Occupant satisfaction with workplace design in new and old environments
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Abstract
Purpose – The aim of this paper is to investigate time‐factors in occupant‐environment relationships.
Design/methodology/approach – The paper analyses satisfaction ratings on 12 workplace environment features collected from more than 5,000 occupants in 48 office buildings in Australia. The database is divided into seven environment categories: first occupied after construction; new occupation after major update; recent relocation into an existing environment; re‐occupying an environment after refurbishment; relocation of workspace in an existing environment; acclimatised occupation of a refurbished workspace; and continued occupation of an existing environment. Cumulative frequency profiles of the collected ratings for each of these categories are analysed qualitatively and quantitatively.
Findings – The study shows that updated environments which are occupied by the same organisation before and after refurbishment are more successful than environments which are occupied by a new organisation after update. New buildings provide the greatest number of satisfied occupants. While many workplace design aspects are successfully addressed in newly designed and updated environments, satisfaction with acoustic and visual design features is equally poor in all investigated environment categories.
Originality/value – The study develops understanding of which environment categories, defined by the duration of the occupant‐environment relationships, are most successful in providing satisfying design features. The study thereby provides advice for facility management decision making.

Keywords Productivity rate, Time‐based management, Customer satisfaction, Facilities
Paper type Research paper

1. Introduction
Post occupancy evaluations typically consist of occupant surveys to discover those elements of a building which are performing well or underperforming and affecting worker satisfaction and potentially productivity. Companies spend less than 10 per cent of their operating expenses on occupancy costs compared with the cost of labour (Kaplan and Aronoff, 1996). It is therefore important to invest in the quality of the environment and facilities that enhance productivity (Roelofsen, 2002).
Intuitively, it would seem sensible to argue that workers would be more satisfied with a new or recently upgraded work environment. The so‐called “Hawthorne Effect” suggests that peoples’ behaviour and performance change following any new or increased attention (Adair, 1984) such as might be perceived from office upgrade. There are indeed many instances of increased productivity resulting from environmental enhancements. Changes in lighting and acoustics in a post office generated an 8 per cent increase in productivity and the lowest error rate in sorting (Browning, 1997). A productivity increase of 10 per cent was observed following improvements to the indoor environment of an office (Roelofsen, 2002). A survey by Knoll (reported by Barber, 2001) of workers
showed that the greatest boost to productivity (over 70 per cent) would come from having state-of-the-art technology, the ability to control climate, storage space, quiet space and space that can be personalised. When lighting dimming controls were introduced, significant improvements in mood, room appraisal, environmental satisfaction and self-assessed productivity resulted (Veitch and Newsham, 2000). Research by Kruk (1989) showed that a well-designed office chair increased job satisfaction by 27 per cent and adjustable, ergonomically designed office furniture increased productivity by 15.4 per cent. It is obviously important to spend time and effort on good environmental design to achieve comfortable conditions – employee’s satisfaction with their work environment has been found to be directly related to employee’s job satisfaction (Carlopio, 1996). Furthermore, Haynes and Price (2004) suggest that innovative workplaces improve organisational performance by attracting and retaining more innovative workers. However, they state that some cases of new work environments were successful in this regard, while others failed, because they proscribed and implemented changes that were inappropriate for the workers and the type of work performed within them. Duffy (1976/1998) stresses that it is important not to put the right organization into the wrong building. In such a case, he argues, the occupants would gradually destroy the work of the designers in order to make themselves comfortable. Such environments would be eroded systematically and overlayed with the real values of their users. Also Preiser (1995) argues that occupants ultimately adapt to the facilities and that the occupants adapt the facilities to suit their needs. In this interaction, he suggests, post occupancy techniques can be used to fine tune the fit between the environments and the needs of their occupants. Eilam and Shamir (2005) state that places gradually acquire symbolic meaning through association over time with individual and group activities and experiences and that imposed change to the environment might result in a loss of identity and a separation of the occupants from familiar physical settings. Brand (1994) elaborates on a framework of opportunities for evolving occupant-environment relationships, which was first published by Duffy in 1976 (Duffy, re-published 1998). Duffy separates design strategies into four groups with different rates of changes “shell, services, scenery and sets” respectively, Brand uses six categories in a similar framework: “site, structure, skin, services, space plan and stuff” and he suggests to add a seventh category for human “souls” as the most continuous driver for change. The “scenery” or “space plan” are finishes and partitions, which do not last longer than a lease and the “sets” or “stuff” is the arrangement of equipment and furniture which changes rapidly. These inner layers provide the opportunity to achieve occupant-environment fit, but the opportunities for their adaptation are constrained by the upper layers of the framework, which have usually much slower rates of change. This conceptual framework explains how existing structures are able to hinder achievement of a successful occupant-environment match.

