

# The Complex Adaptive Workplace: A Theoretical Link between Office Design and Productivity?

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## 1. ABSTRACT

Despite well-publicised successes and failures, the evidence base for the impact of a workplace on an organisation's business performance remains small and confused. Theoretical perspectives are, with few exceptions, limited to matching physical environment to task. The 'edge of chaos' at a critical density of connectivity (Kauffman's K) between the agents in a network may explain how workplaces enable, or retard innovation. Formal rectilinear open plan offices are conceived as freezing occupants in a state of connectivity as low as traditional cellular designs. Offices without minimal acoustic or visual privacy (high K) may create chaotic stress and reversion as individuals seek to recreate safety. In between are offices known to have enhanced informal conversation between their occupants and resultant innovation. Do these represent edge of chaos conditions? The hypothesis can be justified by reference to examples. A research programme is outlined that might test the hypothesis more rigorously.

## 2. INTRODUCTION: NEW WORKPLACES FACT OR FAD.

The term Facility Management emerged in North America during the late 1970's to describe a developing field of study into the design and management of workplaces and their impact<sup>1</sup> on the business of organisations that occupied them. In crossing the Atlantic the same putative body of knowledge became known in the UK as Facilities Management and confused the original sense of workplace design with the provision, and especially the outsourcing of building support services, (Price, 2001a, Lord et al., this volume). For the purpose of this paper I shall simply say FM and restrict the term to its original, American, definition:

*"The practice of co-ordinating the physical workplace with the people and work of the organisation. It integrates the principles of business administration, architecture and the behavioural and engineering sciences".*

As new management tools, or fashions (Abrahamson, 1996), gain a niche in organisational discourse they attract proponents, managers, consultants and academic groups among others, whose interests are served by the continued spread of a particular fashion. Organisations emerge whose existence depends on propagation of the fashion involved (Price, 1999). One measure of the process is the growth in the number of publications devoted to the subject as publishers, and authors, spot the new niche (Abrahamson, 1996; Abrahamson and Fairchild, 1999; Scarborough and Swan, 1999; Price, 2000b).

With some confusion of terminology between issues of workplace design, flexible working, and teleworking the trend may be seen in the current literature on workspaces.

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<sup>1</sup> 'Impact' in this context was largely assessed in terms of costs, risks, and quasi-industrial measures of productivity such as sheets of paper processed per hour.

Occupiers are urged towards mobile or flexible futures. Perhaps even the continuation of the commercial office is in doubt (Bayliss, 1997; Becker, 1990; Becker and Steele, 1995; Bertin and Denbigh, 2000; Clements-Croome, 2000b; Duffy, 1998; Duffy, Laing, and Crisp, 1993; Eley and Marmot, 1995; Harrison, Loe, and Read, 1998b; Horgen et al., 1999; Laing et al., 1998; McGregor and Then, 1999b; Myerson and Ross, 1999b; Oseland and Bartlett, 1999; Raymond and Cunliffe, 1996; Stredwick and Ellis, 1998; Thomson and Warhurst, 1998; Turner and Myerson, 1998a; Verity and Shircore, 1996; Vischer, 1996; Wineman, 1986; Worthington, 1997; Zelinsky, 1998).

Yet the case has not convinced all in the corporate world. While the authors of a recent US Government Report on the subject (Office of Real Property, 1999b) can claim, in an introduction, that Corporate America has

*"Discovered that the only way to remain competitive and stay ahead of rapid changes in business and technology is to continually reinvent itself using workspace as a strategic tool that helps meet these goals"*

in the body of the report the language changes subtly:

*"Corporate America is discovering", "preliminary cost-benefit studies have verified the benefits,"*

A recent case in the Harvard Business Review (Vischer, 1999) produces one CEO stating that

*"Having successfully implemented a move to an open-design concept where everyone including me has the same work space we have seen wonderful changes in terms of culture and quality of work"*

countered by the president of a Boston based real estate company offering

*"What we have learnt is that you may succeed in business despite your space but you seldom succeed because of it. Moving people who are accustomed to private offices to open plan is very controversial. Trust is usually compromised and the culture changes. Some people will quit right away, others will eventually leave for companies that give them back their private offices".*

The well publicised case, at least in the FM world, of advertising agency Chiat/Day withdrawing from the flexible office (Berger, 1999) has delighted 'flexiphobes'. Meanwhile in London a Chiat/Day spin-off, St Lukes, is widely cited as a pioneer of flexible project based workspace (e.g. Turner and Myerson, 1998). What is more, St Lukes recently earned the HBR accolade of 'world's most feared company' (Coutu, 2000).

