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Workplace Environmental Design in Architecture for Public Health

Impacts on Occupant Space Use and Physical
Activity

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*I dedicate this book to my parents
Themistocles & Ninetta and my brother
Michael*

Preface

All fine architectural values are human values

Frank Lloyd Wright (1867–1959)

Walking is man's best medicine

Hippocrates (c. 460 BC–c. 370 BC)

Over the past few decades, studies in epidemiological, pathological, clinical, environmental and experimental fields of medicine have proved that physical inactivity represents a major contributor to many worldwide chronic diseases. Health-related research estimates that if this inactive lifestyle continues, currently healthy population will likely face a number of ailments and chronic diseases. It is suggested by health-related research studies that an increase of even 10% of population-wide daily physical activity levels would significantly benefit public health.

This research seeks to explore patterns of occupant physical activity and movement intensity within office buildings in the belief that office design substantially shapes the nature and frequency of intra-building activity. As the research expresses its statement of relations between activity and floor plans, it develops a vocabulary for describing a building layout's inducement of physical activity, designating for instance, spatial "attractors" and "rewards" for movement. This emphasis goes against the grain of current thinking regarding office layout, especially in the matter of IT (information technology) integration, which prioritizes the minimization of worker activity as a condition of workers' increased productivity.

In adopting health-related and social science monitoring techniques and calculations of human energy expenditure, this project draws on six data collections that involve direct observations, interview questionnaires, self-report diaries, accelerometer readings and wireless occupant location mapping. Exploring the relation between occupant activity within different buildings is diverse and complex as individuals and buildings may vary considerably. During this research, a number of challenges and limitations have been identified and are discussed in this book.

The novelty of this work is that it monitors free-living office environments and studies how architectural design may influence physical activity through *office task alone*.

In this research, statistical analysis of the data and a quantitative model (named “KINESIS” after the Greek word for activity and movement) have been carried out to explore and identify dynamics of human space use and energy expenditure during work-time. The results of the data analysis focus on spatial factors of the office architecture which include the openness of a layout (i.e. open-plan or cellular), the distance between office spaces (e.g. an individual’s desk and the kitchen), the existence of stairs between office locations (e.g. individuals’ desk spaces and the toilet) and the window to wall area ratio of a space that may form a trip destination.

Each of the above-mentioned factors has been shown statistically to significantly influence occupants’ activity and energy expenditure. In agreement with the results of the statistical analysis, the KINESIS model demonstrates a new simple model which simulates the behavior of populations in a given office environment. The research also statistically tests design implementations and illustrates how levels of activity might significantly increase energy expenditure distributions over population levels, and consequently benefit public health, by architectural design alone.

This book is composed by the following parts:

Physical Activity and Disease: Theory and Practice sets out to demonstrate the relation between physical activity and the promotion of health. This includes presentation of the health-related approach associated with the increasingly sedentary lifestyles across the worldwide populations. It describes also how scientific research demonstrates the value of exploring the design for office site movement.

Space-use and the History of the Office Building represents an overview of the history of office architectural design from ancient to present times. Along with recent concepts, theories and practice, it also introduces ideas on how the workplace is currently changing and how it further develops to respond to the current trends in office working.

Research Methods introduces the reader to current methods of measuring and mapping movement in different environments and disciplines. Based on these, the methods selected for the purposes of this research are presented.

Identifying Influential Office Architectural Design Factors of Movement illustrates research data collection results on the basis of which statistical analysis is carried out. From this analysis a quantitative (KINESIS) model is designed.

Conclusion and further objectives are suggested in the final chapter of this book.

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About the Book

This research supports that physical activity varies according to spatial characteristics. The ultimate goal of this research is to identify how occupant physical activity levels could be influenced by architectural design. International heart experts' suggestions (i.e. MRC; Adidas, Wellness Medical Center UK, Dugmore 2007; PricewaterhouseCoopers 2007) have pointed out the value of increasing daily physical activity levels even by 10% of the current. Health-related research shows the importance of increasing daily energy expenditure generally in a population (as stated in the work of Geoffrey Rose 1992). This population-wide activity increase could decrease significantly the incidence of heart attacks and diabetes (N.H.S. Department of Health 2000, 2003, 2004, 2008).