Eilam and Shamir (2005) present work on occupants’ self-concept and organisational change and discuss the impact of workplace change in this context. They suggest that when the change is perceived to be concordant with the self-concept and if it provides opportunities for self-expression and self-enhancement, occupants can be expected to support or even to promote the change, while in the other case, when the change is not concordant with the self-concept, the change will result in stress and lack of motivation and other forms of resistance. It can then be expected that this resistance will lead to poor ratings of the environment, low occupants’ satisfaction and possibly reduced work performance.

The previous discussion tells us that occupants’ satisfaction with the environment will improve after refurbishment when the change is designed in concordance with the users’ needs and self-concept and that on the other hand workers improve their occupant-environment fit during occupation. Therefore it can be assumed that occupants’ participation in the change design process as suggested by Speckelmeyer (1993) as well as the consideration and continuity of successfully adapted environmental features lead to especially successful environments for specific organisations. A further aspect of the occupant-environment relationship is its multi-dimensionality and changing importance weightings between the dimensions. Speckelmeyer (1993) found that unsatisfactory
ratings of a specific design feature have a great impact on the overall rating of the environment, while the same feature is less important for the overall assessment, when rated satisfactory. Further Spreckelmeyer suggests that tradeoffs can be achieved between certain environmental features for example personal workspace design and common facilities and he also argues that spatial reorganization and environmental update is able to re-solve other organizational pressures and work conflicts, which then leads to better satisfaction ratings of the environment. Duffy (1998) highlights additional problems and stressors that may be caused when organizations relocate – possibly moving from a city location to the suburbs or a greenfield site – additional traveling time may negatively impact worker satisfaction ratings of their new environment. In addition there are continual new technological and organizational challenges which require worker adaptation, over which interior design and facility management have no control.

All this suggests that the assessment and evaluation of environments is the highly integrated result of interaction between the environment, the organization and the individuals within them. This paper analyses a large number of occupant responses collected in a range of new, refurbished and unmodified office environments in order to develop an understanding of how the twelve workplace design aspects surveyed (workspace layout, size of personal workspace, personal work surface area, usability of furniture, flexibility of furniture, workspace storage, meeting rooms, shared equipment, social spaces, suppression of noise, visual disturbance and access to privacy) affect the occupant satisfaction with workplace designs and the success of the environment.

2. Database
2.1 Source of the database
This research analyses a database of over 5,000 occupant self-assessment votes collected in 48 surveys in office buildings in Australia between July 2003 and May 2007. The data was collected in projects conducted by a professional consulting firm to evaluate the effectiveness of the built environment on productivity and other work environment performance aspects.

2.2 Categories in the investigation
This study specifically analyses the database in regard to the impact of the environment’s age (for instance whether new, recently refurbished or not) and of the time the individual respondent had been working in the building and at their workspace. The occupants’ assessment of twelve workplace design aspects is analysed. Some of the surveys took place in the same building before and after refurbishment. Three categories were allocated: “first occupied after construction”, “first occupied after major update”, and “existing environment without update prior to survey”. Cases were allocated to a “first occupied” groups, when the surveys were conducted within a year after refurbishment or construction, and to the category “existing environment” otherwise. The statistics of the groups are shown in Table I.

The second set of categories is based on two questions in the survey:

(1) How long have you worked in this building?
(2) How long have you worked at your present desk or workstation?
Both questions are answered with the options:
. less than a year; or
. a year or more.

These categories result in the seven groups, which are used in the following analysis. The group allocations are shown in Table II and the statistics of the groups are shown in Table III. Of the votes, 0.5 per cent have invalid combinations of categories, the remaining votes fall into groups with between 1,235 votes (group 1) and 181 votes (group 6). The meaning of the group allocations are discussed in the following paragraph.
Table III indicates that in groups 1, 2, 4 and 6 a large percentage of the data has been collected in one building. The results for these groups therefore might reflect the quality of the specific buildings rather than being statistically representative for other environments of this kind.

