SICK BUILDING SYNDROME: INDOOR QUALITY & PERFORMANCE IMPLICATIONS

Benedict Dozie Ilozor[1], Doreen Beng Choo Ilozor[2] and Michael Iheoma Okoroh[3]

[1]*Department of Architecture, Hampton University, Hampton, VA 23668, USA; Email: Dozie@mdcplus.com*
[2]*Marketing, Research and Strategy Department, Geelong Grammar School, Corio, Victoria 3214, Australia.*
[3]*The Built Environment Research Group, Division of Construction, School of Computing, University of Derby, Kedleston Road Campus, Derby DE22 1GB, UK*

ABSTRACT

Findings about sick building syndrome in Sydney's offices are presented. The aim is to ascertain whether perceptions of sick building syndrome in offices impact on discrete aspects of workplace performance and management. One hundred offices in the Sydney Central Business District were studied, and data gathered were analysed using partial correlation. Significant associations were found between sick building syndrome perceptions and these aspects of the workplace: time staff work inside office; space, staff and equipment use intensity (impacting indoor quality); rate of space accounting; focus on effective space management; and staff understanding of workspace. However, management control was found to play moderating roles in some of the perceptions. This paper concludes that, with management control, sick building syndrome perceptions in Sydney's offices may be critical to only a limited workplace aspect. The implication is for sick building syndrome to be largely generalised as inconsequential to many aspects of work environment in Sydney, probably in pursuit of the Hawthorne management ideology, which holds that group distinction and not physical work condition, accounts for improved performance and productivity. However, it is misreading to suggest that if people are too comfortable, they are likely to be slacking.

KEYWORDS

Sick building, office, facilities management, performance

INTRODUCTION

Sick building syndrome (SBS) applies to conditions in which a combination of factors such as chemicals, smoke, fumes and other components of building materials create poor indoor air quality, leading to various health complaints (Mitchell, 1999). Indoor air quality is impacted by over 900 different organic compounds (Baechler et al., 1991). The prevalence of harmful natural and artificial substances indoors, combined with poorly ventilated interiors and the long period of time people spend indoors working, can lead to various health problems. Efforts to reduce energy costs have seen the design and construction of completely sealed so called new energy efficient commercial building shells, leading potentially to indoor pollution problems first known as 'tight building syndrome' (Turner and Myerson, 2000; Governo and Kavanagh, 1997). As people become aware of the possibility of problems arising, indoor conditions are blamed for previously imponderable or inexplicable malaise. In some cases, affected individuals or those whose property value has diminished, have sought legal remedies to compensate for damages suffered as a result.

However, in sick building cases, it is often unclear what the actual causal contaminants are (Williams, 2002). What may be certain is that occupants have been infected probably by something within the building. Sick building syndrome cannot be easily traced to a definite origin, but people are aware that they come in contact with it through vaporous contaminants. By legal implication, when claimants are unable to pinpoint a particular causal contaminant of a sickness, their claims before the court will be severely weakened (Mitchell, 1999). For one, it is yet to be definitively established whether insurance cover extends to or precludes SBS in Australia. However, inability to address this issue or ignorance of the requirements provides no absolution from the legal responsibility to comply (Magyar, 1999). Health problems carry the force of law and threats of prosecution are real.

Although building related illness is different from sick building syndrome in terms of a definable source of origin, the occurrence of the former is symptomatic of the presence or prevalence of the latter. This scenario raises the need to examine the perceptions of SBS among workplace stakeholders through the facilities managers. Sydney is chosen as the study setting, as it typifies other main Australian cities.

The aim of the study is to ascertain whether perceptions of SBS in offices impact on discrete aspects of workplace performance and management. Examining this issue gives an insight into grey areas, and lays a foundation for more authoritative investigations of the legal implications of the growing problem of SBS and building related illness in Australian workplaces, their mitigation and possible curative measures.

STUDY FRAMEWORK

Broadly speaking, the three study variables are SBS (the causal physical condition of workspace); office management control, MC (the causal contribution of personnel); and effective facilities space management, FSM (the effect or outcome of both). SBS has been viewed as a whole and not in parts. This study seeks to discover whether SBS issues are perceived by workplace users as critical, and whether the office environment is deemed to escalate this condition. The ordinal scale used to measure how SBS is perceived ranged from: very unimportant, unimportant, average, critical, to very critical.

