.63	3.44	0.047
office 3	0.0986	0.0493	1.32	0.281	2.39	1.20	0.90	0.417
office 4	0.0380	0.0190	1.14	0.336	2.05	1.03	0.91	0.415
office 5	0.0483	0.0241	0.31	0.734	2.24	1.12	0.91	0.413
office 6	0.0088	0.0044	0.09	0.917	10.67	5.33	5.18	0.026
overall	0.0016	0.0008	0.02	0.980	5.70	2.85	2.05	0.132

Table 9.8 ANOVA for the Mobility variables among the three groups.

	staff	N	<i>seat</i>		<i>leave</i>	
			Mean	St.dev.	Mean	St.dev.
office 1	sec.	2	0.5750	0.1061	1.000	0.000
	adm.	21	0.7229	0.1516	2.000	1.265
	mngr	4	0.6625	0.1250	2.250	0.957
office2	sec.	3	0.4000	0.000	5.000	0.000
	adm.	13	0.6192	0.1964	3.154	1.144
	mngr	13	0.6500	0.1363	2.533	0.915
office 3	sec.	3	0.4000	0.000	1.000	0.000
	adm.	15	0.7224	0.1732	2.588	1.326
	mngr	15	0.6967	0.2134	2.467	0.915
office 4	sec.	5	0.8300	0.1396	2.000	0.000
	adm.	16	0.7344	0.1387	2.750	1.125
	mngr	7	0.7833	0.0816	2.833	1.169
office 5	sec.	3	0.4750	0.1768	4.000	1.414
	adm.	17	0.6129	0.2626	2.882	1.166
	mngr	12	0.6450	0.3104	3.000	0.943
office 6	sec.	6	0.7583	0.2577	1.333	0.516
	adm.	6	0.7500	0.2049	2.000	1.265
	mngr	3	0.8250	0.1061	4.000	1.414
overall	sec.	22	0.6824	0.2325	2.000	1.317
	adm.	88	0.6909	0.1915	2.578	1.254
	mngr	54	0.6856	0.1976	2.673	0.985

Table 9.7 Means and Standard Deviations for the Mobility variables in the three staff groups.

spent seated. The variation among the three groups in the time spent seated was not significant at all, which means the groups in these six organisations do not show a significant variation among them in their overall time spent seated (Table 9.8).

The other mobility criteria is the frequency of time each group tends to leave their workspaces and move inside the office building. The mean values indicate that *secretaries* have the lowest frequency in Office 1, Office 3, Office 4, and Office 6, while they have the highest frequency value in the other two offices. *Managers* have the highest values in Office 1, Office 4, and Office 6, while they have the lowest in Office 2. *Administrators* have the highest value in Office 3 and the lowest value in Office 5. The overall mean value showed that *secretaries* have the lowest frequency value, while *managers* have the highest frequency values. The variation among the groups in the frequency of leaving workspaces was only significant in Office 2 and Office 6. The other four offices did not show any significance. The significance of the variation in the two offices was supported by the correlation values, which show a moderate negative relationship in Office 2 ($r = -0.422$), and a significant positive relationship in the case of Office 6 ($r = 0.651$) (Table 9.9). This means that only in these two offices the nature of each group's task initiates a distinctive pattern of movement from each other in opposite directions, while in the other offices there is no significant variation in their task as far as the pattern of leaving the workspace of the group is concerned.

In brief, *secretaries* were found as the highest group in time spent seated, while *administrators* were opposite. As far as the frequency of leaving the workspace is concerned, *secretaries* were the lowest, while *managers* were the opposite. However, no significant variation in the two aspects of mobility level occurred among the three groups.

	<i>seat</i>	<i>leave</i>
office1	0.052	0.209
office 2	0.210	-0.422
office 3	0.068	0.059
office 4	-0.97	0.223
office 5	0.130	-0.110
office 6	0.080	0.651
overall	-0.002	0.132

Table 9.9 Correlation values between status and *mobility* variables.

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

9.5. Status and social differentiation.

Both the syntactical position variables of spatial layouts, and the physical settings variables were investigated for different groups. This section focusses on the social dimension of the three groups. This is mainly in terms of the density of interaction different interaction levels. One aim of this section is to recognise the pattern of the social behaviour of these groups in these organisations. It is expected that groups will show variation in their informal interaction density, since they showed variation in their physical settings of workspaces, and therefore in the opportunity they possess to either support or hamper their informal contact. The critical point here is the claim that such variation in informal interaction is caused by virtue of the variation in the physical environment and not by virtue of the hierarchical structure of status. The argument could be rephrased as "the hierarchical structure of status has caused variation in the physical settings of different groups' workspaces, which in turn has caused variation in the level of informal interaction". The argument was supported by the previous interaction models in Chapter 7, where status (represented by *task characteristics*) was not significant at the $p < 0.05$ level, and only predictors that were associated with the physical settings appeared to be significant ⁴.

These findings should be carefully interpreted since the definition of *status* in this work is only limited to the nature of work undertaken (i.e. secretarial, administrative, or managerial). However, there is no clear evidence for this argument, since most of the work has focussed on formal communication among the staff rather than informal contact. Among these studies is the work of Hatch (1987), who incorporated three aspects of *task characteristics* in his study of the impact of the *physical barriers*, and *task characteristics on interaction activities* ⁵. *Task characteristics* were defined in terms of *position level* in the hierarchical structure i.e. *status*, *task interdependency*, and *level of uncertainty*. His results showed that *position level* was positively associated with time

reported in *meetings*, *building relationships*, and on the *phone*; negatively associated with *working alone*; and not associated at all with *working together* or *interruption*. His work did not distinguish between formal and informal contact in a clear way. However, from his findings if we consider meetings, phone, and working alone as three aspects of formal contact activities, whereas building relationships, working together, and interruption as informal contact activities, then the previous argument which claims that *status* has no significance for informal interaction is supported, apart from the relationship that appeared in his work between *position level* and *building relationships*.

The interaction density in this work will be described under all the previous interaction levels. In order to make the comparison among groups easier, it was decided to reduce the five interaction levels to four levels where both *several times a day* and *a few times a day* levels are combined under '*hourly*' level. Table (9.10) shows the *mean interaction* density for all levels of the three groups. Secretaries in Office 2, Office 3, Office 4, and Office 6 have their maximum interaction at '*rarely*' level, while in Office 1, and Office 5 their maximum encountering is at '*hourly*' and '*daily*', respectively. On the other hand, *secretaries* in all offices except Office 3 have their minimum encountering at '*weekly*' level. It is clear that *secretaries* in Office 1 and Office 5 have better chances for interaction than the other offices. This could be due to allocating their workspaces to less enclosed spaces, with a high level of *visual accessibility*. On the other hand, *secretaries* in Office 4 do not experience as good interaction as in Office 1 and Office 5. This could be because *secretaries* in Office 4 have the highest *enclosure* level among all the six cases (*enclosure* was found to have a high correlation with *visual accessibility* of -0.520 in Office 4 and -0.628 in all cases) ⁶. As both Office 3, and Office 6 are considered more cellular (i.e. individual rooms) than the other offices ⁷, all the three groups had the highest density at '*rarely*' level apart from *administrators* in Office 6. *Administrators* had the highest density at the '*hourly*' level in all offices except in Office

	staff	N	<i>sev/dy</i>		<i>a few/dy</i>		<i>sev/dy + few/dy</i> (hourly)		<i>daily</i>	
			Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
office 1	sec.	2	0.4656	0.0244	0.0172	0.0244	0.4828	0.0488	0.1551	0.0732
	adm.	21	0.3288	0.1841	0.1053	0.1054	0.4341	0.1864	0.3612	0.1836
	mngr	4	0.1470	0.2057	0.1207	0.0598	0.2672	0.1767	0.3448	0.1463
office2	sec.	3	0.2857	0.000	0.000	0.000	0.2857	0.000	0.2143	0.000
	adm.	13	0.3014	0.1650	0.2453	0.1490	0.5467	0.1607	0.1553	0.1424
	mngr	13	0.2872	0.1653	0.1665	0.1006	0.4537	0.1680	0.1955	0.1138
office 3	sec.	3	0.2800	0.000	0.0400	0.000	0.3200	0.000	0.0800	0.000
	adm.	15	0.1553	0.1159	0.1326	0.1293	0.2879	0.1714	0.1065	0.0871
	mngr	15	0.1295	0.0988	0.1303	0.0731	0.2599	0.1498	0.1304	0.0865
office 4	sec.	5	0.1370	0.1279	0.1413	0.0288	0.2783	0.1376	0.1960	0.1684
	adm.	16	0.1441	0.1159	0.1539	0.0558	0.2980	0.1426	0.2674	0.1268
	mngr	7	0.0865	0.0789	0.1037	0.0965	0.1903	0.1475	0.1638	0.1340
office 5	sec.	3	0.1064	0.0364	0.2423	0.1675	0.3490	0.2030	0.3509	0.0565
	adm.	17	0.1902	0.1469	0.1700	0.0883	0.3602	0.1271	0.3524	0.1477
	mngr	12	0.2323	0.0941	0.1831	0.0878	0.4154	0.1269	0.3293	0.1348
office 6	sec.	6	0.1352	0.0721	0.2352	0.1089	0.3704	0.1558	0.1333	0.0754
	adm.	6	0.1998	0.1690	0.1716	0.1938	0.3713	0.2155	0.1690	0.0915
	mngr	3	0.1164	0.0479	0.0185	0.0321	0.1349	0.0550	0.1470	0.1868
overall	sec.	22	0.1840	0.1364	0.1622	0.1227	0.3462	0.1435	0.1910	0.1250
	adm.	88	0.2245	0.1650	0.1560	0.1202	0.3804	0.1821	0.2522	0.1716
	mngr	54	0.1881	0.1422	0.1406	0.0912	0.3287	0.1801	0.2087	0.1403

	staff	N	<i>weekly</i>		<i>rarely</i>		<i>mn-int</i>	
			Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
office 1	sec.	2	0.1034	0.000	0.2586	0.1219	3.328	0.3170
	adm.	21	0.1117	0.1079	0.0931	0.1108	3.465	0.4973
	mngr	4	0.1896	0.0995	0.1983	0.0765	2.828	0.5722
office2	sec.	3	0.2143	0.000	0.2857	0.000	2.786	0.000
	adm.	13	0.0659	0.0603	0.2321	0.1150	3.318	0.4265
	mngr	13	0.1619	0.0732	0.1888	0.1407	3.202	0.5490
office 3	sec.	3	0.2400	0.000	0.3600	0.000	2.640	0.000
	adm.	15	0.1753	0.1155	0.4304	0.1899	2.407	0.5591
	mngr	15	0.2147	0.0871	0.3949	0.1764	2.385	0.5145
office 4	sec.	5	0.0977	0.0966	0.4280	0.2949	2.462	0.7762
	adm.	16	0.1509	0.1038	0.2837	0.1643	2.26	0.5262
	mngr	7	0.1328	0.1169	0.5130	0.2924	2.118	0.7076
office 5	sec.	3	0.0989	0.0828	0.2020	0.1779	2.953	0.6221
	adm.	17	0.1034	0.0878	0.1839	0.1482	3.079	0.4401
	mngr	12	0.1248	0.0615	0.1304	0.1044	3.262	0.3813
office 6	sec.	6	0.0759	0.0447	0.4204	0.1925	2.589	0.5687
	adm.	6	0.1650	0.1142	0.2947	0.1525	2.817	0.6238
	mngr	3	0.2024	0.1403	0.5160	0.2612	2.017	0.3025
overall	sec.	22	0.1057	0.0754	0.3572	0.2111	2.710	0.6063
	adm.	88	0.1260	0.1039	0.2413	0.1844	2.996	0.6241
	mngr	54	0.1694	0.0900	0.2932	0.2204	2.761	0.6929

Table 9.10 Means and Standard Deviations for interaction levels in the three staff groups.

3, whereas they had the lowest density at the '*weekly*' level in all offices except in Office 1 and Office 3. *Managers* showed a dramatic variation in their level of interaction. The highest density reported in Office 2, and Office 5 was on an '*hourly*' basis; in Office 3, Office 4, and Office 6 it was on a '*rarely*' basis; and in Office 1 it was reported on a '*daily*' basis.

The mean values for the three groups in all cases exhibited dramatic results. In all three groups, the '*weekly*' level of interaction is at the lowest level, with *managers* first, then *administrators*, and finally *secretaries* in decreasing order. On the other hand, the highest level in the case of *managers* and *administrators* was reported under '*hourly*' level, while in case of *secretaries* it was on a '*rarely*' level. *Administrators* scored the highest interaction density under both '*hourly*' and '*daily*' levels, and therefore they are the most interactive group. This supports what the previous sections concluded about *administrators*, as they were described to be the key members of organisations. *Secretaries*, in contrast, have the lowest density in both '*hourly*' and '*daily*' levels and the highest in '*rarely*' level. Therefore, they are the less interactive group. *Managers*, however, have achieved an intermediate position. The *mean interaction* for all levels was developed to deal with one interaction level, and therefore make comparison easier. *Administrators* were the highest in the overall interaction level in Office 1, Office 2, and Office 6. *Secretaries* were the highest in Office 3 and Office 4, while *managers* were the highest in Office 5 only. The lowest overall interaction level was achieved by *managers* in Office 1, Office 3, Office 4 and Office 6; and by *secretaries* in Office 2 and Office 5. The *mean interaction* level for all the six cases found that *administrators* are the highest group and *secretaries* are the lowest group in the overall *mean* level of interaction. Therefore, *administrators* are the most interactive group, whereas *secretaries* are the least interactive group.

The broad task that is concerned with the relationship and variation between the interaction density and status will be tested in terms of the correlation values and the ANOVA test. Table (9.11) shows the correlation values of all interaction levels against status. Only Office 6 exhibited two significant correlations. These are on *a few times a day* and on *'weekly'* levels. No other correlation in the other offices was found to be significant even on the *mean interaction* for all levels. The first correlation is between *status* and *a few times a day* level and appeared in a negative relationship, while the second correlation between *status* and *'weekly'* appeared in a positive relationship. All offices showed a negative relationship between *status* and the *mean* interaction for all levels except in Office 5, where the relationship appeared in a positive form. Such a result indicates that in all the offices except Office 5 as status tends to approach the *managers*, the overall level of interaction decreases; and as status tends to approach *secretaries*, the overall interaction level increases. The positive relationship which appeared in the case of Office 5 could have arisen because *managers* in this office have workspaces of better superiority than *secretaries*. This is in terms of factors that were found to affect the level of informal interaction. For instance, *managers* were found to have a higher *visual accessibility*, lower average *proximity*, and higher *connectivity* value than *secretaries*.

The variation among the three groups in their interaction levels shows that Office 2 shows a significance at both *a few times a day* and *'weekly'* levels with $p=0.090$ and 0.002 , respectively (Table 9.12). Other significant variations were found under *'rarely'* in Office 1 and Office 4, with $p=0.051$ and 0.083 respectively. However, in the overall levels for all cases, both *'weekly'* and *'rarely'* were significant with $p=0.011$ and 0.053 . This means that the variation among the interaction of groups is very significant and distinctive on both *'weekly'* and *'rarely'* levels. The overall *mean interaction* level for all cases supports the variations in the level of informal interaction among groups when a significant test was found with $p=0.052$.

	<i>sev/dy</i>	<i>a few/dy</i>	<i>hourly</i>	<i>daily</i>	<i>weekly</i>	<i>rarely</i>	<i>mn-intT</i>
office1	-0.407	0.204	-0.316	0.174	0.238	0.024	-0.314
office 2	-0.034	-0.116	-0.122	0.112	0.394	-0.202	-0.014
office 3	-0.206	0.060	-0.102	0.160	0.136	-0.064	-0.056
office 4	-0.172	-0.218	-0.229	-0.117	0.090	0.168	-0.218
office 5	0.277	-0.092	0.197	-0.072	0.131	-0.197	0.240
office 6	0.008	-0.504	-0.416	0.083	0.493	0.090	-0.275
overall	-0.041	-0.070	-0.079	-0.031	0.227	-0.017	-0.055

Table 9.11 Correlation values between status and interaction levels.

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

	<i>sev/dy</i>				<i>a few/dy</i>				<i>sev/dy + few/dy (hourly)</i>			
	SS	MS	F	P	SS	MS	F	P	SS	MS	F	P
office 1	0.1626	0.0813	2.42	0.110	0.016	0.008	0.82	0.452	0.1041	0.0520	1.58	0.227
office 2	0.0015	0.0007	0.03	0.973	0.083	0.0415	2.64	0.090	0.1033	0.0516	1.90	0.169
office 3	0.0234	0.0117	1.00	0.380	0.0082	0.0041	0.36	0.702	0.0082	0.0041	0.16	0.855
office 4	0.0166	0.0083	0.68	0.515	0.0123	0.0062	1.45	0.254	0.0573	0.0286	1.40	0.265
office 5	0.0391	0.0196	1.26	0.300	0.0134	0.007	0.73	0.493	0.0234	0.0117	0.65	0.529
office 6	0.0188	0.0094	0.65	0.539	0.0941	0.047	2.27	0.146	0.1336	0.0668	2.23	0.150
overall	0.0564	0.0282	1.18	0.310	0.0104	0.0052	0.42	0.659	0.0947	0.0473	1.50	0.226

	<i>daily</i>				<i>weekly</i>				<i>rarely</i>			
	SS	MS	F	P	SS	MS	F	P	SS	MS	F	P
office 1	0.0775	0.0388	1.25	0.304	0.0212	0.0106	0.97	0.393	0.0781	0.0391	3.37	0.051
office 2	0.0126	0.0063	0.39	0.684	0.0733	0.0367	8.04	0.002	0.0187	0.0094	0.56	0.579
office 3	0.0060	0.0030	0.40	0.677	0.0145	0.0072	0.68	0.515	0.0128	0.0064	0.19	0.828
office 4	0.0588	0.0294	1.59	0.224	0.0109	0.0055	0.49	0.620	0.2792	0.1396	2.76	0.083
office 5	0.0037	0.0019	0.10	0.908	0.0035	0.0018	0.28	0.757	0.0231	0.0116	0.62	0.546
office 6	0.0039	0.0019	0.17	0.850	0.0400	0.0197	2.09	0.166	0.1076	0.0538	1.47	0.268
overall	0.0966	0.0483	1.96	0.145	0.0856	0.0430	4.6	0.011	0.2398	0.1199	3.00	0.053

	<i>mn-int</i>			
	SS	MS	F	P
office 1	1.368	0.684	2.72	0.086
office 2	0.307	0.154	0.62	0.544
office 3	0.061	0.031	0.11	0.900
office 4	1.828	0.914	2.39	0.112
office 5	0.330	0.165	0.87	0.431
office 6	1.284	0.642	2.06	0.171
overall	2.509	1.255	3.00	0.052

Table 9.12 ANOVA for interaction levels among the three staff groups.

As was mentioned earlier, the aim of this section is to focus on the social differentiation among groups. The final results which showed that *administrators* are the most interactive group should be carefully interpreted. That is to say that though the researcher tried to ensure the compatibility of all cases (i.e. all cases have the same organisational culture and structure), the three groups did not show the same interaction trend in every case study. One justifiable interpretation could be that the physical settings of workspaces of the same group are not identical in all case studies. In other words, as in Chapter 7 the hypothesis which associates some aspects of the physical settings with informal interaction was supported, the same group of different physical settings potential showed a different level of informal interaction.

In summary, *administrators* were found to be the key group in interaction, where they experienced the highest interaction level, while *secretaries* were the opposite. *Secretaries* achieved their maximum interaction at the 'rarely' level, while in the case of both *managers* and *administrators* it was found at the 'hourly' level. The three groups reported significant variation in their level of interaction.

9.6. Summary

This chapter focussed on the differences in syntactical position of spatial layout, the physical and the social patterns that are caused by virtue of status. As status reflects the nature of work of each group, as well as the degree of its complexity, it is expected that this will initiate variations in syntactical, physical and social patterns of each group. Three groups were adopted in this study. There are *managers*, who represent the highest in rank, and whose job is the highest in complexity compared to the other groups. They are also the major decision-making members in the organisations. *Administrators* are the next in rank. They are the key professional members of the organisations. Their work is more focussed on their area of specialisation. Their role in decision-making is minimal.

The third group is *secretaries*, who are the lowest in rank. Their job is the lowest in complexity and the least in concentration. Throughout the testing of the working hypothesis, two statistical methods were used: a) comparing the mean values of variables with each other; b) applying the analysis of variance test (ANOVA) to test the significance of variation.

At the syntactical level of space, the three groups did not show the same trend in every case study, though some have a clearer trend than others. However, the *mean* values of the level of global *integration* showed that *managers* occupy more segregated spaces than the other two groups, while *secretaries* occupy more integrated spaces than the other two groups. Such a conclusion explains that *managers* tend to be in the *back-stage* of the building, while *secretaries* tend to be in the *front-stage* of the building in these bureaucratic organisations. The hypothesis which claims variation in the global measure of space *integration* among the three groups was supported in only two offices (Office 2, and Office 6). However, the hypothesis was not supported in the overall test for all case studies.

The level of *connectivity* revealed dramatic results. *Secretaries* have the highest *connectivity* value and therefore, they occupy the best connected spaces compared to the other groups. *Managers*, have the lowest *connectivity* values, and therefore occupy the poorest connected spaces compared to the others. This explains how *secretaries* have a better opportunity of spatial accessibility and control compared to *managers*. This finding supports Peponis' results, where he found that the highest group in rank (i.e. *managers*) in factories have the lowest *connectivity*, and therefore they are the poorest connected group, while the lowest group in rank, i.e. shop floor workers, have the highest *connectivity* values, and therefore they are the best connected group⁸. Such results support the argument which describes *secretaries'* spaces as being more accessible, and

they experience better supervision and control than managers. One justification for this trend could be that the well-connected spaces which *secretaries* occupy will be associated with disturbance of privacy and distraction, while the poorest connected spaces will provide *managers* with a better opportunity for privacy in work as well as in communication . This interpretation needs empirical research to test this argument, since most of the work in regard to privacy and distraction is carried out only with regard to *enclosure* and physical barriers. No study, as far as the access to information is concerned, was found to study the impact of the two intelligibility measures of space i.e. *integration* and *connectivity* on the level of privacy, communication, and distraction. The argument which claims variation in the local measure *connectivity* among the three groups has not been supported in this study.

The *same route* index for the three groups also showed that *secretaries* had the highest values, while *managers* had the lowest value. This indicates that *secretaries'* workspaces are the highest in sharing the same route with the rest of the staff, while *managers'* workspaces are the lowest in sharing the same route with the rest of the staff. In this respect *secretaries* will have a better opportunity to walk in routes occupied by more staff than *managers*, and therefore the likelihood of their interaction is the highest. Only two offices (Office 1 and Office 6) showed significant variations with regard to the same route index. The result for the overall case studies disprove the hypothesis, which claims variation of the same route opportunities among different groups of staff.

The physical differences among the groups were focussed on four aspects. These are the level of *enclosure*, level of *crowd*, level of *visual accessibility* ,and level of average *proximity*. At *enclosure* level, the *mean* values revealed that *managers* are the highest in the level of *enclosure*, while *secretaries* have the lowest level. The correlation between *status* and *enclosure* was significant. Such results support Sundstrom (1982)

findings which suggested variation in the perception of privacy among staff of different job complexity⁹. Five offices were found to have significant correlations between *enclosure* and *status* in positive relationships. The argument which is concerned with the variations among the three groups in their level of *enclosure* was supported in five offices, as well as in the overall level for all case studies.

In the case of *crowd* and the level of occupancy, the mean value for all case studies showed that *managers* are the lowest in crowd rate, whereas *administrators* are the highest. Three offices were found to have direct negative relationships between status and *crowd* (Office 2, Office 3, and Office 6). The variation test among groups was supported in four offices as well as in the overall level for all cases, and therefore the argument concerning the variations in the level of *crowd* among the groups is proved. In the case of the level of *visual accessibility*, *administrators* were found to have the highest value, while *managers* have the lowest value. No significant correlation could be established, but the variations among the groups in the level of *visual accessibility* were significant, which means that the variation in the level of *visual accessibility* with regard to different groups is supported. *Managers* were found to have the highest average *proximity* value and therefore, they are the most separated group, while *secretaries* have the lowest value and therefore, they are the most integrated group distance-wise. The variations in the level of *proximity* among the three groups were significant and the argument concerning the variation in the level of *proximity* among the three groups is proved.

The differentiation in mobility was focussed in terms of percentage of total time spent *seated*, and the frequency each group left their workspaces for any reason. The results showed no significant variation in the percentage of the total time spent *seated*. *Secretaries* were the highest in the percentage value, while *administrators* were the

lowest. The frequency of leaving the workspace '*leave*' showed significant variation among groups in two offices only, the others not showing any significance. The *mean* values showed that *managers* are the highest group in number of times they leave their workspaces, while *secretaries* hardly leave their workspaces.