**Table I. Statistics of the survey**

<table>
<thead>
<tr>
<th>Number of buildings surveyed</th>
<th>Total number of respondents</th>
<th>Minimum respondents per building survey</th>
<th>Maximum respondents per building survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>First occupied after construction</td>
<td>4</td>
<td>1,251</td>
<td>21</td>
</tr>
<tr>
<td>First occupied after major update</td>
<td>5</td>
<td>997</td>
<td>14</td>
</tr>
<tr>
<td>Existing environment</td>
<td>39</td>
<td>2,800</td>
<td>14</td>
</tr>
</tbody>
</table>

**Table II. Group allocation, categories of environment age and worker experience of that environment**

<table>
<thead>
<tr>
<th>First occupied after construction</th>
<th>Group 1</th>
<th>–</th>
<th>–</th>
<th>Group 4</th>
<th>Group 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>First occupied after major update</td>
<td>Group 2</td>
<td>–</td>
<td>–</td>
<td>Group 5</td>
<td>Group 7</td>
</tr>
<tr>
<td>Existing environments</td>
<td>Group 3</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.3 Case groups in the investigation

2.3.1 Group 1: first occupied after construction. This group comprises data from occupants in new buildings. Assessment in this group is based on short-term experience. A long occupant-environment relationship has not been developed at this stage. Assessment might be influenced by expectations, rather than being based on experience.

2.3.2 Group 2: new occupation after major update (.1 year experience of workspace and building). Data in this group were collected in environments which were recently updated and occupied by a new organisation. As for environments in group 1, the assessment is based on short-term experience and an undeveloped occupant-environment relationship. The refurbishment is likely to have resolved any problematic environmental design features identified by the previous occupancy, but the ability to remove problematic environmental design features might have been constrained through the existing building structure.

2.3.3 Group 3: recent relocation into an existing environment (.1 year experience of workspace and building). Data in this group was collected among subjects who have moved into an existing environment (with no refurbishment), and have limited experience of the workstation and building. Subjects in this group, for example, might be new to the organisation or may have changed job within the organisation. Major organisational change could even result in change of workspace for complete workgroups and departments in this category.
2.3.4 Group 4: re-occupying an environment after refurbishment. Group 4 includes data from occupants, who have moved back into an existing environment after major update work has been carried out, and who change their individual workspace. These subjects experience the same advantages and disadvantages as the subjects of group 2, but they can compare the previous state of the environment with the state after update measures are implemented.

2.3.5 Group 5: relocation of the workspace in an existing environment. This group includes subjects who change their workspace location in a building with which they are familiar, i.e. they experience churn. While the allocation of the individual workspace changes, the larger context of the work environment remains unchanged.

2.3.6 Group 6: acclimatised occupation of a refurbished workspace. This group comprises data from subjects who occupy refurbished workspace and have experience of their workspace and the building of more than a year.

2.3.7 Group 7: continued occupation of an existing environment. Group 7 includes data from occupants who have experienced no relocation or upgrading of their work environments. Occupants in this group are accustomed to their environment and assessment is based on long-term experience and mature occupant-environment relationships. It can be assumed that some of these surveys were studies to document the situation before refurbishment.

2.3.8 Summary of group allocation. In summary, workers in groups 1, 2, 4 and 6 have varying degrees of experience of being located in new or refurbished work environments. Occupants of offices in categories 3, 5 and 7 are located in buildings that have undergone no upgrading. The data set can be used to test whether upgrading of work environments has an impact on worker satisfaction.

2.4 Statistics of the groups

2.4.1 Distribution of subjects’ age. The distribution of age groups in the seven investigation categories in Figure 1 show similar age profiles for the subjects in new buildings and for subjects, who are long time occupants in one building (groups 1, 4, 5, 6 and 7). The ratio of subjects under 25 is between 4 and 7 per cent. A total of 54 to 60 per cent are in the age group of 25 to 40 and the older subjects between 41 and 60 account for 33 and 40 per cent.

In groups 2 and 3 the population appears to be younger with 12 to 15 per cent under 25 and 65 per cent in the age group between 25 and 60. This can be explained with the fact that newly employed and typically young staff members in buildings in which the majority of occupants belongs to groups 4 to 7, fall into groups 2 and 3.

