# Workplace trends in office space: implications for future office demand

Norm G. Miller
*Burnham-Moores Center for Real Estate, University of San Diego, San Diego, California, USA*



## Abstract

**Purpose** – This study aims to examine the trends in space per office worker and the influence of a number of factors on the ability to reduce space per worker. These trends are important in that they impact future office demand along with property values.

**Design/methodology/approach** – Using both survey and empirical data a simulation model is used to examine the impact on space per worker over the course of a typical lease. Factors considered include the length of lease, the worker growth rate of the firm, turnover and time to fill positions, the type of organizational management hierarchy, whether dedicated or non-dedicated space is utilized and firm policies toward working out of the traditional office.

**Findings** – Space per worker will continue to decline over time, yet collaborative work environments and the effects of traditional management and cultural momentum suggest that downsizing will take time. Counter to the initial hypothesis, growing tenants do not over-consume space in the early years but rather tend to renegotiate leases when growth spurs the need for more space.

**Research limitations/implications** – It appears that modest economic growth is sufficient to offset downsizing trends, but some markets will be more affected than others. Portfolios dominated by larger than average tenants or U.S. Federal Government tenants will be affected much sooner by downsizing efforts compared to smaller private sector tenants. The mix of occupant types and age also matters, and this study does not delve into significant occupant-type differences by market. This study also does not directly consider design influences on productivity other than those mentioned through surveys: natural light, air quality, temperature control, noise and the presence of collaborative space.

**Practical implications** – Forecasters of office space demand must input an estimate of the growth in professional employment and then apply a space per worker assumption. This assumption in most markets will be declining, by as much as 30 per cent over several years. Washington DC is already being affected by downsizing, yet most markets with reasonably good economic growth will be able to offset most of this transition to more intensively used space.

**Social implications** – Much of the existing stock needs to be rebuilt. Much of how the authors work and where is changing. This requires new perspectives on how productivity is measured and how remote workers are measured.

**Originality/value** – This is the first paper to try and reconcile the views of commercial real estate owners and operators with those of corporate space planners, both of who have opposite sides of the same lease. It is also the first to point out the explicit reasons why downsizing efforts are sometimes not as effective as expected.

**Keywords** Workplace, Productivity, Corporate real estate, Office trends, Shared space

**Paper type** Research paper

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## 1. Introduction and background

Office space demand estimation is an important topic. In the USA alone, office inventory represents over 12 billion square feet (111 million $m^2$) of space and US$1.6 trillion in value (Florance *et al.*, 2010). Office space demand is driven by professional employment trends and is especially sensitive to space requirement assumptions. Other factors beyond the number of employees influence space demand including, but not limited to, workspace utilization levels, relative rent levels and cycles, tenant type, occupant employee turnover, firm growth rates and culture. In many office demand models, we simply assume 150, 200 or 250 square feet of space per worker without any solid evidence for such an assumption other than sketchy data and conventional wisdom.

If you ask a corporate real estate manager or a human resources manager they may tell you the target for their firm is 100 square feet per worker (9.29 $m^2$) or even less. The U.S. Government Services Administration (GSA) has been able to reduce space per worker at its Washington DC offices to less than 85 square feet per worker. We already witness much lower figures in Asia and the more expensive European markets than in the USA. Firms that have embraced shared standardized space not dedicated by rank, and not dedicated to specific employees, using shared digital cloud-style file storage systems are, in fact, able to get by with much less space per employee. However, these low targets per worker are only possible when the firm is able to match its leased space with a predictable number of employees spending a predictable amount of time in the office. Firms that are growing or shrinking or experiencing significant turnover struggle with matching fixed leased space with current needs. In fact, one reason US space per worker figures are so high is because so many firms do not last more than several years. They go out of business, split into multiple units, merge with other firms, and this business survival turmoil adds greatly to the space per worker results as leases hold firms to space than no longer matches their needs. These points will be demonstrated using a simple simulation model.

The estimate of office-using employment growth rate is no more or less critical an assumption for office demand estimation than the space required per worker and, at the same time, the disparity of assumptions we observe in the market is baffling. More refined office demand models will use space per worker by industry sector with a forecast of the growth by each sector for each geographic market. Often the planning decisions boil down to a reasonable guess on the space requirement per worker and how important it is for everyone to have space. Some firms will allow employees to work at home, libraries, coffee shops and locations known as "third work places" when they run into 100 per cent utilization rates. Other firms will rent temporary space for overflow demand. These issues will be addressed in more depth later in the paper. One minor but significant reason we find a discrepancy in the amount of space assumed to be required per person is because of terminology, as generated and used differently in the worlds of space managers and asset managers, but this only explains about 16 per cent of the difference. For example, the International Facility Management Association focuses more on usable space, and netting out encroachments, would calculate the average rentable building area (RBA) as 84 per cent usable. Thus, what a developer may call 200 square feet per worker using RBA is only 168 square feet per worker of usable space to a facility manager.

Below is a discussion on US national office space per worker trends compared by various geographic and industry metrics as additional background.

*1.2 Space per worker trend evidence*

If we only look at the square feet per worker on new leases where the tenant moved in within the past 90 days, we see a US national average in late-2013 of 183 square feet. This figure is far below the historical US figures running well above 250 square feet per worker, on average, for the past few decades, according to CoStar data. (The CoStar Group includes data on all major markets in the USA and uses a staff of some 1,500 employees to verify and track data on many attributes of leases and buildings.) Newer modern buildings allow more efficient use of space, especially when built-to-suit for a particular tenant. As the lease ages, the amount of space leased and the number of workers in the space generally changes with the result that the space per worker climbs. As second-generation tenants replace the first-generation tenants, it is often more difficult to use the space as efficiently, and this is the case for most smaller firms who cannot, on their own, drive new supply in the market. Some firms grow and some shrink and some are able to negotiate expansions more easily than contractions, especially in soft markets.

As of late 2013, on leases close to expiration, the average space per worker is often double the estimate for new leases, well in excess of 300 square feet per worker. Newer firms and start-ups squeeze more people into the same space, while older firms cannot downsize until leases expire. This might help explain why the average square feet per worker shown in Figure 1 is so much higher than the figures suggested by corporate real estate executives or facilities managers. Figure 1 is based on RBA and not the usable space that is used by the corporate real estate world. Still, when we do not discriminate by when the lease was signed, and simply look at how much space the average tenant occupies, the figures are quite large compared to stated goals.

