COMPUTER-AIDED SPACE PLANNING

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1 INTRODUCTION

In today's economic climate, it's no surprise that corporations are increasingly faced with problems associated with downsizing, such as organizational restructuring, high churn rates, reduced headcount, consolidation, and increased outsourcing. Anticipating and planning for these changes becomes an integral component in reducing overhead expenditures and typically only the facility management department has the expertise and data to perform analyses concerning site capacity and adjacency studies, with related financial data and projected growth patterns. Restructuring has thus resulted in a higher level of responsibility for space planners. They need to take on a proactive approach to performing space-planning activities such as tracking and monitoring space, people, and equipment in order to respond to the demands of senior management.

2 DATABASE ISSUES

The challenge involved in the successful automation of space planning activities has as much to do with administrative issues as it does with technology. The assurance of accurate and timely data (quality control) implies an understanding of the database issues associated with their management and upkeep. For example, where is the data kept? Who has responsibility for the data? How often can the data be accessed and updated? How is the data archived and integrated with other Computer-Aided Facility Management (CAFM) applications?

It becomes important to prioritize what information to save, what data to encode and the level (scale) at which to track the information. For example, Is space tracked on a department level or a room level? Is furniture and equipment tracked? Is all equipment tracked or just equipment costing over a certain amount? What are the costs and benefits of tracking these elements?

Also, administrative procedures and standards need to be established to insure data currency and integrity so that senior management is confident about decisions based on the data. Each of these decisions has ramifications for the space planner in terms of the time and cost involved in creating and maintaining databases, particularly if the data is tracked graphically in a CAD or CAFM system.

3 THE FOUR STAGE CASP PROCESS

The various activities associated with space planning can be organized into four processes: (1) inventory, (2) requirements, (3) allocation, and (4) planning. The inventory serves as a repository of information reflecting the current state of resources. Requirements for projects are usually based on space needs and desired adjacencies. Automatic or manual allocation depicts various layout and occupancy solutions based on the input from the inventory and requirements. Planning involves the anticipation of future changes (e.g., forecasting future growth patterns or considering lease options).

1. Inventory The inventory comprises the information being tracked. When computers are used, the inventory essentially becomes the "corporate memory" of the organization. The inventory can be of buildings, rooms, occupancy, personnel, organizational structure, space standards, equipment, or furniture. For successful implementation of the corporate memory and to insure data integrity, administrative standards and procedures must be defined such as the type of information to be collected and the appropriate scale of the information.

   For some organizations, space may need to be monitored only at a cost center level in order to accommodate space chargeback accounting procedures. Other organizations may want to keep a room inventory which tracks personnel, equipment and furniture in the room. If so, decisions remain regarding whether to track all equipment or only equipment over a certain value (the same applies for furniture). If the space planner is intending to use the equipment or furniture inventory with an

automated purchasing program, then the manufacturer, model, serial number, cost and other associated attributes should be tracked. Tracking assets to this level of detail can result in significant cost savings to the organization, but requires in increased overhead related to entering and managing the data.

Facility management departments utilizing CAD or CAFM systems can maintain an accurate picture of the location and condition of existing furniture and equipment. The organization can reap the benefits of the inventories by re-using the furniture and equipment for re-modeling jobs instead of making unnecessary purchases. Again, the costs and procedures associated with maintaining extensive databases (both graphic and non-graphic) must be justified with the benefits (cost savings, access to better data, improved methodologies and procedures, reduction of workload, increased capabilities) reaped.

2. Requirements A set of organizational space requirements must then be matched against the existing inventory. Requirements would be defined in the same categories that exist in the inventory (e.g. space, people, and furniture). Establishing a set of space requirements can be a complex problem since there are many variables involved. However, space requirements and subsequent allocations (the third stage in space planning) should be defined to fulfill a number of specific objectives: 1. Space needs of individuals, work groups and business units must be met. 2. Productivity should be promoted by fostering ease of communication and flow of ideas, information and materials. 3. Organizational growth and downsizing trends, in terms of both personnel and space, should be anticipated. 4. Vacant or unused space should be minimized. 5. Location preferences and proximity needs of workgroups should be satisfied while minimizing fixed operating costs such as rent, construction or moving. 6. Any existing standards such as space standards or furniture standards should be adhered to.