*"They don't have their own desks; they just work wherever they want to in the building. The environment is a lever to enable the creative teams to produce advertising in a new way. As the agency explains: If you change the way you work, you will change the way you think."*

Three, not always overlapping, approaches may be found in this and similar debates. The first considers new designs of offices, without necessarily presuming that the office itself will cease to be the dominant work location for the people involved. The second concerns the location independent worker; someone whose job routinely takes them to other occupiers' premises. What form of accommodation best suits their needs? The third concerns teleworkers, those who might be based partly or largely at home, perhaps a long way from their notional place of work. While being aware of the distinctions (c.f. Haynes et al., 2000) this review will focus on the office only.

The argument for flexible offices has been well established with Becker (1990) and Duffy (1990) as the most noted pioneers. Offices or workstations are notoriously under utilised, even during normal working hours so their use by more than one person makes apparent economic sense. Different forms of work require different forms of space, so provision of same should raise effectiveness. Work is increasingly a series of formal and informal

projects, requiring groupings of individuals for limited and variable periods of time. Space can facilitate such groupings; moving people but not fixtures.

At a more abstract level, modern organisations are increasingly perceived as ecosystems rather than machines: systems in which tacit knowledge is developed and exchanged through conversations, formal and informal. Space that encourages such conversations might speed up organisational learning. Knowledge management theory is beginning to regard the level of informal connection in organisations as an important part of the knowledge creation process (Palmer and Richards, 2000). Some degree of interaction in an office environment may be essential to enhance peoples' knowledge of the organisations they work for. Even call centres that have successfully introduced teleworking (Greenbaum, 1999; Levin, 2000) have found provision of opportunities for agents to visit 'the office' an essential part of the mix.

Yet the evaluation of workplace flexibility remains contentious (Vischer, 1999).

Independent academic studies (and they are few) are cautious. Cairns and Beech, (1999a; 1999b), while taking care not to "*seek to deny that any of the concepts of flexible working may be truly valid and applicable*", highlight the advocacy bias in many speeches and presentations on the subject. The revolution foreseen by the pioneers of FM has not materialised (Duffy, 2000). Issues of organisational culture, foreseen by Becker (1990) remain under appreciated (Hörger *et al.*, 1999). Managerial attitudes are seen by those who have succeeded or failed with flexibility initiatives as the single most common determinant of the outcome (Lupton and Haynes, 2000; Price, 2001c).

### 3. TOWARDS A NEW THEORY

#### 3.1 What went wrong?

Clearly some would criticise the question. If flexible office design is not the panacea it's proponents promised then, if anything went 'wrong' it was merely the attempt to implement changes that were inappropriate. Alternatively, as successful cases suggest, more innovative workplaces may stimulate more innovative work, while helping attract and retain more innovative workers. If so, then in the knowledge based economy such workplaces should indeed be a lever to improved organisational performance; Ward's (2000) and Ward and Holtham's (2000) '*most neglected resource in contemporary knowledge management*'.

Francis Duffy, who has some claim to be the UK's leading proponent of workplace design and strategic FM, recently (Duffy, 2000) reflected that the changes he and others anticipated twenty years ago have not come to pass.

*"The skill of managing office space may have developed but the office environment itself remains very much as it was."*

Duffy attributes the failure to conservatism by suppliers, to lingering Taylorism and associated hierarchical cultures in organisations, but most of all to a cost focus on the part of both Facilities Managers and design professionals.

*"Programmes of research could have been initiated, using comparative data from cumulative case studies, to demonstrate the effectiveness, as well as the efficiency, of using the design of the working environment to achieve strategic business purposes."*

Missing from this analysis is any theoretical framework concerning the impact of workplaces on the behaviour of those who use them<sup>2</sup>. The designer is still assumed to be

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2 The best known, Duffy's own model of hives, dens, cells and clubs imposes its own solutions arguing that the design of the office matches the degree of autonomy granted the worker and the repetitiveness of the tasks they are required to carry out.

an expert who knows what best suits the individual<sup>3</sup>. Even if Taylorist ideas are criticised, work is assumed to be something that can be planned and managed. Despite anthropological, Steele's (1988) 'caves and commons' (Hurst, 1995) and biological, Becker's (1990) 'workplace ecology', metaphors in the early workplace literature much of the debate is still framed in terms of 'open-plan' versus the private office. Design is still predominantly considered as a rational rather than an emergent process. An epistemological stance which sees management and design as distinct activities (Leaman, 1992) still predominates in the professions concerned.