While investigating the relation between human physical activity and movement within offices, this research explores:

- The reasons why indoor workplace occupants move in space.
- To what extent can causes of movement (or lack of) be identified in relation to architectural design characteristics?
- How physically active do office-users appear to be in a working day?
- Can any plausible scenarios be envisaged to suggest possible influences of architectural design on workers' physical activity?

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Symbols

Technical or quasi-technical terms used in equations that appear in this book are drawn from a variety of fields (including health-related, social science, physics and applications of architectural theory) and are explained here.

- A Proportionality factor which can be determined for the purposes of the KINESIS model equations by taking into account environmental, cultural and personal characteristics. In this research, this factor has been determined by its statistical analysis indications
- a Window to wall area ratio of a trip destination within the office
- c Counts/min (GTIM Actigraph monitoring output)
- C Levels of “voluntariness” of a trip to an office destination
- d Distance walked in meters
- D Horizontal stair distance in meters. In a typical staircase D is equal to 1.4 times h
- E Energy expenditure in Joules
- E_p Energy expenditure per person per day in the KINESIS model
- E_s Energy expenditure in Joules per stair climb
- g Gravitational acceleration (9.81 m/s^2)
- h While using the stairs, h is the height ascended in meters, where this is about 2.7 m per floor
- m An individual’s body mass in kg
- P Power in Watts
- s Number of staircases. We consider staircases in one storey unit (number of floors)
- U Number of trips per person per day in the KINESIS model
- v Walking speed in m/s
- Δh Change in height of the center of gravity in meters from seated to standing position which is estimated to be 0.4 m

Introduction

Office Environmental Design and Public Health: The Challenge

We spend 90% of our lives indoors (cf. European Commission 2003; National Research Council 1981) yet while humans evolve through their lifestyles, into increasingly indoor creatures, the relation of actual buildings and workplaces to their users' activity, health and disease prevention is still open to research (Evans and McCoy 1998). Duffy and Tanis remarked in 1993 that the objective of the new workplace is to attract and retain the best staff with the aim of stimulating creative work. Creativity and productivity are dominant terms in office management vocabulary. Productivity “designs” hubs of creativity that seem to affect habits of space-use and tie workers down to their desks for long hours. According to literature surveys, office management strategies seem to focus on the efficiency, effectiveness of space-use and job-interaction and neglect occupant health and well-being (Evans and McCoy 1998; Leaman 2000; Kelly 2001).

The history of workplace environmental design has indicated a leading office design preconception for reduced activity around the worksite by having desks that are functionally self-contained (e.g. having a printer, a telephone headset and a computer screen on each individual worker's desk). In this way individual productivity and organizational profitability (cf. Duffy and Tanis 1993) are supposed to increase.

Worldwide reports generally indicate that office workers (International Standard Classification of Occupations 2004) are 60 to 70% of their office-time sedentary (Webb and Eves 2005). Among the U.K. office worker population (that is estimated at 15,866 million people, i.e. 54% of the U.K. adult employed population (International Standard Classification of Occupations 2004; Department Office for National Statistics 2000), 64% of men and 76% of women (Brassington et al. 2002) is classified as either sedentary or moderately active, the latter term designating activity on an irregular basis only. In addition, two-thirds of women and one-third of men reportedly experience difficulty in walking briskly up a slight slope for several minutes.

The focus of this research is to measure the relation between the design of office indoor architectural environment and human physical activity. Exploring and understanding the factors that influence walking in office buildings is critical to efforts to promote higher intensity activity in increasingly sedentary workforces (Centres for Disease Control and Prevention 2001). These factors are themselves influenced by a wide range of personal, environmental and socio-economic variables that form this interdisciplinary research. So far, studies related to this topic of research have been mainly psychosocial, based on self-efficacy and human perception (e.g. of the perceived distance to a walking destination, Vincent et al. 1967). Only a small number of studies have appeared to focus in objectively measured activity rather than people's beliefs, particularly in health-related research examining the environmental correlates of "walking for exercise".