Towards Developing A Facility Space-Time Management Method

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Abstract

A major problem area in the management of facility space in the office sector is maintaining an appropriate balance between the supply and demand for space as organisations and their nature of work change. The changing circumstances affecting the supply and demand for space naturally require new methods and techniques for the management of space over time. This establishes the proposition that time must be included in the planning and management techniques. Through the undertaking of three case studies and a review of recent literature, a sequence of comparative analyses between traditional and space-time methods is made. It is argued that an explicit inclusion of the time factor within management procedures does enhance decisions about the management of space, although it will not completely eliminate traditional practices. In discussing the advantages and limitations of space-time management, suggestions are also offered as a basis to further develop a general method of space management of facilities in rapidly changing circumstances.

Keywords: change, space-time management, allocation, utilisation, management responses

Introduction

Towards the last decade of the twentieth century, there has been serious concern over the impact of information technology (IT) on business operations, particularly in providing facility space in organisations. Many organisations were facing recurrent problems in balancing the supply of and the demand for space during the initial use, re-use and 'change of use' phases. These have been documented either as impact studies concerning organisational change on their space provisions (College of Estate Management, 1983; Becker et al, 1991; Duffy, 1983; Davis et al, 1985; BOMA, 1995), or as new facility prototypes creation (Stone & Luchetti, 1985; DEGW & Teknibank, 1992).

A high level of mismatch has been reported between what is really required and what is being provided in terms of spatial support. The limitations to the traditional methods of space management in changing situations arise from the space per person measure which makes quantitative estimates superfluous (BOMA, 1995) and occupancy costs increasing (Apgar, 1993), or from the allocation procedure which prevails in single location, which effectively reduces the variety of provisions (BOMA, 1995) when there is changing preference and expectations in working practices (The Eclipse Group, 1995; Sproull & Kiesler, 1991).

As a result, industry has developed some radical approaches in the management of facility space – through the use of time factor considerations instead of using an assumed total presence; utilisation levels instead of headcounts; allocation by actual use instead of rank and status; and management responses by levels of predictability of changes instead of pre-determined and rigid solutions (Harrison, 1996; FM DATA Monthly, 1999b). A trend where time dimension and time frames were seriously considered in the space management process was beginning to develop.

In the past, the space-time approach has been studied extensively as a basis for policy formulation, particularly in relation to university buildings (Bullock et al, 1968; 1974; Doidge, 1972; Rawlinson, 1973; 1982), library facilities (UCERG, 1970a), refectory facilities (UCERG, 1970b) and within the context of urban planning (Chapin Jr., 1974; Abercombie, et al, 1974; Cullen & Phelps, 1975; Cullen & Godson, 1974). These policies focused on major functions of facility space management namely estimating requirements, allocation and utilisation of spaces. For example, Bullock's (1974) study on teaching space has found advantages of applying a probabilistic approach over the time-tabling technique in estimating requirements. Doidge's (1972) study on allocation has produced a dynamic allocation model in solving space shortage problems through space sharing, time-tabling and central allocation. Rawlinson's (1973) study has introduced a procedure for activity-space management by allocating activities using time-tabling and classifying spaces as room types. This system was later developed commercially, for use in tertiary institutions of education (Rawlinson, 1982). Additionally, the Unit of Architectural Studies (UAS), University College London, has published a series of papers between 1967 and 1971, focusing on studies on the availability, distribution and patterns of use of space in the college. Another research series (Bullock, 1970), published by the Land Use and Built Form Studies (LUBFS), Cambridge University, between 1970 and 1972, has focused on the development of a comprehensive model of activities appreciating the effect on increasing the provision of space in one facility as related to the resultant use of another.

The common feature of these studies referred to a major proportion of space users who were using space for a limited period of time. Besides, those organisations were experiencing financial cutbacks for new building projects while at the same time having to absorb the growing needs and pressures of demand (Rawlinson, 1984). This background is comparable to the contemporary business organisational climate. Some preliminary researches and application in this area are already in progress in several major organisations across North America and Europe (Becker et al, 1991).

Aims and Objectives of the Paper

The purpose of the investigation is to develop the basis from which to plan the tools needed to rationalise and support tactical, operational and strategic decisions concerning the management of facility space under rapidly changing circumstances of use. The study has two main objectives: first, to develop the theoretical basis for estimating the demand for and allocation of space and second, to propose practical techniques for the space-time management of facilities which could enhance the planning and management measures already in existence. The targeted areas are: estimating the total space required, new forms of procurement to meet these requirements, allocation of space, utilisation, adoption of measures to face the problems of subsequent changes and to the eventual disposal phase should surplus space no longer be required.

Structure of the Paper

The paper has five main parts (Figure 1). Part A, introduces the broad context of the problem. An extensive literature survey together with published case studies on the general concepts of space management over the past thirty years including the changing circumstances and their implications on management is summarised. A review on the literature on space-time methods and techniques across all types of facilities was also undertaken. After assimilating these reviews a method was devised as to how to research the topic based on the aims and objectives of the investigation.

Part B sets out to establish the conceptual framework of the space-time management approach while Part C explains the research approach detailing the hypotheses and the key issues for potential testing through the case study method. The overall findings of the research investigation conducted around the three case studies are reported in Part D. The basic support materials of the case study investigation are presented in the form of an Appendix in Part F. Both parts, D and F, are not presented explicitly in this paper. Finally, Part E reports on the comparative analysis of the case findings with the existing literature and some potential areas of application are suggested. The results of the analysis are summarised and the conclusions offer some important points for further researches. It also highlights the contribution the research has made to theoretical development of the space-time management approach.

The Conceptual Framework of Space-Time Management Method

Given the present and likely future circumstances, the management of facility space establishes a real concern for time in its process. The mechanics of the system has been discussed in detail elsewhere (Haron, 1997). Figures 2 and 3 describe the main parameters of the space-time management technique.

Figure 2 shows the stages of a decision making process over a one-year period. The

process iterates through five main stages: starting with the measurement and diagnosis (through pre-survey activity analysis), planning and control (through allocation and re-allocation activities), organising (through prototype arrangements), re-measurement (through monitoring use), and finally implementation (through communication activities).