### **3.2 Beyond the rationalist paradigm**

Parallel developments in evolutionary approaches to organisational sociology (e.g. Hull, 1988; Aldrich, 1999) and Complex Adaptive Systems theory (e.g. Waldrop, 1994; Price and Shaw, 1998; Maquire and McKelvey 1999; Pascale et al. 2000) are gradually coalescing to offer an alternative paradigm of organisations and their 'management'. They are less intentional creations in which a dominant group exerts power over subordinates and more emergent phenomena maintaining boundaries. While they keep a niche in a social and economic ecosystem organisations replicate particular schemata or memplexes (Price, 1995; Lane, 1996; Gell-Mann, 1996; Carney and Russell, 1997; Price and Shaw, 1998; Blackmore, 1999). The debate, and its implications for management practice, can be conceived as happening along a spectrum of explanations of what organisations are and how they should best be managed. One end of the spectrum is the traditional 'mechanical' perspective. Management is a rational process of setting desired parameters, planning how an organisation will perform, and ensuring compliance. The other sees organisations as 'living' systems, not just metaphorically but literally. Management is the act of creating contexts from which new knowledge and new results emerge. Particular events and actions are bound to be unpredictable and performance is judged in terms of whole system outcomes, not inputs.

Parallel debates can be found in other branches of social science. Economics is developing, some would say redeveloping, an 'evolutionary' approach (e.g. Loasby, 2001) and behavioural research is even beginning to command attention in property valuation (Diaz, 1999). Psychology wrestles with the extent to which behaviour is 'hard-wired' or socially constructed (Ashworth, 2000). However, despite the calls of some pioneers (especially Becker, 1990) most workplace research (such as there is) has stuck within the same quantitative, rationalist framework (Haynes et al., 2000). It is the author's hypothesis, based on this review that pushing harder and harder at what has not worked is unlikely to succeed. We need research, which starts with a different underlying paradigm, if we are going to reach any understanding of the interrelationship between workplace, organisational culture, business results and property strategy.

The alternative may be found in the emerging synthesis of evolutionary and complexity perspectives. There is obvious resonance between the complex systems perspective and the ecological view of workplaces proposed especially by Becker. Such evidence as does exist for success stories points to links between a critical mass of informal interaction and faster knowledge creation (Haynes et al., 2000). Can studies that start with that as a hypothesis explain the contribution of workplace to organisational success?

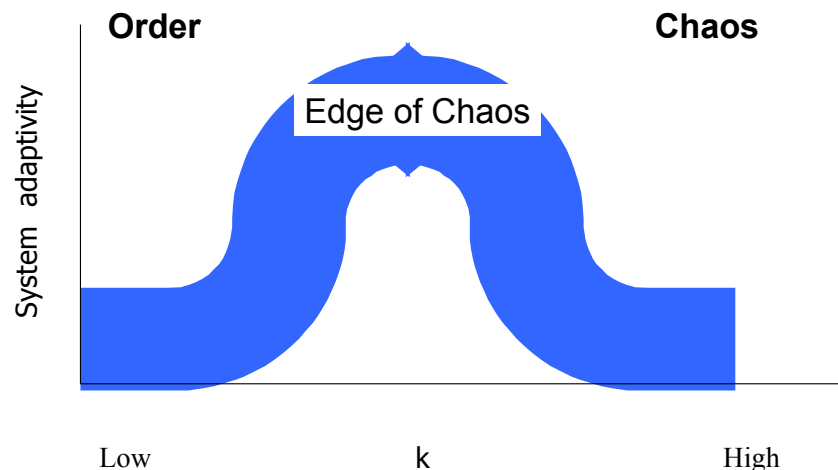
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3 For a notable exception see Hørgen et al., (1999) who advocate 'process architecture' an engagement by the designer with the unwritten rules of the organisation.

### 3.3 Connectivity in the workplace

Kauffman's (1993, 1995) NK networks and the edge of chaos have become one of the enduring messages, or metaphors, of complexity. In essence, according to his simulations, the behaviour of a system of  $N$  agents, each of which can have at least two states (e.g. on/off), depends on  $K$ : the proportion or number of agents whose current state influences the change of state of another. With low values of  $K$  systems are 'frozen' to a particular state. As  $K$  approaches 100% (or  $N-1$ ), behaviour becomes completely erratic with no sustained innovation. Maximum adaptation and emergence of new forms occurs in the narrow zone of critical connectivity (Figure 1): labelled - Complexity's founders were masters of sloganisation (McHugh, 1996) - 'The Edge of Chaos. The term has, been a good meme, gained its niche in organisational commentary, but has not, at least so far as search of current literature has revealed, been used to analyze office environments<sup>4</sup>.