The difference between the populations in groups 5 and 7 could indicate that young occupants are more likely to change the workspace in existing environments, than their older colleagues – possibly
as a result of changing jobs or promotion. Older, more senior employees may tend to be more established in their roles. However, the concentration of newly employed and young staff members in groups 2 and 3 and the imbalance between groups 5 and 7 does not impact the methodology in this study, as individual ratings are used to assess the personal occupant-environment relationship independently from the occupied environment.

2.4.2 Distribution of subjects’ gender. The distribution between male and female occupants, shown in Table IV, is in all groups similar with a slightly higher percentage of the population are women. For all categories between 40 and 50 per cent are male and between 50 and 60 per cent of the population are female.

2.4.3 Distribution of workspace settings. The distribution of workplace settings is shown in Figure 2. As the categories of subjects in long-time occupied environments (groups 4 to 7) is rather a function of the organisational change than the environment, only groups 1 to 3 can be used to characterise the environments in regard to the workplace setting they provide. The distribution in group 1 shows that the majority of subjects in new buildings is either in open space offices or in single offices, while groups 2 and 3 also show work settings, in which small groups of subjects share their work environment. However, the result of group 1 might reflect one particular design in one building, which alone accounts for 88 per cent of the votes in this group. Comparison between the groups 4 and 5 with groups 6 and 7 suggests that subject in open space workspace settings are more likely to change the individual workspace, than subjects in offices occupied by one person.

Figure 1. Distribution of age groups in the investigation categories

Table IV. Distribution of gender groups in the investigation categories

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>Group 4</th>
<th>Group 5</th>
<th>Group 6</th>
<th>Group 7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female (%)</td>
<td>53.4</td>
<td>52.7</td>
<td>57.2</td>
<td>57.1</td>
<td>58.7</td>
<td>56.1</td>
<td>55.0</td>
</tr>
<tr>
<td>Male (%)</td>
<td>46.6</td>
<td>47.3</td>
<td>42.8</td>
<td>42.9</td>
<td>41.3</td>
<td>43.9</td>
<td>45.0</td>
</tr>
</tbody>
</table>
3. Investigation
3.1 Analysis of results
This research uses votes collected from the questionnaire survey on the topic area “Workspace design and management”. The votes are collected as answers to the question: “How satisfied are you with these aspects of your current workspace?” on a seven-point scale between 1 for “very dissatisfied” and 7 for “very satisfied”. Cumulative frequency charts have been prepared from the ratings. Figure 3 assists with interpretation of the cumulative frequency curves. A curve with shape 1 represents a collective vote where the majority rate the environment on the left side of the scale towards “very dissatisfied”. A hanging curve, as line 4, indicates that a relatively large percentage of the population rates the environment positively towards “very satisfied”. Line 3, a straight line, represents an indifferent rating, in which positive, negative and neutral votes have the same percentage. Line 2 is a rating profile with a large percentage of votes in the middle and lesser votes on either end of the scale — as in a normal distribution. For quantitative assessment the upper and the lower 25 per cent-percentile and the median of the cumulative frequency is used. The results are discussed qualitatively using the values depicted and shape of the curve as indicator for the rating.

Figure 2. Distribution of workspace settings in the investigation categories

3.2 Ratings of workspace design and management
The assessment profiles charts for rating of twelve aspects of the workspace design and management for the groups are shown in Figures 4 and 5 and are discussed in the following paragraphs.

3.2.1 Workspace layout. The workspace layout is rated by all seven subject groups with an average rating (Figure 3, line 2, S-shape) with only small differences between the groups. While the rating profiles of groups 1, 4 and 6 lean towards a positive rating, groups 2, 5 and 7 (new occupation after major update, relocation of workspace in an existing environment and continued occupation of an existing environment) show slightly weaker results. Comparing the profiles of groups 4 and 6 (re-occupying an environment after refurbishment and acclimatised occupation of a refurbished workspace) with the profiles of groups 5 and 7 (relocation of workspace in an existing environment and continued occupation of an existing environment) suggests that the internal upgrading of buildings can improve satisfaction with the workspace layout.

3.2.2 Size of personal workspace. The size of the personal workspace is rated by all subject groups between positive and indifferent. While occupants of long-term occupied but recently updated environments (groups 4 and 6) rate this aspect with a positive rating, occupants who recently moved
the first time into a new or an updated environment rate their environment still positive but towards an indifferent ratings.