In soft economies, we would expect a fair amount of shadow space. Shadow space is leased but not occupied. Because labor costs matter much more than occupancy costs, by a factor of approximately 10-15, most tenants are able to honor their leases until the leases expire and pay for more space than they actually need. The extra space also

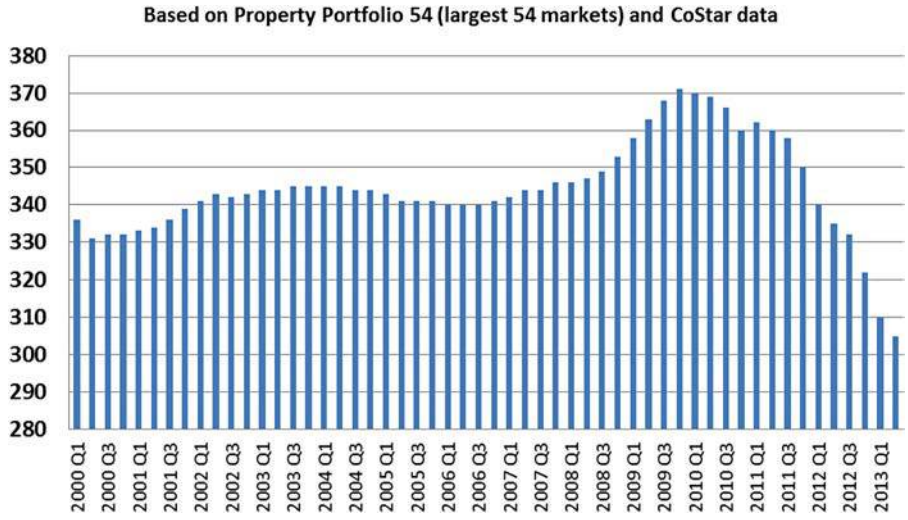



**Figure 1.**
US space per worker trends in square feet

provides a convenient option to expand and hire more workers without the need to move. Thus, we should expect to observe significant extra space in weaker economies, when rents seem to be bargains, and we do. When space per worker trends are climbing, it usually suggests that tenants have not had the chance to downsize yet and are awaiting either the expiration of the lease or simply riding out the weak economy with extra space.

Figure 2 is a sample of averages pulled from mid-2013 from a sample of various cities. Note that while we see more space per worker in the larger cities like New York and Boston, these markets also have more shadow space, as of the point of the survey, compared to smaller markets. One other bias in the square foot per worker data is that in the larger cities where we observe retail space on the ground floors, this space is classified by CoStar as "office" and not retail space, so that there is a slight upward bias in the measurement, especially in large dense cities. Certainly this is insignificant for the nation as a whole, but for cities like New York, San Francisco and Boston, it may mean as much as a 5 per cent upward bias, helping to explain why in Figure 2 we see larger numbers than might be expected. Only Honolulu in this survey is close to 200 square feet per worker as of mid-2013, and Honolulu is an extremely supply-constrained market. We also know that in the very expensive markets of London and Hong Kong, the average space per worker is, on average, much smaller than the figures shown here, so we should not presume that larger, more expensive cities always require more space per worker. Mark Hickey and Aaron Jodka, Senior Economists from PPR (Property Portfolio Research, a division of CoStar) suggest that:

> […] we observe more high-paid jobs in markets like New York and Boston compared to smaller cities and so the space allocated per person is larger while back-office people work in cheaper areas.

Figure 3 provides a rough global comparison of space per worker; we note that the Japanese and Chinese occupy much smaller footprints per person on average, reflecting perhaps both costs and culture. Although these data are somewhat out of date, these still reflects stark differences in the space per worker which likely remain.

Certainly shadow space provides much of the explanation for the run-ups in 2008-2010. If you assume a conservatively high figure of 250 square feet is required per

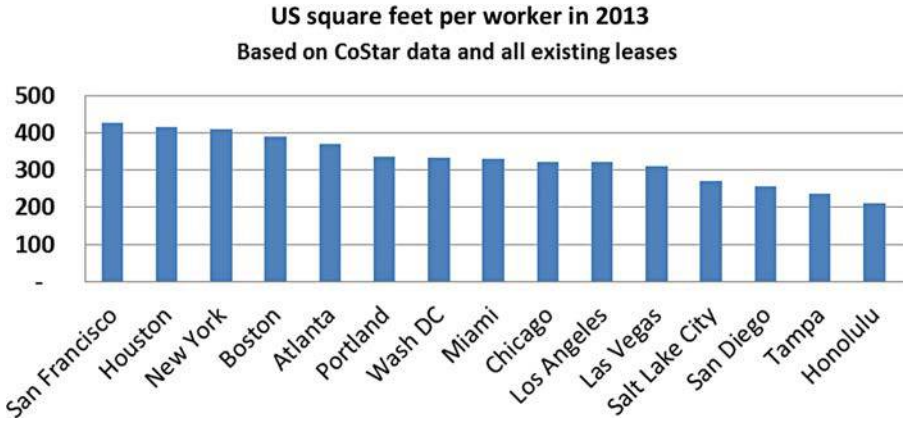
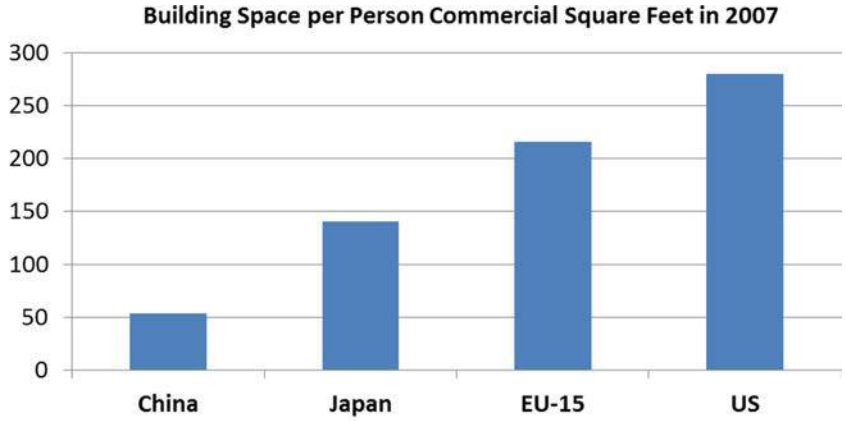



**Figure 2.**
Square feet per worker by US market



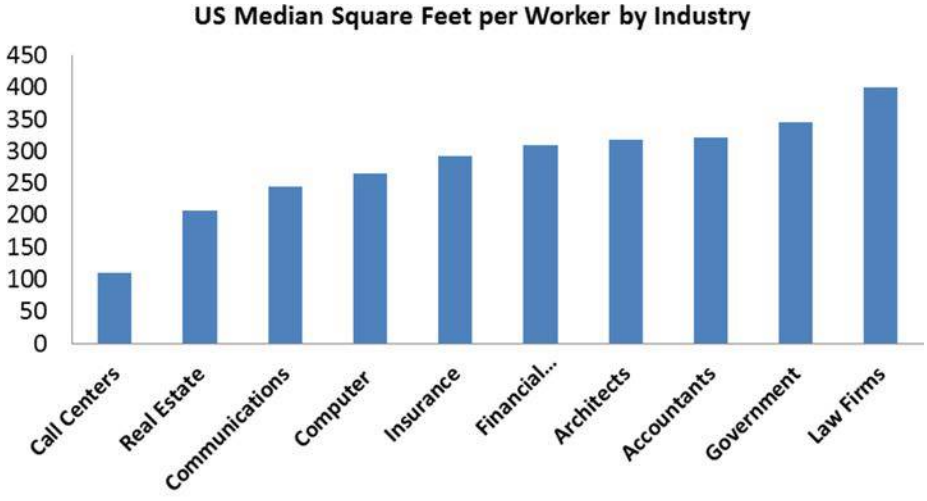

**Source:** World business council for sustainable development

**Figure 3.**
Building space consumption varies around the world

worker, far higher than any industry model would suggest, you would still estimate that the average firm had one-fifth of its space as excess shadow space remaining as of late 2013.