The relevant MC variables are: office standard work hours, average daily maximum permissible hours of work per staff, average daily minimum permissible hours of work per staff, facilities performance monitoring interval, lease expiry period, perceived flexitime practice, teleworking, perceived decrease in costs/overheads resulting from teleworking, allocation of space to flexiplace participants, allocation of space by status, type of business, and team working.

The relevant FSM variables are: time staff work inside office, space use intensity, staff use intensity, equipment use intensity, rate of space accounting, perceived attitude to effective space management, and perceived staff understanding of workspace. The operational definitions of MC and FSM variables are elaborate in Ilozor (1999).

The relationship of the three main variables is depicted in Figure 1. The framework suggests that the achievement of FSM is dependent on SBS perceptions and MC – the later two being causal variables.

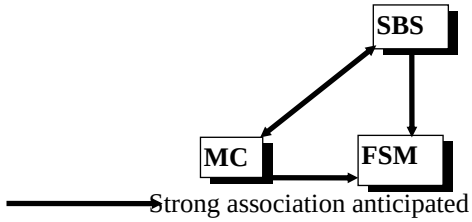

Figure 1: Interconnections of the three variables - adapted from Ilozor (1999)

Any evaluation of a work environment must take into account a number of aspects of management and job attributes (Thorne and Turnbull, 1991; Marans and Spreckelmeyer, 1982). Management is responsible for events that occur in work environments; in many cases, however, it has been shown to have a limited control over workspace settings (Carnevale, 1992, Carnevale and Rios, 1995). From this notion, it can be deduced that SBS may be somewhat independent of MC. Nevertheless, the possibility of interdependence, in some respects, was not ruled out (Goodrich, 1982). Hence, caution needs to be exercised in deciding which would be dependent on the other, and a combination of intuitive logic and theoretical reflections has been used.

It is however certain that in most cases, the existence of SBS precedes MC, as in a case where the offices are rented or leased and not built by management. If time order or sequence is used in establishing dependence, then, SBS can probably be said, in such instance, to influence aspects of MC in use. Based on fairly weighted assessments it was considered appropriate for MC measures to be the test variables (that is, the control group), with SBS (independent variable) and FSM (dependent variables) as the experimental group. In some instances, however, it may be more accurate to regard MC as potentially independent.

RESEARCH STUDY

Data on SBS, MC and FSM variables were collected in Sydney through questionnaires administered to 100 facilities space managers of 100 out of 112 identified offices, of not less than 400m^2.

The Statistical Package for the Social Sciences computer program was used in data analysis. Although the central tendency and dispersion in the data were determined, they have not been

presented here for reasons of brevity, but the variability observed was sufficient to warrant inferential statistical analysis using partial correlation.

Partial correlation was used as the multivariate analytical technique to examine the definite relationships among the three key variables. Partial correlation enables statistical controls, which allow one or two test variables to be held constant, while the relationships between two other variables are examined (Bryman and Cramer, 1997). As partial correlation also computes Pearson's *r* for each of the pairs of the variables (in this case, zero-order correlation coefficients), the sense of the parametric correlation of the variables was also gained.

A limitation of this study is in regard to the requirement to specify conditions for partial correlation as applicable to all multivariate analyses, which has not been fully met by the data. For instance, partial correlation requires that measurements be, at least, at interval/ratio levels. Most of the data are ordinal and nominal. Although Labovitz (1970) suggested that almost all ordinal variables can and should be treated as interval variables, this attribute meant that the data would be treated in a certain way. Nonetheless, the capability of this technique in detecting interaction effects resulting from moderated relationships is limited.

PARTIAL CORRELATION RESULTS

Table 1 presents the zero-order and partial correlations of SBS with discrete FSM measures. The associations between perceived SBS of the office, and the time staff work inside the office and space use intensity, which were not significant in zero-order correlation, became statistically significant. The associations between perceived SBS of the office, and staff use intensity, rate of space accounting and staff understanding of workspace, which were significant in zero-order correlation, became statistically insignificant. The associations between perceived SBS of the office, and equipment use intensity and perceived focus on effective space management, were statistically significant both in zero-order and partial correlations. The summaries are given in Tables 2 and 3.