**Figure 1. The concept (modified from Kaffman, 1993, 1995): A zone of maximum adaptability occurs at some critical density of connectivity. Can offices be visualised in these terms?**



Much of the literature on 'new ways of working' is framed in terms of open-plans and hot desks versus traditional cellular offices. Yet many open-plans reproduce rectilinear layouts in which individuals or small groups are provided with, or create for themselves, spaces that are as enclosed and private as the prevailing environment permits (Figure 2). They reflect a pattern towards the mechanical end of the spectrum. Meetings are conceived as formal events for which people go to a meeting room, not part of the routine of work. 'K' would seem to be low and not changed by any move from one to the other. Sustained examples of offices in which 'K' approaches  $N-1$  are harder to find, perhaps because of individual reactions. A total open plan, with no acoustic privacy and an expectation of every worker at his/her workstation most of the time might fit the bill (Figure 3). Is this why certain call centres suffer such high rates of agent attrition, and its economic consequences (Citex, 1999)? More usually staff perhaps build their own 'walls', again using furniture but typically in a more random manner (Figure 4). The organisation reverts to a more disorderly but equally rigid arrangement.

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4 Ward and Holtham's (2000) conception of knowledge management and knowledge environments as Complex Adaptive Systems comes closest but ultimately goes in a slightly different, albeit interesting direction. They cite Swedish research by Tornquist (1983) as arguing for creative milieux having a certain density of communication with a kind of overcrowding and chaos.



**Figure 2 Order.** In a new open plan environment rectilinear design and dark panels recreate 'Mahogany Row' (Hurst, 1995) and connectivity is low. In the same complex managers were occupying meeting rooms as their own offices.



**Figure 3. Over the edge?** The forced smile on the face of a call centre agent (a posed publicity shot) offers a metaphor for the stressed workplace.

Figure 5 illustrates an alternative. It is an office hailed in an online case study (Lake, 2000) as a success story in flexible working, one which provides a variety of work spaces and has sets of workstations used by different teams on different days. It was



**Figure 4. Chaos! A new office whose occupants insisted on the right to deploy their old furniture 'their way'. In the clutter signs can be seen of individuals, or small groups, setting up their boundaries**



**5. Closer to the Edge of Chaos?. One group to whom this picture was shown claimed it resembled "an untidy bedroom". It is in fact a profiled example of successful 'new officing' in a Local Authority. Signs of casual connectivity abound**

one in which the design team acted as facilitators rather than experts (pers. comm. to IP 1999) and since its implementation the users have gained a reputation for innovation with their customers. One swallow does not make a summer and one picture does not prove a

case but it is clear that this office environment permits a high, but not constant, degree of connectivity. Visually it projects an image that is somewhat disordered but not chaotic or frenetic. Is it at the edge of chaos?

Connectivity can also be seen in the alternative debate on new workplaces: the one which distinguishes 'caves and commons' and private rows (Steele, 1988; Becker and Steele, 1995; Hurst, 1995; Hargadon and Sutton, 2000) rather than open plans and private offices. In 'caves and commons' designs individual workstations - or offices - surround or share informal common space in which frequent informal interaction occurs. Work is a system of fluid conversations and workers move to whatever environment is needed for a particular conversation, or simply find themselves exchanging information by chance. Again some critical mass of connectivity is achieved<sup>5</sup>. The Complex Adaptive Workplace perspective would argue that caves and commons sustain a higher degree of connectivity.

## 4. A RESEARCH AGENDA

### 4.1 Hypotheses

So where does this leave us and what could be done? The following seem to be hypotheses to be tested

1. New Workplace Initiatives succeed when they enable some critical density of spontaneous interaction. Too much and the distractions outweigh the benefits. Too little and benefits are not seen. Recent quantitative research (Haynes, 2002) into the perceptions staff have of the impact of their environment on their productivity has revealed two factors, the beneficial perceptions of interaction with colleagues, and the negative perceptions of interruptions
2. That critical density may vary with sector and type of work.
3. Realising the success will depend on the culture of the organisation and will be greatest in organisations who have most successfully adopted 'new' managerial patterns. Contrast Turner and Myersons' (1998) mould breakers, those who have succeeded because they challenged, or were unconstrained by, the traditional patterns of a particular sector, from their modernisers, those who changed the office but not the thinking that went with it.
4. The success to be realised will be a factor of the extent to which 'new' cultures are a contributor to relative organisational success.
5. Those who have implemented new office and workplace initiatives without changing old cultures will see less value (and perhaps negative returns) from the investment.