Finally, the social differences among groups was investigated. The aim was to inquire whether the three groups experience the same interaction level or not. It was assumed that the differences in status position will generate a differentiation in social pattern among the three groups. In the previous discussion, all the three groups were found to have the minimum interaction level on a '*weekly*' basis. The maximum interaction level in the case of *secretaries* was found at the '*rarely*' level, while in the case of *administrators* and *managers* it was on an '*hourly*' basis. It should be noted that though *secretaries* have achieved the highest interaction on a '*rarely*' basis, their '*hourly*' interaction is higher than *managers* and lower than *administrators*. Generally speaking, *administrators* were found to be the key group in organisations, where they achieved the highest interaction level on both '*hourly*' and '*daily*' encountering and the lowest at the '*rarely*' level compared to the other two groups. On the other hand, *secretaries* were the lowest group in interaction (the *mean* interaction level for all cases for both *secretaries* and *managers* has shown a slight difference between the density of interaction for these two groups in favour of *managers*), where they achieved the lowest interaction density at the '*daily*' level and the highest at the *rarely* level. The overall *mean interaction* for all cases showed that *administrators* are the highest in density, then *managers*, and *secretaries* come last. The broad hypothesis which claims variation in the level of informal interaction among the groups was proved on the *mean interaction* values for all case studies.

The chapter has revealed the spatial, physical and social dimensions of each group. It appeared clearly that as groups vary in the physical settings capabilities they possess in their workspaces, their opportunity for experiencing better informal contact could be affected. The study also found that *administrators* are the key informal communication individuals in organisations, where they achieve the highest interaction density . *Administrators* were also found to have the highest *visual accessibility* value. That was the main support to promote their informal interaction , since the *visual accessibility* in the developed interaction model in the previous chapter was found to be the most significant variable that could affect the level of informal interaction among staff.

Notes and References

¹ For the definition of task characteristics see glossary.

² Sundstrom, E. "Physical enclosure, type of job, and privacy in the office", *Environment & Behavior* 1982, Vol.14, No.5, Sept.1982, p.549.

³ The impact of the syntactic characteristics of space on social pattern was explored through the three tested levels of the research hypothesis. However, the connection between the syntactical positions and different staff groups in the organisation will be investigated under the significance of the spatial variation among the three adopted staff groups.

⁴ See appendix, Table 7.14.

⁵ Hatch, M., "Physical Barriers, Task characteristics, and Interaction Activity in Research and Development Firms". *Administrative Science Quarterly*, Sept.1987, pp.387-399.

⁶ See appendix, Tables 7.4, and 7.7.

⁷ See p.227,230.

⁸ Peponis, J., 1983, "Typology and Social Functions of Factory Space", Ph.D. thesis submitted to Bartlett School of Architecture & Planning, University College, University of London ,p.253.

⁹ Sundstrom, E., & et al., 1982, op. cit., p.558.

Summary of the Research Findings

This part of thesis will revise and summarise the research findings in each chapter.

Chapter 6:

Aim:

To design the research work, methods, and level of analysis to test the research hypothesis. The chapter also exposed the considerations that were taken into account while selecting the case studies, so as to allow variation in the targeted variables and freeze the unnecessary variables. Offices which were selected to conduct the research were chosen in a way that corresponded to the research needs. The chapter also aimed to focus on the appropriate techniques and methods used to measure the targeted variables. Finally, the numerical values of variables were compared to each other in order to ensure their variations among case studies.

Findings:

1. Six case studies were selected to conduct the research work . These are: Saudi Telecom Headquarters Office (Office 1), Saudi Telecom Western Province Office(Office 2), Samarec Headquarters Office (Office 3), Samarec Corporate Engineering Office (Office 4), Dallah Headquarters Office (Office 5), and Jaffali Headquarters Office (Office 6). All these offices are located in Jeddah apart from the first office which is located in Makkah. They were found to correspond to the research needs.
2. Three sets of variables (the independent variables) are measured in the selected case studies. These are the spatial environment variables, which consist of the level of *integration* of a single space with the whole system, the level of connectivity of each space to its immediate neighbours, and the percentage of workspace allocated in the *same route*. The second set of variables is the physical environment variables. These are the level of *visual accessibility*, level of *enclosure*, *proximity*, and being in the *same room*. The third set of variables is the organisational variables. There are two aspects of

the level of mobility: percentage of remaining seated, '*seat*', and frequency of leaving the workspace, '*leave*'. Other organisational variables are the nature of task among staff i.e. managers, administrators, and secretaries, and being under the same organisational division i.e. department.

3. Informal interaction (the dependent variable) was measured in five levels describing the frequency of informal interaction among staff. These are *several times a day, a few times a day, daily, weekly, and rarely*. Finally the *mean interaction* for the five levels was introduced.

4. Informal interaction was measured in terms of frequency through questionnaire.

5. The spatial properties of layout were measured through the space syntax computer program. The program uses the theory being developed at the Bartlett School of Planning and Architecture. The validity of this tool as a reliable technique that has application in the real world was ensured from previous research.

6. Measures of the physical variables (*visual accessibility, enclosure, proximity, and being in the same room*) were obtained through the inspection of the offices.

7. Measures for the organisational variables were obtained through questionnaire.

8. The spatial hypothesis of interaction was to be tested on three levels, the individual (level 1), the small group (level 2), and the large group (level 3).

9. Office1 was the highest in the frequency of informal contact, whereas Office3 was the lowest.

10. Office 4 was characterised by the deepest spaces among the other offices (highly segregated), while Office 6 had the shallowest spatial structure (highly integrated).

11. Office1 was the strongest in *connectivity* value, while Office 6 was the weakest.

12. The majority of workspaces in Office 2 were reported to be allocated to the same route, while the majority of staff in Office 3 were allocated to different routes.

13. The *enclosure* values in the six offices from highest to lowest were Office 6, Office 3

,Office 4, Office 2, Office 1, and Office 5. While in case of the *visual accessibility* it was Office 1, Office 2, Office 5, Office 6, Office 4, and Office 3. In case of the *physical proximity* (from highest to lowest) it was Office 3, Office 1, Office 6, Office 5, Office 2, and Office 4.

14. Staff in Office 4 and Office 6 have the highest seated percentage, while staff in Office 5 have the lowest.

Chapter : 7

Aim :

To test the impact of the spatial structure on the level of interaction at the individual level (level 1). The second task is to develop the overall model of interaction that describes the significant predictors. At the same time, three relationships were investigated: firstly, the association between the physical variables (*visual accessibility, enclosure, proximity, and same room*) and the frequency of informal interaction; secondly, the relationship between the level of mobility and frequency of informal interaction; thirdly, the relationship between task characteristics and frequency of informal interaction. Pearson correlation, and regression including stepwise regression were used to enumerate the statistical data.

Findings:

1. The global measure of *integration* was only found to be negatively associated with '*rarely*' level of encountering. However, the level of *integration* did show some significant relationship with other interaction levels but not on the *mean interaction*.
2. The local measure of connectivity was found to be negatively associated with the '*rarely*' level of encountering and positively with the *mean interaction*.
3. The level of *visual accessibility* was found to be strongly associated with the *mean interaction*.
4. Proximity is negatively associated with *mean interaction*.

5. The impact of *enclosure* on interaction is always perceived in its *visual accessibility* capabilities.
6. The effect of mobility on interaction is associated with the level of openness of the plan. In other words, staff with high *visual accessibility* can maintain a high level of interaction even if their level of mobility is low, whereas staff in a conventional plan of low *visual accessibility* can maintain a better level of interaction if their level of mobility is high.
7. One aspect of mobility i.e. percentage remaining seated '*seat*' was the fourth strongest predictor of informal interaction. The result supports the argument which associates the level of mobility with informal interaction.
8. The second aspect of mobility i.e. percentage leaving the workspace '*leave*' was only found to be significant at some interaction levels of individual cases. However, no significant relationship was found between '*leave*' and the *mean interaction* for all cases.
9. The relationship between *task characteristics* and interaction was found to establish different results at different interaction levels in different cases. These results demonstrate that organisations perceived the task assigned to the three different groups (*managers, administrators, and secretaries*) differently. Another interpretation is that workspace potential (with regard to the physical environment) of staff of the same group varies among the six offices. The overriding conclusion is that *task characteristics* was only found to be positively significant in the *mean interaction* of Office 5. No other significant relationship was reported at the *mean interaction* level. The association between status and interaction is disproved although Chapter 9 revealed a highly significant variation of interaction among the three groups.

Chapter : 8

Aim:

To test the spatial hypothesis of interaction on small groups (level 2) and on large groups (level 3). The hypothetical model which associates the spatial structure with the level of interaction is examined at the second level of the analysis. The aim was to come up with a description for specific group layouts that would support interaction within and between groups. Two types of small groups were identified under the notion of the boundary. These are the spatial groups and the organisational groups. "Spatial groups" refers to employees under the same spatial boundary (i.e. the room). "Organisational groups" refers to employees under the same organisational divisions (i.e. departments). Both the spatial and organisational groups are hypothesised to be realised in interaction boundaries. The two measures of space intelligibility (*integration* and *connectivity*) were developed for each group in order to test the impact on spatial structure of the pattern of interaction within and between groups.

Findings:

1. The hypothesis which is related to the notion of interaction boundary as defined by the ratio of the density of interaction within the group to the density of interaction between the groups in both spatial and organisational groups was supported.
2. Within organisational groups, the level of *integration* was only found to be significantly associated with *a few times a day* level ($r = -.498$). *Connectivity* was moderately associated with *a few times a day* ($r = -.380$), and with *several times a day* ($r = .376$). But neither the level of *integration* nor the level of *connectivity* were reported to have a significant relationship with the *mean interaction*.
3. Between organisational groups, *integration* scored a significant correlation with *a few times a day* ($r = -.477$). On the other hand, *connectivity* was moderately associated with 'weekly' level ($r = .358$), and with 'daily' level ($r = .368$). However, no significant

relationship was reported between the two measures of space and the *mean interaction* level.

4. Organisational groups did not exhibit a consistent and a clear pattern with both the level of *integration* and *connectivity*.

5. Within spatial groups, *integration* was significantly associated with both *several times a day* level ($r = .416$), with *a few times a day* level ($r = -.426$), and with the *mean interaction* ($r = .367$). *Connectivity* showed a significant relationship with '*daily*' level ($r = -.595$), and positive relationships with *several times a day*, and *mean interaction*.

These results confirm that staff interaction within the same spatial groups will increase when they occupy deep as well as well-connected spaces.

6. The results between spatial groups were consistent with results within spatial groups. The level of *integration* was found to have a significant negative relationship with *several times a day* ($r = -.415$) and a positive relationship with '*weekly*' level ($r = .608$). Such a trend is exactly opposite that within spatial groups, which means that as spatial groups tend to be shallower their level of interaction on *several times a day* will increase and decrease at '*weekly*' level. *Connectivity* did not show any significance.

7. Several design criteria were suggested with respect to spatial systems and level of interaction that will be of a great benefit to designers. The notion of spatial intelligibility was introduced. Spatial systems will be intelligible to their users if they encourage not less than *daily* interaction. In this respect, and as far as within spatial groups is concerned, a) spatial systems that maintain an *integration* of not less than 1.7 and connectivity of not less than 0.7 will be able to encourage interaction at a *several times per day* level. b) spatial systems that maintain an *integration* of not less than 1.2 and connectivity of not less than 0.4 will be able to encourage interaction at a *daily* level. c) Spatial systems below *integration* of 1.2 and *connectivity* of 0.4 are considered to be unintelligible. On the other hand, in the case of between spatial groups as the level of

integration in the spatial system tends to 0, interaction on *several times per day* is encouraged.

8. The results of testing the spatial hypothesis on large groups (level 3) revealed that connectivity is strongly associated with almost all interaction levels. However, global *integration* was reported to be significant at a '*daily*' level in a positive relationship and negatively significant with *a few times a day level*. There was no significant impact for the level of *integration* on the *mean interaction*. The results suggest that well-connected spatial structure is needed to maintain a high level of interaction among large groups.
9. The two measures of spatial intelligibility showed more significance with informal interaction at the group level than at the individual level of analysis.

Chapter : 9

Aim:

The aim was to investigate the social and physical patterns of three groups of staff (*managers, administrators, and secretaries*). The need for this work was initiated from the nature of jobs assigned to each groups. As the nature of the tasks assigned to each group varies in complexity and in the need for concentration or participation, they may require a different level of contact between staff. The differentiation in the need for interaction is reflected in the differentiation in the physical settings among the three groups. Four main relationships were investigated concerned with the social and physical patterns of the three groups. Firstly, the three groups will experience variation in their level of informal interaction. Secondly, group workspaces will vary in their spatial locations. Thirdly, group workspaces will vary in their physical settings. Fourthly, groups will vary in their pattern of mobility.

Findings:

1. *Administrators* were found to be the key group in interaction, where they experienced the highest *mean interaction* level. *Secretaries* were the lowest group in interaction.

Secretaries achieved their maximum interaction at the '*rarely*' level, while in the case of both *managers* and *administrators* it was found at the '*hourly*' level. The '*hourly*' interaction in the case of *secretaries* is higher than it is in the case of *managers*.

2. The three groups reported significant variation in their level of interaction.

3. The comparison of the mean values revealed that the three groups showed different values in their level of global *integration*. *Managers* were allocated to deeper spaces than the other two groups. On the other hand, *secretaries* occupied the shallowest spaces.

However, the significance of variation in *integration* values among the three groups was only proved in Office 2 and Office 6. No significant variations were found in the other offices nor in the overall test of all cases.

4. No significant variation on up to $P < .1$ was found between the three groups in their local measure of *connectivity*. However, the mean values for the three groups revealed that *secretaries* have better connected spaces than *administrators*, and those have better connected spaces than *managers*.

5. Although in the overall mean values *secretaries'* workspaces were the highest allocated to the *same route* with other staff, and *managers* were the opposite, only Office 1 and Office 6 regarded this as a significant variation among the three groups. However, the overall ANOVA test for all offices disproves the significance of variation.

6. A significant relationship was found between the level of enclosure and the three groups ($r = .435$). Such a result supports the hypothesis of status differentiation by virtue of enclosure.

7. *Administrators* are the highest group in the crowd rate (number of employees sharing the room). Therefore *administrators* are the members of organisations whose work most requires that they are related to each other. Such a result indicates that *administrators* are key members in organisations as far as interaction is concerned. The argument is confirmed by the highest *several times a day* and '*daily*' levels of interaction maintained by *administrators* in all cases.

8. The variation among the three groups in their level of *crowd* was reported to be significant in Office 2, Office 3, Office 4, and Office 6. The variation was also significant in the overall case.
9. *Administrators* were the highest at the level of visual accessibility. This confirmed the argument mentioned in #1, since *visual accessibility* was found to be the strongest predictor of interaction. However, significant variation was reported among the three groups in their level of *visual accessibility*.
10. *Managers* are the most dispersed group (distance wise), while secretaries are the most compact group. Significant variation in their proximity index was reported.
11. *Secretaries* were the highest group in time spent seated, while *administrators* were the lowest. However, no significant variation in the two aspects of mobility occurred among the three groups .

CHAPTER: 10

CONCLUSION

10.1. Overview

The broad theme of this thesis is to provide a better understanding of the problem of interaction through studying the relationship between the spatial structure of office layouts and the interaction pattern. This will enable us to formulate design guidelines that will help both designers and managers to control and manage the problem of informal interaction in offices. Facility managers and planners should adopt these measures to manage interaction in offices in a way that supports their organisational objectives.

Organisations look at interaction in different ways. Some regard interaction as a key to different issues such as creativity, industrial relations, social atmosphere and friendship, organisational performance and productivity.

Different organisational theories have implied different levels of interpersonal relations among staff. The social dimension was emphasised in both humanistic and systems theories. This study was conducted on offices in Saudi Arabia. Although Saudi organisations are characterised by a bureaucratic system with vertical hierarchical structure, the organisations consider informal interaction to be an activity that facilitates formal communication channels and increases productivity. Organisations were found to reflect their structure in the physical properties of the workplace. The literature review established a connection between organisation theory and physical settings ¹.

Saudi organisations are characterised by a different culture compared to western organisations. Religion, social habits, and culture have a clear impact on social organisation. Saudis are fully influenced by religious and social values. Consequently, their attitudes and behaviour have developed a different social and organisational context from western organisations. As this study is concerned with Saudi organisation, it is necessary to clarify their social and organisational contexts ².

Saudi governmental organisations have mostly adopted the conventional plan consisting of individual rooms of different sizes for single and multiple occupancy to accommodate their staff. This is mainly because of the need for privacy for high status staff and the ability of this kind of layout to accommodate organisational groups under one spatial boundary (i.e. room). This layout was also found to express the differentiation in status among staff. As a consequence, the problem of interaction arose. Staff were reported to have complained about a deterioration in the level of interaction, and they were dissatisfied. The research claims that the level of informal interaction among the staff could be enhanced through the spatial structure of the layout.

As the main task of the research is to test the spatial hypothesis of interaction, the need to develop an overall model to express significant predictors of informal interaction necessitates the incorporation of other physical and organisational variables that are expected to influence the level of interaction. Models that describe designing for people have enabled the researcher to establish three set of variables that are assumed to influence the level of interaction in offices³. These are physical environment variables, spatial environment variables, and organisational variables. The physical environment variables refer to the level of visual accessibility, enclosure, and proximity. The spatial environment variables refer to the pattern of spatial structure. The organisational variables refer to task characteristics and level of mobility.

These variables were also developed based on a study of office trends world-wide, which were found to have three characteristics. These are the heavy use of information technology, increasing mobility, and churn in organisational objectives, policies and facilities. The research established a connection between these three factors and the need for informal interaction in offices.

The first set of variables (i.e. physical variables) are the richest area in the literature⁴. But the second and the third set of variables have not been given enough attention. The researcher's contribution to the field is reflected in three aspects. Firstly, very few studies were found to associate empirically spatial patterns with social patterns. Moreover, no such study was conducted on offices. The significance of the study lies in the need to explore the connection between spatial structure and informal interaction, an approach that would provide another means to influence interaction apart from the conventional notion of physical accessibility (i.e. visual accessibility and proximity). Organisations therefore could substantially benefit from the potential of spatial structure to influence the flow of communication among their staff.

Secondly, offices in Saudi Arabia have been not been studied in terms of their spatial quality and its impact on social behaviour. The problem of interaction in Saudi workplaces therefore could be resolved through the notion of spatial-social relationship. As the current approach in Saudi organisations is limited to the interaction solution within the workspace itself (through its level of visual accessibility), the spatial hypothesis of interaction urges the design team to think about workspaces in relation to each other throughout the spatial system. Thus this study aims to provide a new knowledge in a Saudi Arabian context that shows the impact of spatial organisation on levels of informal interaction.

Thirdly, throughout the literature there was no model that describes empirically the significant physical, spatial and organisational predictors that influence the level of interaction in offices.

10.2. Description of the problem

The practical problem of this research has been studied from three angles. Firstly, the first published report on Saudi organisations revealed the need to improve the chain of communication among staff and the need for organisations to emphasise participation through further decentralisation for better performance ⁵. Secondly, management in Saudi organisations expressed their desire to improve productivity through increased participation. Thirdly, staff in the pilot study expressed their dissatisfaction with the opportunity for informal interaction in their workplaces.

As both privacy and interaction have become key objectives in Saudi workplaces the convention of relying on the level of enclosure and openness of plan to solve the problem of interaction should not be the only design solution. In other words, the potential of the spatial structure should be considered as well. The study aims to investigate the impact of the spatial structure of layout on the level of interaction. The hypothesis was tested in conjunction with other variables related to the physical environment and organisations as this will allow us to develop the overall interaction models.

The study was conducted on commercial organisations where business is the organisational context. Six case studies in Saudi Arabia were adopted to test the research hypothesis. These are Saudi Telecom in Makkah, Saudi Telecom Headquarters Office, Samarec Headquarters Office, Samarec Co-orporate Engineering Office, Dallah Headquarters Office, and Jaffali Headquarters Office. All these offices are located in Jeddah, except the first office which is in Makkah. The six organisations are characterised by a distinctive management style which has led other Saudi organisations to become fully enthused with their performance. These organisations were selected based on the assumption that they meet the expectations of other Saudi organisations.

Informal interaction in these organisations is perceived as a means to support communication among members of organisations and improve organisational performance. The study of these organisations has revealed some characteristics that are described by bureaucratic, humanistic and systems theory. The bureaucratic dimension is realised in terms of differentiation among staff in their hierarchical structure. The human dimension is realised in the need to support interpersonal relations among different groups of staff. The systems dimension is realised in the incorporation of technology in organisations and the level of automating different organisational processes. The most significant was the need for interpersonal relations among staff. Five perspectives were investigated that emphasised the need for interaction to support organisational processes⁶. These were with regard to the way staff carry out their work, office trends, and cultural issues .

The researcher's intention was to focus on providing empirical evidence of the role of informal interaction in organisation effectiveness. Interaction was found to be a strong predictor of worker satisfaction, organisational performance, and productivity in workplaces⁷.

Formal and informal communication pattern have been used widely as tools to study organisational culture and climate⁸. The ability to influence the pattern of communication in organisations will affect organisational culture. In fact, interaction is not always an advantage to organisations. In some cases, it can act as a crucial problem through threatening employee's privacy in the workplace. Privacy, another strong predictor of employees' satisfaction with the workplace, was sometimes overwhelmed by interaction⁹. The tension between interaction and privacy has become a matter of dispute in today's offices. The need for privacy comes from the need to have more concentration to do highly complicated tasks. The need for interaction arises from the need to support

the interpersonal work-related processes among different members of staff (i.e. participation). In most cases, this will result in a design solution that either encourages interaction at the cost of privacy, or encourages privacy at the cost of interaction. Some recent approaches were developed which tried to provide workplaces that provide staff with the opportunity for both privacy and participation ¹⁰. Factors determining the level of interaction and privacy are mainly related to organisational structure ¹¹.

Today's organisations are influenced by so many factors. These have urged managers to question and reconsider the way their organisations operate. Three main factors have caused changes in office trends. Firstly, the introduction of information technology, which has one significant effect on office design with regard to communication demonstrated in the ability to bridge distance. Many organisations would think that the increased use of information technology would eliminate the need for informal interaction. In fact, the study has established a connection between the use of information technology and the social dimension of organisations ¹². The need to have regular breaks while working on VDUs is one of the factors that provides employees with the opportunity to interact with each other since they can leave their home bases to visit any of the focal points in the building for any services.

Secondly, there is more mobility in offices. There are two considerations with regard to office facilities that cause staff to be more mobile than ever: a) the notion that abandons the idea of 'fixed position' and the provision of multiple activity settings of different physical properties that are convenient for different tasks; b) the need to encourage shared facilities and equipment among staff. These two approaches were initiated by the need to utilise organisation facilities more efficiently. The trend toward mobility was also supported by the use of information technology through the introduction of work breaks.

Thirdly, there is the "churn" (i.e. changes) in organisations. Today's organisations are characterised by being more dynamic and more responsive to changes: changes in business, in work-style, level of automation and the use of information technology; changes in management policy with regard the way jobs are performed, and in the way facilities are managed. These changes will force organisations to adjust their policies and facilities in order to support their basic strategic objectives. However, these changes will automatically affect both formal and informal processes in organisations.

Research has established a connection between these three factors in office trends and their influence on informal interaction. Firstly, the connection between information technology and interaction was evidenced by the need to have regular breaks while working on VDUs. In fact, the connection between technology and the social aspect of organisations was the main criterion that characterised the systems theory of organisation with its emphasis on sociotechnical aspects. Secondly, the increased level of mobility also influences the level of interaction. Thirdly, whatever the changes in organisations are, the need for informal interaction might also change over time. Such changes necessitate high flexibility in the measures that are taken to influence informal interaction (i.e. physical environment). In the way that physical settings and facilities become part of the changing cycle of organisations to support changes in organisational needs, changes in the interaction policy will urge managers to change the arrangement of the physical settings and the pattern of using facilities.

The current approach in Saudi Arabia is limited to the choice between conventional vs. open plan, which only explores visual accessibility through the physical enclosure of individual workspaces. Other features in the physical environment include proximity among co-workers, which reflects the density of occupancy or the level of compactness vs. dispersion. This was also used to influence the level of interaction

among staff. These two physical environment measures (i.e. proximity and physical enclosure) were prevalent because much research has provided empirical evidence about their effect in supporting informal interaction.

It is the working theme of this study to explore the relationship between the spatial structure of office layouts and the level of informal interaction among employees (the research hypothesis). The researcher has argued that the potential of office layouts to influence the level of interaction through their spatial structure should be explored rather than confining the design solution to physical enclosure and proximity. The problem of layout refers to the typology of spatial structure. This design solution (i.e. the spatial layout) will foster the concept of thinking about the syntactical positions of spaces in relation to each other, a concept that goes hand in hand with the nature of the interpersonal activity of interaction. The research developed a hypothetical model which revealed the expected effect of the notion of the depth of the spatial structure on interaction, as this will help to conceptualise the research problem ¹³.