TABLE 1
Zero-order (Z) and partial (P) correlations of SBS with FSM measures controlling for MC measures

	EFFECTIVE FACILITIES SPACE MANAGEMENT MEASURES													
PHYSICAL CONDITION OF OFFICE	Time staff work inside the office		Space use intensity		Staff use intensity		Equipment use intensity		Rate of space accounting		Focus on effective space management		Staff understanding of open-plan workspace	
	Z	**P**	Z	**P**	Z	**P**	Z	**P**	Z	**P**	Z	**P**	Z	**P**
Sick building syndrome	0.14	**0.25***	0.17	**0.30***	0.18*	**0.10**	0.22*	**0.27***	-0.20*	**-0.25**	0.28*	**0.29***	0.20*	**0.24**

* Significant at the 95% significance level (i.e., p<=0.05) - NB: Coefficients given are rounded to two decimal places

Table 2
SBS & MC measures associated with FSM measures at the 95% level of significance (p<=0.05) in zero-order correlation

	EFFECTIVE FACILITIES SPACE MANAGEMENT MEASURES, FSM				
	Staff use intensity	Equipment use intensity	Rate of space accounting	Focus on effective space management	Staff understanding of workspace

PHYSICAL CONDITION OF OFFICE, SBS	**SBS**	**SBS**	**SBS**	**SBS**	**SBS**
MANAGEMENT CONTROL MEASURES, MC	Maximum work hours	Standard work hours	Monitoring interval	Monitoring interval	Flexitime practice
	Maximum work hours	Maximum work hours	Teleworking	Teleworking	Teleworking
	Minimum work hours	Minimum work hours	Allocation of space for flexiplacers	Costs/overheads decrease from teleworking	Costs/overheads decrease from teleworking
	Business type	Monitoring interval	Team working	Team working	Allocation of space by status
		Lease term			Team working

Table 4
Conditioned Relationships Between SBS) & Effective Facilities Space Management Measures

FSM MEASURES	Moderated Relationships (Interaction Effects)	Multiple Causation	Unchanged Relationships (Robust or Replicated Cases)
Time staff work inside office	SBS		
Space use intensity	SBS		
Staff use intensity		SBS	
Equipment use intensity	SBS*		
Rate of space accounting	SBS		
Focus on effective space management			SBS*
Staff understanding of workspace	SBS		

* Relationship significant in zero-order and partial correlations

DISCUSSION

Perceived SBS in the office was positively associated with staff & equipment use intensity, focus on effective space management and staff understanding of workspace. It was negatively associated with the rate of space accounting. The zero-order correlation for space use intensity was not significant.

Although there was no significant association between perceived SBS in the office and the time staff work inside office, a remarkable discovery was made on controlling the influence of MC. The weak positive association appreciated relatively significantly from 0.14 ($p=0.08$) to 0.25 ($p=0.05$). This point suggested that, in certain categories, there might be high interaction effects of MC moderating the relationship. For the relevant categories, given certain MC aspects, the more the perceived SBS in the office, the more the time staff work inside office. It means that incidence of SBS is increased when staff work more inside office. The more people in the office at any given time, the more the complaints about interruptions and health problems from noise (Beaver, 1985; Carnevale, 1992).

Significantly moderated associations were observed with respect to space and equipment use intensity, since there were significant increases in the correlation coefficients. It means that with MC set aside in all categories, the more the perceived SBS in the office, the greater the space and equipment use intensity. This situation is synonymous with the outcome of crowding which

Carnevale (1992) discussed. See Table 2 for all suspect MC variables impacting the relationships.

As the increased correlation coefficients became insignificant in terms of the rate of space accounting and staff understanding of workspace, it means that, in certain categories of the population, the observed significant associations were due to moderation from the interaction effects of MC. In the relevant category, given certain MC measures, the more the perceived SBS in the office, the less the rate of space accounting, but the better the staff understanding of workspace. This result is expected, since there will be little need for space accounting if staff mostly work inside office. Staff interact more within the office, and are therefore likely to learn more about their surrounds.

The correlation coefficient decreased in terms of staff use intensity. A logical evaluation of the time order of the variables suggested multiple causation situation. This point implies that staff use intensity may be influenced independently by perceived SBS in the office and MC aspects. However, independently, there will be no significant association between perceived SBS in the office and staff use intensity. This finding is not in accordance with expectations, since the resulting illness (Woudhuysen, 1990), can lead to absenteeism, which in turn brings about less staff use.