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<sup>5</sup> Undoubtedly other factors, especially culture and management attitude (Haynes and Lupton, 2000; Price, 2001c) are important. Turner and Myerson (1998) refer to 'modernisers', corporations who have moved to fashionable new offices but where *"Staff shuffle uneasily down foliage filled avenues unsure whether sitting and chatting to a colleague over a cappuccino on a designer bench will be interpreted as slacking or having an informal meeting"*

## 4.2 What is needed to test these?

As they stand the justification of the propositions above relies on inadequately structured action research by the author over several years managing the innovation process, examining flexible work initiatives (FMGC unpublished; Price, 2001c) and consulting to organisations concerned at the interface between FM and their culture. The view that professionals get 80% of their ideas through casual interaction (Liebson, 1981) has been much repeated but I have not found it further researched. Personal observations lead to sympathy with the premise. In 1983, as a newly appointed manager, I discovered the power of office design when in facilitating inter-professional communications when circumstances (opening a new office in Guangzhou, South China) lead us to create a caves and commons design with professional workstations grouped around a shared meeting table<sup>6</sup>.

Where studies of occupants perceptions of their office environment have been published they have tended towards either a purely positivist occupier survey or to a blend of such surveys with either physical or cost based assessments of building performance (Bottom et al., 1999; Lorch, 1999). Phenomenological, or phenomenologically leaning, studies of workspaces or the interplay of workspace and culture are only beginning to appear (Hörger *et al.*, 1999; Lupton and Haynes, 2000). Observational research is conspicuously absent from the 1990's literature (Haynes *et al.* 2000). In part the problem may reflect the multi-faceted nature of FM research, blending as it does the research traditions of economics, sociology, building physics and psychology. In another it reflects the lack of a general conceptual paradigm linking business results, space and behaviour. Potentially the evolutionary and 'complexity' paradigms of cultural and social phenomena, with research approaches that have more in common with the natural sciences (Waddington, 1977), offer an alternative, an explanation in the scientific sense rather than a model. The hypothesis, expressed mathematically, is that:

$$\text{Innovation} = f(\text{commonality, culture, connectivity})$$

It follows that some way of measuring each variable is needed

1. A workplace classifier for the degree of commonality. Possible approaches include the degree of visual contact the space allows, the ratio of dedicated and common space or relative space, and time, devoted to formal and informal meeting areas. Spatial syntax methods hold promise (Thompson pers. comm.)
2. A connectivity indicator means developing and validating one or more measures of the degree of spontaneous connectivity in offices. Possible approaches include Haynes (2002) interaction / interruption ration. social network analysis and software, direct observation and surveying users as to of 'connectivity time'.
3. The cultural indicator would mean developing techniques for comparing aspects of corporate culture and patterns from office to office or organisation to organisation. Traditional cultural research has been very geared to direct observation of offices and ethnography. Newer approaches exist, as in analysis of an organisation's 'unwritten rules', stories, and metaphors. Some text based analytical methods have started to explore comparative organisational culture and there are survey- based methods of assessing managerial attitudes to such factors as modern human resource management practices and staff commitment or loyalty. Analysis of the drivers and modes of networking (Palmer and Richards, 1999) via online questionnaires also appears to hold promise

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6 The oil exploration business was struggling, at the time, to integrate the different professional perspectives of geologists, geophysicists and paleobiologists.

4. Finally comparative studies will then need to be undertaken in specific sectors where business relevant outcomes or proxies of them can be compared. Ideally an independent measure of knowledge productivity is needed. Such a measure is likely to be sector specific and may prove elusive. Search of the current knowledge management literature have not, to date, revealed obvious candidates. It may well be that surrogates will be needed. What might they be? The final sections of the paper consider some possibilities.

### ***Contact centres***

Modern contact centres have built up recruitment and training investments of up to ca £10,000 before an individual agent is fully ready to be online with customers. Turnovers ranging from 5 to 50% per annum in centres of hundreds of agents represent major costs. They also possess internal measures of assessing sales and service levels per agent. The relative impact of workspace has not been assessed.

### ***Universities***

Today's universities have to operate as businesses to survive and are inherently knowledge based. For many research income and reputation is key to their strategy. Thanks to the Research Assessment exercise a comparison of perceived outputs is available for every department in the country<sup>7</sup>. Are the higher scoring departments more likely to retain and use the traditional common room.