10.3. Interpretation & Discussion

The research findings have provided support for the idea that relates spatial structure to social pattern. The three measures of spatial structure i.e. the global level of *integration*, the local measure *connectivity*, and the *same route* opportunity showed different trends over the six adopted case studies. The verification of the spatial hypothesis of interaction was different at the three chosen levels (i.e. individual, small group, and large group).

At the individual level, the level of *integration* did not show any significance on the pooled data for all the six case studies on the *mean interaction* level. Although the association between the global *integration* and the *mean interaction* is not supported,

findings suggest that highly segregated spaces do support interaction¹⁴. The argument was derived from the study of the trends of the level of *integration* in the reported significant individual cases. This argument goes hand in hand with the Peponis (1983) findings, where he found a positive relationship between the global *integration* and density of encountering.

The second measure of spaces (i.e. connectivity) appeared to be a significant predictor of interaction on the *rarely* level as well as on the *mean interaction* level. Such results confirm the argument which associates the level *connectivity* of spaces with the frequency of informal interaction. The approval of the hypothesis, which relates the level of *connectivity* with interaction, suggests well-connected spaces for more interaction.

The third measure of spatial structure which is the route opportunity, was only found to be a significant predictor at the *daily* level of interaction, but it had no significance on the mean interaction level. This means that no significant relationship between the same route opportunity and informal interaction was found in this study. Although *same route* was found to have a moderate correlation with the mean interaction, it could not contribute to explaining any variation in the mean interaction through the regression analysis. This happened because *same route* was correlated with other incorporated variables.

The three findings with regard to the relationships between the three measures of spatial structure and the level of informal interaction should be carefully interpreted. The rejection of the hypothesis that associates both the global measure of *integration* and the *same route* opportunity with interaction does not eliminate the impact of these two measures of space on interaction, especially when these two measures were found to be highly significant in individual samples. Other studies, like Peponis (1983) in factories,

also confirm the relationship between the global *integration* and density of encountering. There is more than one reason which could explain the rejection of the hypothesis that associates the level of *integration* and *same route* with interaction. These include differences in organisational policies with regard to the physical properties of workspaces for different groups of staff. For instance, among the six case studies different groups of staff (i.e. *managers, administrators, and secretaries*) which experience different patterns of interaction occupy spaces of different level of *integration*. Another reason could be the variation in the correlation values among the same variables in different case studies. Furthermore, the amount of processed data could have influenced the significance of the test.

At the small group level, the spatial hypothesis with regard to both spatial and organisational groups showed different trends. Results with regard to organisational groups were inconsistent and no clear relationship could be established between spatial structure and the level of informal interaction. Such a finding indicates that the spatial structure of layouts has no effect on informal interaction within and between organisational departments. In contrast, the impact of both the level of *integration* and *connectivity* on interaction within and between spatial groups was clearer. Within the spatial groups, both the global *integration* and the local *connectivity* were positively associated with interaction. On the other hand, results between spatial groups suggest that more integrated spaces would increase interaction . Findings with regard to spatial groups helped the researcher to develop design guidelines describing the spatial quality of Saudi organisation. In this respect the term spatial intelligibility refers to the ability of the spatial system to encourage interaction on at least *daily* interaction. With respect to within spatial groups, it was found that: a) the spatial system should maintain an integration level of not less than 1.7 and a connectivity level of not less than 0.7 to support interaction on *several times a day* level ; b) the spatial system should maintain an

integration level of not less than 1.2 and a connectivity level of not less than 0.4 to support interaction at a *daily* level. Systems below an integration level of 1.2 and a connectivity of 0.4 are considered to be unintelligible. Findings between spatial groups showed that as the level of *integration* approaches 0, interaction at *several times a day* is encouraged.

Furthermore, at the third level of analysis (i.e. large group), the relationship between the global *integration* and interaction was not supported on *mean interaction*. On the other hand, *connectivity* showed a significant relationship with almost all interaction levels.

The findings that describe the relationships between the two measures of spatial structure and interaction provide clear evidence that the effect of the spatial structure on interaction is stronger at group level than it is at individual level. This could refer to the nature of interaction activity, as it is based on the interpersonal relations among subjects. Another interpretation could be that in the case of groups the analysis deals with the mean value of the whole group, whereas in case of individual the analysis deals with a discrete value.

The effect of the spatial properties of workplace on the level of interaction could give a new scope to resolving the problem of privacy vs. interaction in offices. In other words, staff who maintain different levels of enclosure and visual accessibility, and therefore their level of informal contact opportunity is highly influenced, could also experience some informal interaction opportunity through their potential locations in the structural system of space. This solution will benefit the Saudi governmental offices where workspaces still possess a high level of visual and spatial enclosure to provide

better privacy, and staff can maintain the opportunity of informal interaction by virtue of the syntactic positions in the spatial structure.

However, the findings showed that the impact of the physical variables (i.e. visual accessibility, and proximity) is much stronger than spatial variables. The level of visual accessibility was the strongest predictor of interaction. Such results support the argument which associates the absence of intervening barriers with interaction, and therefore the open office layout with ease of informal communication and interaction. Proximity, on the other hand, was the second strongest predictor of interaction. Among the organisational variables, the degree of mobility represented by the degree of performing desk vs. non-desk work was also found to be a cause of interaction. Variables that were expected to influence interaction and were not supported in the study are task characteristics, and organisational boundary through organisational division. The absence of a relationship between organisational division and interaction contradicts Davis' findings, where he suggested that informal communication will be active through formal communication channels ¹⁵. This could be due to the superiority of the physical environment in affecting social pattern, over that of the formal organisation. Another interpretation focus on the absence of the physical environment in Davis' work.

The study has taken the analysis further forward to investigate the spatial, physical, and social patterns of staff performing different tasks (i.e. *managers*, *administrators*, and *secretaries*). These differ in their status and task complexity as well as in their positions in the hierarchical structure of organisations. The researcher believes that the differences in the nature of performed task will dictate workspaces of different physical potential. The variation in the physical potential of the workspaces will also dictate different social patterns. The differentiation in the physical settings is expected to be exhibited in the differentiation in the spatial pattern (syntactic measures), and

differentiation in the physical pattern (including visibility, crowd, enclosure, and distance). Staff of different tasks are also expected to experience a different level of mobility in their workplace.

Although the three groups of staff showed significant variations in *integration* values in some offices, the variation was not significant in the pooled data. *Managers* were also found to occupy spaces that are more segregated, whereas secretaries occupy spaces that are more integrated. Such results indicate that managers tend to be in the back-stage occupying deeper spaces and *secretaries* tend to be in the front-stage occupying shallower spaces. On the other hand, the measure of *connectivity* revealed that *secretaries* are in the best connected spaces, whereas managers are in the poorest connected spaces. These findings prove that secretaries have better spatial accessibility than *managers*. No significant variation was found among the three groups in their level of local *connectivity* in the pooled data. The three groups were found to have significant variations in their level of *visual accessibility, enclosure, crowd, and proximity*. Surprisingly, the three groups revealed significant variations in the physical properties of their workplaces (i.e. *visual accessibility, enclosure, proximity, and crowd*) but they failed to show any significant variations in the spatial properties of workspaces in terms of *integration* and *connectivity*. This result revealed a significant finding about the way management assigns spaces to the three groups. In fact, this indicates that although management uses the physical properties of the workplace to differentiate among staff, they failed to differentiate among their staff spatially. This could be due to the lack of awareness of management of the spatial complexity of layouts.

As far as the variation in the social pattern is concerned among the three groups, administrators were found to be the key group in organisations, and they reported the highest level of interaction. On the other hand, secretaries reported the lowest level of

interaction. The three groups exhibited significant variations in their pattern of interaction.

10.4. Limitations and Considerations

Although the study was conducted on Saudi organisations, the findings of the empirical study could be generalised but with some considerations. These considerations are with regard to the social and organisational issues of Saudi organisations which make them somewhat different compared to western organisations. The nature of Saudi organisations as being fully influenced by both religion and culture raises the issue of the applicability of the research findings to other organisations. In this respect, this research could benefit other non-Saudi organisations by increasing their concern with the role of spatial quality on the social organisation.

The findings of this research were obtained from the six selected offices in Saudi Arabia. There were some limitations in these samples, which did not meet fully the criteria of the selection. Most of these limitations were with regard to the organisational criteria. For instance, not all the six cases belong to the governmental sector. Another was the diversity of the businesses such as telecommunication, marketing, and banking.

Limitations with regard to methods and tools were mainly with respect to space syntax concept. Findings which associate the spatial structure with social structure in this research are based on the theory of space syntax, a theory which adopts the notion of *convex* space as a unit of spatial structure. The theory showed limitations in terms of the omission of some of the space characteristics (i.e. shape and size). The theory also undermined the impact of distance. Moreover, there is the omission of other space quality such as functional varieties of space and the level of physical enclosure.

As the research intention was to explore the general connection between the physical environment and society, the research focussed only on aspects of the physical environment that could influence interaction. That is why it was the concern to control other variables such as personal characteristics including sex, race, age. Other considerations that were taken into account in the selection of the samples were with respect to the management style, needs for informal interaction, and hierarchical structure of the organisation ¹⁶. Furthermore, there were several considerations with respect to the physical and spatial criteria ¹⁷.

10.5. Implications for Researchers

The study was launched on six different organisations in Saudi Arabia. The researcher tried to ensure that these organisations had almost similar management styles. This is of a great importance since this variable is intended to be kept constant, so as to eliminate any effect of management style on interaction. All of these organisations are almost bureaucratic organisations, although participation with some staff exists. These organisations, however, possess an interpersonal relations system that describes the communication network among members of the organisation. These network channels are in both horizontal (more informal than formal) and vertical (more formal than informal) directions, which reflects the nature of communication in bureaucratic organisations.

Further research is recommended to explore the effect of different management styles on the pattern of interaction, and subsequently on the pattern of the physical settings of organisation. Although Duffy (1974b) has studied the relationship of two structural dimensions of organisations (i.e. bureaucracy and interaction), representing two different styles of organisation, on two physical criteria of the workplace (differentiation and subdivision)¹⁸, his work was limited to two organisational structures

and two physical properties of the workplace . For example the spatial pattern of the two kinds of organisations has not been studied.

The scope of future research should therefore associate different management styles with different physical properties of the workplace. In this respect the hypothetical argument of Sundstrom (1986), where each structural dimension of the organisation should be reflected in one or more properties of the workplace ¹⁹, should be tested empirically. This would reveal at least the nature of office layout for four different organisations: firstly, organisations of different levels of information technology such as fully automated organisations, partially automated organisations, and non-automated organisations; secondly, the nature of office layout of purely bureaucratic organisations as very concentrated systems of authority, or of participative organisations as very dispersed systems of authority; thirdly, office layout could be influenced by the nature of processes in the activity systems, for instance, formal vs. informal processes. Organisations that emphasise the informal processes tend to bring people close to each other and promote casual meetings among members of organisations, whereas the ones which emphasise the formal processes tend to provide staff with more private workspaces. Fourthly, the kind of work style, whether participative as teamwork or individual, can also reflect different kinds of physical settings. Trickett (1990) mentioned measures of differentiation among organisations in the last three dimensions²⁰. However, empirical studies are crucial to establish stronger evidence.

The pattern of informal interaction within formal channels is an area of research that requires further study. This is vital to organisations, since informal communication will support formal communication. The argument was supported by Davis (1953) where he found that formal communication usually confirms what is already being said informally ²¹. This happened with members of the staff whose job requires contact with

each other according the work flow sequence. The physical environment would support these formal contacts by proximity or openness. Subsequently, this would support the informal casual meetings. However, his study tried to reveal the pattern of informal interaction within formal channels through investigating the relationship between interactions of staff within the same organisational hierarchical division (i.e. departments), as well as between different organisational hierarchical divisions.

The overall result in this study has not supported the argument which claims that people within the same departments would experience better opportunities for informal interaction with each other than with people in different departments. However, the hypothesis was only supported on Office 1, Office 2, Office 3 in a strong relationship and in Office 4 in a moderate relationship. The reason why the other two offices did not reveal any significance of informal interaction within formal channels could be due to the allocation of staff of different departments under the same spatial enclosure (i.e. room). In this case, the physical environment could have supported the informal interaction within different departmental members and overridden the effect of formal channels. As four offices out of six have shown an association between informal interaction and formal channels, though the overall result for the six offices did not establish a significant relationship, the researcher thinks that further research is required in this field, with particular intention to freezing aspects of physical environment, to acquire a better understanding of the connection between formal and informal communication.

The space syntax technique which was used as a tool to describe the spatial structure of layouts, should be applied more in the real world. This would reveal its responsiveness to the understanding of the kinds of relationship that connect people with space. The technique has been adopted in this study since it was based on human perception of the spatial environment. The unit of the spatial structure is the convex

space, a concept which is based on the ability to maintain visual accessibility (the strongest predictor of interaction) between any two points within the boundary of this convex space. Further theories which describe the spatial structure within the nature of human perception of the physical environment are needed. As space syntax theory was studied in conjunction with informal interaction, other research could also benefit from this technique to study the connection between the spatial structure and other social behaviour, for example the relationship between spatial structure and privacy, distraction, and satisfaction with spatial location.

The spatial criteria were measured in terms of three variables. These are the level of *integration*, level of *connectivity*, and the *same route* opportunity. The connection between these spatial structure measures and interaction revealed the contribution of the degree of *connectivity* in explaining some variance in interaction. Both the *integration* and *same route variables* did not contribute to explaining any variance in the interaction through the regression analysis since both were correlated with other variables. These findings were revealed from the study at the individual level. However, when the study focussed on a small and large group's interaction, the results established a stronger relationship between the spatial measures and interaction. Further research is recommended to investigate the impact of the syntactic measures on the level of informal interaction on different group size, as well as on groups under both organisational and spatial control.

The study also recommends that further research should freeze all variables that could influence interaction and focus on the syntactic measures of space so as to explore their significance for interaction. Probably conducting the spatial hypothesis of interaction on mice could give a better understanding of the problem of complexity of spatial structure for interaction. This will urge researchers to conduct empirical experiments in

laboratories in which more controlled observation can be reported within an adaptable spatial environment that could vary in their spatial characteristics with regard to the level of *integration* and *connectivity*. Such a study could be similar to the one by Vestal & Schnell (1986) where they investigated the influence of environmental complexity and space on the social interaction of mice. There the definition of the spatial complexity was limited to the three different spatial environment that differ in number of boundaries. A similar study seems to be called for, with spatial environments taken to the syntactic analysis level.

Visual accessibility was the strongest predictor of interaction. This widens the scope for further researchers into the significance of visibility on interaction. Previous research has undermined the importance of visual accessibility on interaction where the focus was on the physical enclosure and proximity with less concern to visibility ²². Although Baker (1984) examined the impact of visibility on interaction, his work was limited to people sitting around tables. The study here urges researchers to examine the role of visibility in interaction among different staff workspaces in office environments. The findings have suggested that the effect of enclosure on interaction is perceived in terms of its visual accessibility capabilities. This was clear when enclosure obtained a correlation of $r = -.319$ with interaction, but failed to appear on any significant level to contribute to the explanation of the variance in interaction when enclosure entered the regression analysis. This occurred since visual accessibility overrides the importance of enclosure, since enclosure and visual accessibility were found to have a correlation of $r = -.628$. In this respect, the issue of visual privacy is raised.

Further research is urged to conduct studies that differentiate between enclosure and visibility through enclosure of different visual accessibility properties (i.e. material, glass vs. solid). The method used to measure the visual accessibility index for each

employee is different from that in the Baker (1984) study ²³. Baker's approach tried to introduce a quantitative measure for visibility of different group size seated around a table. Measures of visibility were calculated based on the cosine of the angle between each pairs. The total visibility value for each individual is the sum of each cosine value for each angle with every other individual. This would be ideal for workplaces with absolute openness and devoid of any intervening barriers. The technique used in this study is similar to the one used by Sundstrom & et al (1982) where each individual is asked to point out other individuals that are visible from his own workspace ²⁴. The overall index of visual accessibility for each employee is developed. However, Baker's method is an approach based on a purely mathematical procedure. Researchers are urged to apply Baker's approach to open plan offices so as to explore the potential of the visual accessibility through other techniques.

Research on the effect of proximity is the richest area in interaction. Findings have shown that proximity is associated with interaction. But unexpectedly, proximity was not the strongest predictor of interaction. There were three reasons behind adopting proximity as a variable in this study. First, the spatial theory of space syntax is a distance-free theory, which studies the relationships of spaces in relation to each other with no regard to distance. Secondly, there was a need to focus more on the nature and the ambiguity that confuses distance with visibility. This argument was fully explored in Baker's work. Thirdly, there was a need to generate an overall model to describe significant predictors of the physical environment on interaction. However, further research could incorporate further environmental variables that could be the cause of interaction, since the incorporated variables could only explain 53.75% of the variation in interaction.

The three groups of staff adopted in this study as they perform different kinds of tasks and differ in their involvement in the decision-making process did not establish any significant connection with interaction. Sundstrom's (1982) argument which suggested that people who perform different tasks of different level of complexity could perceive the need for privacy differently, has been supported on interaction ²⁵. This occurred when the three groups revealed significant variations in interaction between each other. However, no significant correlation was found between task characteristics and interaction. This will necessitate the need for further studies to reveal the kind of relationships between different aspects of tasks such as complexity, participation, managerial, clerical, technical, etc.

10.6. Implications for Managers

Managers are the ones who will run the organisation through all its life cycle. It is quite important for managers to understand the nature of their office facilities and the implications of these facilities for organisation performance. However, this study addresses certain measures and guidelines to managers so as to control and manage the problem of informal interaction among their members of staff. Managers are urged to think of informal interaction as a tool to support informal communication and increase employee's productivity through better job satisfaction. Staff tend to perceive formal communication channels as associated with more stress and strain through the noise and long talk on the telephones, formalities of conferences and seminars, and the health problem associated with the use of VDUs. In contrast, informal communication is undertaken in both working as well as non-working hours, in working as well as non-working areas, in an atmosphere where employees are more relaxed, and it always occurs in an unplanned manner and in a way that it is effortless and of a high speed of dispersion.

Managers should realise that the way they manage the pattern of interaction in general, and the pattern of communication in particular, contributes to shaping the overall climate of their organisation. This is vital because staff who interact with each other will develop almost the same image and perception of their organisation. Interaction therefore could be regarded as a tool for management to influence the way staff perceive events and decisions in the organisations. Managers, at the same time, should not reject the need for privacy in favour of interaction. The kind of task performed represented in its complexity and level of participation could urge staff to look for a workspace whose physical properties would respond positively to them. Organisations should be aware that neither the closed plan nor the open plan responds to their staff's basic needs. Instead, providing staff with multiple activity settings could be more efficient. These would provide staff with both interaction and privacy throughout the physical potential of the settings. These settings are characterised by different physical conditions where some provide high privacy, others are of high participative capabilities. In this case employees would have the opportunity to choose the kind of settings that will suit the performed task. These settings are accessible to all staff without assigning any particular setting to any particular staff.

Additional scope to help managers to manage the problem of interaction in offices lies in providing employees with the opportunity to fit out their workspaces the way they like. This will help staff to generate the kind of workspaces that will respond to their actual needs. This implies the opportunity to select the location of the workspace, the level of enclosure, the level of visibility, the kind of furniture and so on. It is for the benefit of the organisation to maintain a high level of flexibility in their facilities, so as to manipulate, rearrange and adjust them the way they support more effectively the organisation's objectives. This will let management perceive the physical settings and all the facilities as part of the change cycle in the organisation.

The spatial findings of this study addresses a message to managers to pay more attention to the problem of space and conceive it in terms of its local and global measures. Staff whose jobs require contact with each other could be placed in well-connected spaces. Managers could also allocate job-related employees in the same route so as to provide them with better interaction opportunities every time they visit their workspaces. It could be worthwhile for staff to encourage informal contact among staff of different organisational departments through allocating them the same spatial boundary. In other words, as findings of the research found a correlation between interaction and people within the same spatial boundary (i.e. room), managers could use the potential of space to encourage interaction across the organisational division. This will urge managers to abandon the conventional approach of placing every organisational department under one spatial boundary. Becker (1990) in his total workplace approach supported this idea through "functional inconvenience".

The results of the two syntactic measures of space (*integration* and *connectivity*) as regards interaction have suggested three design guidelines for better interaction among staff: a) organisational groups should be realised in spatial groups; b) spaces within spatial groups should be deep (more segregated than integrated), on their own, and well-connected to each other; c) spaces between spatial groups should be shallow (i.e. more integrated than segregated) ²⁶.

The research has also suggested to managers that the increased use of information technology will not eliminate the need for the social interface in organisation. In fact there is always a social dimension to technology that will contribute to the support of informal contact. As staff should have regular breaks after each continuous working session, managers could also encourage informal contact among staff members by making staff have their regular breaks at the same time.

As the level of mobility was the fourth predictor of interaction, the concept of spatial mobility which abandons the idea of fixed position for staff would also support informal interaction . Managers should also urge staff to move inside the office building. This could be achieved by various measures, such as "functional inconvenience", which is concerned with the abandonment of the concept of spatial proximity and concerned more with the provision of common areas so as to increase accidental contact. Informal contact could also benefit from mobility and spatial structure potential, if managers classify the level of mobility of each group of staff, and by placing highly mobile staff in the deepest spaces (highly segregated) and low mobile staff in the shallowest spaces (highly integrated). In this case highly mobile (the ones who occupy deeper spaces) will pass through a sequential series of spaces each time they move, and subsequently interact with the low mobile staff.

The study has revealed that managers are unaware of the understanding of the syntactic structure of spaces . This was clear when the management in the six adopted case studies did not show any understanding of the syntactic position of workspaces. The management idea with regard to the spatial structure of spaces was only limited to locations of workspaces on the main corridors, minor corridors, or main nodes. The study strongly recommends that managers should think about the nature of the syntactic positions of spaces and how they can support different tasks of different groups of staff. This could result in a simple understanding of the notion of *front-stage* vs. *back-stage* workspaces.

Managers should also think of non-working areas in the workplace as places where they could generate focal points and nodes of multiple activities. Furthermore, managers are recommended to conduct a communication and interaction audit, investigating employees' satisfaction with the existing opportunity for informal interaction.

10.7. Implications for Designers

Members of the design team are the ones who are responsible for providing the appropriate physical settings in organisations. It is through the design processes that designers study the actual needs of organisations and suggest suitable design solutions that respond to these organisational needs. The work of designers and managers should complement each other. In fact, designers are responsible for providing the kinds of physical settings that are more responsive to organisational needs. These are concerned with the type of shell, scenery, services, and set .

Managers should also be involved with designers in the processes of selecting the physical settings in the early stages. This is very necessary, since managers are the ones who are supposed to carry out the management of these facilities over the life cycle of the organisation. By giving managers the opportunity to participate in the design processes, they will be able to run an organisation's facilities in a more effective way, particularly with respect to future changes. However, the designers' decisions with regard to the selection of the physical settings will always affect the degree to which managers thereafter can manage these facilities effectively. This is in terms of the degree of flexibility these facilities possess. However, it is always recommended that designers provide types of physical settings that are characterised by a high degree of flexibility and can be adapted easily to support different objectives. Therefore, designers are requested to provide an office environment that can be changed at any time. The conception of the physical elements of buildings in terms of their shell, scenery, services, and set will initiate the need to achieve a high level of adaptability in each level of these four aspects. However, the design team should provide the type of shell and services that can accommodate workspaces of different size, enclosure, location, and physical conditions.

The research findings dictated certain design guidelines to designers in order to achieve the kind of physical settings that can support the social and communication processes in organisations. The spatial findings of this study address to designers the issue of the potential of the spatial environment to influence the pattern of informal interaction. Designers are urged to think about the potential of the notion of depth (i.e. level of integration). This could be achieved by thinking of the capabilities of different building shells to provide more choices in the creation of workspaces of different levels of integration. For example, a shell that is shallow (i.e. wall to wall length to width ratio) would only accommodate workspaces of a single or double loaded corridor. In this case, all the created workspaces are likely to be of similar *integration* value. On the other hand, a deep shell (typical landscaped office) could accommodate workspaces of interrelated relations with intersected corridors, and subsequently would provide workspaces of different *integration* values. The level of *connectivity* could also have two different trends in the two examples of the shallow and deep shells. This occurs when workspaces in the shallow shell of single or double loaded corridors can only maintain a limited number of connections with their adjacent workspaces, whereas in the deep shell examples workspaces could have more choices in the levels of connectivity. This notion of deep and shallow plans is also applicable to the idea of providing front-stage and back-stage inside the building. As a rule of thumb, the shallow plan is characterised mainly by front-stage spaces only, whereas the deep plan provides better opportunities to create spaces of different front-stage and back-stage criteria.