Figure 3 captures the dynamic relationships between supply and demand. It conceptually illustrates the variation of management responses adopted according to the problem situations, expressing the changes in use over time. The crucial task in this model lies in identifying the recurrent problem situations and their expected time frames of occurrence.

To date, documentations of the approach (Figures 1 & 2) in facility planning, design and management are readily available (FM DATA Monthly, 1997) and are steadily increasing.

The Research Approach

The effects of the changing circumstances lead to several questions for those involved in the management of facility space, as shown below. Six key questions which need to be addressed are as follows:

1. Which spatial factors significantly affect the activities, operations and management of an organisation in contemporary conditions?
2. How may the relative suitability of facility space be assessed and reviewed over time?
3. How may the relative severity of the spatial constraint imposed by a facility on the occupying organisation be measured?
4. To what extent are traditional space standards and space allocation procedures relevant and applicable in an era of rapid change?
5. How should an organisation calculate its total demand for space over the short, medium and long term period?
6. What methods and techniques might be developed to assist in the management of space through time?

Three hypotheses were generated: first, given the dynamic space requirements affected by time factor, the traditional methods for estimating space requirements will become increasingly inadequate. Applied research in the 1980s and 1990s has identified the major limitations to traditional approaches to space management in contemporary conditions, particularly the over-estimation of spaces required, uneven distribution of spaces, insufficient provision of space types, inefficient space demarcation and extreme levels of utilisation occurring at all levels of the organisation. Although each has different and multiple causes, the most significant cause of these inadequacies has been traced to the simple 'space per person' criterion.

Second, the explicit inclusion of time within space management procedures is likely to result in a more reliable method for estimating space requirements, allocating space and providing the balance of supply and demand over time. This is supported by the development of the conceptual framework of space-time management. On the management of the demand-side, the quantitative measure is based on full-time equivalent (FTE) people hours load incorporating a forecast of possible future needs, so as to ensure that a real demand for space is estimated at each level of the organisation. On the supply side, the quantitative measure is in space hours availability. Its relationship to the level of availability will ensure that a real supply of space is attained at each level of the facility. On the demand and supply

interface, the utilisation is based on the level of satisfaction in the duration of use and occupancy which ensures that a reasonable utilisation is targeted. The balance between supply and demand will depend on the acceptable level of tolerance of space utilisation across the different levels of the organisation.

Third, the space-time management methods will provide a more viable and efficient basis for the planning and management of space than the traditional methods. Firstly, it will provide a better forecasting method for estimating the quantitative and qualitative space requirements. It will provide better estimates of the 'real' demand/supply for space (actual/effective) and a richer view of the variety of spaces required over time. Secondly, an improved allocation and use procedure will allow flexibility in spatial adjustments for minimising wastage. Finally, it will provide an expert basis for a comprehensive management response system, incorporating the basic time frames and relating these to the management problems and appropriate management options.

The expected advantages of applying the method were considered in a selection of key issues; the demand side focused on arriving at a better estimate of the aggregate spatial support requirements and their varieties, while the supply side focused on improved allocation/ reallocation procedures. The management side focused on control measures through improved utilisation and expert management responses to changing problem situations. These issues were analysed through three case studies, as a basis for exploratory investigation.

The aim of the case study strategy was to support the potential relevance in the application of the new space-time method alongside the traditional approach by using data from the original case studies. The sample for the study comprised commercial business organisations occupying headquarters and other building facilities. These organisations were from the high change rate category in terms of people and space. In this investigation, the measure was changes per period (Birchall & Lyons, 1995), in the previous 24 months. This period was considered a rapid pace at the time the study was undertaken.

The data on the demand, supply, utilisation and time frames aspects were collected using structured interview questionnaire with key personnel who are responsible for policy formulation and implementation of space use in their respective organisations. They included the director, the facility manager, the property manager or the human resource manager. The interview data is supported with materials from documentary sources such as building plans and space policies. A comparative analytical technique was applied following closely to these steps: within-case, cross-case and paired case comparisons (Eisenhardt, 1989; Yin, 1994), incorporating similarities and differences (Tversky, 1977) to draw out the key findings. These are then compared with existing conflicting or similar literature (Eisenhardt, 1989:544). Eisenhardt's work is instrumental to the development of this analytical framework because previous writings tend not to provide the framework for theory building from cases as developed in her analysis.

Testing the Study's Hypotheses

Initial results from the case studies showed that the three organisations were at different levels of acceptance of the full capability of the space-time method as a management tool. At their lowest level of acceptance organisations display a reluctance of implementing space-time method unless prodded by top management. At their highest level, organisations will

fully implement the space-time method across the full spectrum of change. The details of these findings will now be compared against those of recent literature.

Hypothesis 1: *Given the contemporary and likely future work conditions, the traditional methods for estimating space requirements will become increasingly inadequate.*

The findings of the case studies initially gave mixed results. On one hand, all the case organisations have asserted that traditional space standards were still applicable. On the other hand, in-depth analysis confirmed that the effects of inadequacies were present.

Where the traditional space standards remains relevant, work organisation is conducted around the presence of staff within the facility. This suggests *full occupancy* - an essential requirement for assigning space in the traditional method. Where the standards do not remain relevant, work organisation is conducted according to their actual duration of performing the activities. This could be much less than the required amount of contractual hours per week. As a result, assigned workspace was under-utilised over the total available organisational time (Figure 4) as indicative from the difference in space hours and people hours utilisation graphs. Therefore the 'space per person' allocation is considered inadequate when space-time budget records of the actual use of the workspace were applied.

Furthermore, there is a weak relationship between the number of employees and the amount of space provided. The difference between theoretical space per person ratios and the actual use ratios of each organisation was inconsistent (Table 1) particularly in two of the three cases, which indicates substantial positive and negative differences. Should management rely on this indicator, future estimates for space provision could be grossly misleading.