### ***Generalising to businesses***

Despite the prevailing consensus concerning the knowledge economy the actual measurement of knowledge creation and innovation in organisations remains problematic except at the level of ratios of market to book value (Bontis, 1998); a measure that is probably too global to be a surrogate for workplace innovation and is, in any case, not available to firms structured as partnerships. In part also measuring the value of knowledge and creativity is also problematic. A recent release by the American Productivity and Quality Centre (APQC, 2001) puts it well:

Measuring knowledge management (KM) is not simple. Determining KM's pervasiveness and impact is analogous to measuring the contribution of marketing, employee development, or any other management or organizational competency. It is nonetheless a necessity if KM is to last and have significant impact in an organization

Surrogates such as product development times, or patents may work in some sectors, as, in others, may competitor opinion or benchmarks. However as APQC note the measures may be anecdotal. To the extent that knowledge, innovation and creativity are ultimately processes which happen in individual minds (and the collective group-mind) measures of recruitment (offers accepted relative to rivals) and retention / turnover may also be relevant<sup>8</sup>.

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<sup>7</sup> It has been argued that the system is flawed in measuring true innovation because it relies of self-assessment by the existing elite and hence suffers an in built self-preservation instinct, but any method of assessment of any organisation will always reflect some prevailing environmental factors.

<sup>8</sup> A recent unsubstantiated press article on St Luke's pointed out that their turnover of staff is approximately half the industry average.

## 5. WHY

As John Kay recently observed, business and managerial theory today is broadly comparable to nineteenth century medicine. Outside of a few specific areas it lacks any sound framework of theory and empirical evidence. The Evolutionary / Complex Adaptive Systems perspective affords the best candidate for a theory, one attracting an increasing level of serious comment. The workplace as a subset of that approach has yet to be researched.

1. If faster creation and commercialisation of knowledge is indeed the key to continued economic success for a firm in today's economy, or to the extent that it is, the jury is out on organisational futures in many knowledge dependent sectors.
2. If new workplaces, when combined with new patterns of management, do indeed speed the emergence of knowledge, then to the extent that proposition '1' is true, they are a key strategic lever.
3. If both propositions '1' and '2' are true, under what circumstances, or in what niches, will 'old pattern' organisations survive?

The workplace may be linked to more than mere corporate productivity. It might be linked to corporate survival.

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## 7. REFERENCES CITED

- Abrahamson, E. (1996) Management fashion. *Academy of Management Review* 21[1].254-285.
- Abrahamson, E., and Fairchild, G. (1999) Management Fashions: Lifecycles, Triggers and Collective Learning Processes *Administrative Science Quarterly* 44[Dec] 708-740
- Aldrich, H. (1999) *Organisations Evolving*, New York, Sage.
- APQC (2001) *Measurement for Knowledge Management*  
<http://www.apqc.org/free/articles/dispArticle.cfm?ProductID=1307>
- Ashworth, P. (2000) *Psychology and 'Human Nature'* London Psychology Press
- Bayliss V. (1997) *Redefining Work*. London, RSA.
- Becker F. (1990) *The Total Workplace: Facilities Management and Elastic Organisation*. New York, Praeger Press.
- Becker F. and Steele, F. (1995) *Workplace by Design: Mapping the High-Performance Workscape*. San Francisco, Jossey-Bass.
- Berger W. (1999) Lost in Space. *Wired* 7[2], Wired Digital, Inc.  
[http://www.wired.com/wired/archive/7.02/chiat\\_pr.html](http://www.wired.com/wired/archive/7.02/chiat_pr.html)
- Bertin I. and Denbigh, A. (2000) *The Teleworking Handbook: New Ways of Working in the Information Society*. 3rd Ed Kenilworth, TCA (Telecottaging Association).  
<http://www.tca.org.uk/handbook/index.htm>
- Bontis N. (1998) Intellectual capital: an exploratory study that develops measures and models. *Management Decision* 36[2], 63-76 <http://www.emerald-library.com/>
- Bottom, C.W., McGreal, W.S. and Heaney, G. (1999) Appraising the Functional Performance Characteristics of Office Buildings, *Journal of Property Research* 16[4] 339-358.