Designers should also think of the non-working areas as they are always shallower than working areas. These non-working areas such as lobbies, foyers and corridors, are where most of the accidental contact takes place. This occurs because these non-working areas are the main link to working areas, and where usually staircases, lifts and escalators are placed. Designers are also encouraged to note that the more

diversity in routes the less chance employees have to meet each other. In other words, eliminating the number of route choices when staff are willing to travel from point A to point B will increase the opportunity for staff to bump into each other.

Designers should perceive scenery (i.e. walls and partitions) for its visual accessibility properties (i.e. visual privacy) as well as its physical enclosure. This is vital since visual accessibility was found to be the strongest cause of interaction, while enclosure could not add to the explained variance (i.e. interaction) . Consequently, this will influence decisions with regard to the level of subdivision and the degree of openness. This will widen the scope for designers to provide walls and partitions of different visual accessibility properties (i.e. glass vs. solid). In the meantime, this could help staff to maintain the desired levels of visual accessibility and spatial territory simultaneously. The ability of different building shells to provide different levels of visual accessibility to users should also be taken into account. For example, regardless of the way scenery is laid down, a circular shell will have the maximum visual accessibility opportunity, whereas a U-shape shell will provide less visual accessibility opportunity. One approach which could be efficient to organisations is to develop several types of workspaces of different physical conditions that respond to the needs of different groups of staff and ask designers to provide types of shell, scenery, services, and set that could accommodate any type of these workspaces anywhere in the plan. It should be noted that these workspaces should vary in the dimensions of different physical criteria rather than use basic standards ²⁷. However, the approach is restricted to the nature of organisational facilities.

The three types of organisation in term of facilities which describe the fit between the actual needs and the development over time (i.e. the loose fit, tight fit, and elastic fit) , will determine the applicability and the workability of this approach ²⁸. The approach

entails the division of the whole floor plan into workspace-units. Each has the flexibility to accommodate any type of work variety in workspaces. In this case, management as well as staff would have the opportunity to fit out any type of workspace, any time, anywhere.

10.8. Summary

The study explored the connection between physical settings and informal interaction. This work is distinguished from the others in two ways. Firstly, there is the need to develop an overall model describing the significant environmental and organisational predictors of interaction. Secondly, there is the role of spatial quality in accounting for three levels of interaction. More specifically, the concern was to reveal the impact of spatial structure in office layouts on the level of informal interaction. Space was the main area of concern in this work due to the shortcomings of previous research which associated the pattern of space with the pattern of behaviour in office environment. This was mainly due to the lack of descriptive methods and theories that describe the spatial pattern in its social context.

As the idea of managing informal interaction through space management and planning was supported in this study, it addresses an important message to organisations to improve the level of communication and therefore organisational effectiveness through space management. Other findings suggest that the impact of physical enclosure on informal interaction is always perceived through the visual accessibility property of the physical enclosure. This has raised two issues with regard to the physical enclosure: first, the visual accessibility property of the physical enclosure (i.e. solid vs. glass); secondly, the spatial property of the physical enclosure (i.e. degree of enclosure measured through number of enclosed sides). This has implications for the distinction between visual privacy and spatial privacy.

Notes and References

¹ See p.102.

² See pp.62-70.

³ See pp.165-167.

⁴ See p.90.

⁵ See p.64.

⁶ See pp.64-66.

⁷ See pp.48-51.

⁸ See pp.42-43.

⁹ See p.57.

¹⁰ See p.57,183.

¹¹ See pp.55-58.

¹² See pp.58-61.

¹³ See p.195.

¹⁴ see p.269.

¹⁵ Davis, K., 1953, Management Communication and Grapevine, *Harvard Business Review*, Sep-Oct.1953, 43-49.

¹⁶ See pp.207-208.

¹⁷ See p.209.

¹⁸ Duffy, F., 1974b, op. cit. p.217-235.

¹⁹ Sundstrom, E., 1986, *Workplaces: The psychology of the physical environment in offices and factories*. Cambridge University Press. p. 347.

²⁰ Trickett, T., 1990, *The hidden dimension*, Proceeding paper, Facilities Management International Conference, "organisation" ,9-12 Apr.1990.

²¹ Davis, K., 1953, op. cit., p.45.

²² See p.98.

²³ Baker, P., M., 1984, Seeing is Behaving, Visibility and Participation in Small Groups, *Environment and Behavior*, vol. 16, No.2, March 1984, pp.159-184.

²⁴ Sundstrom, E., Town, J., Brown, D., Forman, A., McGee, C., 1982, Physical Enclosure, Type of Job, and Privacy in the Office. *Environment and Behavior*, vol.14, No.5, Sept. 1982, p.548.

²⁵ Ibid. p.558.

²⁶ See p.307,308.

²⁷ The concept also developed the notion of 'activity settings' by Stone & et al (1985).

²⁸ See p.36.

GLOSSARY

A few times a day is an interaction level which describes staff ability to experience encountering based on a few times a day basis.

Action office is derived from the analysis of the basic needs of each individual. Desks, chairs, shelves, and storage boxes can be arranged in different configurations.

Bureaucracy in Saudi's organisations is defined in terms of centralisation in decision-making, formalisation, and complexity of work. Staff are structured in a hierarchical pattern with the ability of high status staff to highly influence the decision-making process. Staff in higher positions have more complex work than staff in lower positions. The nature of work in Saudi organisations is characterised by being very complicated with a high level of routine. Most of the processes in Saudi organisations are formal, as there is a heavily reliance on formal communication channels. For further reading on bureaucratic organisations see p. 62. On the other hand, **participation** in Saudi organisations reflects one aspect of bureaucracy, which is the level of participation in the decision-making process. In this study the participation dimension is found in the nature of the organisational and social context of Saudi organisations. For further reading about the participative dimension in Saudi organisations see p. 64 .

Carrier is the shallowest point in the spatial structure. It is the highest integrated space in the whole system as well as the least in depth.

Churn refers to changes which take place during the organisation life cycle. These may be internal or external changes.

Conventional office is defined as a space surrounded by full-height, fixed partitions or walls (i.e. room). This space is occupied by one or more persons. The Saudi conventional

office consists of rooms of different sizes for single and multiple occupancy. In the case of multiple occupancy the room is subdivided by partitions.

Convex space is the unit of analysing the spatial structure in space syntax theory.

Convexity is defined as any line drawn between two points in space without crossing the boundary of the space.

Daily interaction is an interaction level which describes staff ability to encounter on a daily basis.

Enclosure is any physical barrier surrounding the workspace. It could be a wall or a partition. In this study only barriers above eye level are adopted.

Global measure integration or real relative asymmetry is one measure of describing spatial structure in space syntax theory. It is concerned with the level of integration vs. segregation of each space compared to the whole system of spaces.

Grapevine is all the informal interaction that takes place within a group. It denotes everything, including informal communication (i.e. useful information).

Informal communication is defined as relatively unstructured information exchange that tends to occur in face-to-face encounters.

Interaction boundary in this study is defined as the ratio of interaction density within the group (i.e. both organisational and spatial groups) to the density of interaction across the group. There will be an interaction boundary when the density of interaction within the group exceeds the density of interaction across the group or vice versa.

Justified map is a graphic map which describes the arrangement of spaces in levels according to their depth with the carrier or the original space at the lower level of the map. Lines are drawn between spaces representing their interconnections.

Landscape office is a large open space characterised by random scrambled layout. Workspaces are arranged in the pool area in irregular patterns with no visual separation at all.

Local measure of connectivity or control value is the other measure of describing spatial structure in the space syntax theory. It is concerned with how well or poorly a space is connected to its immediate neighbours.

Mean depth is the number of steps a space is deep from the carrier or from the original space.

Mobility is the level of movement inside the office building. In this work two criteria were developed to measure the level of mobility. These are percentage of time staff remain seated, and frequency of staff leaving their workspace for any reason.

Multiple activity settings is a new concept in designing workplaces. The concept echoes the changes in the way work is performed. It enables staff to have a private home base with an access to quiet spaces, shared facilities, and public areas.

Open plan is a large open space with light and movable head-high partitions surrounding workspaces.

Organisational climate refers to enduring organisational or situation characteristics that organisational members perceive. Others define it as meaning and sense-making as perceived by individuals in the physical settings context.

Organisational culture refers to shared interpretations and understanding of organisational events. Understanding shared meanings among staff necessitates the study of all relevant issues such as the structures of meaning, beliefs and values, patterns of symbolic relationships, organisational stories, expectations, and organisational transactions.

Organisational effectiveness is defined as an organisation's success in maintaining: a) satisfaction and commitment amongst its members. b) Communication and co-ordination within and amongst its work units. c) Adequate production. d) Mutually supportive relationships with its external environment. The total workplace in offices and factories has the potential to contribute to these proposed elements of effectiveness (source: Centre for Facilities Management, University of Strathclyde).

Organisational groups are members of staff that belong to the same organisational division (i.e. department).

Organisational structure refers to relatively stable characteristics of organisations. These usually describe the nature of the organisation, especially with regard to work roles, work-units, and their interrelationships.

Private office is defined as a space surrounded by full-height fixed walls (i.e. room) and occupied by one employee only.

Programmatic dysfunctional refers to the failure of the physical environment to cope with human needs throughout building the life cycle. The dysfunctional effect begins from the first day of occupancy. Some organisations try to ignore it, but after a certain period of time it becomes recognisable to everyone.

Proximity is the shortest travelling distance that separates two employees.

Pseudo-Fixed-Features are features in the physical environment that are simple to change or move, but which are perceived as fixed.

Rarely interaction is staff ability to encounter on a rare basis.

Relative asymmetry is a term that compares how deep the system is from a particular point with how deep or shallow it theoretically could be.

Same department is a criterion developed to measure percentage of staff under the same organisational division (i.e. department).

Same room is a criterion developed to measure percentage of staff under the same room. The room is defined as a space surrounded by full-height walls.

Same route is a criterion developed to measure percentage of staff whose workspaces share the same route. All routes are analysed to lead to the shallowest point in the system.

Semi-lattice pattern and tree pattern are two different ways of describing the pattern of spatial structures. Semi-lattice pattern is defined when the spatial structure meets

certain conditions. Tree structure is defined as when the spatial structure meets other more restrictive conditions.

Several times a day is the highest interaction level among staff. It refers to staff ability to experience informal interaction with each other on a several times per day basis.

Spatial groups are members of staff who share the same room. The room is defined as a space that is surrounded by full-height walls.

Spatial structure is the structure of spaces in relation to each other. The concept includes all the local and global forces that shape the overall spatial structure.

Task characteristics is defined in this study in terms of the nature of staff work in performing managerial vs. clerical work. In Saudi organisations employees in the top positions of the hierarchical structure are the ones who carry out the managerial work, whereas employees in the lower positions of the hierarchical structure are the ones who carry out the clerical work. Managerial work in Saudi organisations tends to be more complex than clerical work.

Total workplace refers to the need to look at the complexity of the workplace. It incorporates all the social, physical, and organisational issues that affect organisational effectiveness.

Visual accessibility is defined as the ability of staff to see each other while they are seated in their own workspace.

Weekly interaction is staff ability to encounter on a weekly basis.

APPENDICES

QUESTIONNAIRE 1

ASSESSING EMPLOYEES SATISFACTION WITH INFORMAL INTERACTION
OPPORTUNITY IN THEIR WORKSPACES.

This study is launched to assess employees satisfaction with their perceived level of interaction and privacy in governmental offices. Please answer the following questions:

1) How do you rate the perceived level of privacy in your workspace? (tick one answer please).

- Very low
- Fairly low
- Satisfactory
- Fairly high
- Very high

2) How do you rate the opportunity that you possess in your workplace with regard to the informal contact with your colleagues (tick one answer please).

- Very low
- Fairly low
- Satisfactory
- Fairly high
- Very high

3) How do you rate the need and importance of privacy to perform your work efficiently (tick one answer please).

- Not important
- Slightly important
- Moderately important
- Very important
- Extremely important

4) How do you rate the need and importance of informal interaction to support the social atmosphere of the organisation and the formation of friendship (tick one answer please).

- Not important
- Slightly important
- Moderately important
- Very important
- Extremely important

5) How do you rate the need and importance of informal interaction to support the process of information transfer and the exchange of ideas and opinions (tick one answer please).

- Not important
- Slightly important
- Moderately important
- Very important
- Extremely important

Interview

- Why is the majority of governmental offices are conventional offices?.
- How does the management view the need for both privacy and interaction?.
- What design measures do you use or recommend to the design team to achieve privacy and interaction?.
- Have you thought about the ability of the morphology of spatial structure to affect social encountering?.

QUESTIONNAIRE 2

ASSESSING INTERACTION DENSITY AND OTHER INDEPENDENT VARIABLES

Dear respondent,

This questionnaire is significant to my research. The research aims to examine the impact of spatial layouts on the level of informal interaction among staff in office environment. The research findings will only be used for the academic purpose and will not affect you or your organisation in any way. Thank you for your assistance and co-operation.

The researcher

Adel Ben yaseen
Centre for Facilities Management
University of Strathclyde
Graham Hills Building
50 George Street
G1 1QE
Glasgow

1. What type of work do you do in the organisation?

- A. Managerial -----
- B. Administrative ----- (tick one answer please)
- C. Clerk/ Secretarial -----

2. Out of the total time spent in the office building, what is the percentage of the time you spend :

- A. Seated -----
- B. Standing -----
- C. Walking -----

3. How often do you leave your workspace for both work and personal purposes, in an ordinary day?

- A. At least once every 15 minutes -----
- B. At least once every 30 minutes -----
- C. At least once an hour ----- (tick one answer please)
- D. At least once every 2 hours -----
- E. At least once a day -----

4. Would you please indicate how frequently you talk (face-to-face) informally (all the formal and regular meetings are excluded) to the people listed in the table below.

This question refers to all the face-to-face conversation in any subject even if it is trivial and including greetings.

- Tick one answer only for each person.
- If you do not know the person, leave spaces in front of his name empty.
- Leave spaces in front of your name empty.

Name	FREQUENCY				
	(1) rarely or never	(2) once a week	(3) once a day	(4) a few times a day	(5) several times a day
Omer Ali					
Khalid Hasan					

TABLES & FIGURES

	TASK	SEAT	STA.	WAL.	MOV.	CV	RRA	ENCLOS
SEAT	0.052							
STAND	0.053	-0.746						
WALK	-0.136	-0.686	0.028					
MOVE	0.209	-0.345	0.155	0.349				
CV	-0.002	0.243	-0.274	-0.065	0.496			
RRA	-0.022	-0.007	0.268	-0.283	-0.262	-0.316		
ENCLOS	0.544	-0.061	0.227	-0.156	-0.108	-0.543	0.070	
VIS-ACC	-0.281	0.041	0.190	-0.270	-0.091	0.337	0.218	-0.589
SM-RM	-0.413	-0.092	0.406	-0.305	-0.048	0.297	0.362	-0.502
PROX	0.198	-0.054	-0.094	0.183	-0.146	-0.332	0.360	0.220
SM-RT	-0.405	-0.015	0.279	-0.282	-0.127	0.327	0.268	-0.579
SM-DP	-0.413	-0.092	0.406	-0.305	-0.048	0.297	0.362	-0.502
RARELY	0.024	-0.008	-0.017	0.030	-0.170	-0.156	-0.041	0.182
WEEKLY	0.238	-0.007	0.062	-0.057	-0.335	-0.085	-0.083	0.145
DAILY	0.174	0.351	-0.506	0.025	0.020	-0.148	-0.090	0.196
FEW/DY	0.204	-0.149	0.065	0.152	0.157	-0.051	-0.357	0.266
SEV/DY	-0.407	-0.239	0.409	-0.088	0.186	0.300	0.330	-0.499
MN-INT	-0.314	-0.195	0.303	-0.038	0.304	0.295	0.210	-0.424

	VIS-ACC	S-RM	PROX	S-RT	S-DP	RARELY	WEEK.	DAILY
SM-RM	0.845							
PROX	-0.409	-0.487						
SM-RT	0.934	0.957	-0.497					
SM-DP	0.845	1.000	-0.487	0.957				
RARELY	-0.324	-0.324	0.496	-0.284	-0.324			
WEEKLY	-0.012	-0.109	0.148	-0.063	-0.109	-0.103		
DAILY	-0.436	-0.516	0.135	-0.486	-0.516	-0.143	-0.362	
FEW/D	-0.283	-0.403	-0.050	-0.392	-0.403	-0.003	0.119	-0.234
SEV/D	0.750	0.926	-0.474	0.843	0.926	-0.413	-0.199	-0.517
MN-INT	0.636	0.766	-0.602	0.681	0.766	-0.720	-0.273	-0.288

	FEW/D	SEV/D
SEV/D	-0.349	
MN-INT	-0.094	0.887

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

Table 7.1. Correlation among variables in Office 1.

	TASK	SEAT	STA.	WAL.	MOV.	CV	RRA	ENCLOS
SEAT	0.210							
STAND	-0.204	-0.419						
WALK	-0.072	-0.747	-0.291					
MOVE	-0.422	-0.838	0.238	0.708				
CV	-0.214	-0.422	-0.022	0.460	0.386			
RRA	0.541	0.342	0.104	-0.437	-0.426	-0.173		
ENCLOS	0.654	0.133	0.024	-0.158	-0.171	-0.135	0.338	
VIS-ACC	-0.138	-0.123	0.080	0.071	0.069	0.147	-0.064	-0.251
SM-RM	-0.644	-0.389	0.135	0.311	0.370	0.198	-0.507	-0.677
PROX	0.474	0.356	-0.185	-0.239	-0.285	-0.164	0.408	0.540
SM-RT	-0.305	-0.208	-0.149	0.328	0.201	-0.091	-0.816	-0.246
SM-DP	-0.276	-0.289	-0.132	0.396	0.305	0.003	-0.842	-0.138
RARELY	-0.202	0.133	0.128	-0.234	-0.059	-0.003	0.278	-0.175
WEEKLY	0.394	0.119	0.025	-0.143	-0.206	0.119	0.478	0.376
DAILY	0.112	-0.046	-0.151	0.159	-0.033	-0.307	0.039	0.122
FEW/D	-0.116	-0.146	0.063	0.107	0.135	0.104	-0.432	-0.163
SEV/D	-0.034	-0.010	-0.050	0.047	0.068	0.096	-0.145	-0.025
MN-INT	-0.014	-0.144	-0.089	0.217	0.156	0.074	-0.451	-0.026

	VIS-ACC	S-RM	PROX	S-RT	S-DP	RARELY	WEEK.	DAILY
SM-RM	0.389							
PROX	-0.585	-0.705						
SM-RT	0.214	0.413	-0.494					
SM-DP	0.215	0.416	-0.440	0.942				
RARELY	-0.132	0.207	-0.079	-0.431	-0.467			
WEEKLY	-0.173	-0.429	0.276	-0.510	-0.512	-0.143		
DAILY	-0.463	-0.194	0.281	0.041	0.079	-0.166	-0.110	
FEW/D	0.015	0.134	0.030	0.499	0.521	-0.356	-0.444	0.021
SEV/D	0.558	0.110	-0.338	0.163	0.150	-0.281	0.036	-0.628
MN-INT	0.477	0.072	-0.222	0.572	0.605	-0.786	-0.208	-0.294

	FEW/D	SEV/D
SEV/D	-0.343	
MN-INT	0.325	0.697

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

Table 7.2. Correlation among variables in Office 2.

	TASK	SEAT	STA.	WAL.	MOV.	CV	RRA	ENCLOS
SEAT	0.068							
STAND	-0.322	-0.669						
WALK	0.136	-0.823	0.197					
MOVE	0.059	-0.495	0.285	0.474				
CV	-0.167	-0.143	0.120	-0.032	-0.313			
RRA	0.236	-0.220	0.060	0.229	0.106	-0.171		
ENCLOS	0.821	0.260	-0.432	-0.046	0.008	-0.275	0.358	
PROX	-0.008	-0.202	0.055	0.180	0.158	-0.156	0.424	0.122
SM-RT	-0.133	0.283	-0.095	-0.333	0.062	-0.110	-0.204	0.042
SM-DP	0.162	0.138	-0.067	-0.125	0.073	-0.184	0.036	0.180
RARELY	-0.064	-0.178	0.052	0.193	0.203	0.031	-0.003	-0.026
WEEKLY	0.136	0.220	-0.097	-0.211	-0.536	0.122	0.153	0.103
DAILY	0.160	0.156	-0.160	0.021	-0.015	-0.158	-0.087	-0.006
FEW/D	0.060	-0.034	-0.089	0.053	0.136	-0.050	-0.137	0.045
SEV/D	-0.206	-0.004	0.217	-0.187	0.052	0.008	0.063	-0.091
MN-INT	-0.056	0.070	0.055	-0.158	0.014	-0.052	-0.028	-0.028

	PROX	S-RT	S-DP	RARE.	WEEK.	DAILY	FEW/D	SEV/D
SM-RT	-0.582							
SM-DP	-0.751	0.629						
RARELY	0.681	-0.581	-0.697					
WEEKLY	-0.268	0.129	0.229	-0.534				
DAILY	-0.470	0.186	0.512	-0.328	0.065			
FEW/D	-0.533	0.415	0.526	-0.598	-0.047	0.057		
SEV/D	-0.057	0.364	0.094	-0.433	-0.012	-0.371	0.107	
MN-INT	-0.553	0.607	0.585	-0.887	0.174	0.084	0.662	0.720

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

Table 7.3. Correlation among variables in Office 3.

	TASK	SEAT	STA.	WAL.	MOV.	CV	RRA	ENCLOS
SEAT	-0.097							
STAND	-0.028	-0.835						
WALK	0.217	-0.604	0.066					
MOVE	0.223	-0.360	0.311	0.196				
CV	-0.333	0.263	-0.225	-0.150	-0.115			
RRA	-0.299	-0.340	0.266	0.231	0.091	-0.277		
ENCLOS	0.512	-0.064	0.057	0.033	0.065	-0.265	-0.182	
VIS-ACC	-0.222	-0.073	0.190	-0.142	0.056	-0.160	-0.014	-0.520
SM-RM	-0.233	0.143	-0.075	-0.151	-0.187	0.168	-0.372	-0.514
PROX	-0.226	-0.058	0.049	0.034	-0.034	-0.069	0.474	0.092
SM-RT	0.152	0.166	-0.133	-0.108	0.002	0.247	-0.546	0.071
SM-DP	-0.393	0.274	-0.269	-0.108	-0.042	0.159	-0.309	-0.244
RARELY	0.168	0.283	-0.076	-0.402	-0.397	-0.117	-0.144	0.236
WEEKLY	0.090	-0.218	0.275	-0.002	0.170	-0.063	0.269	-0.089
DAILY	-0.117	0.137	-0.253	0.118	0.068	0.350	-0.167	-0.165
FEW/D	-0.218	-0.272	0.117	0.323	0.353	-0.132	0.243	-0.212
SEV/D	-0.172	-0.353	0.134	0.447	0.316	-0.052	0.020	0.002
MN-INT	-0.218	-0.343	0.071	0.519	0.418	0.057	0.099	-0.168

	VIS-ACC	S-RM	PROX	S-RT	S-DP	RARELY	WEEK.	DAILY
SM-RM	0.713							
PROX	-0.504	-0.682						
SM-RT	0.247	0.438	-0.765					
SM-DP	0.403	0.473	-0.460	0.456				
RARELY	-0.173	-0.266	0.268	-0.176	-0.122			
WEEKLY	0.033	0.001	0.227	-0.319	-0.396	-0.345		
DAILY	0.027	0.274	-0.387	0.316	0.262	-0.592	-0.158	
FEW/D	0.284	0.105	-0.003	0.013	0.274	-0.518	0.183	0.078
SEV/D	0.056	0.079	-0.200	0.250	0.130	-0.384	-0.326	-0.011
MN-INT	0.172	0.222	-0.318	0.292	0.256	-0.862	-0.073	0.456

	FEW/D	SEV/D
SEV/D	-0.006	
MN-INT	0.454	0.754

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

Table 7.4. Correlation among variables in Office 4.