Figure 3. Interpretation of cumulative frequency curves to be used with the graphs in Figures 4 and 5

The finding for the size of the personal workspace suggests that the trend to smaller personal workspaces in new and updated buildings is not followed when environments of currently occupying organisations are updated. A reason for this finding could be that for the cases of groups 4 and 6 (re-occupying an environment after refurbishment and acclimatised occupation of a refurbished workspace), the requirements, demands and experience of the actual occupants, are fed into the design process, while in the cases of groups 1 and 2 (first occupied after construction and new occupation after major update), requirements and demands are not effectively connected to the design development process.

3.2.3 Personal work surface area. The ratings of the personal work surface area produce similar profiles as the size of the personal workspace discussed in section 3.2.2. Occupants in updated existing environments (groups 4 and 6) are again the most satisfied with their personal work surface area suggesting that refurbishments in these buildings generally took account of workers needs.

3.2.4 Usability of furniture. The rating for the usability of furniture produces an average rating, which leans towards the positive side. New environments (group 1) and updated existing environments (groups 4 and 6) produce the best rating profiles. However, all profile lines are close together with percentiles and medians only 0.6 points apart on the rating scale.

3.2.5 Flexibility of furniture. The rating of the flexibility of furniture produces average to positive rating profiles. All groups except new environments (group 1) and updated environments in long-term occupied buildings (group 4) have medians between 3 and 4. Group 1 and 4 have better median ratings between 4 and 5.

3.2.6 Workspace storage. Workspace storage is rated with an average rating profile, only the profile of group 1 (first occupied after construction) shows a clearly negative rating. Interestingly the profile of group 4 (re-occupying an environment after refurbishment) shows the best rating, followed by group 6 (acclimatised occupation of a refurbished workspace). This could indicate that the issue of workspace storage is better addressed in refurbishment projects, when the needs and the experience of the actual occupants can influence the design process. However, 50 per cent of the subjects in all groups rate their satisfaction with this aspect as less than 4 (i.e. an unsatisfactory rating). Insufficient attention in design has been given to workplace storage.
Figure 4. Assessment profiles for the investigation groups – workspace design

- Workspace layout
- Size of personal workspace
- Personal work surface area
- Usability of furniture
- Flexibility of furniture
- Workspace storage
3.2.7 Meeting rooms. The satisfaction with meeting rooms is rated positively for group 1 (first occupied after construction) and still positive but weaker for group 4 (re-occupying an environment after refurbishment). It is rated poorly by subjects in group 6 (acclimatised occupation of a refurbished workspace). All other rating profiles show indifferent assessment of this aspect. The results for group 6 indicate that the update measures taken were not able or not meant to improve the environment in this regard in the existing workspace setting (occupant’s moved back into their old workspaces). This could be due to space constraints or due to lack of demand analysis before the update measures were planned.

3.2.8 Shared equipment. Shared equipment is rated indifferent or with a flat S-shape profile as median for all subject groups except group 1 (first occupied after construction). The rating of group 1 is clearly positive. This shows that the aspect of shared equipment is addressed successfully in the design of new environments.
3.2.9 Social spaces. The profiles of the assessments of satisfaction with social spaces show a similar pattern as the profiles of the rating of meeting rooms. The profile for group 1 indicates that this aspect was addressed very successfully in the design of the new environments resulting in 50 per cent of the subjects rating satisfaction with this aspect of the environment with 5 or better.

3.2.10 Suppression of noise. The suppression of noise seems to be a problem in all types of environments. The profile lines all exhibit the same shape and position in the chart. The shape shows a negative rating and 50 per cent of the subjects in all groups rate their satisfaction with the ability to suppress unwanted noise with 2.5 or even lower – a highly unsatisfactory outcome. This result shows clearly that noise is a problem in the built environment, which is currently not successfully addressed through the design of new and updated environments. The results also show clearly that occupants do not acclimatise to poor acoustic quality in existing environments over time.

3.2.11 Visual disturbance. The rating of the satisfaction with the ability to avoid visual disturbance shows similar agreement between the seven groups, only the profile of group 2 (new occupation after major update) shows slightly weaker ratings than the rest of the population. Profiles indicate an average rating with a median value between 3 and 3.5, again representing an aspect not successfully dealt with in office design.

3.2.12 Access to privacy. Access to quiet spaces and privacy is considered not to be good in most types of environments. While in groups 2, 5, 6 and 7 (new occupation after major update, relocation of workspace in an existing environment, acclimatised occupation of a refurbished workspace and continued occupation of an existing environment) rate the environment with a clearly negative rating profile and 50 per cent of the occupants rates the environment with 2 or weaker.