*1.3 Space per worker by industry or function*

Figure 4 compares occupied space per worker by industry group. It is not surprising then that the government space has not only historically been fairly generous to workers but also includes some public access and service space that might help explain the well-above average space use per worker results. Law firms come in tops as high space demanders followed by accountants, architects and financial institutions, which often

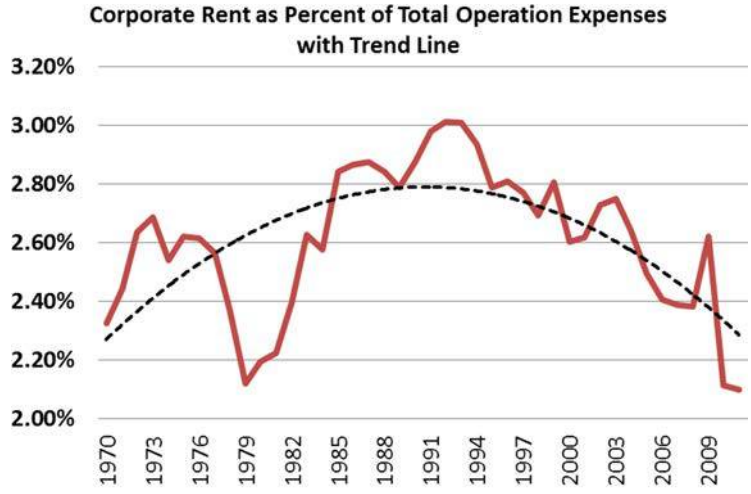



**Source:** CoStar data for all leases

**Figure 4.**
Space per worker by industry

include generous open space at branches. The results in Figure 4 are not inclusive of all industries but merely serve to demonstrate that we will find systematic differences in space demands when we analyze each industry group. If a particular industry group, such as telemarketing which operates through call centers, is moving into an area and has stated that they need to hire 1,000 new workers, it would have dramatically less impact on office market space demand than 1,000 architects or computer software designers. When possible, space per worker in demand estimate models should be adjusted for what is typical in the relevant industries present in local markets.

Space per worker has always been an important assumption in office forecast models, and it is worth mentioning a few of these studies that take space per worker as an input into office demand estimates. An excellent review of the literature of office demand was provided by Rabianski and Gibler (2007). They observe that models of office market demand analysis have become more complex and able to segment demand by industry and/or geographic area, as better data have become available. Early studies (Jennings, 1965; Detoy and Rabin, 1972; Lex, 1975; Martin and English, 1985) attempted to understand how much office space was needed by using ratios of non-manufacturing employment to population or office space to employment. As better industry breakdown became available, we saw more segmentation into industry grouping (Kelly, 1983; Schloss, 1984; Clapp, 1987; Birch, 1986) or by headquarters or private vs public space or the size of the firm (Carn *et al.*, 1988; Dowall, 1988). Throughout most of the literature we see heavy reliance on FIRE use as a proxy for office employment. FIRE is the Bureau of Labor Statistics classification for the finance, insurance and real estate industries, which is utilized by Clapp (1993a, 1993b) and many others. Most of the early models estimating future office space demand relied on crude estimates of space required per worker based on surveys from Building Owners and Managers Association International or gross estimates of total space divided by employment (Clapp, 1993a, 1993b). DiPasquarle and Wheaton (1996) note that space per worker should vary by occupation as seen in Figure 5. Space may vary over time as the occupation and technology changes, and that




**Source:** CRSP

**Figure 5.**
Public corporation rent as a percent of operational expenses through 2011

space per worker may vary by market and costs. All of these former speculations are correct, but the question remains what factors drive space per worker other than design norms and culture? Further, why have so many reports and surveys come out in recent years suggesting dramatic downsizing?

For example, in a 2010 report by Cushman and Wakefield (2010) aimed at corporate real estate executives, the firm suggests that space per worker can be reduced by 25 per cent, not by reducing the actual office space per worker but by increasing the headcount per unit of space with more sharing of space. Based on this presumption, Cushman and Wakefield illustrate the benefits of moving from 200 to 150 square feet per headcount. Naturally, such strategies, if widely implemented, could reduce the total demand for office space. In late 2013, CBRE moved into its new LA office called CBRE 360 where 100 per cent of the space is shared. That is, no one has dedicated private space. This is the single most effective way to downsize a firm's footprint.

Finally, by way of background, it is useful to note that the occupancy cost as a per cent of overall US public firm revenues had been increasing from 1970 through 1990 but then has been decreasing for the past two decades as shown in Figure 5 below. Real rents have also been declining over this same period from 1990 to 2011, suggesting that one reason there has not been more pressure to use space more efficiently is that costs have been declining on a relative basis. The great recession most likely triggered renewed pressure for leaning-up all possible expenses.

In the next section, a model will be developed to simulate the effects of various factors influencing the efficiency of office space use. One caveat that should be mentioned is that design is not explicitly part of the research process here and clearly this is a limitation of the research.

## 2. Method

Based on the CoStar, existing industry data and author-derived survey data describing factors which affected the space required per person, a model was developed. What is different about this model is that it is the first to explicitly consider factors which increase or decrease space per worker, aside from design, although space friction discussed below is a type of design constraint as is the standardization of space. The approach taken was to take a planned space per person as a baseline and then to examine the effects of factors which contributed to achieving or not achieving the space per worker goal. Each of these modeled factors is described in turn, after which the model utilized is described:

- *Lease term:* The initial theory is that the length of lease should affect the results on space per worker in that longer-term leases should require excess space up front for a growing firm. The faster a firm expects to grow, the more extra space they should lease at time zero. Shorter-term leases and options were not considered here but are certainly a way to reduce the need to lease extra space for a growing firm and might explain why the results do not support the theory. In fact, what is most interesting empirically is that recent vintage leases reveal much lower space per worker than older leases near expiration, and yet for a growing firm, one might expect just the opposite. Another consideration is that while many firms might expect to grow, many do not, and mergers, dissolutions and downsizing all contribute to the empirical results, suggesting that firms have the most efficient

space intensity near the start of a lease in contrast to the initial theory suggested here.