The case studies evidence also showed that individuals and groups have a tendency to ask for a wider range of primary workspace types to be provided within the central facility (Table 2), indicative from the levels of acceptance. Should management apply the current perceived indicators for increase in dedicated workspaces particularly, then there will be a serious mismatch between the demand and supply in the future.

Recent research and reviews seemed to reconfirm the inadequacy of the "old ways of planning workspace" which tend towards excessiveness and inefficient responses (McGregor, 1999:59) as mentioned previously. McGregor forwarded questions such as, "what if organisations need less space, not more?" or "what if different locations are needed or if not required at all?" Such claims have been substantiated through performing comparative analyses on annual occupancy costs (Apgar, 1998). It was found that these costs were highest in traditional space office types, gradually decreasing in shared spaces or virtual arrangements of the new working environment organisation (Apgar, 1998:129). Some claimed upwards of 25 per cent in cost savings from a square-foot reduction (US General Services Administration, 1999). These are brought about by applying fewer differentiating categories, removing or reducing the number of status based standards which have significant influence towards over estimation of usable area requirements (USGSA, 1999).

We conclude from the literature and case studies that the traditional methods of estimating space requirements are becoming increasingly inadequate when applied to changes that involve changing work organisation, but may remain relevant in the traditional working arrangement types.

Hypothesis 2: *The explicit inclusion of time within the space management procedures is likely to result in more reliable methods for estimating space requirements, allocating space and adjusting the balance of supply and demand.*

The space-time analysis carried out on the case studies data has produced estimates of the total space requirement that are some 17 per cent to 33 per cent lower than those resulting from traditional methods (Table 3) and releasing 27 per cent to 35 per cent of usable area for diversification.

This was effectively achieved through a reallocation technique, commonly practised in industry such as in these companies: IBM UK Ltd. (IBM, 1991), Digital (Digital, 1993) and Andersen Consulting (Chadwick, 1993; 1996). Space allocation procedures now depend on the average duration of activities or time spent at the workspace. The higher the average time spent at the workspace, the more eligible for space assignment. Conversely, a shorter duration would lead to a degree of space sharing (Table 4). As a result, primary usable areas have lesser allocation for dedicated workspaces, creating a balance which could be diversified into other space types (Figure 5).

When estimating capacity requirements, organisations need first to adopt reasonable targets for utilisation of space. The case studies simulation showed that the actual reported facilities utilisation was between 36 per cent and 41 per cent compared to the theoretical levels of 75 percent (Table 5) giving a difference of 33 per cent - 39 per cent as gross misrepresentation on utilisation.

Should the current utilisation be required to be improved, to say, 50 per cent, assuming full occupancy at 70 per cent, then the frequency factor should theoretically be increased to 71 per cent. This will allow the facilities to accommodate higher numbers of full-time equivalent (FTE) users, possibly up to 38 per cent more (Table 6) when the additional numbers are contracted at lower working hours - implying a potential increase in part-timers. Should spaces be available to a capacity of 24 hours maximum per day, their implication on the facility demand capacity would be overwhelming. There is a potential to increase the total number of FTE to a maximum of 167 per cent if their contractual hours were at 39 hours work week or up to 366 per cent at 18 hours work week (Table 7).

If, on the other hand, the level of utilisation and contractual hours are unchanged, the capacity could be augmented from the occupancy levels. Some form of sharing arrangement operates. The fixed availability of supply of each space type could be effectively occupied by more than one FTE so that each workstation could accommodate more changes in number of users (Table 8).

However, these kind of adjustments which target on utilisation levels were feasible in short-term arrangements. In long-term arrangements, when business plans and strategies were considered, the spatial flexibility of existing spaces is simultaneously considered.

The analysis on spatial features has found three categories of facility space types: the least constrained facility, moderately constrained and the most constrained facility. A facility space was considered to be least constrained by their dispersed cores and uninterrupted floorplate, such as in Case 1 (Figure 6) which facilitates sub-divisioning arrangements. In contrast, the most considered facility has fragmented floorplates of less than 500m, semi-dispersed cores and awkward column positions, such as in Case 2, which allows

poor subdivisioning. By combining management responses and spatial analysis, the case findings showed that it is not necessary for the most constrained building to have the most significant impact on management when organisations have gone through changes; neither will the least constrained facility require the least effort (Figure 7). The implications on management are usually supported by the endorsement of space-time policies at the top management level and the eventual acceptance at the end user level; individual, working group, business units.

Recent literature again tends to confirm the reliability of applying the 'space-time' notion in terms of estimating capacity requirement and for planning through different time frames. Thus organisational people hours demand measure could be theoretically deployed into space, place and time (Nutt, 1999:29), regardless of change factors. The emphasis is placed on the FTE in demand forecasting allowing variation in duration of use. Elsewhere, when there is a constant target on duration of use, variation occurs at occupancy levels (FM DATA Monthly, 1998). The method could also enlarge the requirement for a variety of work settings to suit changing needs and new work processes (Varcoe, 1998; USGSA, 1999). The overall space availability is optimised if spatial flexibility (FM DATA Monthly, 2000) becomes an important issue in space utilisation or reutilisation over different time frames.

Combining recent literature with the case findings, it is concluded that explicit consideration of time within the space management procedures is likely to result in more reliable methods for estimating space requirements, allocating space and adjusting the balance of supply and demand. The space-time measures in people hours, space hours, and utilisation levels, are seen as the common denominators in future changes and could be accommodated and managed with reasonable flexibility.

Hypothesis 3: *A space-time management method will provide a more viable and efficient basis for the planning and management of space than traditional methods.*

The case studies support the well-known fact that management responses to changing conditions are related to their problem situations and potential future plans. Decisions tended to vary across specific time frames of change expectation: a time frame of less than eight weeks (immediate-short term); up to six months ahead (short-medium term); and five or ten years ahead (medium-long term). The anecdotal evidence showed that most change expectations tend not to involve move or relocation decisions; rather, typical responses were modifications to space use, space adaptation, review of space standards and flexible work arrangements (Table 9).