	TASK	SEAT	STA.	WAL.	MOV.	CV	RRA	ENCLOS
SEAT	0.130							
STAND	-0.097	-0.635						
WALK	-0.133	-0.815	0.078					
MOVE	-0.110	-0.470	0.422	0.290				
CV	-0.175	-0.014	-0.105	0.087	-0.123			
RRA	-0.080	0.030	-0.098	0.038	-0.165	0.106		
ENCLOS	0.358	0.361	-0.259	-0.282	0.000	-0.222	-0.034	
VIS-ACC	-0.002	-0.361	0.140	0.349	-0.033	0.131	-0.064	-0.881
SM-RM	-0.029	-0.368	0.109	0.376	-0.011	0.108	0.110	-0.749
PROX	0.003	0.192	-0.423	0.064	-0.270	0.357	0.471	0.217
SM-RT	-0.034	-0.305	0.227	0.201	-0.008	-0.045	-0.102	-0.631
SM-DP	0.148	0.368	-0.150	-0.396	-0.160	-0.298	0.136	0.134
RARELY	-0.197	-0.051	-0.070	0.128	-0.049	0.111	-0.079	-0.053
WEEKLY	0.131	0.176	-0.205	-0.054	-0.383	-0.079	-0.071	0.227
DAILY	-0.072	0.428	-0.232	-0.379	-0.099	0.227	0.129	-0.001
FEW/D	-0.092	-0.025	0.363	-0.250	0.467	-0.283	-0.106	0.105
SEV/D	0.277	-0.495	0.168	0.500	0.032	-0.089	0.082	-0.169
MN-INT	0.240	-0.327	0.280	0.191	0.237	-0.166	0.077	-0.068

	VIS-ACC	S-RM	PROX	S-RT	S-DP	RARELY	WEEK.	DAILY
SM-RM	0.865							
PROX	-0.238	-0.155						
SM-RT	0.754	0.702	-0.221					
SM-DP	-0.147	0.029	-0.178	-0.099				
RARELY	0.008	-0.063	0.290	-0.206	-0.223			
WEEKLY	-0.121	-0.138	0.086	0.082	0.012	-0.099		
DAILY	-0.132	-0.186	0.145	-0.193	0.056	-0.302	-0.311	
FEW/D	-0.161	-0.111	-0.402	0.097	0.201	-0.576	-0.057	-0.096
SEV/D	0.362	0.472	-0.198	0.323	0.008	-0.236	-0.102	-0.520
MN-INT	0.165	0.281	-0.385	0.300	0.185	-0.839	-0.169	-0.061

	FEW/D	SEV/D
SEV/D	-0.075	
MN-INT	0.546	0.661

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

Table 7.5. Correlation among variables in office 5.

	TASK	SEAT	STA.	WAL.	MOV.	CV	RRA	ENCLOS
SEAT	0.080							
STAND	-0.227	-0.903						
WALK	0.114	-0.862	0.561					
MOVE	0.651	-0.171	-0.125	0.477				
CV	-0.029	-0.590	0.750	0.253	-0.292			
RRA	0.748	-0.287	0.014	0.536	0.625	0.255		
ENCLOS	0.580	0.377	-0.405	-0.249	0.176	-0.146	0.165	
VIS-ACC	-0.243	0.435	-0.321	-0.459	-0.388	-0.481	-0.427	0.222
PROX	0.610	-0.174	-0.054	0.400	0.467	0.265	0.780	0.194
SM-RT	-0.578	0.176	-0.010	-0.328	-0.532	0.230	-0.634	-0.041
SM-DP	0.153	0.026	-0.189	0.174	0.389	-0.498	0.069	0.038
RARELY	0.090	0.011	0.039	-0.067	0.249	-0.122	0.171	-0.444
WEEKLY	0.493	-0.406	0.223	0.520	0.131	0.253	0.571	0.218
DAILY	0.083	0.169	-0.131	-0.172	-0.378	0.099	-0.183	0.484
FEW/D	-0.504	0.260	-0.133	-0.345	-0.172	-0.099	-0.555	-0.010
SEV/D	0.008	-0.178	0.038	0.298	-0.012	0.013	0.097	0.120
MN-INT	-0.275	0.048	-0.076	-0.003	-0.227	0.013	-0.321	0.292

	VIS-ACC	PROX	S-RT	S-DP	RARE	WEEK.	DAILY	FEW/D
PROX	-0.505							
SM-RT	-0.011	-0.392						
SM-DP	0.245	0.023	-0.397					
RARELY	-0.166	0.062	-0.570	0.155				
WEEKLY	-0.147	0.414	-0.286	-0.266	-0.261			
DAILY	0.211	-0.070	0.264	0.063	-0.524	0.310		
FEW/D	0.239	-0.502	0.553	0.068	-0.365	-0.660	-0.086	
SEV/D	-0.101	0.257	0.255	-0.168	-0.494	0.116	-0.212	-0.033
MN-INT	0.158	-0.148	0.660	-0.098	-0.882	-0.136	0.185	0.601

	SEV/D
MN-INT	0.664

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

Table 7.6. Correlation among variables in Office 6.

	TASK	SEAT	STA.	WAL.	MOV.	CV	RRA	ENCLOS
SEAT	-0.002							
STAND	-0.121	-0.652						
WALK	0.085	-0.791	0.066					
MOVE	0.132	-0.477	0.233	0.445				
CV	-0.154	-0.022	-0.073	0.084	0.122			
RRA	0.083	-0.016	0.112	-0.070	-0.038	-0.083		
ENCLOS	0.435	0.253	-0.187	-0.202	-0.039	-0.303	-0.067	
VIS-ACC	-0.104	-0.174	0.130	0.136	-0.033	0.172	-0.026	-0.628
SM-RM	-0.214	-0.138	0.150	0.071	-0.023	0.285	0.096	-0.628
PROX	0.175	0.014	-0.088	0.015	-0.056	-0.139	0.145	0.339
SM-RT	-0.113	-0.003	-0.021	0.024	0.034	0.144	-0.309	-0.161
SM-DP	-0.006	0.093	-0.075	-0.072	0.074	0.077	0.041	0.103
RARELY	-0.017	0.104	-0.074	-0.096	-0.045	-0.162	-0.059	0.272
WEEKLY	0.227	0.067	-0.008	-0.087	-0.226	-0.058	0.170	0.244
DAILY	-0.031	0.130	-0.128	-0.040	-0.030	0.134	0.115	-0.256
FEW/D	-0.070	-0.086	0.067	0.054	0.217	-0.079	-0.246	-0.014
SEV/D	-0.041	-0.245	0.181	0.177	0.073	0.174	0.023	-0.251
MN-INT	-0.055	-0.210	0.145	0.171	0.137	0.175	-0.019	-0.319

	VIS-ACC	S-RM	PROX	S-RT	S-DP	RARELY	WEEK.	DAILY
SM-RM	0.723							
PROX	-0.455	-0.480						
SM-RT	0.419	0.402	-0.527					
SM-DP	0.065	0.196	-0.155	0.569				
RARELY	-0.355	-0.368	0.490	-0.209	0.042			
WEEKLY	-0.195	-0.191	0.246	-0.185	0.043	-0.050		
DAILY	0.081	0.228	-0.364	-0.058	-0.225	-0.529	-0.270	
FEW/D	0.043	-0.061	-0.269	0.228	0.069	-0.372	-0.181	-0.024
SEV/D	0.499	0.429	-0.225	0.301	0.105	-0.479	-0.189	-0.149
MN-INT	0.482	0.439	-0.487	0.334	0.029	-0.889	-0.242	0.296

	FEW/D	SEV/D
SEV/D	-0.088	
MN-INT	0.386	0.766

Significance level is .59 at 1%, .48 at 5%, and .41 at 10%.

Table 7.7. Overall correlation among variables in the six cases

PREDIC-TORS	SEV/DY <i>P</i> -VALUE	FEW/DY <i>P</i> -VALUE	DAILY <i>P</i> -VALUE	WEEKLY <i>P</i> -VALUE	RARELY <i>P</i> -VALUE	MN-INT <i>P</i> -VALUE
constant	0.187	0.064	0.464	0.920	0.010	0.000
task-ch	0.856	0.481	0.966	0.017	0.000	0.626
seat	0.501	0.306	0.237	0.341	0.007	0.686
leave	0.055	0.716	0.510	0.317	0.106	0.162
cv	0.356	0.539	0.799	0.496	0.847	0.641
rra	0.472	0.734	0.281	0.111	0.255	0.290
enclosure	0.101	0.251	0.566	0.880	0.007	0.381
vis-acc	0.419	0.168	0.524	0.804	0.003	0.097
sm-rm	0.001	0.885	0.227	0.272	0.416	0.043
prox	0.324	0.444	0.258	0.035	0.527	0.013
sm-rt	0.100	0.357	0.573	0.313	0.537	0.053
sm-dp	-----	-----	-----	-----	-----	-----
ANOVA	0.000	0.402	0.275	0.032	0.000	0.000
<i>p</i> -value						
R-SQ (adj)	91.6 %	4.6 %	12.6 %	47.1 %	75.1 %	74.4 %

Table 7.8 R-sq and *P*-values for variables in office 1.

PREDIC-TORS	SEV/DY <i>P</i> -VALUE	FEW/DY <i>P</i> -VALUE	DAILY <i>P</i> -VALUE	WEEKLY <i>P</i> -VALUE	RARELY <i>P</i> -VALUE	MN-INT <i>P</i> -VALUE
constant	0.393	0.568	0.250	0.913	0.824	0.183
task-ch	0.211	0.788	0.562	0.992	0.634	0.548
seat	0.023	0.009	0.115	0.902	0.217	0.706
leave	0.010	0.012	0.323	0.937	0.527	0.997
cv	0.073	0.012	0.237	0.283	0.684	0.714
rra	0.084	0.013	0.195	0.896	0.931	0.445
enclosure	0.582	0.953	0.133	0.167	0.341	0.962
vis-acc	0.008	0.683	0.060	0.604	0.428	0.018
sm-rm	0.242	0.549	0.228	0.908	0.125	0.434
prox	0.922	0.733	0.960	0.875	0.710	0.699
sm-rt	0.873	0.974	0.429	0.142	0.833	0.679
sm-dp	0.172	0.046	0.094	0.043	0.440	0.851
ANOVA	0.006	0.010	0.206	0.083	0.156	0.027
<i>p</i> -value						
R-SQ (adj)	64.2 %	57.8 %	18.4 %	32.9 %	22.8 %	43.4 %

Table 7.9 R-sq and *p*-values for variables in office 2

PREDIC-TORS	SEV/DY <i>P</i> -VALUE	FEW/DY <i>P</i> -VALUE	DAILY <i>P</i> -VALUE	WEEKLY <i>P</i> -VALUE	RARELY <i>P</i> -VALUE	MN-INT <i>P</i> -VALUE
constant	0.970	0.300	0.135	0.105	0.109	0.599
task-ch	0.624	0.588	0.004	0.652	0.119	0.273
seat	0.356	0.288	0.035	0.456	0.651	0.343
leave	0.410	0.750	0.961	0.006	0.092	0.649
cv	0.096	0.192	0.014	0.036	0.292	0.539
rra	0.143	0.962	0.003	0.972	0.237	0.186
enclosure	0.574	0.676	0.005	0.221	0.082	0.022
vis-acc	-----	-----	-----	-----	-----	-----
sm-rm	-----	-----	-----	-----	-----	-----
prox	0.554	0.604	0.017	0.059	0.734	0.841
sm-rt	0.534	0.220	0.005	0.832	0.062	0.023
sm-dp	0.316	0.714	0.000	0.004	0.389	0.406
ANOVA	0.287	0.061	0.001	0.002	0.002	0.002
<i>p</i> -value						
R-SQ (adj)	9.0 %	25...3 %	58.2 %	54.3 %	49.5 %	51.8 %

Table 7.10 R-sq and *p*-values for variables in office 3

PREDIC-TORS	SEV/DY <i>P</i> -VALUE	FEW/DY <i>P</i> -VALUE	DAILY <i>P</i> -VALUE	WEEKLY <i>P</i> -VALUE	RARELY <i>P</i> -VALUE	MN-INT <i>P</i> -VALUE
constant	0.670	0.105	0.443	0.451	0.491	0.996
task-ch	0.854	0.558	0.316	0.323	0.935	0.903
seat	0.014	0.106	0.156	0.482	0.573	0.264
leave	0.393	0.006	0.096	0.775	0.096	0.097
cv	0.121	0.058	0.368	0.419	0.559	0.410
rra	0.362	0.051	0.111	0.746	0.295	0.240
enclosure	0.871	0.121	0.443	0.489	0.898	0.819
vis-acc	0.090	0.458	0.003	0.261	0.284	0.295
sm-rm	0.091	0.639	0.044	0.855	0.126	0.124
prox	0.724	0.689	0.018	0.415	0.685	0.897
sm-rt	0.768	0.244	0.543	0.721	0.941	0.746
sm-dp	0.016	0.252	0.551	0.032	0.701	0.168
ANOVA	0.092	0.006	0.023	0.235	0.644	0.397
<i>p</i> -value						
R-SQ (adj)	35.1 %	67.1 %	51.0 %	19.2 %	0 %	6.1 %

Table 7.11 R-sq and *p*-values for variables in office 4

PREDIC-TORS	SEV/DY <i>P</i> -VALUE	FEW/DY <i>P</i> -VALUE	DAILY <i>P</i> -VALUE	WEEKLY <i>P</i> -VALUE	RARELY <i>P</i> -VALUE	MN-INT <i>P</i> -VALUE
constant	0.713	0.250	0.083	0.796	0.731	0.002
task-ch	0.555	0.449	0.005	0.454	0.749	0.030
seat	0.112	0.884	0.001	0.595	0.077	0.579
leave	0.342	0.065	0.679	0.104	0.117	0.022
cv	0.695	0.964	0.000	0.117	0.043	0.015
rra	0.071	0.953	0.381	0.552	0.005	0.008
enclosure	0.091	0.269	0.011	0.294	0.167	0.594
vis-acc	0.338	0.162	0.007	0.179	0.912	0.513
sm-rm	0.286	0.895	0.011	0.281	0.685	0.092
prox	0.092	0.319	0.167	0.382	0.000	0.000
sm-rt	0.776	0.333	0.599	0.290	0.282	0.501
sm-dp	0.244	0.846	0.967	0.671	0.049	0.861
ANOVA	0.019	0.310	0.001	0.380	0.009	0.004
<i>p</i> -value						
R-SQ (adj)	46.4 %	10.8 %	73.3 %	6.8 %	56.3 %	62.9 %

Table 7.12 R-sq and *p*-values for variables in office 5

PREDIC-TORS	SEV/DY <i>P</i> -VALUE	FEW/DY <i>P</i> -VALUE	DAILY <i>P</i> -VALUE	WEEKLY <i>P</i> -VALUE	RARELY <i>P</i> -VALUE	MN-INT <i>P</i> -VALUE
constant	0.040	0.309	0.215	0.049	0.054	0.246
task-ch	0.053	0.978	0.404	0.536	0.851	0.430
seat	0.016	0.364	0.468	0.015	0.046	0.147
leave	0.124	0.292	0.308	0.054	0.292	0.761
cv	0.062	0.233	0.415	0.016	0.172	0.646
rra	0.230	0.718	0.856	0.067	0.083	0.207
enclosure	0.920	0.703	0.126	0.115	0.131	0.515
vis-acc	0.129	0.204	0.368	0.270	0.153	0.100
sm-rm	-----	-----	-----	-----	-----	-----
prox	0.047	0.617	0.311	0.138	0.298	0.942
sm-rt	0.007	0.213	0.714	0.938	0.016	0.017
sm-dp	0.379	0.195	0.639	0.057	0.298	0.240
ANOVA	0.040	0.498	0.489	0.078	0.101	0.155
<i>p</i> -value						
R-SQ (adj)	87.7 %	12.7 %	14.3 %	80.4 %	76.4 %	67.5 %

Table 7.13 R-sq and *p*-values for variables in office 6

PREDIC-TORS	SEV/DY <i>P</i> -VALUE	FEW/DY <i>P</i> -VALUE	DAILY <i>P</i> -VALUE	WEEKLY <i>P</i> -VALUE	RARELY <i>P</i> -VALUE	MN-INT <i>P</i> -VALUE
constant	0.297	0.000	0.000	0.136	0.584	0.000
task-ch	0.435	0.462	0.122	0.055	0.009	0.135
seat	0.019	0.236	0.000	0.197	0.324	0.005
leave	0.621	0.005	0.602	0.001	0.064	0.155
cv	0.267	0.185	0.689	0.833	0.005	0.011
rra	0.758	0.875	0.520	0.256	0.005	0.469
enclosure	0.051	0.092	0.040	0.630	0.824	0.132
vis-acc	0.000	0.430	0.008	0.804	0.474	0.005
sm-rm	0.007	0.003	0.001	0.415	0.125	0.075
prox	0.401	0.000	0.000	0.398	0.000	0.000
sm-rt	0.878	0.750	0.000	0.502	0.260	0.267
sm-dp	0.796	0.412	0.001	0.179	0.419	0.382
ANOVA	0.000	0.000	0.000	0.001	0.000	0.000
<i>p</i> -value						
R-SQ (adj)	55.9 %	23.5 %	51.8 %	13.2%	53.5 %	54.9 %

Table 7.14 R-sq and *p*-values for variables in the six offices.

	STEP	1	2	3	4
OFFICE 1	constant	0.02901	-0.04753		
	• SM-RM**	1.001	1.013		
	t-ratio	12.27	15.33		
	• LEAVE*		0.0373		
	t-ratio		3.77		
	s	0.0742	0.0601		
	R-SQ	85.76	91.06		
OFFICE 2	constant	0.1264	0.04611	-0.5477	
	• VIS-ACC**	0.76	0.74	0.72	
	t-ratio	4.29	4.29	4.59	
	• LEAVE**		0.029	0.61	
	t-ratio		1.66	2.32	
	• SEAT**			0.109	
	t-ratio			2.88	
	s	0.103	0.0993	0.0903	
R-SQ	45.58	51.90	62.14		
OFFICE 4	constant	0.4364	0.1734		
	• SEAT**	-0.42	-0.51		
	t-ratio	-2.80	-3.75		
	• SM-DP**		0.56		
	t-ratio		2.71		
	s	0.0937	0.0830		
R-SQ	25.42	44.07			
OFFICE 5	constant	0.1327	0.07670	-0.02895	0.04206
	• SM-RM	0.41	0.41	0.65	0.69
	t-ratio	3.27	3.24	3.41	3.67
	• RRA*		0.043	0.046	0.139
	t-ratio		0.54	0.60	1.47
	• ENCLOS*			0.030	0.041
	t-ratio			1.64	2.12
	• PROX*				-0.0077
	t-ratio				-1.57
	s	0.111	0.112	0.109	0.106
R-SQ	29.08	29.91	36.97	43.08	
OFFICE 6	constant	0.08510	0.17534	-1.0296	-0.6648
	• SM-RT**	0.21	0.24	0.63	0.85
	t-ratio	0.98	1.10	2.25	4.08
	• SEAT**		-0.13	-0.22	-0.16
	t-ratio		-0.81	-1.42	-1.5
	• TASK-CH*			0.115	0.086
	t-ratio			1.94	2.00
	• PROX**				0.0168
	t-ratio				3.30
	s	0.119	0.121	0.108	0.0766
R-SQ	7.47	12.74	36.64	71.34	

Continued..

	STEP	1	2	3	4
OVERALL	constant	0.1092	0.1933	0.1872	
	• VIS-ACC**	0.731	0.700	0.528	
	t-ratio	12.37	11.92	5.74	
	• SEAT**		-0.117	-0.113	
	t-ratio		-2.77	-2.73	
	• SM-RM**			0.192	
	t-ratio			2.40	
	s	0.0976	0.0953	0.0936	
	R-SQ	52.95	55.49	57.32	

Table 7.15 Significant predictors developed by stepwise regression for "several times a day" level in the six offices.

* $p < .1$

** $P < .05$

	STEP	1	2	3	4	5
OFFICE 2	constant	0.03693	0.01696	-0.53674	-0.31565	0.4928
	• SM-DP**	0.267	0.260	0.518	0.521	0.59
	t-ratio	2.83	2.83	3.10	3.08	5.05
	• CV**		0.030	0.045	0.050	0.055
	t-ratio		1.48	2.16	2.21	3.51
	• RRA**			0.20	0.19	0.263
	t-ratio			1.81	1.66	3.28
	• LEAVE**				-0.011	-0.133
	t-ratio				-0.62	-4.75
	• SEAT**					-0.94
	t-ratio					-4.85
s	0.0953	0.0929	0.0884	0.089	0.0615	
R-SQ	25.87	32.55	41.68	42.79	74.45	
OFFICE 4	constant	0.06801	0.08166	-0.02970		
	• LEAVE**	0.0323	0.0306	0.0318		
	t-ratio	3.95	4.13	4.69		
	• CV*		-0.0188	-0.0217		
	t-ratio		-2.41	-3.01		
	• SM-DP			0.181		
	t-ratio			2.26		
	s	0.0380	0.0343	0.0312		
R-SQ	42.66	55.56	64.96			
OVERALL	constant	0.1861	0.2435	0.2062		
	• PROX**	-0.00170	-0.00276	-0.00274		
	t-ratio	-3.62	-5.48	-5.63		
	• SM-RM**		-0.159	-0.155		
	t-ratio		-4.32	-4.35		
	• LEAVE**			0.0149		
	t-ratio			3.15		
	s	0.0664	0.0623	0.0602		
R-SQ	9.23	20.78	26.51			

Table 7.16 Significant predictors developed by stepwise regression for "a few times a day" level in the six offices.

* $p < .1$

** $p < .05$

	STEP	1	2	3	4	5	6	7	8
OFFICE 3	constant	0.03510	0.03579	0.02408	0.26493	0.17558	0.18030	0.11187	-0.2654
	• SM-DP**	0.202	0.373	0.39	0.46	0.49	0.50	0.41	0.89
	t-ratio	2.13	3.23	3.26	3.99	4.38	4.33	3.65	4.56
	• SM-RT**		-0.36	-0.40	-0.59	-0.69	-0.69	-0.56	-0.56
	t-ratio		-2.29	-2.35	-3.30	-3.83	-3.75	-3.19	-3.66
	• CV**			0.044	0.080	0.111	0.107	0.096	0.200
	t-ratio			0.65	1.24	1.73	1.63	1.60	3.15
	• RRA**				-0.194	-0.187	-0.173	-1.45	-0.40
	t-ratio				-2.26	-2.27	-1.96	-1.78	-3.51
	• SEAT**					0.116	0.126	0.156	0.186
	t-ratio					1.78	1.82	2.42	3.29
	• ENCLOS**						-0.009	-0.063	-0.083
	t-ratio						-0.50	-2.22	-3.27
	• TASK-CH**							0.087	0.115
	t-ratio							2.32	3.39
• PROX**								0.0088	
t-ratio								2.85	
s		0.0776	0.0721	0.0729	0.0676	0.0647	0.0658	0.0601	0.0519
R-SQ		14.44	28.82	30.02	42.31	49.32	49.88	60.14	71.65
OFFICE 4	constant	0.1872	0.3580	0.4789	0.4484				
	• CV	0.077	0.063	0.043	0.028				
	t-ratio	3.08	2.61	1.68	0.92				
	• PROX**		-0.0064	-0.0094	-0.0082				
	t-ratio		-2.14	-2.78	-2.30				
	• VIS-ACC**			-0.53	-0.85				
	t-ratio			-1.69	-1.94				
	• SM-RT				0.19				
	t-ratio				1.04				
s		0.110	0.103	0.0985	0.0983				
R-SQ		29.22	41.40	48.43	51.08				
OFFICE 5	constant	0.16075	0.08319	0.17012	0.17510	0.22791	0.08716	0.23317	
	• SEAT**	0.313	0.342	0.373	0.365	0.328	0.419	0.433	
	t-ratio	3.52	4.66	4.95	4.49	3.80	5.83	6.59	
	• CV**		0.169	0.159	0.161	0.157	0.224	0.289	
	t-ratio		3.50	3.33	3.28	3.22	5.28	5.95	
	• TASK-CH**			-0.047	-0.051	-0.031	-0.172	-0.174	
	t-ratio			-1.38	-1.39	-0.76	-3.42	-3.80	
	• ENCLOS**				0.004	-0.013	0.112	0.123	
	t-ratio				0.34	-0.66	2.98	3.55	
	• SM-RM**					-0.23	-0.85	-0.78	
	t-ratio					-1.18	-3.72	-3.73	
	• VIS-ACC**						1.66	1.61	
	t-ratio						3.62	3.85	
	• PROX							-0.007	
	t-ratio							-2.19	
s		0.112	0.0922	0.0903	0.0923	0.0914	0.0715	0.0649	
R-SQ		35.00	58.24	61.71	61.94	64.52	79.47	84.00	

continued..

	STEP	1	2	3	4	5	6	7
OVERALL	constant	0.3385	0.5947	0.5586	0.4681	0.4456	0.4508	0.4817
	• PROX**	-0.0039	-0.008	-0.007	-0.007	-0.006	-0.006	-0.006
	t-ratio	-4.66	-8.97	-7.84	-7.95	-7.19	-7.34	-7.22
	• SM-RT**		-0.420	-0.457	-0.469	-0.380	-0.330	-0.325
	t-ratio		-7.67	-8.32	-8.74	-6.45	-5.25	-5.21
	• SM-RM**			0.164	0.199	0.206	0.311	0.276
	t-ratio			2.81	3.44	3.67	4.16	3.58
	• SEAT**				0.125	0.148	0.145	0.164
	t-ratio				2.92	3.51	3.49	3.83
	• SM-DP**					-0.131	-0.155	-0.147
	t-ratio					-3.16	-3.64	-3.45
	• VIS-ACC**						-0.199	-0.251
	t-ratio						-2.09	-2.53
	• ENCLOS**							-0.0156
	t-ratio							-1.68
	s	0.120	0.100	0.0976	0.0948	0.0917	0.0905	0.0898
	R-SQ	14.30	41.13	44.56	48.04	51.85	53.48	54.51

Table 7. 17 Significant predictors developed by stepwise regression for "daily" level for all cases.