- *Sharing of space or non-dedicated space:* Also known as office hotelling, this is the single most dominant factor in the simulation model supporting dramatic downsizing results. Simply implementing a policy of sharing space will significantly reduce space per worker, especially if the firm assumes that a certain portion of the workforce will be out of the office at any point in time, or allows third work places (e.g. home, coffee shops and libraries). Such a policy requires some standardized work stations and cloud-based storage, and without these, a firm faces great resistance to office sharing.
- *Employee turnover or churn:* Based on survey data d, described later, 80 per cent of all firms reported that turnover per year ranged from 10 to 30 per cent per year. The greater the turnover in the firm, the more vacant seats one would expect, depending, in part, on the time required to fill a position.
- *Time to fill vacant positions:* Most firms reported from one month to six months to fill vacant positions. The longer it takes a firm, on average, to find new talent, the greater will be their space per worker result.
- *Growth rate of the firm in employees:* Most firms expect to grow. On average, they do not. In fact, most small firms go out of business in less than ten years. Business week surveys suggest that only 40 per cent of all start-up firms will last five years. So while the economy may be growing on average, it is the result of a minority of successful firms. The growth rate of the firm is varied from negative to positive based on a range of expectations in the model below. Obviously, declines in firm size result in much higher space per worker figures.
- *Uncertainty behind the growth rate of the firm:* Firms that grow in spurts have more trouble matching up space needs with people working in the firm. This point seems obvious.
- *Management hierarchy and the number of specialized office space types:* Firms that have a management hierarchy where different levels of management require different types of non-substitutable space create what is here called ***space friction.*** The greater the number of types of office space, the greater the space friction, whereby space cannot be used as intensively. The opposite of space friction would be 100 per cent standardized space, fully useable by anyone in the firm.

### *2.1 Modeling process*

These variables are used in the following model to describe key elements in the decision as to how much space to lease and, over time, the resulting space per worker.

$x_i$ = office space type, 1, 2, 3, 4, etc. where each type represents a non-interchangeable type of space with any other. Space types typically are of different sizes with larger sizes allocated to more senior staff and management.

s = shared office space percentage for each office space type $x_i$ from 0 to 1.0 for 100 per cent.

n = lease term in months or the specific month.

gw = goal space per worker in terms of average square feet based on total firm space divided by the average number of workers allocated office space. The total

space of the firm is based on RBA, including all space required for the firm such as common areas, conference rooms and hallways and storage areas.

ge = goal space per employee based on the total number of employees of the firm assigned to a particular region or office. This is merely a derivation of gw dependent on t, described below.

t = percentage of total worker time expected to be spent intentionally working at home, airports, libraries, coffee shops or other locations.

p = percentage of time that workers spend with clients or outside the office, in work-related functions, while they are based in the traditional office space. p may overlap with t above, but is defined here as a per cent of (1-t) time based within the regular office space.

gr = growth rate in the firm in terms of employees per year stated on a percentage basis in negative or positive terms.

c = churn rate based on the per cent of employees that turnover each year from 0 to 1.0 for 100 per cent.

cm = average time in months required to fill a vacated position.

U = utilization rate defined as the per cent of total time desks are occupied using a one shift day of 8 to 10 hours. There is no weighting by square feet, so each desk is counted as one. This calculation is an output that is based on the simulation results. Where U exceeds 1.0, there would a need to double up, use conference rooms for temporary space, secure or rent temporary space outside the regular office. This variable is an output that is put into an optimization framework using a stock out model approach, as described in the next section.

The goal space, gw, is based upon the following process: if the firm is growing, then required space per worker is solved at the end of the lease term and back calculated to find the amount of space occupied in each period from the start of the lease. We assume here that there is only one type of space, although this single standardized space assumption will be relaxed below to allow for multiple unique non-substitutable spaces. The process of accommodating expected growth in worker counts is merely a geometric progression, where,

gw = ge/t(p), and then we solve for each period of the lease back to zero based upon the following pattern derived from the compounded growth rate:

$$OSPW = ge/t(p)/(1 + gr)^n \quad (1)$$

The importance of solving for the space required in any period is that while the goal space may be 100 square feet per worker, a firm signing a five-year lease will need to overconsume space in the beginning to accommodate employee growth. Temporary overflow space providers are not modeled here, although clearly such providers could feed into a decision as to how conservatively to model space needs. Examples are HQ, Instant Office, Regus and others that provide monthly rentals of fully furnished spaces while firms like Liquid Space provide small conference rooms by the hour. The costs for a typical instant workstation may run from $800 to $900 per month for 120 square feet plus access to conference space and common areas, converting to about double the rate for long-term leased traditional space in bulk. For the instant space provided by firms like Liquid Space, we see rates in the US$60-90 range per hour for a conference room in a major city that would hold four to six people. While firms rarely sign long-term leases while in downsizing mode, downsizing simply happens

unexpectedly, and this also results in extra space consumption. Such uncertainty is modeled through the range of growth rate assumptions, from negative to positive, using the 80 per cent confidence range of typical growth rates for a sample of CBRE tenant firms and CoreNet Global members surveyed.

Now let's factor into the model the time spent outside of the office, which is only relevant if $s > 0$, and we need to do this for each office type $x_i$ so that we repeat and sum the model based on allocating all space to one of the potential office space types.

$$OSPWx_i = s(ge/t(p)/(1 - gr)^n) \quad (2)$$

This sharing of space has the effect of reducing the total space required as a function of the degree of sharing and p, the time spent working outside the office, while assigned to space inside.

Next let's factor in the churn rate, c, and time to fill the vacated slots, cm.

$$OSPWxi = s(ge/t(p)/(1 - gr)^n)/(cm/12c) \quad (3)$$

This has the effect of adding some friction to the efficient use of space by acknowledging that some of the time space will be empty waiting for new hires.

Next, let's factor in various types of space in the simulation by using a ratio of space for each office type; thus, for type $x_1$, we may have 1.5 times the average space per worker and for $x_4$, we may have 0.5 times the average space per worker. The average weighted space will be the same as for the goals, but we must recognize that churn in space $x_1$ in this case will create a larger impact on the overall unplanned space per worker compared to the $x_4$ worker type space. We do not show this in equations, as it is merely a repeat of (3) for each x space type where the result is summed. Note that the more office type spaces that cannot be substituted, the more friction in the system.