- Cairns G. and Beech, N. (1999a) Flexible working: organisational liberation or individual straitjacket? *Facilities* 17[1/2], 18-23 [www.emerald-library.com](http://www.emerald-library.com)
- Cairns G. and Beech, N. (1999b) User involvement in organisational decision making. *Management Decision* 37[1], 14-23 [www.emerald-library.com](http://www.emerald-library.com)
- Carney, D. P. and Williams, R. (1997) The memetics of firms, entrepreneurship and the new body politic: The memetics of the marketplace, *Management Decision*, 35{5/6} 447-451
- Citex, (1999) Whole-life cost model *Building*, 73-79.
- Clements-Croome D. (2000) *Creating The Productive Workplace*. London, E & FN Spon.
- Coutu D. L. (2000) Creating the most frightening company on Earth: An interview with Andy Law of St. Luke's. *Harvard Business Review* 78[Sep/Oct] 142
- Diaz, J. (1999) The first decade of behavioural research in the discipline of property. *Journal of Property Investment & Finance* 17[4] 326-332.
- Duffy F. 1990 Measuring building performance. *Facilities* 8[5] 17-21
- Duffy F. (1998) *The New Office*. London, Conran Octopus.
- Duffy F. Laing, A., and Crisp, V. (1993) *The Responsible Workplace - the Redesign of Work and Offices*. London, Butterworth Architecture in association with Estate Gazette.
- Eley J. and Marmot, A. (1995) *Understanding Offices*. London, Penguin Books.
- Furnham A. (1992) *Personality at work: The role of individual differences in the workplace*. London, Routledge.
- Gell-Mann, M. (1996) Address to the US National Defence University " *In the case of societal evolution, the schemata consist of laws, customs, myths, traditions, and so forth. The pieces of such a schema are often called "memes,"* <http://www.dodccrp.org/comch01.html>
- Greenbaum T. L. (1999) Avoiding a 'virtual' disaster. *HR Focus* 75[2], 11-12
- Hargadon A. and Sutton, R. I. (2000) Building an innovation factory. *Harvard Business Review* 78 [May/June], 157-166
- Haynes B., (2002) An Evaluation of the Perceived Influence of the Office Environment on Productivity in Local Government Offices. *International Research Symposium in Facilities Management, University of Salford, April 2002*
- Haynes B., Matzdorf F., Nunnington N., Ogunmakin C., Pinder J. and Price I., (2001) *Does property benefit occupiers? An evaluation of the literature* Occupier.org Report Number 1. <http://www.occupier.org/report.htm>
- Horgen T. H., Joroff, M. L., Porter, W. L., and Schön, D. A. (1999) *Excellence by design: Transforming workplace and work practice*. 1-304 New York, John Wiley and Sons Inc.
- Hull, D. (1988) *Science as a Process* Chicago, University of Chicago Press.
- Hurst D. K. (1995) *Crisis & Renewal: Meeting the Challenge of Organizational Change*. Cambridge MA, Harvard Business Press.
- Kauffman, S.A. (1993), *The Origins of Order: Self Organization and Selection in Evolution*, Oxford University Press.
- Kauffman, S. A. (1995), *At Home in the Universe: The Search for The Laws of Complexity*, Oxford University Press.
- Kay J. (1993) *Foundations of corporate success: How business strategies add value*. Oxford, Oxford University Press.

- Laing A., Duffy, F., Jaunzens, D., and Willis, S. (1998) *New Environments for Working: The redesign of offices and the environmental systems for new ways of working*. London, E & FN Spon.
- Lane, T., (1996) Genes, memes, templates and replicators, *Behavioural Science*, 41[3] 205-214.
- Leaman, A. Is Facilities Management a Profession? *Facilities* 10[10] 18-20.
- Leibson, D.E., (1981) How Corning designed a 'talking' building to spur productivity, *Management Review*, September 6-12.
- Levin G. (2000) Call Centre Management Review. <http://www.incoming.com/slccmr.html>
- Loasby, B. J. *Making Sense of Making Artefacts: Reflections on John Ziman's Technological Innovation as an Evolutionary Process* <http://www.ets.net/>
- Lorch, R., Ed. (1999) Post-occupancy Evaluation. *Building Research and Information*, 29[2] special issue
- Lupton P. and Haynes, B. P. (2000) Teleworking - the perception-reality gap. *Facilities* 18[7/8], 323-327 <http://www.emerald-library.com/>
- McGovern, P. (1995) Learning from the guru's: Managers' responses to the unwritten rules of the game, *Business Strategy Review*, 6[3] 13-25.
- Maquire S and McKelvey B., (1999) Special Issue: A Review of Complexity Books
- *Emergence* 1[2] [http://www.emergence.org/Emergence/Contents1\\_2.html](http://www.emergence.org/Emergence/Contents1_2.html)
- McGregor W. and Then, D. S.-S. (1999) *Facilities Management and the Business of Space*. London, Arnold.
- McLennan P. (2000) Intellectual capital: future competitive advantage for facilities management. *Facilities* 18[3/4] 168-171 [www.emerald-library.com](http://www.emerald-library.com)
- Myerson J. and Ross, P. (1999) *The Creative Office*. London, Laurence King
- Office of Real Property. (1999) *The Integrated Workplace*. 1-167 Washington DC, US Government Office of Government wide Policy. <http://policyworks.gov/org/main/mp/library/policydocs/Completeiwrpt.pdf>
- Palmer J. and Richards, I. (2000) Get knetted: network behaviour in the new economy. *Journal of Knowledge Management* 3[3], 191-202 [www.emerald-library.com](http://www.emerald-library.com)
- Pascale, R.T., Milleman, M. and Gioja, L., (2000) *Surfing on the edge of chaos: The new art and science of management* New York, Crown Publishers
- Price I. (1995) Organisational memetics?: organisational learning as a selection process *Management Learning* 26 [3] 299-318
- Price, I. (1999) Images or Reality? Metaphors, Memes and Management. In M.R. Lissack and H. P. Gunz Eds. *Managing Complexity in Organisations'*: Westport, Quorum Books pp 165-179
- Price I. (2000) Benchmarking Higher Education and UK Public Sector Facilities Management. Jackson, N and Lund H. Eds. *Benchmarking for Higher Education*, Milton Keynes, Open University Press 139-150
- Price, I (2001a) The History of Facility and Facilities Management In Best, R., Di Valence, G. and Langston, C. Eds. *Building in Value: Workplace Strategies and Facility Management* Butterworth-Heinemann in press
- Price, I. (2001b) Complexity, memetics and reality: A new science of organisations or not, In. Sharifi, S. and Button, W. Eds. *Chaos, Complexity and Management*, London Routledge in press