* $p < .1$

** $P < .05$

	STEP	1	2	3	4	
OFFICE 1	constant	-0.09948	-0.00988	0.1091		
	• TASK-CH**	0.050	0.057			
	t-ratio	1.36	1.58			
	• PROX**	0.0034				
	t-ratio	0.99				
	s	0.0874	0.0874	0.0902		
	R-SQ	14.21	10.19	0.00		
OFFICE 2	constant	0.2527	0.1646			
	• SM-DP**	-0.251	-0.245			
	t-ratio	-3.42	-3.84			
	• ENCLOS		0.034			
	t-ratio		2.97			
	s	0.0686	0.0599			
	R-SQ	31.92	50.22			
OFFICE 3	constant	0.2837	0.1969	-0.3284	-0.3834	
	• LEAVE**	-0.040	-0.040	-0.048	-0.053	
	t-ratio	-3.19	-3.42	-4.53	-5.30	
	• SM-DP**		0.212	0.663	0.751	
	t-ratio		2.35	3.96	4.71	
	• PROX*			0.0069	0.0081	
	t-ratio			3.05	3.76	
	• CV**				-0.124	
	t-ratio				-2.33	
	s	0.0770	0.0715	0.0625	0.0578	
R-SQ	26.60	39.02	55.11	63.10		
OFFICE 4	constant	0.6465				
	• SM-DP**	-0.82				
	t-ratio	-4.31				
	s	0.0766				
	R-SQ	44.64				
OFFICE 6	constant	-0.04557	0.06536	0.12079	0.3297	0.3731
	• RRA*	0.195	0.168	0.159	0.169	0.275
	t-ratio	2.31	1.92	1.75	2.26	3.42
	• SEAT**		-0.11	-0.16	-0.298	-0.360
	t-ratio		-1.08	-1.18	-2.37	-3.27
	• CV**			-0.056	-0.239	-0.314
	t-ratio			-0.57	-2.18	-3.16
	• SM-DP*				-0.60	-0.57
	t-ratio				-2.44	-2.71
	• LEAVE*					-0.037
	t-ratio					-2.14
	s	0.0769	0.0763	0.0788	0.0645	0.0546
	R-SQ	30.85	37.49	39.45	63.50	76.76

continued..

	STEP	1	2	3
OVERALL	constant	0.06114	0.10807	0.04317
	• PROX	0.00201	0.00196	0.00165
	t-ratio	3.56	3.58	3.09
	• LEAVE**		-0.0178	-0.0205
	t-ratio		-3.20	-3.79
	• TASK-CH*			0.037
	t-ratio			3.57
	s	0.0822	0.0797	0.0766
	R-SQ	8.16	14.33	21.42

Table 7.18 Significant predictors developed by stepwise regression for "weekly" level in the six offices.

* $p < .1$

** $p < .05$

	STEP	1	2	3	4	5
OFFICE 1	constant	-0.05234	0.10211	0.21726	0.2275	0.2321
	• TASK-CH**	0.071	0.073	0.081	0.073	0.092
	t-ratio	2.37	2.76	3.44	2.84	3.25
	• SEAT**		-0.225	-0.221	-0.216	-0.228
	t-ratio		-2.73	-3.01	-2.92	-3.14
	• RRA			-0.100	-0.086	-0.069
	t-ratio			-2.55	-2.01	-1.58
	• VIS-ACC**				-0.072	-0.142
	t-ratio				-0.93	-1.58
	• ENCLOS**					-0.024
	t-ratio					-1.43
s	0.0642	0.0565	0.0503	0.0505	0.0491	
R-SQ	20.32	41.18	55.57	57.49	61.82	
OFFICE 3	constant	-0.1659	0.1316	0.2952	0.2600	0.2796
	• PROX	0.0112	0.0136	0.0117	0.0117	0.0107
	t-ratio	5.03	5.73	3.73	3.68	3.28
	• RRA		-0.34	-0.35	-0.38	-0.39
	t-ratio		-2.18	-2.24	-2.32	-2.40
	• SM-RT*			-0.27	-0.29	-0.38
	t-ratio			-0.92	-0.96	-1.23
	• ENCLOS*				0.022	0.023
	t-ratio				0.69	0.74
	• LEAVE*					0.024
	t-ratio					1.15
s	0.135	0.127	0.128	0.129	0.128	
R-SQ	44.96	52.49	53.84	54.62	56.75	
OFFICE 4	constant	0.5592				
	• LEAVE*	-0.078				
	t-ratio	-2.12				
	s	0.195				
	R-SQ	15.79				
OFFICE 5	constant	0.2316	0.1883	0.04562	0.04768	
	• RRA**	-0.067	-0.008	-0.126	-0.133	
	t-ratio	-0.90	-0.10	-1.50	-1.42	
	• CV**		-0.081	-0.120	-0.114	
	t-ratio		-1.59	-2.52	-1.92	
	• PROX**			0.0110	0.0110	
	t-ratio			2.68	2.61	
	• SM-DP**				0.08	
	t-ratio				0.17	
	s	0.103	0.100	0.0889	0.0909	
R-SQ	3.29	12.88	34.27	34.37		

continued..

	STEP	1	2	3	4	5
OFFICE 6	constant	0.6479	1.0729	0.9586	1.0274	
	• SM-RT**	-0.66	-0.86	-0.103	-1.08	
	t-ratio	-2.08	-3.07	-3.96	-3.04	
	• ENCLOS		-0.104	-0.144	-0.140	
	t-ratio		-2.41	-3.37	-2.90	
	• SEAT**			0.41	0.39	
	t-ratio			2.04	1.71	
	• RRA*				-0.06	
	t-ratio				-0.23	
	s	0.177	0.150	0.132	0.139	
R-SQ	26.52	51.95	66.08	66.27		
OVERALL	constant	-0.04366	0.10222	0.13006	0.20246	
	• PROX**	0.00835	0.00890	0.00863	0.00887	
	t-ratio	9.57	10.67	10.54	10.89	
	• RRA**		-0.129	-0.127	-0.127	
	t-ratio		-4.10	-4.14	-4.19	
	• CV**			-0.050	-0.051	
	t-ratio			-2.78	-2.89	
	• TASK-CH**				-0.036	
	t-ratio				-2.19	
	s	0.123	0.116	0.113	0.112	
R-SQ	41.53	48.32	51.28	53.06		

Table 7.19 Significant predictors developed by stepwise regression for "rarely" level in all cases.

* $p < .1$
** $P < .05$

	STEP	1	2	3	4	5
OFFICE 1	constant	2.718	2.406	3.316	3.314	3.463
	• SM-RM**	2.27	2.32	1.96	1.90	3.22
	t-ratio	5.85	6.86	5.37	2.98	2.97
	• LEAVE		0.152	0.134	0.134	0.115
	t-ratio		3.01	2.75	2.69	2.28
	• PROX**			-0.025	-0.025	-0.028
	t-ratio			-2.00	-1.95	-2.21
	• VIS-ACC*				0.08	
	t-ratio				0.12	
	• SM-RT*					-1.5
	t-ratio					-1.23
s	0.353	0.307	0.290	0.296	0.287	
R-SQ	57.78	69.35	73.89	73.91	75.57	
OFFICE 2	constant	2.739				
	• VIS-ACC**	2.33				
	t-ratio	3.61				
	s	0.387				
	R-SQ	33.43				
OFFICE 3	constant	1.769	2.337			
	• SM-RT**	2.98	2.98			
	t-ratio	4.87	5.10			
	• ENCLOS**		-0.168			
	t-ratio		-1.94			
	s	0.377	0.360			
R-SQ	44.99	51.52				
OFFICE 5	constant	3.082	3.146	3.828	3.356	2.202
	• CV**	0.23	0.24	0.43	0.43	0.42
	t-ratio	1.24	1.15	2.27	2.34	3.04
	• RRA**		-0.05	0.50	0.52	0.81
	t-ratio		-0.16	1.50	1.61	3.14
	• PROX**			-0.053	-0.049	-0.058
	t-ratio			-3.16	-3.01	-4.64
	• LEAVE**				0.114	0.179
	t-ratio				1.62	3.21
	• TASK-CH**					0.376
	t-ratio					4.02
s	0.408	0.417	0.353	0.341	0.260	
R-SQ	5.99	6.09	35.44	42.64	68.26	
OFFICE 6	constant	1.650				
	• SM-RT**	2.48				
	t-ratio	2.77				
	s	0.503				
	R_SQ	39.01				

continued..

	STEP	1	2	3	4
OVERALL	constant	2.591	3.2996	3.255	3.574
	• VIS-ACC**	2.51	1.73	1.58	1.44
	t-ratio	9.28	6.04	5.46	4.92
	• PROX**		-0.0182	-0.0183	-0.0188
	t-ratio		-5.34	-5.43	-5.65
	• CV**			0.148	0.145
	t-ratio			2.20	2.19
	• SEAT**				-0.41
	t-ratio				-2.17
	s	0.450	0.410	0.404	0.398
R_SQ	39.47	50.28	52.06	53.75	

Table 7. 20 Significant predictors developed by stepwise regression for the *mean interaction* in all cases.

* $p < .1$
** $P < .05$

Fig. 8.1 The relationship between RRA and DAILY interaction WITHIN spatial groups

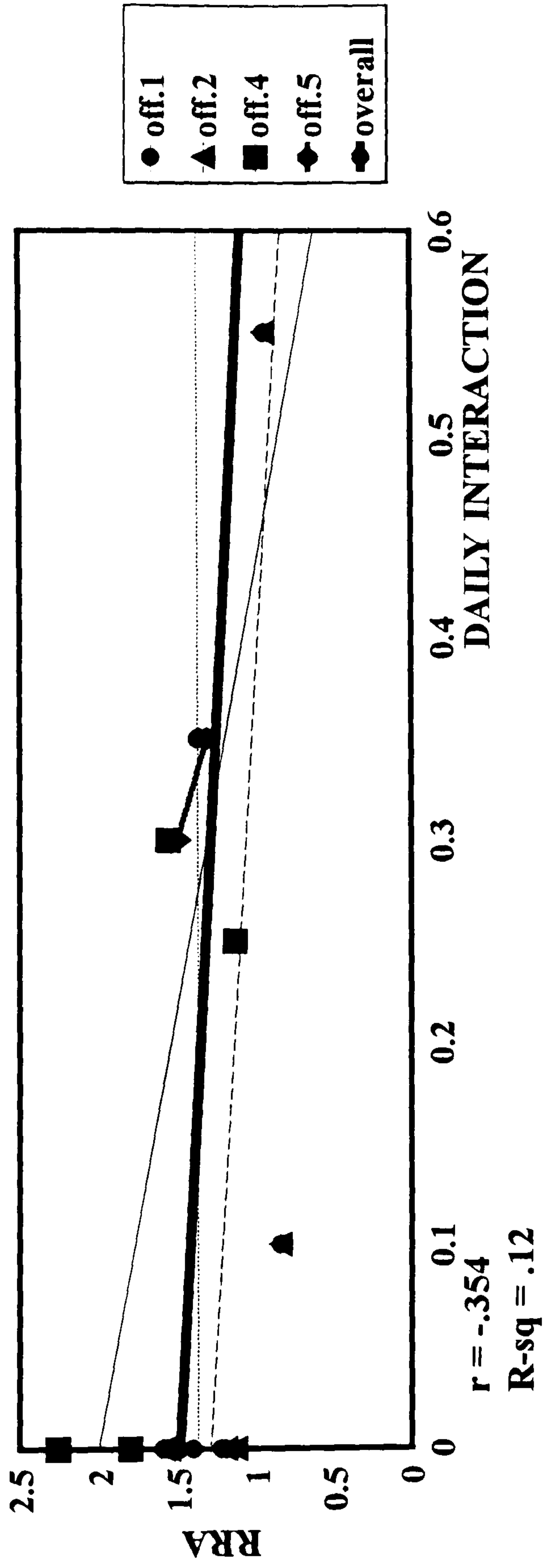


Fig. 8.2 The relationship between RRA and SEVERAL TIMES PER DAY interaction WITHIN spatial groups

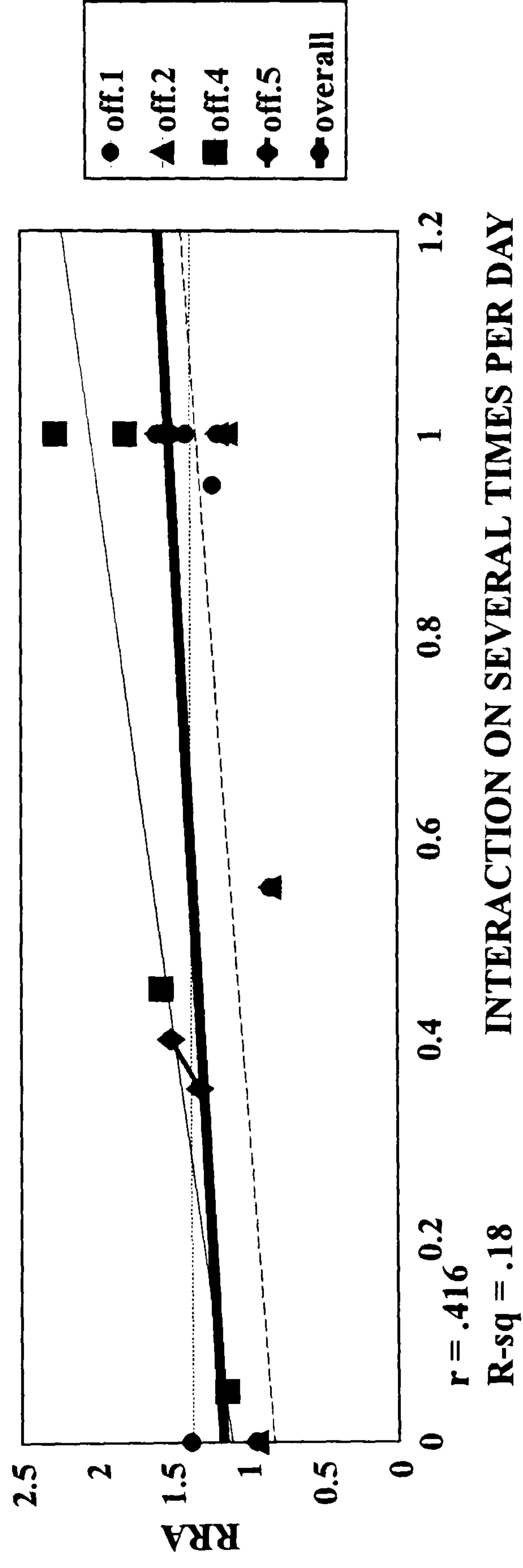


Fig. 8.3 The relationship between RRA and FEW TIMES PER DAY interaction WITHIN spatial groups

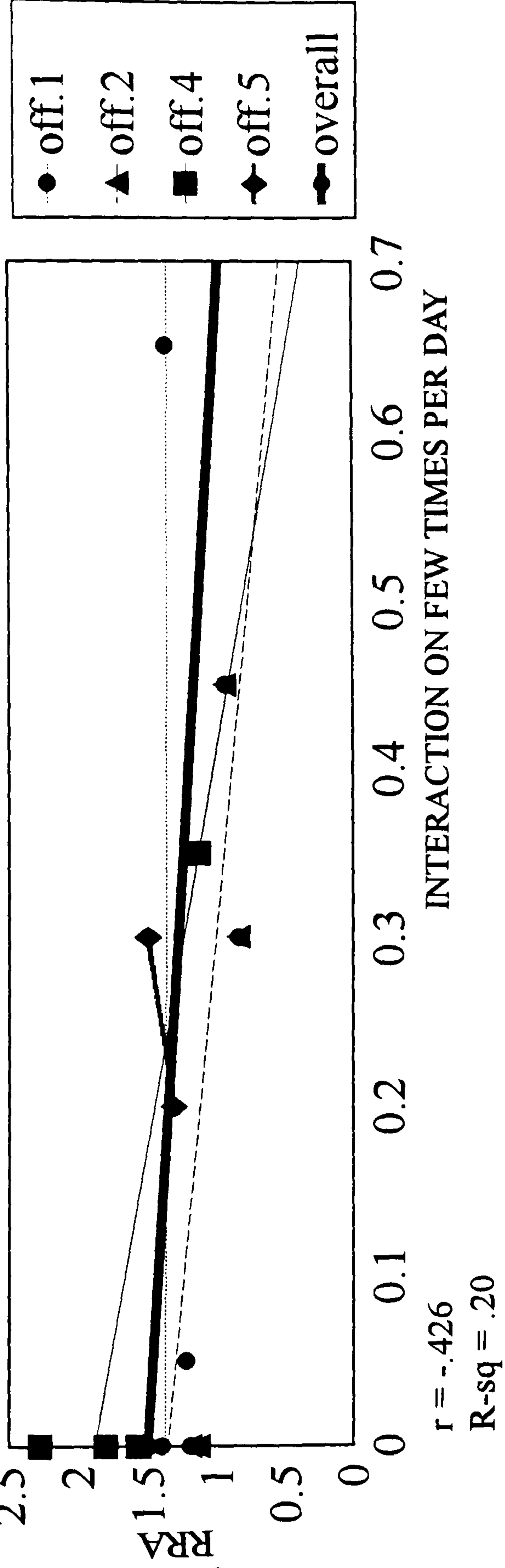


Fig. 8.4 The relationship between RRA and MEAN interaction WITHIN spatial groups

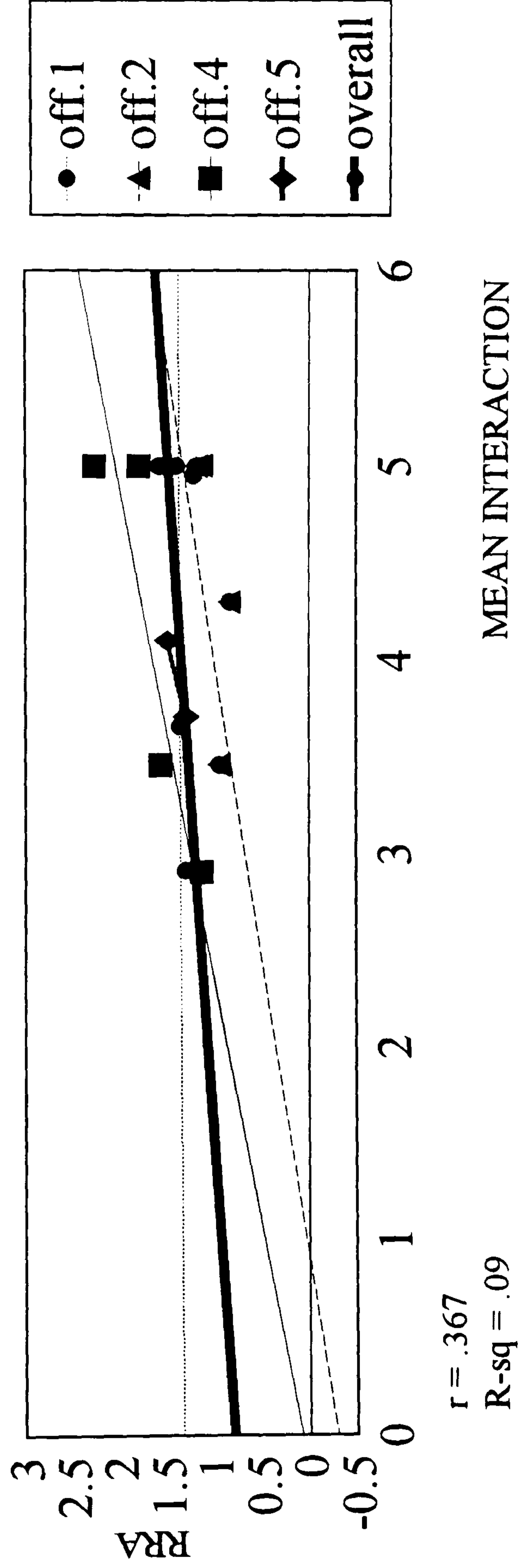


Fig. 8.5 The relationship between CV and SEVERAL TIMES PER DAY interaction WITHIN spatial groups

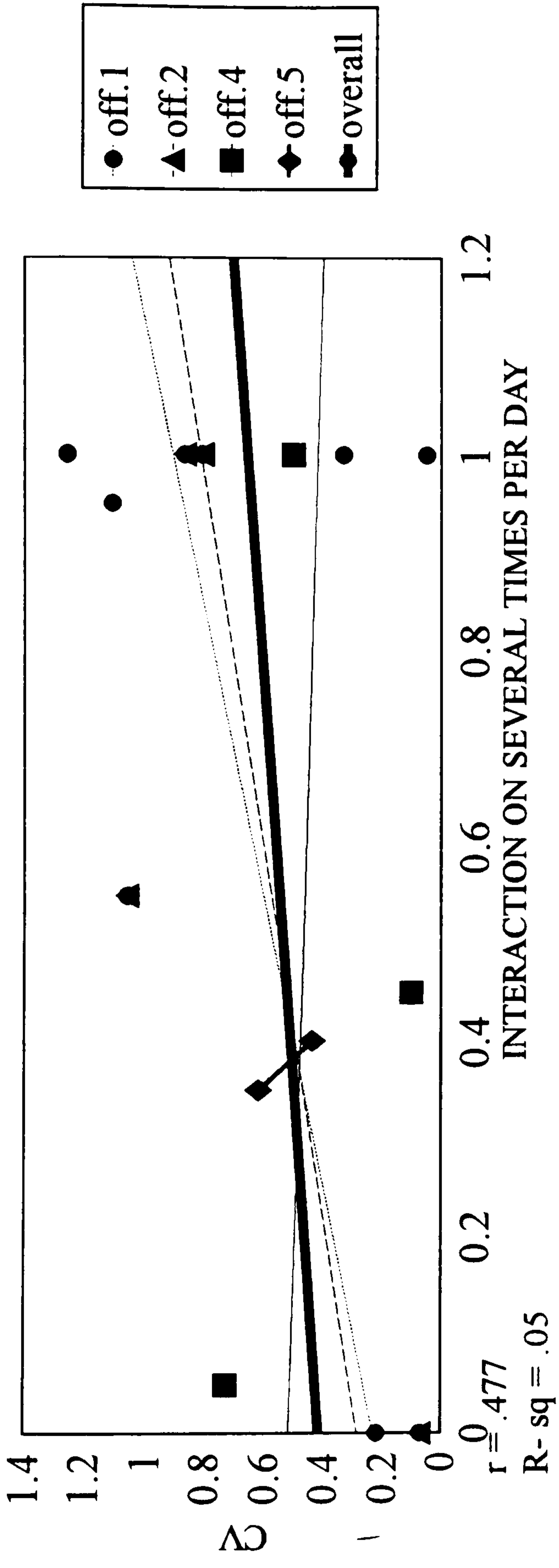
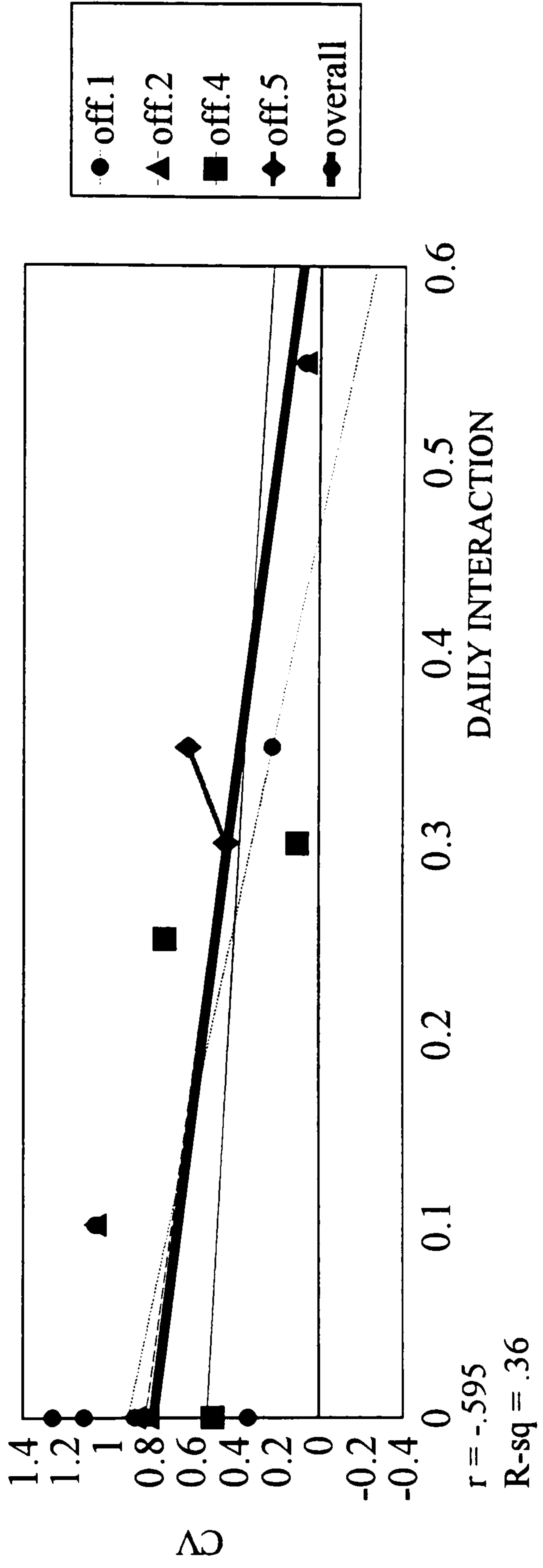