The last step in the model is to decide how certain one need be that there is enough office space. We can view this decision much like a stock out problem in operations management. Imagine inventory as space available to house workers and imagine that we are unsure about how many workers we will need to house over the next several years. The longer the term of our analysis the more difficult the problem becomes, and, in turn, optimal space decisions are harder for longer-term leases or when owned space is involved. Still this operations management perspective is a useful framework for modeling space demand, consistent with an optimization based on marginal utility analysis in economics.

From an inventory management perspective, we have two kinds of costs: overage costs, $C_o$, when we have too much inventory (space) and underage costs, $C_u$, when we have insufficient inventory. We need to select the right level of inventory or office space per worker (OSPW) that balances these two costs. If these two costs were equal, then we would end up seeking the amount of OSPW that has a 50 per cent probability, P, of being too much or too little space. In this case, we seek to find OSPW that satisfies the following condition:

$$P(OSPW) = C_u/(C_u + C_o) \text{ such that } P(OSPW) < X = 0.5$$
$$\text{where X is the actual space required}$$

The ratio which provides an optimum could be based on the marginal costs of adding temporary space, where available, such as that provided by instant office space providers. Using a sample of temporary office providers and annualizing the cost, which obviously will vary by market, we end up with typical rents, which are at least four times that of traditional space. This is akin to comparing a hotel room rent with an apartment, and thus, such differentials are not unexpected. This is similar to using the differential between the costs of having too much space to the cost of having sufficient space. The cost of having too much space is less than the cost of not having enough, so if the cost of too much space is one-fifth that of too little space, we end up with the same exact ratio, as when the cost of marginal space is five times as expensive, seeking the following solution:

$$P_x < \text{OSPW} = 4/(4 + 1) = 4/5 = 80\%,$$

implying that we wish to have 80 per cent confidence that we will have sufficient space. $P_x$ is the probability the demand for space is less than x, the actual needed. If the cost of temporary space is higher, say nine times that of regular space, then we will want to be approximately 90 per cent confident we have sufficient space at any point in time. General estimates for temporary office space suggest the cost is about 8-10 times the typical cost for longer-term leased space, based on anecdotal evidence collected by the author at the CoreNet Global conference in 2012.

The approach used in operations management is no different from that used in microeconomics. We set the marginal benefits equal to the marginal costs as the minimal sufficient condition for an investment decision. The last unit of space added, OSPW*, is that which sets the expected cost of too much space, $C_o$, equal to the expected cost of too little space, $C_u$, recognizing that these costs may not be equal per unit of space.

The concept of optimizing office inventory or seeking to avoid stock outs of sufficient space is identical and parallel to the utilization, U, goal of firms, where they seek a minimum or average utilization rate. Utilization rates are based upon the occupancy rate for all available desks over the course of working days, measured periodically. Traditional firms have rather modest utilization rates, typically 50-60 per cent, according to CoreNet Global research. But firms that allow sharing of desk spaces, known as non-dedicated office space, and some telecommuting may experience utilization rates of 80 per cent or higher. Firms like Accenture and Procter & Gamble intentionally run at 80 per cent and even 90 per cent or higher utilization rates.

The impact of space friction: The above model becomes more complicated when the internal spaces (inventory) are not substitutable. We might think of office cubicles as fairly homogeneous and substitutable and, in those firms, with fairly generic and flexible space, there is less friction in adjusting to the needs of workers with different levels of specialization and authority. In firms with more structured authority or specialization and less flexible space, there will be higher transaction costs to adjust space, resulting in space inventory supply friction. In this case, the optimal space model becomes a summation of several sub-space optimization models, each with its own inventory of space and its own demand.

Firms like Procter & Gamble have moved to more standardized space, which allows for greater ease of space optimization strategies. Other firms with formal hierarchies of managers, each with different space requirements, will end up with much more required space per person simply because of the lack of substitutability. Think of a firm with one chief

executive officer, one chief operating officer, ten senior vice presidents (VPs) and 30 VPs, 50 sales staff and then 300 other staff workers of various kinds, each with their own space requirements. A senior VP leaves the firm and rather than move a regular VP into the office, it sits empty rather than risk the charge of favoritism being applied to the facilities manager that allocates space. These frictions increase the need to secure more space per worker for the entire firm as the probability increases that space will remain unoccupied for uncertain periods. So one might conclude that the less substitutable the space, the higher will be the summed average space per worker in a firm, all other things equal.

## 3. Data and sample descriptive statistics

Three sources of data were used in this study. CoStar data, already mentioned, are used for background and starting parameters. CoStar data include a US national sample of millions of office leases. Surveys were administered by the author to two different occupant groups. One is CoreNet Global members, consisting of mainly owner occupants with a bias toward large public firms. The second, aimed at including smaller and privately owned companies were tenants of buildings managed by CBRE. These samples are described in Table I.

Three important comparisons are provided below in Figures 6 and 7 on the targeted space per worker versus the actual, and the targeted utilization rates versus the actual. In Table I, we see the much faster growth rate expectations of the smaller firms and the slightly lower turnover rates. These are consistent with prior expectations and verify a range of turnover assumptions in the models tested. In Figures 6 and 7, we observe the time required to fill a position is also much longer for the larger public firms. Target utilization rates are above actual, as one might expect, and the space per worker figures are higher than desired.

Within the surveys, respondents were asked about strategies to reduce space per worker. Typical answers were:

| Attribute | CoreNet | CBRE tenants |
|---|---|---|
| Sample size of respondents | 78 | 212 |
| First-generation space (%) | 50 | 26 |
| Second-generation space refurbished (%) | 50 | 74 |
| Non-dedicated Shared space as per cent of all | 15 | 5 |
| Allow telecommuting by workers (yes) (%) | 71 | 55 |
| Use temporary office space providers (yes) (%) | 21 | 3 |
| Time required to fill a position (Ave Months) | 3.8 | 1.8 |
| Typical lease in years | 5.0 | 5.0 |
| Lease expansion options (yes) (%) | 57 | 58 |
| Different types of office space configurations | 2.9 | 3.3 |
| Private space as percent of all space (%) | 20 | 36 |
| Years in business | 30.6 | 22.0 |
| Average number of employees | 29,623 | 204 |
| Employee turnover per year (stated) (%) | 12.0 | 8.4 |
| Expected growth rate of the firm in employees (%) | 4.2 | 18 |
| Publicly owned (%) | 75 | 36 |
| Non-profit firm (%) | 7 | 0 |