In a situation of unexpected demand, the case findings showed that short-term tactical measures by offering space sharing typical operational measures through furniture arrangement, activity settings or an innovative strategy by space charging were adopted. However the activity, some kind of control measures were used; by decreasing the amount of space per person or by adopting fewer space standards. This has created some management problems particularly when Headquarters sites were preferred over other locations, to the point of being detrimental to health and safety of the workers. Alternatively, an adaptation strategy was applied as a mean to defer direct property investments in new buildings as the decision process suggests that a 'space-time management method' is already in practice at different levels of implementation in the case studies (Table 10) although at different levels of impact and acceptance.

The space-time budgeting technique complements the new management method to derive the required utilisation levels of the different organisational operations. The space-time analysis from case studies indicated this as feasible (as discussed earlier). Those who actually used their space for less than 20 per cent of the time for which it was available found themselves targeted by management to improve the utilisation of the workspaces.

Recent papers lend explicit support to space-time management. The current key objective of workspace management is to match requirements of the tasks to be performed to the most effective time-space relationship (McGregor, 1999: 61). The initiatives combined the organisational needs from short-term to long-term demand to achieve the balance between supply and demand (FM DATA Monthly, 1999a) at facilities portfolio level. Its development in the offices sector is supported when "key trends of IT convergence and performance offer greater time and space options to end users" (Watts, 1999:105) and this goes beyond mere allocation. The end users have now "choice in the selection of work setting - as they look for more freedom, fluidity and excitement" (Watts, 1999:107). A recent contribution supports this initiative under the development of Integrated Workplace (USGSA, 1999) while another has represented it as purely business strategy (Centre for Digital Culture, 2000).

Both the case studies and the literature indicate that space-time management is viable in view of its ability to produce real estimates for future requirements in amount and diversity of space types, although there is already an indication that the method may not be fully facility related; it also presents potential disadvantages in its implementation at the individual, group and business units' levels of operation.

Application Areas

A major concern of highly variable use pattern is to develop a management system that permits a versatile and flexible response in the provision of spatial support. Space-time management necessarily treats the three time frames – short, medium and long-term - as equally important, although Facility Management authors tend to stress on the strategic nature (Lawson, 1996; Reeves, 1999), relating particularly to critical decision making requirements in holding properties and real estate.

There are four broad areas of potential application for this method (Figure 8): strategic planning and forecasting of space requirement; strategic positioning through estimating capacity requirement; strategic management for the management of change and strategic design for future management of space.

- *strategic planning and forecasting of space requirement*, when the management decides on a fundamental organisational change through new working practices, innovative contract of employment, different business priorities or technological advancement. The changing nature of work will demand more effective control and allocation of net usable areas (NUA) and net internal areas (NIA); Figure 8 (a) conceptually indicates the demand-led initiatives;

- *strategic positioning through estimating capacity requirement*, where the opportunities for spatial support in the market supply may have changed with the introduction of new types of space, new uses, mixed uses, new types of venue and location, and/ or new types of leasing arrangements. Opportunities for support of fully serviced office space on a 'provide as and when needed basis' may now exist.

If the nature of supply is measured in space hours, a more precise matching to the facility resource may help determine a new workforce structure through new contracts and employment. This allows the dynamic changes in demand to occur continuously and enables the organisation to better position itself in the market as supply dictates. Figure 8 (b) conceptually indicates the supply-led initiatives;

- *strategic management for the management of change,* where the use of space fluctuates throughout different time periods, with peaks and troughs. The method can better balance supply and demand by improvements in utilisation through reallocation procedures. This is targeted at two sources, the duration of use or the occupancy levels in their respective time frames of short, medium and long term. Hence, during peak times, the duration of use may be reduced, and occupancies increased, and vice versa for the troughs. This results in a uniform distribution in the long term. Figure 8 (c) shows the utilisation-led initiative;

- *strategic design for future management of space*, where the spatial design needs to be appraised to determine the extent of flexibility, adaptability, capacity and suitability of buildings and facility spaces, using building plans and post-occupancy evaluation tools; Figure 8 (d) conceptually shows the management-led initiative.

Table 11 shows examples of these practical management techniques across the different levels of management and utilisation.

Result of the Analysis

Whilst recognising that many traditional methods of management remain relevant to traditional working organisations, especially where work is organised in one location, our case studies showed that factoring in measurement of demand by people hours load rather than mere occupancy resulted in a significant reduction in the net usable area estimates. On the supply side, the measurement of workspace by space hours availability also gave a more reliable estimate of the facility capacity, although the influence of the relative severity of spatial constraints needs to be noted as placing varying degrees of limitations on the activity, operations and management of an organisation.

The method was seen to have immediate application in all forms of work practices over space and time. A typology of space-time management has been developed in tandem (Figure 9), which shows the interaction of the two dimensions: predictability and utilisation. Very predictable events of high utilisation require the application of the traditional method in space assignment. In the other extreme situation, very unpredictable events with low utilisation require the application of space-time method with ready availability of flexible spaces and locations. If displayed in a continuum, the nature of allocation will transmute correspondingly with variations in facility locations and the group of users.

The challenge remains to ensure data collection and analysis which is as accurate as possible. Estimates based on selective memory, or diary self-reports or subjective observation may either be unavailable due to personal or time constraints, or may produce over-estimates of important activities or under-estimates of personal time (Hartley, 1975). Similarly, at the facility level, the initial assumption treats

its data as considerably reliable when these are bound to change through adaptation or renovation activities. Thus, this would require regular observation. Adding in further checks to data collection, and ensuring proper monitoring and review stages are crucial in highlighting problems and remedies. This should also be done where new space management initiatives have been implemented. Measures of efficiency on the part of the time which the facility space is actually being used should be monitored. This area, if already researched has been under-reported.