There was only a slight change in the correlation coefficient in terms of perceived focus on effective space management, thus indicating largely robust data. This characteristic signifies the existence of a definite relationship. Therefore, it means that, irrespective of the influence of MC, the more the perceived SBS in the office, the greater the focus on effective space management. This situation stems probably from improved occupation of the spaces by staff working more inside office.

CONCLUSION

The results of the study have shown that there is a definite relationship between perceived SBS in the office and focus on effective space management. The order is that, the more the perceived SBS of the office, the greater the focus on effective space management. As this result might have stemmed from improved occupation of the spaces by staff working more inside office, the implication of this finding is that where SBS is perceived to be less, staff tend to work more outside the office and spaces are relatively less completely occupied most of the time.

With the moderating influence of MC in certain categories, an increased perception of SBS in the office seems to be associated with staff working more inside office. Space and equipment use intensity is raised as a result. Increased space occupation attracts reduced rates of space accounting, since the rate of churn is less. More people in the office at any given time are associated with interruptions and health problems (Beaver, 1985; Carnevale, 1992). These problems are probably behind the improved staff understanding of workspace, as ascertained from the results.

As independently perception of SBS in the office and staff use intensity are not associated, it implies that encouraging staff to work more inside office does not necessary ensure that they are used fully for organisational productive purposes. Apart from the problem of routine, redundancy and diminishing returns, crowding can result to illness (Woudhuysen, 1990; Carnevale, 1992), which will invariably give rise to absenteeism.

This presentation has not provided exhaustive review and examination of all aspects that are relevant to sick building and effective facilities space management and performance of workplaces. However, it furnishes some contexts in which this topic would continue to be fruitfully investigated.

REFERENCES

1. Baechler, M.C., Hadley, D.L., Marseille, T.J., Stenner, R.D., Peterson, M.R., Naugle, D.F. and Berry, M.A. (1991), *Sick Building Syndrome: Sources, Health Effects, Mitigation*, Noyes Data Corp., U.S.A.
2. Beaver, J.E. (1985), Sound advice for the office. *Computer Decisions* **17:5**, 64-66.
3. Bryman, A. and Cramer, D. (1997), *Quantitative Data Analysis with SPSS for Windows*, Routledge, New York.
4. Carnevale, D.G. (1992), Physical settings of work: A theory of the effects of environmental form. *Public Productivity & Management Review* **15:4**, 423-436.
5. Carnevale, D.G. and Rios, J.M. (1995), How employees assess the quality of physical work settings. *Public Productivity & Management Review* **18:3**, 221-231.
6. Goodrich, R. (1982), Seven office evaluations: A review. *Environment and Behavior* **14:3**, 353-378.
7. Governo, D.M. and Kavanagh, E.P. (1997 March 31), *Indoor Environmental Claims: Air Quality*, 5 Mealey's Emerging Toxic Torts 22.
8. Ilozor, B.D. (1999), *Open-plan Measures in the Determination of Facilities Space Management of CBD Commercial Office Buildings.* A published facilities management PhD thesis at the Faculty of Design, Architecture and Building, The University of Technology, Sydney.
9. Labovitz, S. (1970), The assignment of numbers to rank order categories. *American Sociological Review* **35**, 515-524.
10. Leaman, A. (1992), Open-plan offices: Kill or cure. *Facilities* **10:6**, 10-14.
11. Leaman, A. and Bordass, W. (1993), Building design, complexity and manageability. *Facilities* **11:9**, 16-27.
12. Magyar, S.V. Jnr. (1999), Occupational health management. *Professional Safety* **44:9**, 23-27.
13. Marans, R.W. and Spreckelmeyer, K.F. (1982), Evaluating open and conventional office design. *Environment and Behavior* **14:3**, 333-351.
14. Mitchell, W.J. (1999), CGL pollution exclusion provisions and the sick building syndrome. *Defense Counsel Journal* **66:1**, 124-134.
15. Thorne, R. and Turnbull, J.A.B. (1991), *Post Occupancy Evaluation Case Study: Technical Report*, Architectural Psychology Research Unit, Department of Architecture, University of Sydney, Australia.
16. Turner, G. and Myerson, J. (2000), New workplace, new culture. *The Journal of Quality and Participation* **23:5**, 29-33.
17. Williams, P. (2002), Indoor air quality for facilities managers: Understanding the salient issues concerning air-conditioned environments. *CIB W70 International Conference*, Glasgow, UK, 455-480.
18. Woudhuysen, J. (1990 Jan.), Open and shut case. *Management Today* **1**, 25.