**Table I.**
CoreNet global and CBRE survey median, 2012 results

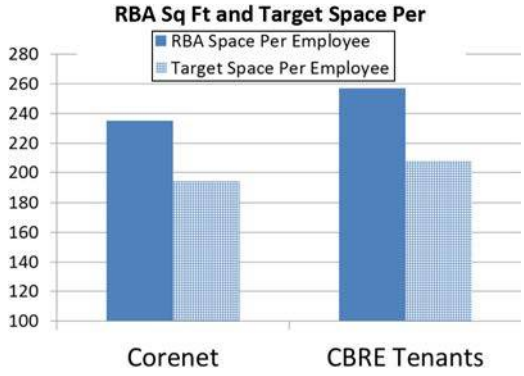



**Figure 6.**
RBA space per worker and target space per worker in square feet

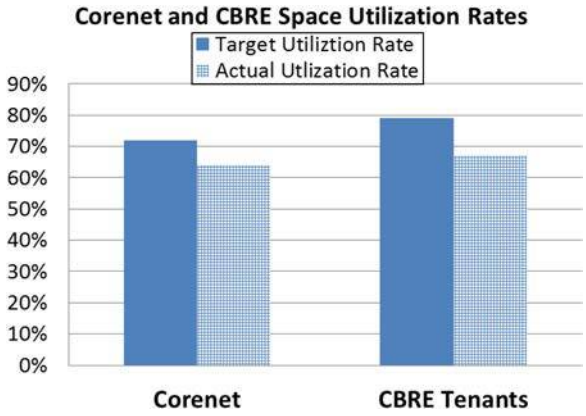



**Figure 7.**
Utilization rates

- allowing the worker to work anywhere, when not in team meetings;
- reducing the per cent of dedicated private space;
- standardizing space and using more open designs;
- requiring that files are stored on a centralized "cloud" server; and
- using temporary office space providers when overflow demand for space exceeds capacity.

## 4. Results of the simulation model

Several models were tested, somewhere, all the space is non-dedicated and somewhere, there are only standardized spaces. There are too many variations to describe here and one might suggest that many of the results are obvious. Nevertheless it is useful to quantify the impact of lease term, space friction, employee churn and so forth on the ability of the firm to use space efficiently. The real contribution of this study is to demonstrate explicitly the impact of reality-based assumptions on space per worker results.

The key variables for the model, are shown in Table II below, where all workers who are treated the same (no difference in space per worker) are as follows, with the low, base and high figures provided.

The longer the term of the lease, the initial theory here is that more space must be leased now relative to the average number of employees using that space over the term of the lease. In Figure 7, we use 100 per cent non-dedicated office space and assume that 50 per cent of the employees are randomly out of the office at any one time on average. The other assumptions are as listed above with an average employee growth rate of 5 per cent. The goal of the tenant is to get down to 100 square feet per worker, noting that many of the employees are out of the office at any one time. The results are based upon the assumption that the faster the firm is growing, the more space you need to lease up-front to accommodate the extra employees. However, we also note that uncertainty over growth rates and the ability to renew existing space and the option of additional space with expansion clauses suggest great benefits to shorter leases, such as five years, even for growing firms. That explains why expansion clauses are so common among many office leases and why five-year leases are far more common than ten-year leases. Empirically, this result and theory turned out to be incorrect. Longer-term leases do not result in more space per worker up-front. When corporate real estate experts were asked about the result, the consensus view was that it is easier to renegotiate a lease when expanding versus contradicting and so there was no need to lease so much extra space up-front (Figure 8).

Again, this theory on lease term and growth rates turned out to be incorrect and yielded the only results in the model that were inconsistent with empirical evidence. In response to this incorrect model specification, the author contacted several firms to ask

| Variable inputs | Low | Base | High |
|---|---|---|---|
| Initial number of workers | | 119 | |
| Average planned space per worker | 65 | 150 | 200 |
| Annual turnover rate in employees (%) | 5 | 20 | 33 |
| Time in months required to fill a position | 1 | 3 | 5 |
| Growth rate in the firm with respect to number of total employees (per cent) | 0 | 5 | 18 |
| Length of initial lease | 3 | 5 | 10 |

**Table II.**
Key model inputs

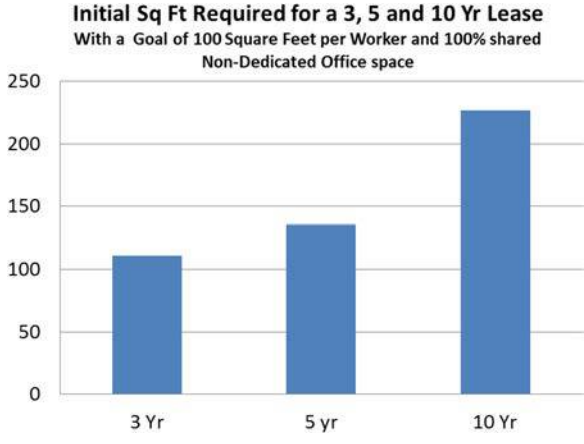



**Figure 8.**
Theoretical impact of lease term on space required at the time of the initial lease

whether they planned for expansion space at the time of initial leasing. While anecdotal in nature, the typical response was that expanding was not difficult. Landlords will renegotiate larger spaces and new terms for such firms, while downsizing firms met with more resistance.

In Figures 9-11 the summary of model simulations is provided. The distribution shown is from 10,000 simulation runs using the model inputs. The certainty level shown