Conclusions and Recommendations

As a conclusion, a number of points need to be borne in mind:

- the calibration of the allocation guidelines relating to sharing, at the individual and group levels, has significant influence on the real demand estimates of the organisation;
- the determination of the extent of control over allocated spaces at all levels of operation tends to influence the basis for adjustments of supply and demand for space over time;
- the targeted utilisation levels which could be manipulated separately from either the duration of use or the size of groups tend to influence the employment structure directly rather than presented as an option to improve space use;
- the integrity of the data derived from space-time budget technique establishes the options for management responses offered by the expert system;
- the organisational and facility policies are essential elements which initiate the management of space over time.

Further research could focus on these areas. Resulting improvement in quantitative data, measures of efficiency and understanding of strategic and design problems and possibilities would enhance management's capacity to make allocation decisions which are more accurate and precise.

If the above findings were to be offered to the case studies organisations, they would perhaps see why things were as they were. Obviously present developments are spurred by the shift to virtual spaces or satellite centres, which are state-of-the-art in the current world of business organisations. But it is also clear that, the approach will not completely eliminate the traditional method, rather it will enhance and support management in making secure decisions about use and management of space.

Some day the limits to change will be reached. Prudent space-time management may not ward off that day but, hopefully, it will delay it for a while. This is the special outcome from the present research. As results of further empirical investigation are available, a general method of space resource management of facilities can be developed.

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Table 1: Comparing Theoretical Against Actual Space Per Person Indicators From Traditional Method

		Case 1	Case 2	Case 3
Theoretical Estimates	FTE NUA1 (1) NUA1 per person sq.m. per person	1323 12896 9.7	236 3436 14.6	891 16678 18.7
Actual Estimates	FTE NUA2 (2) NUA2 per person sq.m. per person	1323 12896 13.8	236 3317 14.1	891 11274 12.7
Difference	NUA per person sq.m. per person	+ 4.1	- 0.5	- 6.0

Source: Haron (2000)
(1) Appendix 2; Table 2.5 (Case 1), Table 2.23 (Case 2), Table 2.42 (Case 3)
(2) Appendix 2; Table 2.6 (Case 1), Table 2.24 (Case 2), Table 2.43 (Case 3)

Note: FTE = Full time equivalent, NUA = Net usable area

Table 2: Comparison of Space Classification in Three Studies

	Case 1	Case 2	Case 3
Space classification			
Dedicated workspace/office	unacceptable (-)	just tolerable (-)	just tolerable (-)
Shared workspace	just tolerable (-)	na (-)	acceptable (+)
Group space (Ancillary)	just tolerable (-)	just tolerable (-)	just tolerable (-)
Amenity space	acceptable (+)	unacceptable (-)	just tolerable (-)
Special space	acceptable-just tolerable (+-)	just tolerable (-)	acceptable (+)
Indicate:			
Diversity of space type	just tolerable	unacceptable	just tolerable

Source: Haron (2000)
Appendix 2; Table 2.8 & 2.11 (Case 1), Figures 2.22 & 2.29 (Case 2), Figure 2.41 & 2.44 (Case 3) Appendix 3, Table 2.64

Note: Unacceptable refers to complaints received and management having to take remedial steps
Just tolerable refers to complaints received and management not having to take remedial steps
Acceptable refers to no complaints received and therefore no action is necessary

Table 3: Comparing Demand Estimates Between the Traditional and Space-Time Approaches, in Net Usable Area (sq. m.)

	Demand estimates		
	Case 1	**Case 2**	**Case 3**
Traditional method theoretical NUA (sq. m.) (1)	12896	3436	16678
Space-time method (adjusted) NUA (sq. m.) (2)	10677	2297	13575
Percentage difference	-17%	-33%	-19%

Source: Haron (2000)
(1) Appendix 2; Table 2.5 (Case 1), Table 2.23 (Case 2), Table 2.42 (Case 3)
(2) Appendix 2; Table 2.12 (Case 1), Table 2.29 (Case 2), Table 2.48 (Case 3)

Note: (1) estimated from space per person standard on total number of FTE
(2) estimated from effective working hours, i.e. space-time budgets on total number of FTE

Table 4: Reclassification and Reallocation of Work Activities by Time Budget

Categories	**Occupation type**	**Average time spent at desk**	**Suggested sharing ratios**
Group A	Directors	< 20%	1 : 10*
Group B	Managers, professional, Marketing, Sales	21% - 40%	1 : 3
Group C	Technical	41% - 70%	43 : 100
Group D	Support (Administration, Personnel, Clearical and Secretarial)	> 70%	1 : 0.75**

Note:
1. Suggested sharing ratios (desk to person) are based on the average duration of time spent at the workspace. These could be as low as 1:2 (shared assign) or as high as *1:10 (free address). It is unsual for Directors to share space. Group D represent assignment of space**
2. According to the field studies and applied research literature, ratios are derived from evaluation surveys on the level of satisfaction of the users involved.

Table 5: Levels of Utilisation of Workspaces Across the Three Case Studies

		Case 1	Case 2	Case 3
Traditional 100% Space-time budget - Theoretical	FTE (1)	1323	236	891
	FTE hours (1)	49613	8850	33396
	Space unit hours (2)	66510	11800	44528
	Utilisation	75%	75%	75%
Actual reported Space-time budget - Adjusted	FTE (1)	1323	236	891
	FTE hours (1)	25061	4289	18193
	Space unit hours (2)	66510	11800	44528
	Utilisation	38%	36%	41%
% difference	Utilisation	- 33%	- 39%	- 34%

Source: Haron (2000)
(1) Appendix 2; Table 2.7 (Case 1), Table 2.25 (Case 2), Table 2.44 (Case 3)
(2) Appendix 2; Table 2.8 (Case 1), Table 2.26 (Case 2), Table 2.45 (Case 3)

Note: (1) estimated from traditional contractual arrangements of 37.5 hours per week
(2) estimated from space-time budgets reported as actual working hours per week

Table 6: Summary Table For Estimating Demand Capacity at Different Contractual Policies at Current Space Hours Availability