Fig. 8.6 The relationship between DAILY interaction and CV WITHIN spatial groups



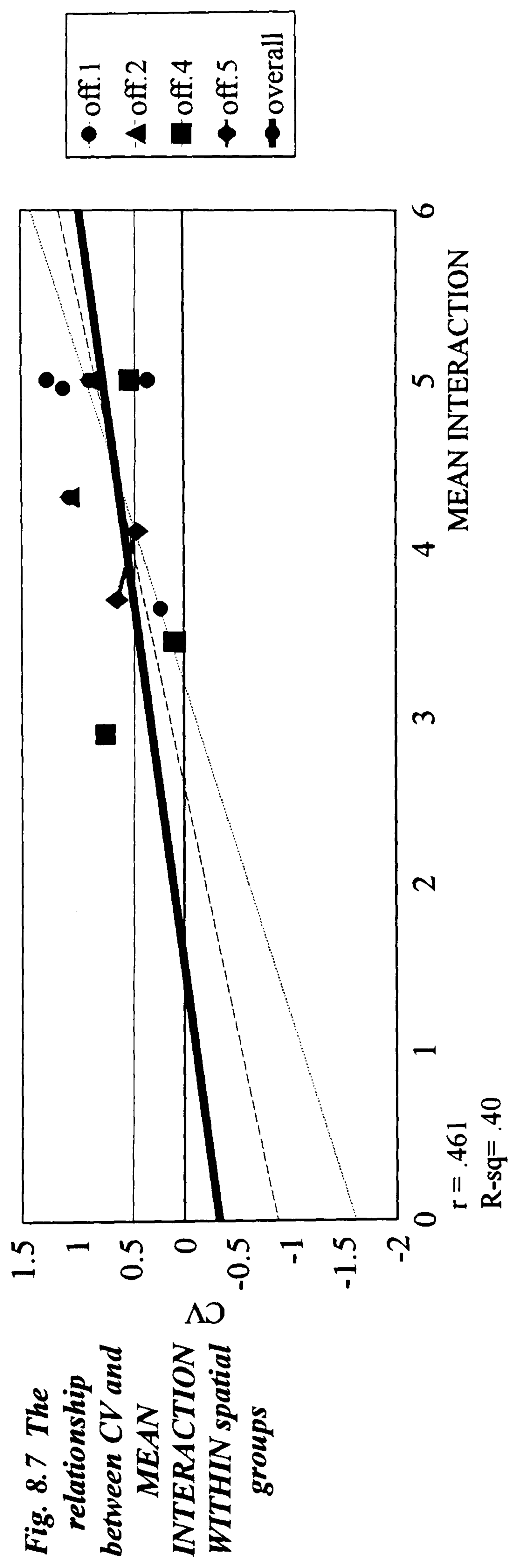


Fig. 8.8 | The relationship between RRA and SEVERAL TIMES PER DAY BETWEEN spatial groups

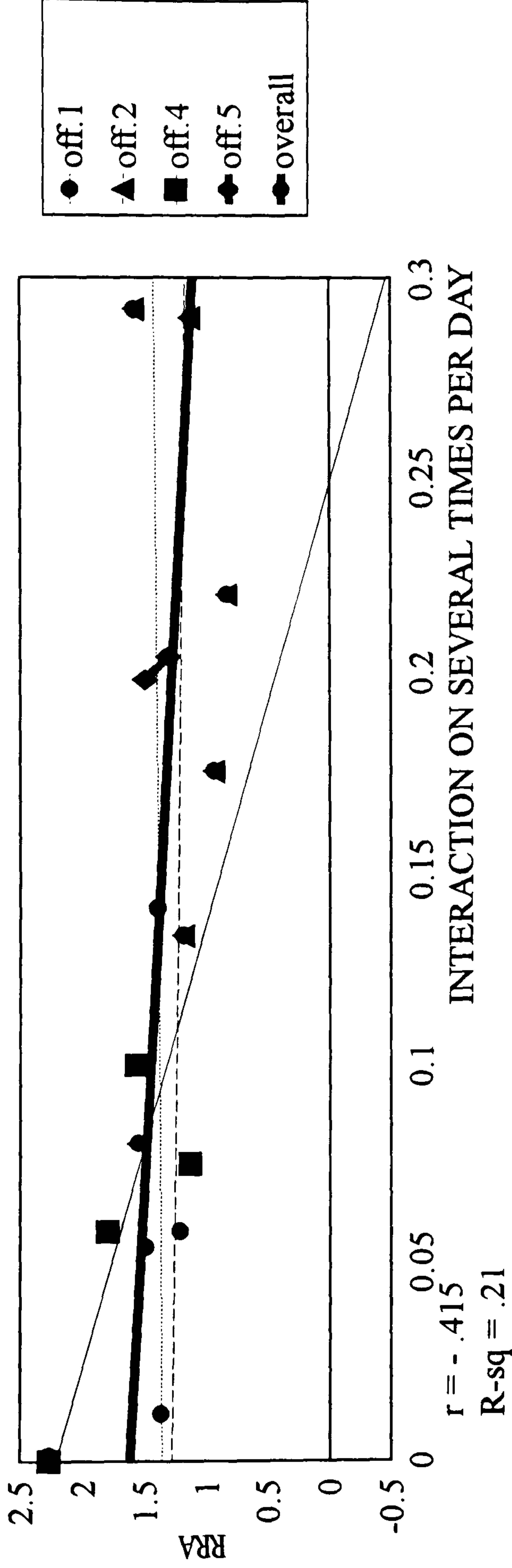
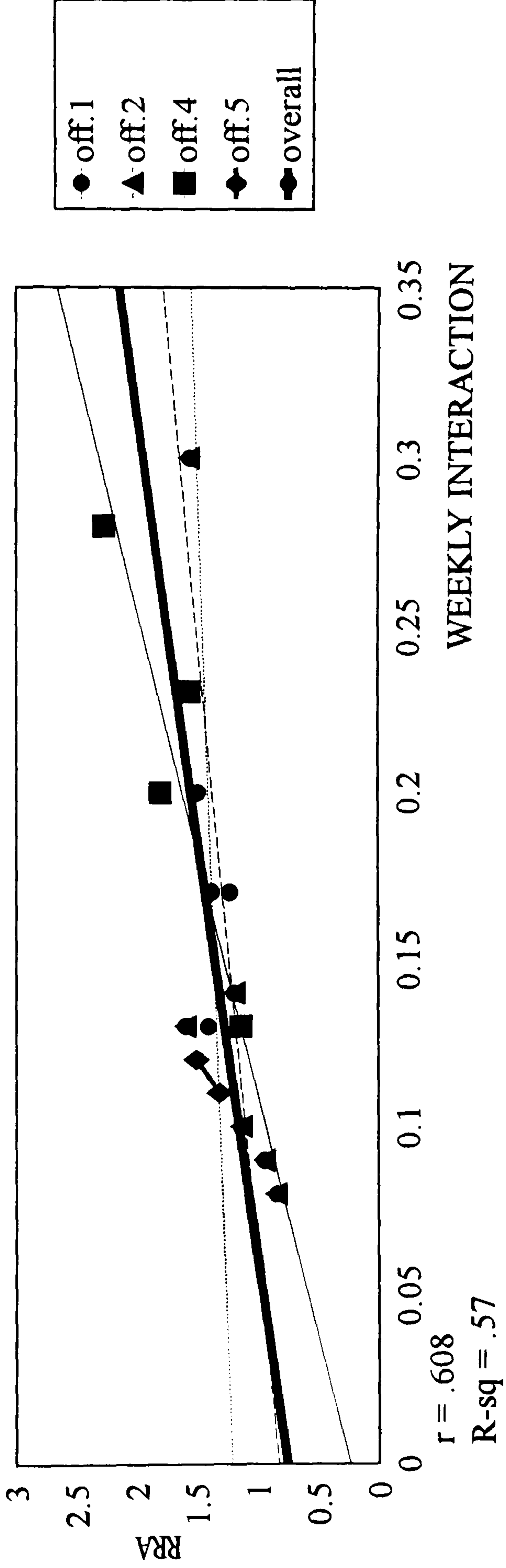
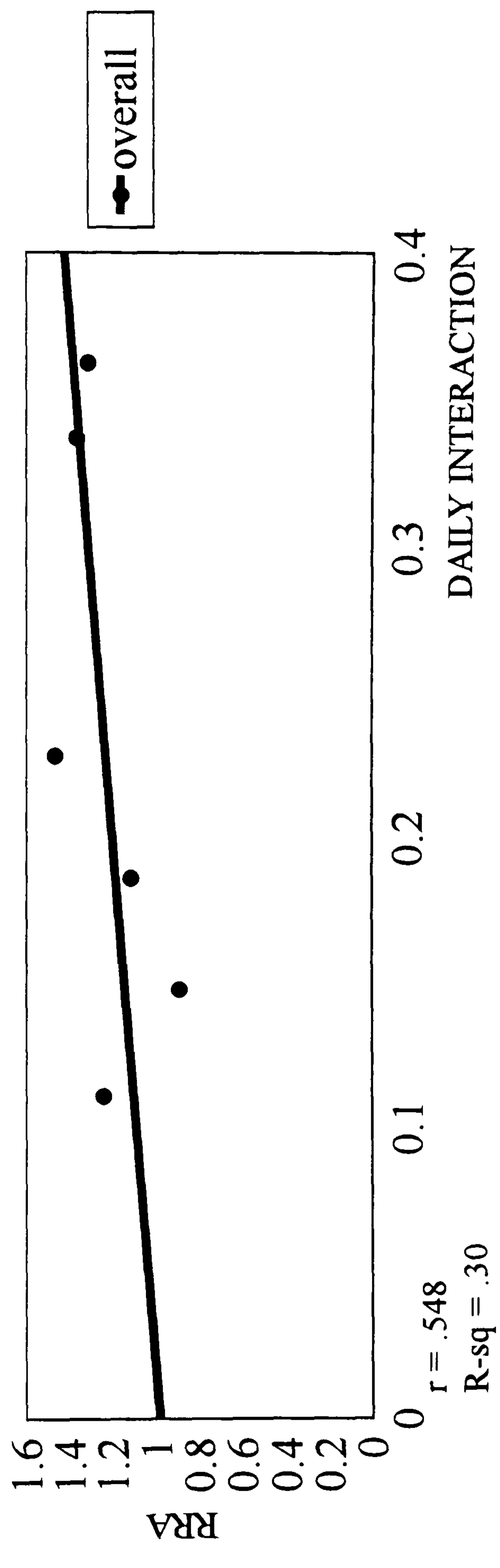
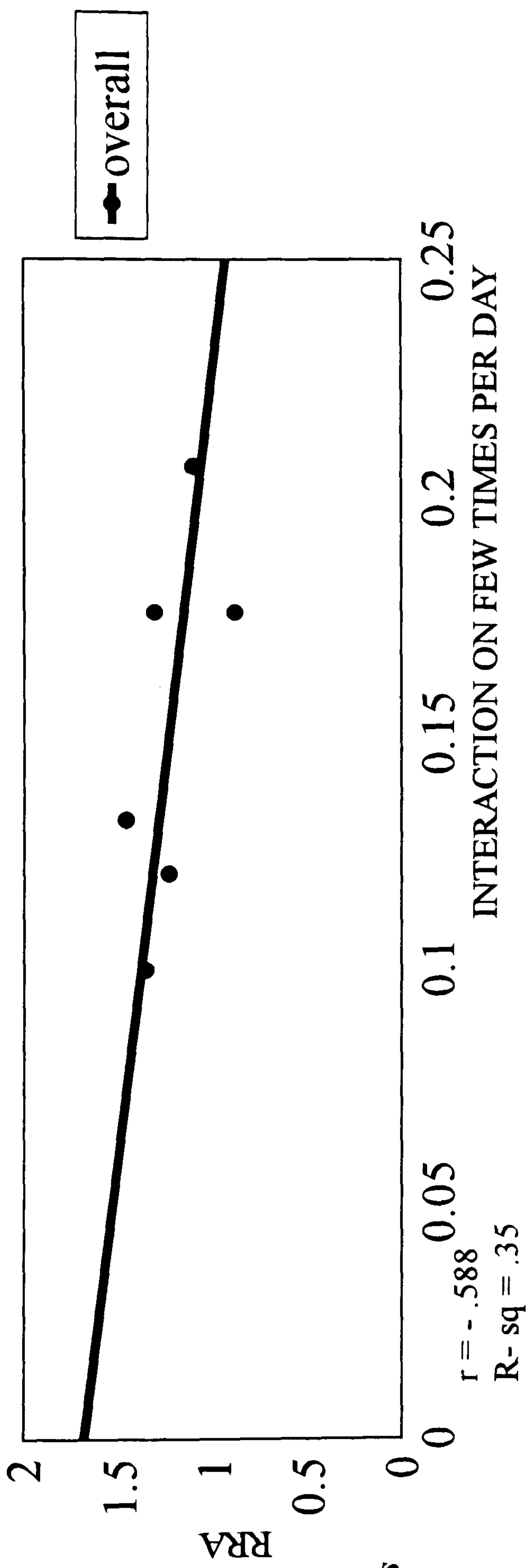


Fig. 8.9 The relationship between RRA and WEEKLY interaction BETWEEN spatial groups





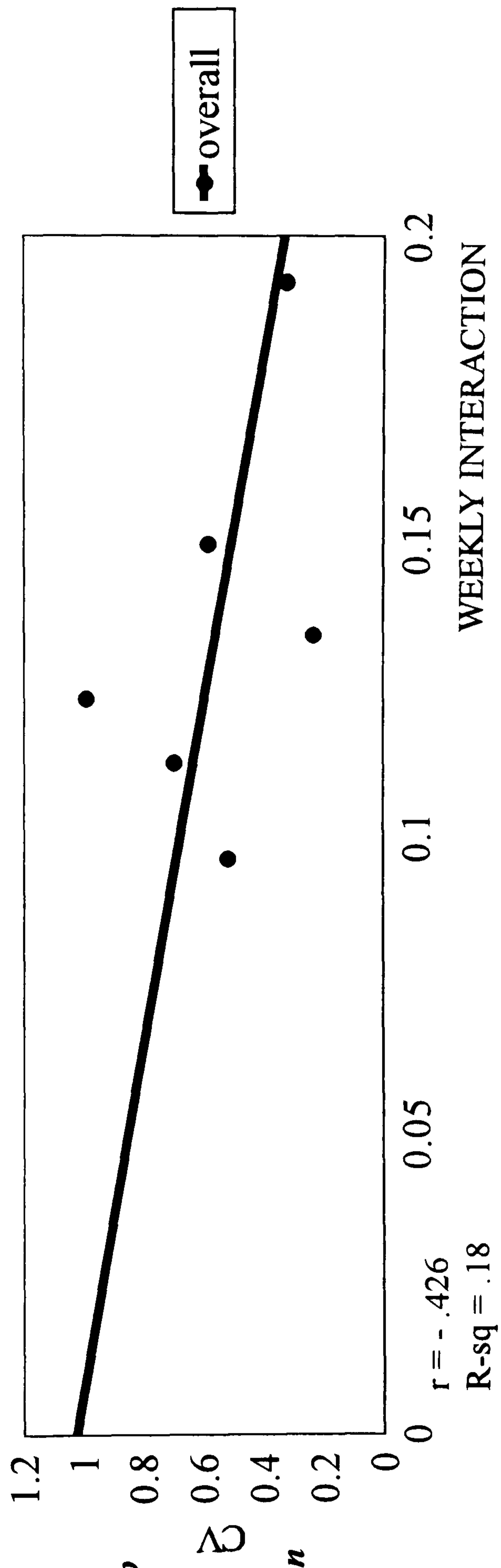
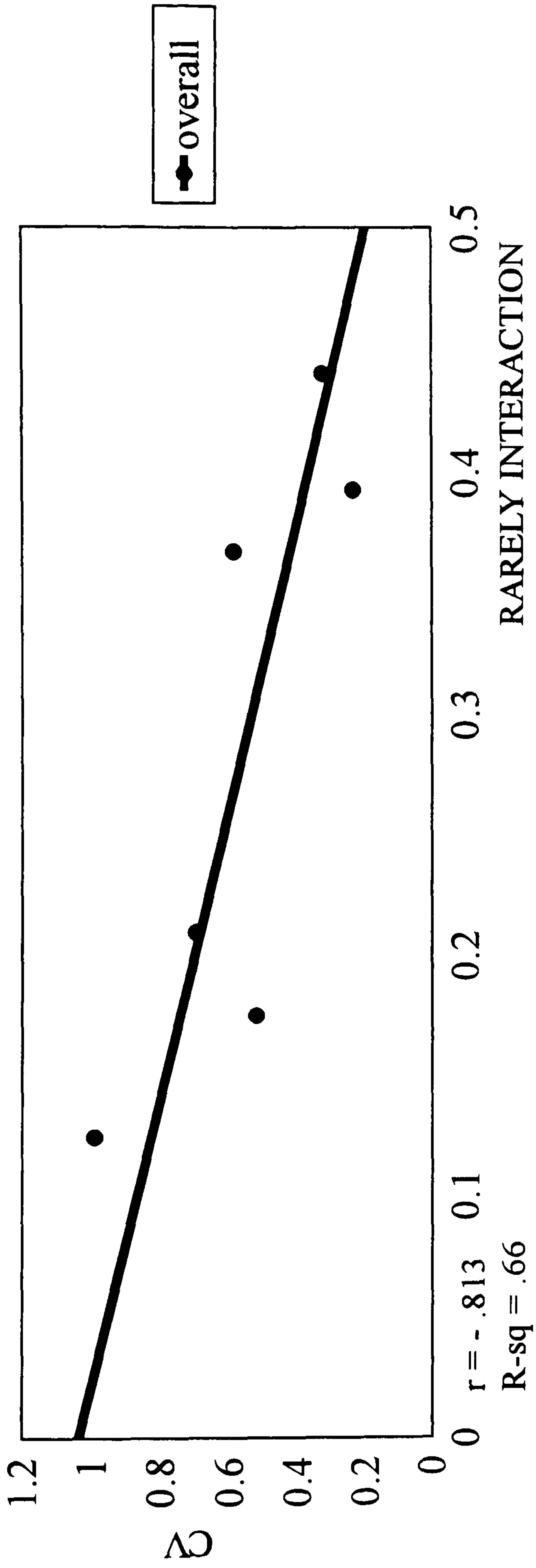


Fig. 8.15 The relationship between CV and DAILY interaction in LARGE groups

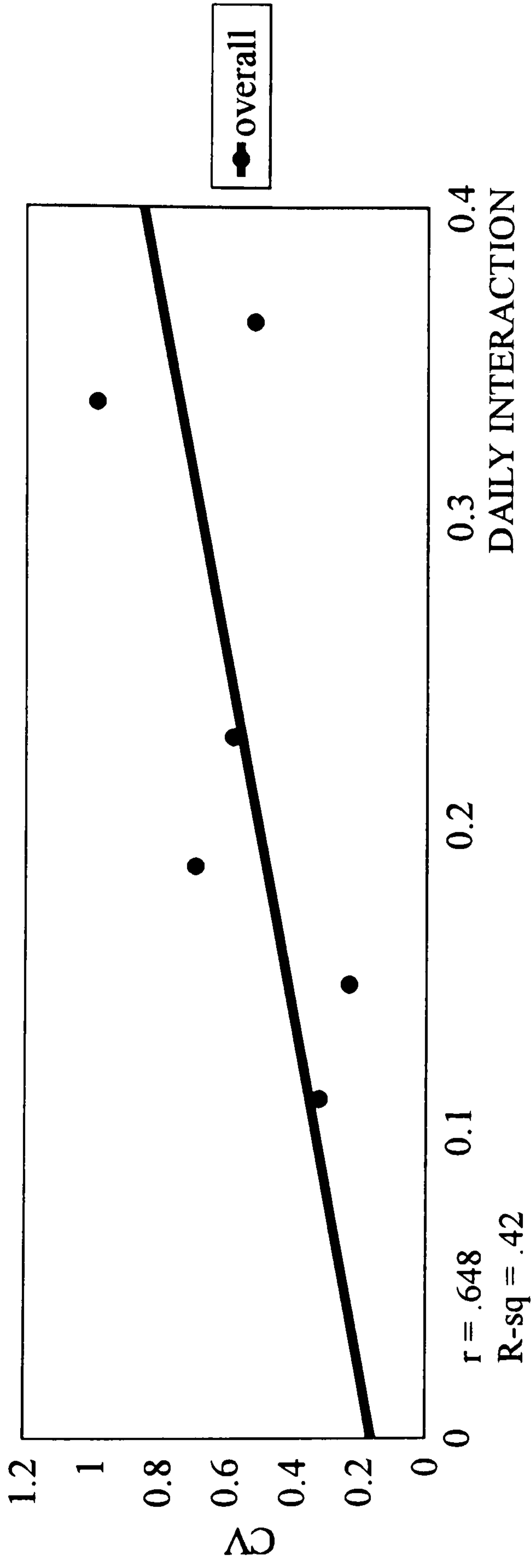
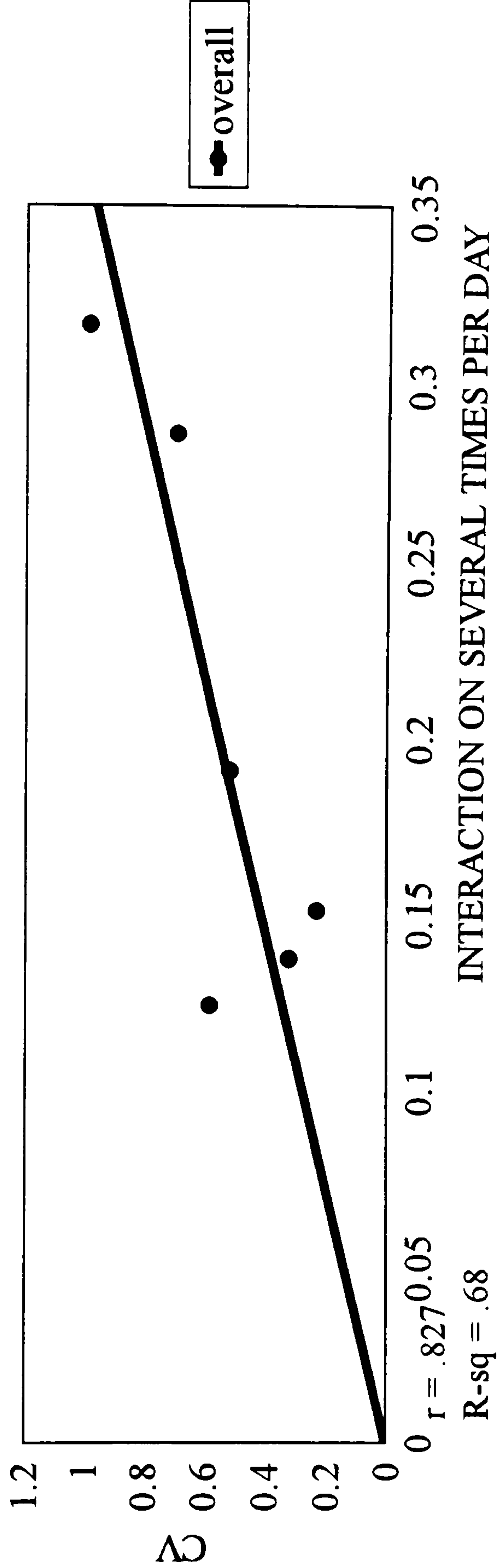
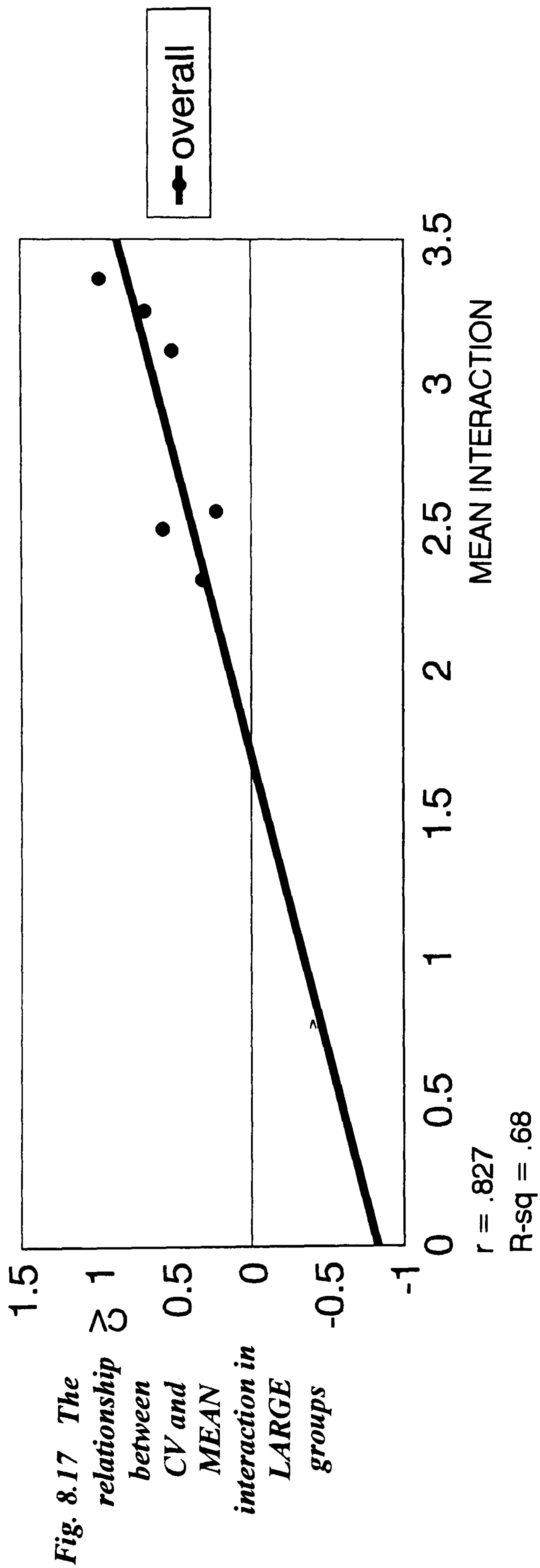


Fig. 8.16 The relationship between CV and SEVERAL TIMES PER DAY interaction in LARGE groups





**INTEGRATION AND CONNECTIVITY
VALUES FOR SPACES**

THE SYNTACTICAL VALUES FOR SPACES IN OFFICE 1.