Environments in groups 1 and 4 (first occupied after construction and re-occupying an environment after refurbishment) are more successful in this category with an indifferent rating profile. This could indicate that this aspect is dealt with in the design and update of environments, but that the issue is not resolved to the full satisfaction of the occupants.

3.3 Summary of results
Table V summarizes the previous findings using the percentage of subjects who rate the environment with average satisfaction ratings of 4 or weaker as criterion for the assessment. Table V lists the differences between the average rating and the actual rating for each environmental feature for each group. The average of the differences are then calculated for each group and converted into a simple rating for the groups over all environmental features.

The rating given in Table V confirms that groups 1 and 4 (first occupied after construction and re-occupying an environment after refurbishment) are most successful in providing a satisfying workplace environment. Group 1 occupants are well satisfied with the provision of social spaces, meeting rooms and furniture, but less satisfied with the design of their personal workplace. It seems that the trade-off between common and personal workplace features takes place as suggested by Speckelmeyer (1993). Surprisingly group 2, (new occupation of workspace after major update, less than one year experience of workspace and building) is most dissatisfied with the workplace design. This result could be biased by one specific environment which provides about 80 per cent of the data in this group (see Table III). On the other hand, subjects that moved into existing and not updated environments (group 3), rate the workplace design close to the average over all environment groups. This could indicate that occupants do not have high expectations when moving into existing environments, while the updated environments of group 2 do not meet the raised expectations of workers moving into an upgraded building or fully consider worker requirements. Another explanation could be that environments of group 3 are, as discussed in the introduction, adapted to use through their previous occupants, while environments in group 2 are newly designed and not yet adapted to use after refurbishment is carried out.
Table V. Differences between the actual and average ratings for environment features and total ranking

<table>
<thead>
<tr>
<th>Group</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Workspace layout</td>
<td>9</td>
<td>-8</td>
<td>0</td>
<td>10</td>
<td>-7</td>
<td>5</td>
<td>-7</td>
</tr>
<tr>
<td>Size of personal workspace</td>
<td>-7</td>
<td>-3</td>
<td>2</td>
<td>12</td>
<td>1</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Personal work surface area</td>
<td>-9</td>
<td>-3</td>
<td>4</td>
<td>10</td>
<td>0</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Usability of furniture</td>
<td>7</td>
<td>-8</td>
<td>-2</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>-2</td>
</tr>
<tr>
<td>Flexibility of furniture</td>
<td>17</td>
<td>-9</td>
<td>-4</td>
<td>0</td>
<td>-8</td>
<td>0</td>
<td>-11</td>
</tr>
<tr>
<td>Workspace storage</td>
<td>-3</td>
<td>-5</td>
<td>1</td>
<td>11</td>
<td>-1</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Meeting rooms</td>
<td>17</td>
<td>-10</td>
<td>-1</td>
<td>6</td>
<td>6</td>
<td>-22</td>
<td>-10</td>
</tr>
<tr>
<td>Shared equipment</td>
<td>13</td>
<td>-2</td>
<td>-1</td>
<td>6</td>
<td>7</td>
<td>-9</td>
<td>-5</td>
</tr>
<tr>
<td>Social spaces</td>
<td>30</td>
<td>-14</td>
<td>-4</td>
<td>4</td>
<td>-10</td>
<td>-23</td>
<td>-13</td>
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<tr>
<td>Suppression of noise</td>
<td>1</td>
<td>-5</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>-1</td>
</tr>
<tr>
<td>Visual disturbance</td>
<td>2</td>
<td>-7</td>
<td>0</td>
<td>2</td>
<td>-1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Access to privacy</td>
<td>21</td>
<td>-8</td>
<td>-3</td>
<td>11</td>
<td>-13</td>
<td>-8</td>
<td>-8</td>
</tr>
<tr>
<td>Average</td>
<td>8.2</td>
<td>-0.8</td>
<td>-0.6</td>
<td>6.2</td>
<td>-4.7</td>
<td>-1.8</td>
<td>-4.7</td>
</tr>
<tr>
<td>Rank</td>
<td>1</td>
<td>7</td>
<td>3</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

Perhaps the major update of existing environments may never be as satisfactory as new build. The update of the environments of group 2 was possibly constrained by existing environment layouts as described by Duffy (1976/1998) and Brand (1994). Unfortunately information about what refurbishment measures were adopted is not documented to allow analysis of the nature and quality of the environment update.