	Case 1		Case 2		Case 3	
Space hours	66150	66150	11800	11800	44528	44528
Utilisation factor *(b)*	50%	50%	50%	50%	50%	50%
Projected FTE loads *(c)*	33075	33075	5900	5900	22264	22264
Current FTE load *(d)*	25061	25061	4289	4289	18193	18193
Difference FTE loads *(e = c-d)*	8014	8014	1611	1611	4071	4071
Hrs per week *(f)*	39	19	39	18	41	20
Additional FTE *(g = e/f)*	205	422	41	90	99	204
Actual FTE *(h)*	1323	1323	236	236	891	891
Total FTE *(i = g+h)*	**1528**	**1745**	**277**	**326**	**990**	**1094**
Actual Full time *(j)*	1288	1288	236	236	876	876

Source: Haron (2000)
(1) Appendix 2; Table 2.7 (Case 1), Table 2.25 (Case 2), Table 2.44 (Case 3)
(2) Appendix 2; Table 2.8 (Case 1), Table 2.26 (Case 2), Table 2.45 (Case 3)
(3) Appendix 2; Table 2.13 (Case 1), Table 2.31 (Case 2), Table 2.50 (Case 3)
(4) Appendix 2; Table 2.14 (Case 1), Table 2.32 (Case 2), Table 2.51 (Case 3)

Note:
(a) Assume a constant space availability in space hours per week at current operating hours.
(b) 50% utilisation is decided by the management as the describe level
(c) Projected FTE load in people hours estimated from multiplying spacehours by utilisation factor
(d) Current FTE load in people hours estimated from space-time budget analysis
(e) Difference in FTE load between projected and current
(f) Full time contractual hours have two option here;
1) at 39 - 41 hrs per week, 2) at 18 - 20 hours per week
(g) Additional FTE numbers are estimated by dividing the difference from (e) by contractual hours (f)
(h) Actual FTE numbers taken from the original case data
(i) Total FTE numbers sums up the additional (g) and the actual (h)
(j) Actual Full time numbers are taken from the original case data
(k) We take each part time employee as 0.5 - 0.6 the equivalent of full time staff
(l) The total percentage increase in FTE numbers can be estimated to give the FTE capacity estimates for the facility

Table 7: Summary Table for Estimating Demand Capacity at 24 Hours Maximum Space Availability

	Case 1		Case 2		Case 3	
Space hours	222264	222264	39648	39648	149614	149614
Utilisation factor *(b)*	50%	50%	50%	50%	50%	50%
Projected FTE loads *(c)*	111132	111132	19824	19824	74807	74807
Current FTE load *(d)*	25061	25061	4289	4289	18193	18193
Difference FTE loads *(e = c-d)*	86071	86071	15535	15535	56613	56613
Hrs per week *(f)*	39	190	39	18	41	20
Additional FTE *(g = e/f)*	2207	4539	395	863	1381	2831
Actual FTE *(h)*	1323	1323	236	236	891	891
Total FTE *(i = g+h)*	**3530**	**5853**	**631**	**1099**	**2271**	**3721**
Actual Full time *(j)*	1288	1288	236	236	876	876
Part time *[k = (i-j) x 2]*	4484	9130	-	-	2791	5690
Total % increase in FTE *[l (g/h) x 100%]*	**167%**	**342%**	**167%**	**366%**	**155%**	**318%**

Source: Haron (2000)
(1) Appendix 2; Table 2.8 (Case 1), Table 2.26 (Case 2), Table 2.45 (Case 3)
(2) Appendix 2; Table 2.15 (Case 1), Table 2.33 (Case 2), Table 2.52 (Case 3)
(3) Appendix 2; Table 2.16 (Case 1), Table 2.34 (Case 2), Table 2.53 (Case 3)

Note:
(a) Assume that space hours are available at maximum capacity, 24 hours daily, within the week.
(b) 50% utilisation is decided by the management as the describe level
(c) Projected FTE load in people hours estimated from multiplying space hours by utilisation factor
(d) Current FTE load in people hours estimated from space-time budget analysis
(e) Difference in FTEload between projected and current
(f) Full time contractual hours have two option here;
1) at 39 - 41 hrs per week, 2) at 18 - 20 hours per week
(g) Additional FTE numbers are estimated by dividing the difference from (e) by contractual hours (f)
(h) Actual FTE numbers taken from the original case data
(i) Total FTE numbers sums up the additional (g) and the actual (h)
(j) Actual Full time numbers are taken from the original case data
(k) We take each part time employee as 0.5 - 0.6 the equivalent of full time staff
(l) The total percentage increase in FTE numbers can be estimated to give the FTE capacity estimates for the facility

Table 8: Improving Utilisation Through Changes in Occupancy Factor Workspaces

	Case 1	Case 2	Case 3
Enumerated # of workstation *(a)*	1655	278	905
No of user *(b)*	1358	236	905
Actual # of workstation *(c)*	1323	236	891
No of user *(d)*	1323	236	891
Recalibrated # of workstation *(e)*	991	198	662
No of user *(f)*	1323	236	891
Seat used *(1) = b/a*	0.82	0.85	1.00
Seat used *(2) = d/a*	0.80	0.85	0.98
Seat used *(3) = f/e*	1.34	1.10	1.35

Note: (1) derived from layout plan analysis
(2) derived from 1 : 1 allocation procedure
(3) derived from space-time method.

Table 9: Problem Situation and Prevailing Management Responses in Current Situation to Future State

Level of management	Case 1	Case 2	Case 3
Individual level: Current	inadequate	adequate	adequate
Future	Desk on demand		
less requirement		Sharing of PCs	do nothing
Working Group level: Current	inadequate	adequate	adequate
Future	Sharing group space	Increase in use of IT	Move functions around
changing requirements	Increase commons area		
Business units level: Current	adequate	adequate	adequate
Future	Activity settings	Space standards	Move functions around
changing requirements	And space charging		
Organisational level: Current	more than adequate	adequate	adequate
Future	Consolidation	Design strategies;	Move functions around
changing requirements	and teleworking	adaptation	

Note: Haron (2000) Appendix 2, Section B of A1, A2, A3

Table 10: Time Frame of Predictability of Each Level of Management Across Three Case Studies