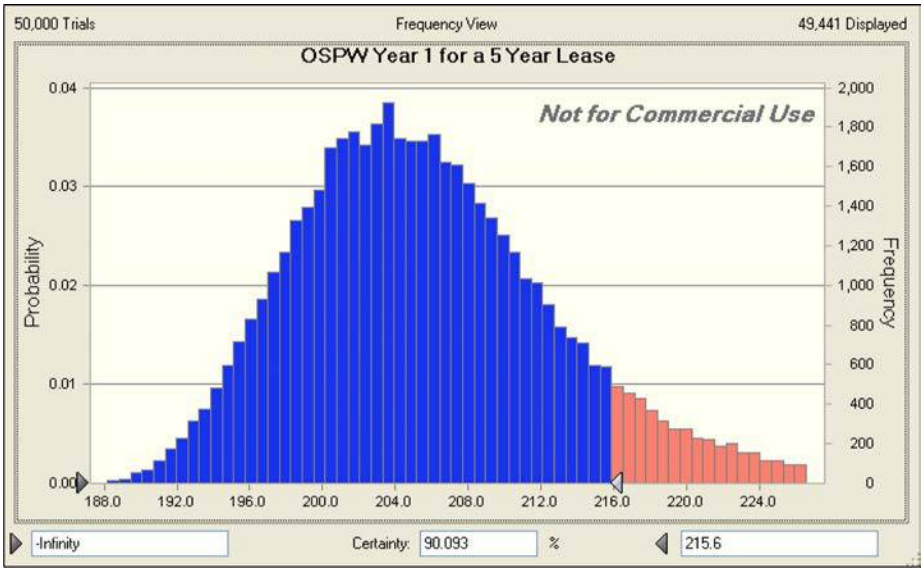



**Figure 9.**
Space required per worker as a function of growth rates (first-year results)

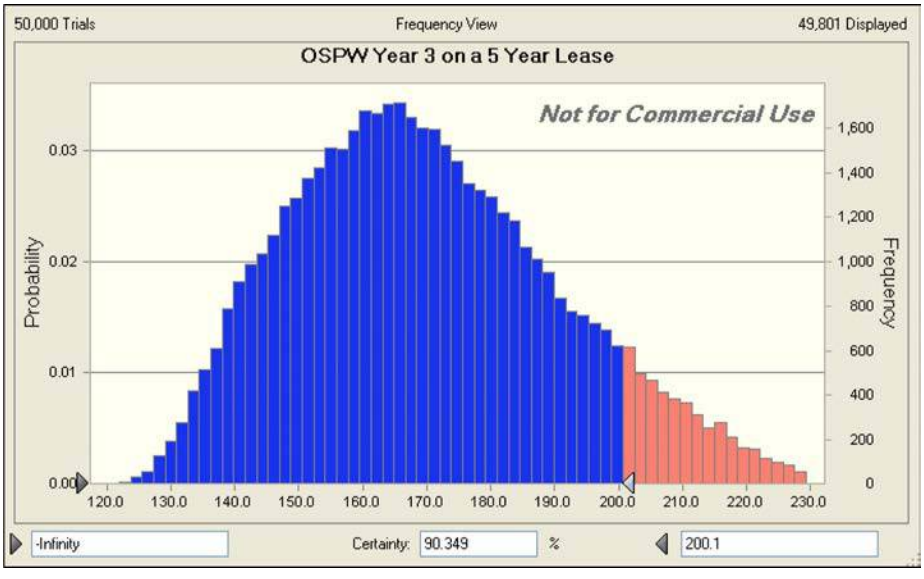



**Figure 10.**
Space required per worker as a function of growth rates (third-year results)

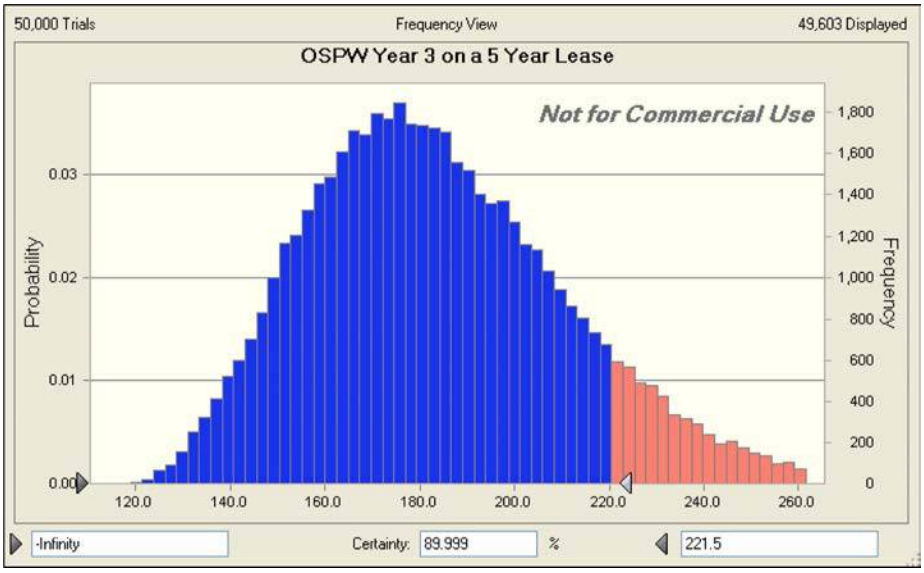



**Figure 11.**
Space required per worker with dedicated space for senior management and non-dedicated space for staff with an overall goal of 142 square feet per worker

is the probability that there is sufficient space for all employees and the space required for hitting that goal. The graph distribution shade changes where the probability level shown is met. For example, in Figure 9 where the certainty of 90.093 is shown, this is a percentage probability that the actual space per worker result will be 215.6 feet or less. The distribution curve shown reveals the actual possible combinations of space per worker over the range of variable inputs tested. The distributions appear to be fairly normal with just the slightest touch of skewness.

Figures 9 and 10 suggest that faster growth rates (up to 20 per cent employee growth per year) should also drive a firm to require more space per worker up-front, but again this is not supported by empirical evidence. Firms that expect to grow do not lease much extra space, so the results in Figures 8 and 9 do not provide any guidance on the behavior of space decisions. If one assumes that any long-term lease can be renegotiated at any time for an expanding firm, the results would instead suggest much less space per worker required at the start of the lease. The remainder of the variables tested did perform as expected and provide some insights into the challenges behind downsizing goals.

Churn rates and employee turnover are investigated next. Starting back at the base case but increasing the churn rate of the employee turnover results in slightly less efficient space use. While there is some impact on space efficiency, it is modest as long as the time to fill positions is quick with low volatility. So, churn alone does not have much impact. On the other hand when the time required to fill a position increases, one sees a corresponding and somewhat linear increase in the amount of space required, so that if the average churn is 10 per cent with one month to fill a position, on average, and this is changed to three months, there will be an increase in the vacant space and resulting space per worker by approximately 2 per cent per year.

Unique office spaces and what is called here space friction has far more impact than churn rates. When a firm has 100 per cent standardized non-dedicated space, in theory, anyone can use any office, but when the number of unique offices is increased and these are non-substitutable, the demand for office space accelerates, especially when all space is dedicated to specific individuals. Below four types of spaces are introduced that are not substitutable. The result is a significant increase in space per worker versus the case of homogeneous space, all of which may be substituted. The following unique space assumptions are tested (Table III).

The results are shown in Figure 11 with 100 per cent sharing among Space Type 1 but no sharing within space types 2, 3 and 4. The average space allocation is 142 for each worker, but with turnover and growth and space frictions, one observes significantly higher figures. In year one, the space required per worker is 220, on average, and 251 at the 90 per cent confidence level. Year three is shown below, suggesting 181 square feet on average and 221 at the 90 per cent confidence level.

*4.1 Simulation model findings*

- While firms may target 200, 150 or figures as modest as 100 square feet per worker, only a firm with an extremely stable worker base, little turnover, modest growth and fairly standardized non-dedicated space could possibly achieve these targets, on average, over the course of an entire lease. Longer-lease terms make it harder to hit space targets.
- Positive firm growth rates and longer-lease terms in theory should result in more space per worker at the start of a lease, but these findings are not empirically supported. Apparently, firm expansion and lease renegotiation is not as difficult as expected. On the other hand, firms that have downsized results in significant excess space per worker.

Obviously, shrinking firms will far exceed space per worker targets, which explains much of the shadow space observed in the market during and shortly after recessions.