The good rating of existing environments by new occupants (group 3) can also be explained with the fact, that these new occupants join an existing organisation in an occupied and well-adapted environment, in which the majority of occupants, their more senior colleagues, belong to groups 5 and 7 (relocation of workspace in an existing environment and continued occupation of an existing environment).

Group 4 occupants experienced an environment “before and after” i.e. they moved back into an updated environment and it can be assumed that occupants’ needs and experience in the environment were acknowledged in the design of the update measures. The results confirm the assumption, that refurbishment of previously occupied environments generates more satisfying results than the update of the first-time occupied environment of group 2.

The difference between groups 4 and 6, (occupation after major refurbishment, occupied by the same organisation before and after the update), is that the occupants of group 4 change their individual workplace, while occupants of group 6 move back into their previous office layout. This means that the office layout is not improved for group 6 and it can be assumed that some other facilities, such as office furniture, remain untouched by the update measures. Therefore group 4 achieves a better rank than group 6.

Groups 5 and 7 achieve the same rank. Both groups consist of subjects that have continued to work in the same building for more than a year and who are accustomed to their environment. The difference is that group 5 workers have changed their individual workstations, while subjects in group 7 have experienced their workstation for longer than a year. This difference has little impact on the general assessment of the environment. This indicates that the overall workspace situation is more important than the individual workplace.

4. Discussion and conclusion
This paper presents ratings of 12 workplace design features collected from over 5,000 occupants with differently developed occupant-environment relationships. The seven environment categories are:
(1) first occupied after construction;
(2) new occupation after major update;
(3) recent relocation into an existing environment;
(4) re-occupying an environment after refurbishment;
(5) moving workspace in an existing environment;
(6) occupation of a refurbished environment for more than one year; and
(7) continued occupation of an existing environment are investigated.

The investigated workspace design features are: workspace layout, size of personal workspace, personal work surface area, usability of furniture, flexibility of furniture, workspace storage, meeting rooms, shared equipment, social spaces, suppression of noise, visual disturbance and access to privacy.

The results show that the acoustic and visual quality of the environments’ design, rated as adequate noise suppression and avoidance of visual disturbance, are equally unsuccessful in all types of environments. This means that these physical aspects of environmental quality, which are considered highly influential on workplace productivity and wellbeing (Davies, 2005), are currently not addressed successfully in new designs or upgrading measures and that the occupants do not acclimatise to their acoustic and visual environment over time. Sundstrom et al. (1994) suggest in this context that although the acoustic quality of the workplace design is improved in post move situations, other changes such as higher spatial density might counteract these improvements.

The study shows that highly satisfying workplace features can be implemented in new buildings. For instance, the provision of social spaces and meeting rooms was particularly appreciated. In this group only the design of the individual workplace is rated as less satisfying than the average rating. This might reflect the trend towards smaller individual workplaces, but the low rating for these features is made up by very positive ratings of other workplace design aspects.

The relative success of long-term occupied but recently updated buildings compared to newly occupied updated buildings confirms that the consideration of occupants’ demands and experience in the design process helps to achieve more positive design outcomes than design and refurbishment detached from occupants experience. Additionally, workers moving into newly renovated offices may have high expectations that are not met when balanced against the possible constraints of an existing building that limits the creation of effective workspace design improvements. This finding provides a strong argument for demand analysis, environmental evaluation and briefing before environments are updated.

Another aspect of this might be that the general context of work environments remains unchanged, when long-term occupied environments are updated by the occupying organisation. In this case the implemented improvements as well as the familiarity with the existing environment contribute to a positive experience of the updated environment. Problems and change-stress for the occupants caused by for example a new work location (e.g. through changed work travel), as suggested by Duffy (1998), are avoided when an organization updates its existing environment.

This research confirms the findings of occupant-environment relationship characteristics in new and old environments reviewed in the introduction. It discusses well-rated and weakly-rated environment categories individually and in context with the overall assessment and thereby develops understanding of how the issues discussed affect the occupant satisfaction with workplace design and the success of the environment in general. The paper gives advice on how to design and to operate future and existing environments and recommends greater attention be given to acoustic and visual performance aspects of office design and the participation of occupants in the design process to create more successful workplace environments.

References

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