Level of management	Time frame of predictability		
	Case 1	Case 2	Case 3
Individual	na	na	na
Group	2-8 weeks	na	na
Departmental/Business units	3 months	1 year	1 year
Organisational	6 months	1 year	1 year
Indications to 'real' demand	Fully aware	Not fully aware	Not fully aware

Source: Haron (2000) Appendix 2, A1, & A3, Section A

Table 11: Some Example of Space-Time Management Measures to Accommodate Changes in Use Over Time

variability in use	individual Workstation	Group space	Business units/Divisional spaces	Property portfolio spaces
short term tactical measures	•free address •kit of parts •clear desk policy	•time-tabling •shared facilities •group address	•chargeback system	•hotelling
medium term operational measures	•JIT/hotelling •electronic home office •first come first served	•booking system •team office •shared office	•system furniture •non-territoral office •universal plan	•conversion •refurbishment •universal plan
long term strategic and innovative measures	•flexible working •shared office •non-territorial office	•touchdown •mobile net working	•satellite office •telecentres	•virtual office •telecentres •24 hours office

Figure 1: Structure of the Paper

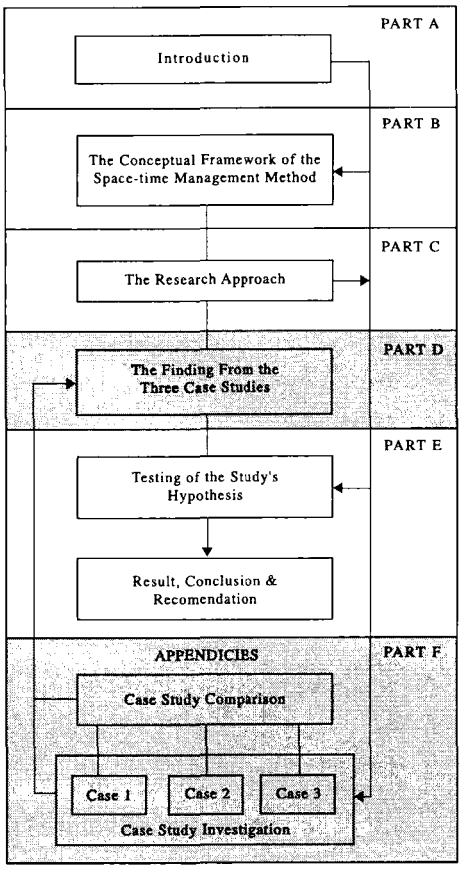


Figure 2: The Space-Time Management Process

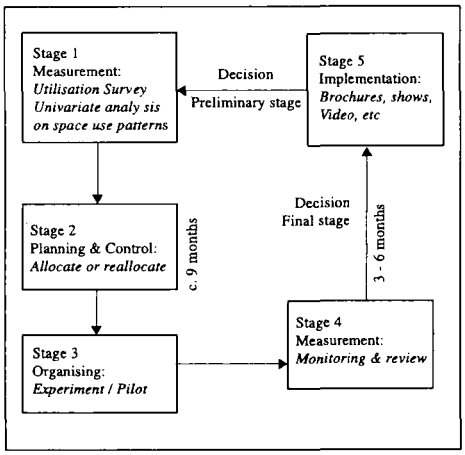


Figure 3: The Space-Time Management System

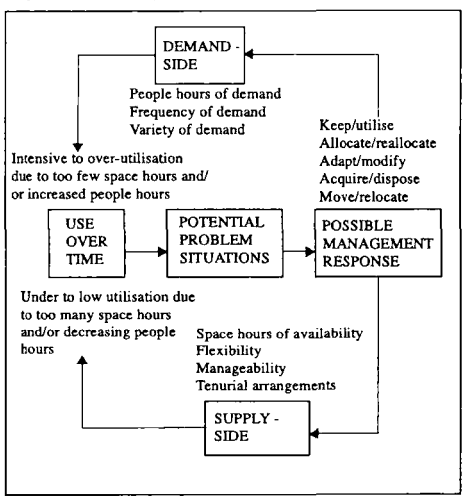


Figure 4: Matching People Hours and Space Hours to Show the Level of Utilisation by Actual Time in Use Across Three Case Studies

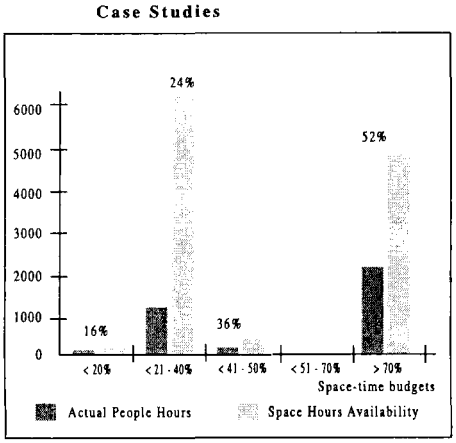
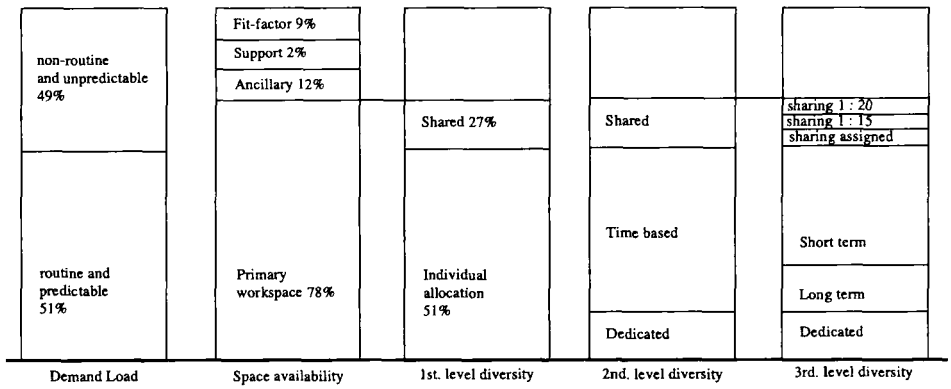
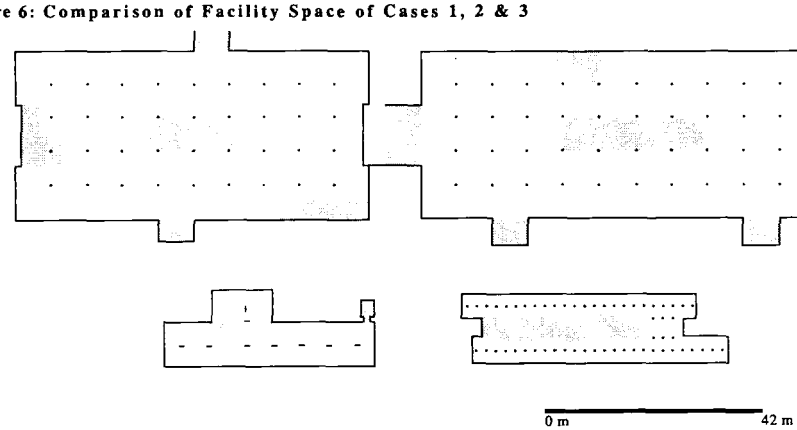