- The greater the churn rate of workers, the more space required per worker, but only modestly. Time required to fill a position has more impact on space per worker results.
- The greater the number of non-standardized spaces that are not substitutable between ranks within the firm, the lower will be utilization rates and the greater will be the space per worker. In firms with totally dedicated space and several layers of unique spaces, the average consumption of space per worker will be as much as twice or more that of a firm that shares standardized non-dedicated space. The implication is that branch operations with more

| Space type | Per cent of total | Average square feet each (including common areas) |
|---|---|---|
| 1 | 80 | 117 |
| 2 | 10 | 150 |
| 3 | 7.5 | 300 |
| 4 | 2.5 | 450 |

**Table III.** Unique space assumptions

standardized space will be able to use space more efficiently than headquarters and those with more managerial delineation within office space allocations.

*4.2 Implications of downsizing on the office market*

Based on input from CoreNet Global members and CBRE tenants, the larger tenants are the ones working harder to use space more efficiently, especially those with footprints over 75,000 square feet. This group tends to encourage digital storage on centralized cloud-based servers and use more non-dedicated standardized space for all but the most senior of managers. This group represents 1.8 per cent of all tenants in the USA by count and 27.9 per cent of all office space. Those using more than 50,000 square feet represent 36 per cent of the total office stock. If using some of the space sharing strategies described above, we assume 36 per cent of the firms can reduce their primary leased office footprint by 50 per cent, moving from 250 to 125 square feet, this would be the equivalent of 540 million square feet out of some 12 billion office square feet as of 2010. Historically this is equivalent to 3.6 years of average US deliveries of net new space to the market, which has averaged close to 150 million square feet per year since 1983.

Decreases in total office consumption, based mostly on higher utilization rates, take time, and it is likely that these moves toward more efficient use of space will require many years of transition. At the same time that the market is seeing some downsizing, there is also a new kind of space being required, one that lets in more natural light with better natural ventilation, with better temperature control and provides for more collaborative and more productive workspace. With this perspective in mind, some of the existing office space may be considered obsolete and require retrofitting. The innovations of cloud-based computing, shared storage, video conferencing and high-speed Internet has freed up locational constraints, allowing many professionals to work anywhere they wish, mostly coming to the office for collaborative work and meetings, and some firms are taking advantage of this flexibility. If all the 12 billion plus square feet of existing US stocks were instantly updated to accommodate the new style of work and the higher-quality features of more sustainable real estate, the market would not need any more space for a few years. But such a transition to better space takes time and the growing markets and downsizing markets need not match up.

One major problem for landlords faced with high space utilization tenants is the need for much greater parking per 1,000 square foot of leased space. While traditional models of parking supply suggest three to four cars per 1,000 square feet, this figure will likely need to be doubled when space per worker is down to 150 square feet or less.

## 5. Conclusions

The largest firms- and the GSA-represented entities have embarked on a path toward more efficient use of space seeking much higher utilization rates. This is possible with extensive use of standardized non-dedicated space and a policy that allows great flexibility in terms of where employees work. Slightly more than a third of the US market is represented by larger firms that are attempting to downsize footprints over the next several years. Others will follow over time. Still the culture of private space remains entrenched in the USA, and it is not clear how long the

transition to smaller footprints will take. Only a smaller percentage in space per worker will drive some markets into negative absorption in the years to come. Portfolios with a heavy percentage of large public firms or GSA-managed entities are most at risk from downsizing. Markets like Washington DC with the large presence of GSA-managed entities are more likely to see negative absorption from these trends sooner than markets dominated by smaller non-GSA firms.

Few firms will ever be able to hit their target allocations of space per worker. Simulation models tested here suggest that a variety of challenges are posed by turnover rates, time to fill positions and managerial space friction. Firms retaining a multi-level hierarchy of management, with private dedicated office space configuration as a signal of rank, will find it harder to use space efficiently just as second-generation tenants do not fit as efficiently into any given space as first-generation tenants.

The need for collaboration and innovation works against the trend of working at home or even in private offices. Overall, we should expect a greater spread of square feet per worker figures over the next several years, as some firms reduce footprints significantly while others maintain current practices with private dedicated space.



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## Appendix

Survey questions sent to CBRE tenants and to cornet global members:

1. Are you the first generation user of the space used for your current office? Yes__ No__
2. If a second or later generation user, did you refurbish the space interior? Yes__ No__
3. Average estimate of space in square feet per total employee count (includes all rentable building area and all employees, even those permitted to work in non-traditional office settings): _____
4. Target space in square feet per employee if you have one: _____
5. Average space in square feet per worker (based on average utilization and those expected to work at the office some of the time): _____
6. Target utilization rate for all work stations in the office (per cent that they are expected to be utilized per normal working day): _____
7. Average actual utilization rate if known (per cent of normal working day work stations are used):_____
8. Do you have only one work shift per day? Yes ___ No ___
9. Do you allow or encourage office sharing of spaces versus exclusive space allocation? Yes __ No__

10. What per cent of the offices are non-dedicated spaces, used by more than one worker? ___%
11. Do you allow telecommuting from home or other meeting places? Yes__ No__
12. Do you utilize temporary office space providers for overflow space demand or conference space demand? Yes ___ No ___
13. Turnover of employees each year, on average, in per cent of the total? ___%
14. Annual growth rate of your firm expected over the next five years to ten years in terms of the number of employees? _____%
15. How long does it take, on average, to fill a position once vacated? ____Months
16. How long are your typical leases in years? ____Years
    Typically net leases ____ or Full Service___
17. Do you have options for expansion space built into your typical lease? yes ___ No___
18. How many different types of non-substitutable office spaces do you have that are distinct in size and or indicate rank within the firm? ____ types of unique office spaces.
19. What per cent of all your office spaces are private and exclusive spaces dedicated to middle or senior management? ____%
20. Your industry type (NAIC categories are below) ___ (use list below).
    - 11 Agriculture, forestry, fishing and hunting
    - 21 Mining, quarrying, and oil and gas extraction
    - 22 Utilities
    - 23 Construction
    - 31-33 manufacturing
    - 42 Wholesale trade
    - 44-45 retail trade
    - 48-49 transportation and warehousing
    - 51 Information
    - 52 Finance and insurance
    - 53 Real estate and rental and leasing
    - 54 Professional, scientific and technical services
    - 55 Management of companies and enterprises
    - 56 Administrative and support and waste management and remediation services
    - 61 Educational services
    - 62 Health care and social assistance
    - 71 Arts, entertainment and recreation
    - 72 Accommodation and food services
    - 81 Other services (except public administration)
    - 92 Public administration/Government
    - Other _____
21. Number of total employees? _____
22. Years in business__? ___
23. Publicly owned firm__? Yes___ No___

24. Non-profit organization__? yes ___ No___
25. Do you have strategies to reduce space use? If so, please describe?_____
_____
_____
_____
26. Other comments on space planning and trends on office space per worker?____
_____
_____
_____

**Corresponding author**
Norm G. Miller can be contacted at: nmiller@sandiego.edu