- Price, I. (2001c) *Flexible Working Policies and Environments in UK Local Authorities: Current Practice* Research report for COPROP. In press
- Price, I. (2002) Can FM Evolve? *Journal of Facilities Management* 1[1] in press Jan 2002
- Price I. and Shaw, R. (1998) *Shifting the Patterns: Transforming the performance of people and companies*. Chalfont, Management Books 2000.
- Raymond S. and Cunliffe, R. (1996) *Tomorrow's Office: Creating Effective and Humane Interiors*. London, E & FN Spon.
- Scarbrough H., and Swan J. (1999) *Knowledge Management and the Management Fashion perspective* British Academy of Management Refereed Conference, 'Managing Diversity', Manchester, <http://bprc.warwick.ac.uk/wp2.html>
- Scott-Morgan, P. (1994), *The Unwritten Rules of the Game*, New York, McGraw Hill
- Stallworth O. E. and Ward, L. M. (1996) Recent developments in office design. *Facilities* 14[1/2], 34-42
- Stredwick J. and Ellis, S. (1998) *Flexible Working Practices: Techniques and Innovations*. London, Institute of Personnel and Development.
- Steele, F. (1988) The ecology of executive teams: a new view of the top. *Organizational Dynamics*, Spring 65-78
- Thomson P. and Warhurst, C. (1998) *Workplaces of the Future*. Basingstoke, Macmillan.
- Turner G. (1997) *The Changing Government Workplace*. Leicester, De Montfort University.
- Turner G. and Myerson, J. (1998) *New Workspace New Culture: Office design as a catalyst for change*. Aldershot UK, Gower.
- Verity J. and Shircore, I. E. (1996) *Smart Office: 11 Steps to the User-friendly Office*. London, Bloomsbury.
- Vischer C. (1996) *Workplace Strategies: Environment as a Tool for Work*. New York, Chapman & Hall.
- Vischer J. (1999) Will this open space work? *Harvard Business Review* 77 [May/June], 28-36
- Ward V. (2000) Physical Space: The most neglected resource in contemporary Knowledge Management? *Sparknow.net* <http://www.sparknow.net/cgi-bin/eatsoup.cgi?id=6024>
- Ward V. and Holtham, C. W. (2000) The Role of Private and Public Spaces in Knowledge Management. *Knowledge Management: Concepts and Controversies* [Conference Proceedings Only] Warwick, University of Warwick. [www.sparknow.net](http://www.sparknow.net)
- Waddington, C.H. (1977) *Tools for Thought*, London Jonathon Cape
- Waldrop, M.M., (1992), *Complexity: The Emerging Science at the Edge of Order and Chaos* New York, Simon & Schuster.
- Wineman J. D. (1986) *Behavioural Issues in Office Design*. New York, Van Nosstrand Reinhold.
- Worthington J. (1997) *Reinventing the Workplace*. Oxford, Architectural Press.
- Zelinsky M. (1998) *New Workplaces for New Workstyles*. New York, McGraw Hill.