Figure 5: National Space Diversity from the Original Allocation of Primary Workspaces, Simulated from Case Study 1



Source: Haron (2000) Appendix 2, Figure 2.5 (Demand load), Figure 2.10 (Space availability)

Figure 6: Comparison of Facility Space of Cases 1, 2 & 3



Note: Anti-clockwise, first two building plans are from Case 1, next from Case 2, and finally Case 3

Figure 7: The Extent of Impact from Change Againts Facility Profits by Space-Time Management Intervention Profiles

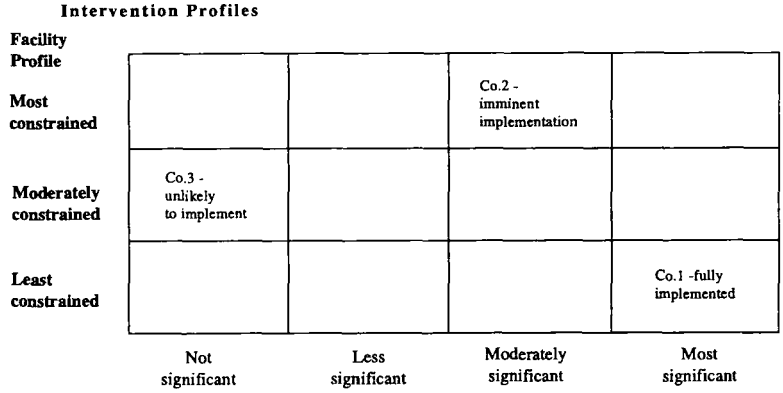


Figure 8: Application Areas of the Space-Time Management Methodology

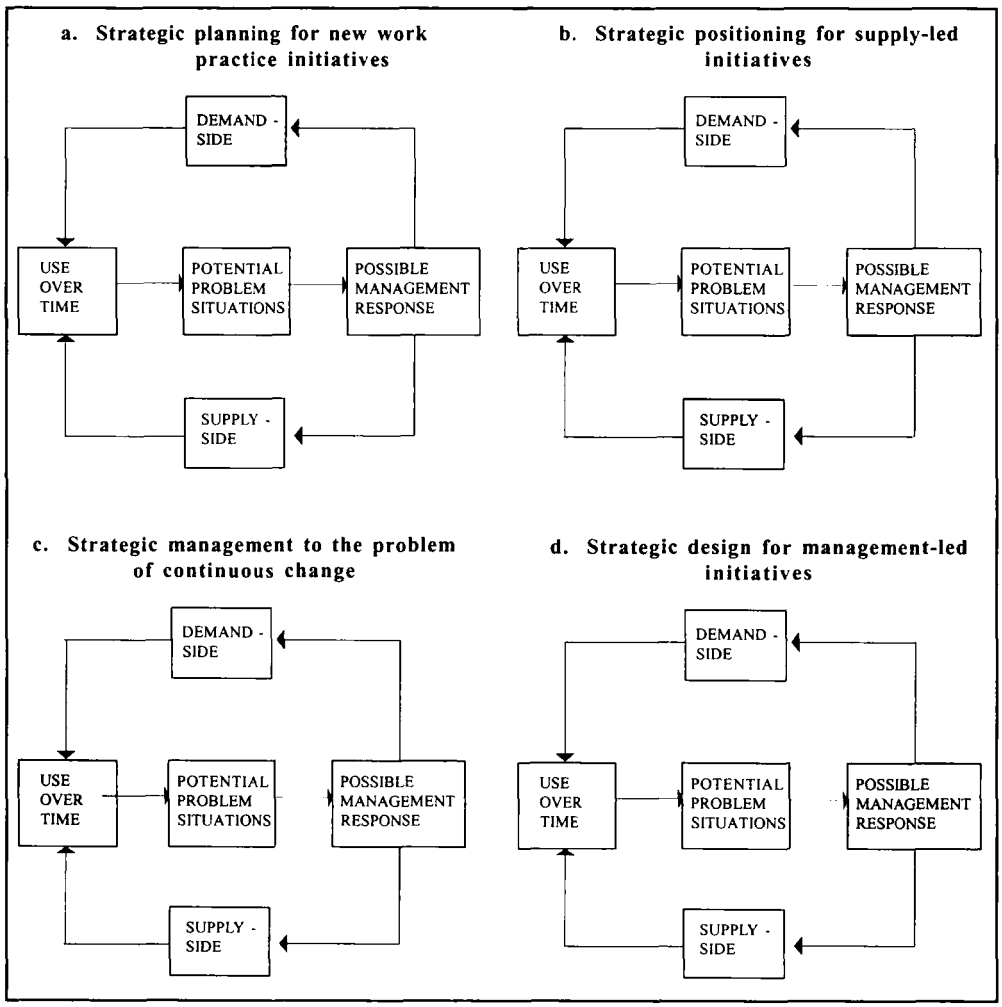


Figure 9: Practical Concept of Space-Time Management