Space No.	No. of Conn- ections	CV Value	RRA Value
1	1	0.33333	1.39703
2	1	0.33333	1.06365
3	1	0.20000	1.28061
4	1	0.25000	1.53991
5	1	0.20000	1.28061
6	2	1.50000	1.12715
7	1	0.20000	1.32294
8	1	0.20000	1.07423
9	4	1.41667	1.03190
10	2	0.75000	1.58224
11	4	1.75000	1.29648
12	1	0.33333	1.33882
13	1	0.25000	1.53991
14	3	2.50000	1.10598
15	1	0.20000	1.32294
16	1	0.20000	1.32294
17	1	0.50000	1.58753
18	5	3.25000	1.01602
19	1	0.20000	1.30707
20	2	1.20000	1.29648
21	1	0.25000	1.52403
22	1	0.20000	1.77274
23	4	3.20000	1.24886
24	5	4.25000	1.48170
25	1	0.20000	1.77274
26	1	0.50000	1.14831
27	1	0.20000	1.77274
28	1	0.20000	1.77274
29	4	2.62500	0.69851
30	2	0.45000	0.85198
31	5	3.58333	0.98956
32	1	0.20000	1.28061
33	3	1.32500	0.77260
34	1	0.25000	1.53991
35	2	0.45833	0.83610
36	1	0.33333	1.39703
37	2	1.12500	0.85727
38	3	2.12500	0.84668
39	8	2.95000	0.57680
40	2	0.62500	0.84668
41	1	0.50000	1.41820
42	1	0.20000	1.32294
43	5	3.32500	0.78318
44	5	4.20000	1.03190
45	1	0.20000	1.07423
46	1	0.20000	1.07423
47	2	0.50000	1.30707
48	2	0.75000	1.58224
49	3	1.58333	1.04777
50	3	0.70833	0.79377
51	4	2.40000	1.23298
52	1	0.20000	1.30707
53	1	0.33333	1.13773

54	1	0.33333	1.13773
55	1	0.25000	0.98956
56	1	0.25000	0.98956
57	1	0.25000	1.52403

THE SYNTACTICAL VALUES FOR SPACES IN OFFICE 2.

Space No.	No. of Conn- ections.	CV Value	RRA Value
1	1	0.50000	1.58513
2	2	1.50000	1.32754
3	1	0.50000	1.58513
4	2	1.50000	1.32754
5	2	0.64286	1.07657
6	1	0.20000	1.72383
7	1	0.20000	1.72383
8	5	4.25000	1.46624
9	1	0.20000	1.72383
10	1	0.25000	1.49266
11	4	2.20000	1.23508
12	2	0.64286	1.07657
13	1	0.14286	1.08978
14	7	4.00000	0.83219
15	1	0.25000	1.12940
16	1	0.25000	1.12940
17	1	0.25000	1.12940
18	4	3.14286	0.87182
19	1	0.25000	1.01382
20	2	0.39286	0.84540
21	1	0.50000	1.26480
22	1	0.16667	0.91805
23	2	1.25000	1.00722
24	4	2.16667	0.75624
25	4	1.73810	0.69680
26	1	0.25000	0.95438
27	2	0.32143	0.82559
28	2	0.21429	0.75624
29	7	2.65476	0.63405
30	3	1.14286	0.73973
31	1	0.14286	0.89163
32	1	0.16667	1.05345
33	6	3.08730	0.79587
34	1	0.16667	1.05345
35	1	0.11111	1.06336
36	1	0.50000	1.31434
37	2	1.11111	1.05675
38	1	0.11111	1.06336
39	2	0.23611	0.87182
40	1	0.12500	0.94447
41	1	0.07143	0.94447
42	1	0.07143	0.94447
43	1	0.07143	0.94447
44	1	0.07143	0.94447
45	1	0.07143	0.94447
46	1	0.07143	0.94447
47	1	0.07143	0.94447
48	1	0.07143	0.94447
49	1	0.07143	0.94447
50	14	12.29167	0.68689
51	1	0.07143	0.94447
52	1	0.07143	0.94447
53	3	0.38095	0.72652
54	8	4.34286	0.68689

55	5	1.48611	0.85531
56	2	0.32500	0.90154
57	4	1.10476	0.81568
58	3	0.65476	0.82559
59	3	0.69444	0.99401
60	4	0.84921	0.79256
61	3	0.69444	0.99401
62	3	0.90476	0.81568
63	2	0.32143	0.82889
64	4	1.23810	0.70010
65	2	0.32143	0.82889
66	6	2.32143	0.66047
67	2	0.23810	0.70670
68	1	0.12500	0.94447
69	1	0.12500	0.94447
70	1	0.07143	0.94447
71	9	4.28333	0.80577
72	14	4.76786	0.59773
73	2	0.45000	0.97750
74	2	0.39286	1.03033
75	1	0.20000	1.72383
76	2	0.50000	0.93457
77	1	0.50000	1.74364
78	2	1.25000	1.48606
79	2	0.47619	0.83880
80	2	0.47619	0.83880

THE SYNTACTICAL VALUES FOR SPACES IN OFFICE 3.

Space No.	No. of Conn- ections.	CV Value	RRA Value
1	1	0.25000	1.41012
2	1	0.25000	1.41012
3	4	3.25000	1.20625
4	1	0.25000	1.41012
5	1	0.25000	1.21353
6	4	1.80556	1.00966
7	1	0.05556	1.02301
8	1	0.33333	1.22203
9	2	0.30556	1.01573
10	3	2.05556	1.01815
11	2	1.00000	1.21960
12	1	0.12500	1.20989
13	1	0.12500	1.20989
14	2	1.00000	1.21960
15	2	0.55556	1.01937
16	1	0.12500	1.20989
17	1	0.12500	1.20989
18	1	0.12500	1.20989
19	1	0.12500	1.20989
20	1	0.12500	1.20989
21	8	7.05556	1.00602
22	18	12.37500	0.81913
23	1	0.05556	1.02301
24	1	0.50000	1.42105
25	3	1.55556	1.01573
26	2	1.33333	1.21717
27	1	0.33333	1.21960
28	1	0.05556	1.02301
29	1	0.05556	1.02301
30	2	0.19841	0.77545
31	7	3.16667	0.67230
32	1	0.05556	1.02301
33	1	0.05556	1.02301
34	3	0.80556	0.88224
35	4	2.00000	0.83006
36	3	1.50000	0.78637
37	3	0.82143	0.90529
38	1	0.07143	1.06912
39	1	0.07143	1.06912
40	1	0.07143	1.06912
41	14	10.66667	0.86525
42	2	1.07143	1.06669
43	1	0.50000	1.27057
44	2	1.00000	1.25843
45	2	1.00000	1.45138
46	2	0.57143	1.06305
47	2	0.75000	1.44896
48	1	0.25000	1.45502
49	1	0.25000	1.45502
50	4	3.00000	1.25115
51	2	0.32143	1.05820
52	1	0.07143	1.06912
53	1	0.07143	1.06912

54	1	0.07143	1.06912
55	2	0.17143	0.82156
56	4	0.82619	0.67472
57	1	0.33333	1.47565
58	1	0.33333	1.47565
59	3	2.33333	1.27178
60	3	1.33333	1.07276
61	2	0.60000	0.88709
62	1	0.50000	1.30576
63	1	0.05882	1.10431
64	1	0.05882	1.10431
65	2	1.05882	1.10189
66	1	0.05882	1.10431
67	1	0.25000	1.48051
68	4	3.33333	1.27664
69	1	0.25000	1.48051
70	1	0.25000	1.48051
71	1	0.33333	1.47565
72	1	0.25000	1.67225
73	3	1.50000	1.29120
74	2	0.83333	1.29363
75	1	0.14286	1.29120
76	1	0.14286	1.29120
77	1	0.14286	1.29120
78	2	0.55882	1.09825
79	2	0.39216	1.09582
80	1	0.25000	1.67225
81	1	0.25000	1.67225
82	4	3.33333	1.46837
83	3	0.64216	1.08004
84	3	1.58333	1.27178
85	17	12.97619	0.90044
86	1	0.14286	1.29120
87	1	0.05882	1.10431
88	1	0.05882	1.10431
89	2	1.16667	0.88345
90	1	0.50000	1.08732
91	1	0.05882	1.10431
92	1	0.05882	1.10431
93	1	0.05882	1.10431
94	2	0.15882	0.79122
95	10	4.66667	0.68443
96	7	5.55882	1.08732
97	2	1.14286	1.28877
98	1	0.50000	1.49264
99	1	0.14286	1.29120
100	4	0.65952	0.68079
101	1	0.16667	0.88588
102	2	1.00000	1.48900
103	1	0.05263	1.10674
104	1	0.05263	1.10674
105	1	0.05263	1.10674
106	1	0.05263	1.10674
107	6	2.99286	0.68200
108	2	0.19549	0.78637
109	19	14.47619	0.90287
110	1	0.05263	1.10674
111	1	0.05263	1.10674
112	1	0.14286	1.29605

113	1	0.14286	1.29605
114	1	0.14286	1.29605
115	7	6.05263	1.09218
116	1	0.14286	1.29605
117	1	0.14286	1.29605
118	1	0.14286	1.29605
119	1	0.50000	1.30819
120	1	0.50000	1.30819
121	2	1.00000	1.29605
122	2	0.75000	1.48658
123	1	0.25000	1.49264
124	1	0.25000	1.49264
125	4	3.00000	1.28877
126	1	0.05263	1.10674
127	2	0.30263	1.09582
128	1	0.05263	1.10674
129	1	0.05263	1.10674
130	2	0.55263	1.10067
131	2	1.05263	1.10431
132	2	1.05263	1.10431
133	1	0.05263	1.10674
134	1	0.50000	1.50478
135	1	0.33333	1.30333
136	2	1.33333	1.30091
137	3	1.55263	1.09946
138	1	0.50000	1.07762
139	2	1.14286	0.87374
140	2	0.55556	1.01937
141	1	0.33333	1.22203
142	1	0.05882	1.10431
143	2	1.05882	1.10189
144	1	0.50000	1.30576
145	1	0.05263	1.10674
146	2	1.05263	1.10431
147	1	0.50000	1.30819
148	2	1.33333	1.10674
149	1	0.50000	1.31061
150	1	0.25000	1.03393
151	1	0.07143	1.06912
152	3	2.07143	1.06427
153	1	0.33333	1.26814
154	1	0.33333	1.26814
155	1	0.07143	1.06912
156	1	0.05556	1.02301
157	1	0.05556	1.02301
158	2	1.33333	1.08368
159	1	0.50000	1.28756
160	2	1.33333	1.49264
161	1	0.50000	1.69652
162	1	0.05882	1.10431
163	1	0.10000	0.88831
164	1	0.14286	0.87617
165	1	0.16667	0.88588
166	2	0.43333	0.87860
167	2	0.43333	0.87860
168	2	0.60000	0.88709
169	1	0.33333	0.99024
170	1	0.05556	1.02301

THE SYNTACTICAL VALUES FOR SPACES IN OFFICE 4.

Space No.	No. of Conn- ections.	CV Value	RRA Value
1	1	0.50000	1.79675
2	1	0.50000	2.02427
3	1	0.50000	1.79675
4	2	1.50000	1.78736
5	2	1.10000	1.55984
6	2	0.60000	1.55515
7	1	0.10000	1.56453
8	2	1.10000	1.55984
9	1	0.10000	1.56453
10	10	7.83333	1.32762
11	1	0.10000	1.56453
12	1	0.10000	1.56453
13	1	0.10000	1.56453
14	1	0.10000	1.56453
15	3	1.43333	1.15170
16	3	1.66667	0.98516
17	1	0.09091	1.19158
18	1	0.09091	1.19158
19	1	0.09091	1.19158
20	1	0.09091	1.19158
21	1	0.09091	1.19158
22	1	0.09091	1.19158
23	1	0.09091	1.19158
24	1	0.09091	1.19158
25	1	0.09091	1.19158
26	1	0.09091	1.19158
27	1	0.08333	1.19861
28	1	0.08333	1.19861
29	1	0.08333	1.19861
30	1	0.08333	1.19861
31	1	0.08333	1.19861
32	1	0.08333	1.19861
33	1	0.08333	1.19861
34	1	0.08333	1.19861
35	1	0.08333	1.19861
36	1	0.08333	1.19861
37	1	0.20000	1.78502
38	1	0.20000	1.78502
39	1	0.25000	1.57157
40	1	0.50000	1.60440
41	5	3.75000	1.54811
42	4	2.45000	1.33466
43	1	0.25000	1.57157
44	2	1.20000	1.78033
45	1	0.20000	1.78502
46	1	0.50000	2.01723
47	1	0.14286	1.20096
48	4	1.39286	1.13528
49	1	0.14286	1.20096
50	1	0.14286	1.20096
51	7	5.00000	0.96405
52	2	1.50000	1.59502
53	2	0.28571	0.86788

54	4	1.97619	1.15405
55	3	1.00000	1.36750
56	4	2.33333	1.58798
57	2	0.58333	1.59502
58	2	1.25000	1.82020
59	1	0.50000	2.05711
60	2	1.50000	1.61379
61	1	0.50000	1.85069
62	2	0.75000	1.38157
63	1	0.25000	1.82489
64	1	0.33333	1.80613
65	1	0.14286	1.01331
66	7	4.72619	0.77640
67	1	0.14286	1.01331
68	3	1.75000	1.56922
69	2	0.83333	1.79675
70	2	1.50000	2.02896
71	1	0.50000	2.26587
72	1	0.25000	1.58798
73	1	0.25000	1.58798
74	4	2.58333	1.35108
75	1	0.25000	1.38392
76	1	0.14286	1.00158
77	7	4.56710	0.76467
78	1	0.14286	1.00158
79	4	2.58333	0.98047
80	4	1.83333	1.14701
81	3	1.08333	1.36046
82	1	0.50000	1.82958
83	1	0.25000	1.21738
84	1	0.33333	1.82489
85	1	0.33333	1.82489
86	3	0.72619	0.82800
87	2	1.25000	1.36750
88	1	0.50000	1.83193
89	2	0.75000	1.36281
90	1	0.14286	1.00158
91	1	0.14286	1.00158
92	11	10.14286	0.95467
93	1	0.14286	1.01331
94	1	0.14286	1.01331
95	12	11.14286	0.96170
96	3	2.33333	1.58798
97	2	1.33333	1.59268
98	1	0.08333	1.19861
99	1	0.33333	1.38861
100	1	0.14286	1.20096
101	1	0.33333	1.22207
102	1	0.25000	1.39095
103	1	0.25000	1.21738

THE SYNTACTICAL VALUES FOR SPACES IN OFFICE 5.

Space No.	No. of Conn- ections.	CV Value	RRA Value
1	1	0.50000	1.18565
2	1	0.11111	1.07592
3	1	0.50000	1.33575
4	1	0.11111	1.07592
5	1	0.25000	1.19322
6	1	0.50000	1.33575
7	1	0.33333	1.39377
8	1	0.33333	1.39377
9	1	0.50000	1.33575
10	1	0.50000	1.33575
11	1	0.50000	1.30044
12	4	3.50000	1.28530
13	1	0.25000	1.49090
14	1	0.25000	1.49090
15	1	0.50000	1.33575
16	2	1.50000	1.18061
17	1	0.50000	1.38621
18	1	0.50000	1.56658
19	1	0.06250	0.98258
20	1	0.06250	0.98258
21	2	0.13942	0.91951
22	1	0.07692	1.09736
23	1	0.07692	1.09736
24	1	0.07692	1.09736
25	1	0.11111	1.07592
26	1	0.11111	1.07592
27	1	0.11111	1.07592
28	2	0.75000	1.27773
29	2	0.66667	1.55523
30	1	0.16667	1.56027
31	2	0.70000	1.81632
32	1	0.20000	1.54513
33	1	0.50000	1.74821
34	1	0.20000	1.26512
35	1	0.33333	1.20710
36	1	0.25000	1.14277
37	1	0.16667	1.25629
38	1	0.16667	1.25629
39	1	0.25000	1.28278
40	1	0.16667	1.56027
41	1	0.20000	1.82137
42	1	0.25000	1.88696
43	3	2.00000	2.00931
44	5	2.58333	0.93969
45	3	1.83333	1.30044
46	1	0.06250	0.98258
47	1	0.06250	0.98258
48	1	0.06250	0.98258
49	1	0.06250	0.98258
50	1	0.06250	0.98258
51	16	10.44444	0.77698
52	2	0.56250	0.97753
53	2	1.06250	0.98006

54	2	1.08333	1.13016
55	2	1.08333	1.13016
56	2	1.08333	1.13016
57	2	1.08333	1.13016
58	2	1.07692	1.09484
59	2	0.32692	1.08727
60	2	1.08333	1.13016
61	2	1.08333	1.13016
62	2	1.06250	0.98006
63	5	3.03333	1.28530
64	1	0.25000	1.04943
65	2	0.58333	0.93086
66	4	1.64583	0.84383
67	1	0.50000	1.18565
68	1	0.25000	1.49090
69	3	0.66667	1.00150
70	3	0.89583	0.93339
71	2	0.66667	1.13142
72	3	2.50000	1.33197
73	1	0.33333	1.53757
74	4	1.91026	1.02925
75	2	0.75000	1.22980
76	2	1.50000	1.43288
77	1	0.07692	1.09736
78	2	0.14583	0.92708
79	2	0.16026	0.99772
80	4	1.49359	0.98762
81	13	8.11111	0.89176
82	9	6.22276	0.87032
83	1	0.11111	1.07592
84	1	0.07692	1.09736
85	2	0.32692	0.88420
86	12	4.94444	0.92708
87	4	1.75000	0.79464
88	1	0.25000	1.00024
89	4	1.51250	0.79464
90	1	0.20000	1.14529
91	1	0.25000	1.88696
92	1	0.33333	2.02823
93	3	2.33333	1.82263
94	1	0.25000	1.44927
95	4	2.66667	1.24368
96	3	1.70000	1.00150
97	2	1.20000	1.54261
98	2	1.00000	1.70280
99	2	1.00000	1.42279
100	2	0.66667	1.55523
101	2	0.41667	1.22223
102	2	0.75000	1.44423
103	2	1.50000	1.64730
104	1	0.33333	1.68767
105	1	0.20000	1.54513
106	3	1.53333	1.48207
107	5	3.33333	1.33954
108	2	0.40000	1.20457
109	5	3.16667	1.05952
110	3	1.36667	1.11628
111	1	0.33333	1.32188
112	1	0.20000	1.26512

113	6	3.83333	1.05069
114	1	0.16667	1.25629
115	3	0.91667	1.62208
116	4	2.53333	1.68136
117	2	0.36667	1.50225
118	5	2.75000	1.61577
119	2	0.53333	1.81128
120	1	0.33333	2.21490
121	2	0.53333	1.67757
122	2	1.33333	2.21238
123	1	0.50000	2.41798
124	2	0.70000	1.14025
125	3	0.73333	1.10493
126	2	0.83333	1.50099
127	2	1.50000	1.70406
128	1	0.50000	1.90966
129	1	0.33333	1.50603
130	2	0.70000	1.14025
131	2	1.50000	1.34332
132	1	0.50000	1.54892
133	4	1.91667	0.93717
134	6	4.00000	1.35467
135	5	3.70000	1.47828
136	2	0.53333	1.48459
137	3	2.00000	1.68010
138	1	0.20000	1.68388
139	1	0.20000	1.49090
140	2	0.39286	0.97501
141	7	5.50000	1.15790
142	2	0.64286	1.35846
143	2	1.50000	1.56153
144	2	0.50000	0.86654
145	3	2.25000	1.18818
146	4	2.25000	1.07718
147	1	0.50000	1.33575
148	2	1.50000	1.34332
149	1	0.50000	1.54892
150	1	0.20000	1.68388
151	1	0.20000	1.68388
152	1	0.20000	1.49090
153	1	0.33333	1.53757
154	1	0.25000	1.23485
155	1	0.33333	2.02823
156	1	0.25000	1.44927
157	1	0.50000	1.85290
158	1	0.50000	1.63847
159	2	1.14286	1.36098
160	1	0.50000	1.76713
161	1	0.14286	1.36350
162	1	0.14286	1.36350
163	1	0.14286	1.36350
164	1	0.14286	1.36350
165	1	0.33333	1.88569

THE SYNTACTICAL VALUES FOR SPACES IN OFFICE 6.

Space No.	No. of Conn- ections.	CV Value	RRA Value
1	3	1.04000	0.71068
2	1	0.04000	0.71930
3	2	0.16500	0.63746
4	2	0.45833	1.06818
5	2	0.83333	1.32661
6	1	0.33333	0.90451
7	1	0.50000	0.98634
8	1	0.04000	0.71930
9	1	0.04000	0.71930
10	1	0.04000	0.71930
11	1	0.04000	0.71930
12	1	0.04000	0.71930
13	1	0.04000	0.71930
14	1	0.04000	0.71930
15	2	0.20667	0.51255
16	1	0.14286	1.25339
17	1	0.14286	1.25339
18	1	0.14286	1.25339
19	1	0.14286	1.25339
20	1	0.14286	1.25339
21	1	0.04000	0.71930
22	1	0.04000	0.71930
23	1	0.14286	1.25339
24	1	0.50000	0.98634
25	2	1.04000	0.71068
26	1	0.04000	0.71930
27	2	0.37333	0.71499
28	2	0.37333	0.71499
29	1	0.04000	0.71930
30	1	0.50000	0.98634
31	2	1.04000	0.71068
32	2	1.04000	0.71068
33	2	0.62500	1.07249
34	1	0.33333	1.59796
35	1	0.12500	1.08971
36	1	0.12500	1.08971
37	1	0.12500	1.08971
38	2	0.62500	0.85713
39	2	0.54000	0.67192
40	1	0.50000	0.98634
41	2	1.04000	0.71068
42	2	1.04000	0.71068
43	1	0.50000	0.98634
44	1	0.04000	0.71930
45	7	6.20000	0.97773
46	5	2.50952	0.75376
47	3	1.36667	0.82267
48	6	2.28333	0.59008
49	5	2.28333	0.96050
50	4	2.36667	0.81406
51	3	2.00000	1.32230
52	25	18.66667	0.44364
53	3	1.16500	0.62885

54	8	5.33333	0.81406
55	2	1.20000	1.22754
56	1	0.50000	1.50320
57	1	0.20000	1.02941
58	1	0.33333	1.09833
59	1	0.20000	1.23616
60	2	1.16667	0.85713
61	1	0.50000	1.13279
62	1	0.20000	1.02941
63	1	0.25000	1.08971
64	1	0.25000	1.08971
65	2	1.16667	0.85713
66	1	0.50000	1.13279

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