   Typical data input for requirements include: Organizational Area Requirements To begin the layout of space, the facility planner must first know which operating groups to plan for and how much space each requires. The essential data is a list of operating groups and their area requirements.

   Locational and Adjacency Requirements Since the physical layout of workstations, workgroups and business units influences the overall productivity of the organization, adjacency requirements are used to analyze long-term locational strategies. Groups that must interact should be contiguous or close in proximity. Likewise, groups with the risk of productivity drop due to frequent interaction should be farther apart. Both positive and negative relationships, reflecting the interaction between operating groups, should be considered. In the absence of locational analysis, groups are usually placed where space either is currently available or can be easily accommodated though renovation or leasing. The results of such haphazard allocation are often inefficient and uneconomical, and can lead to higher churn rates in the long run.

   Personnel and Space Standard Requirements Space standards for workstation layouts include furniture, fixtures and equipment, and are typically associated with personnel classification levels. For example a corporate standard for an Associate Manager might require a workstation area (e.g., 200 sq. ft.), furniture (desk of a certain size with a type of chair and a bookshelf), equipment (type of computer, personnel phone) and fixtures (carpeting, art work). Many space planning software applications utilize space standards as a fast method for forecasting space requirements, accurately entering personnel requirements, and placing them graphically on a floor plan. A CAD program can store the set of required workstation components for the Associated Manager and place the graphic configuration quickly. Attributes (e.g., manufacturer, make, model, cost, etc.) can also be associated with the graphic space standard.

   Cost Information (Renovation, New Construction, Lease) The cost of space in general, including both current and predicted life cycle expenses, will dictate how economical an organization's use of space is, and largely determine the cost of space used by individual operating groups. These costs influence what action should be taken with available space, and how much of what space to allocate to operating groups.

3. Allocation Space allocation involves assigning activities (business units, workgroups, individuals, etc.) to a physical location (sites, buildings, floors, etc.). The process must take into account requirements for the activities, and should satisfy the objectives mentioned above, which in the broadest sense are to promote efficiency and productivity.

   Allocation can be performed manually or automatically. Since space planning belongs to a class of problems that are "over constrained,"most automatic algorithms employ heuristics that generate near-optimal solutions, and then provide the planner with a set of editing tools to manipulate solutions.

   Software for automatic space planning has attracted interest because of the following: 1. More quantitative data can be processed simultaneously. 2. Data can be processed faster. 3. Data and solutions are presented graphically. 4. Multiple "what-if" scenarios can be developed and compared. 5. Quantitative criteria are provided to aid in evaluating solutions. 6. Qualitative changes can be made quickly and are automatically updated for visual analysis.

   Solutions are often given a scored rating based on adjacency and locational requirements of workgroups. Graphic presentation of the solutions are shown three ways: 1. A stack plan is a vertical representation of the area in a multi-story building. Each group's space allocation might appear as hatched or color-coded sections on floors. Adjacency requirements and unused/occupied area per floor can also be displayed (figure 2). 2. A block plan is a horizontal solution that uses the outline of the floorplan. Hatched or color-coded blocks that represent the relative size of groups' space allocation are mapped into the physical boundaries of the floorplan (figure 3). 3. A bubble diagram is an interim solution for a block plan in which circles represent relative sizes of groups' spaces and are used to schematically place the location of workgroups based on adjacency requirements (figure 4), but without calculating geometric fits.

   A desired and practical function of CASP programs is to superimpose the block plan on a detailed CAD floor plan (either by a DXF export/import utility or directly if generated in a CAD program) that includes interior partitions and furniture layouts. The block plan then becomes a useful tool for the interior designer who generates detailed drawings of the floor layout using the departmental block outlines as a guideline for workstation layout.

4. Planning As the term implies, planning is fundamental to each stage of the space planning process. Planning involves a continual examination of variables that will affect alternative solutions at future points in time. These variables can include anticipated organizational growth or shrinkage patterns, leasing options, cost factors associated with space, renovation, construction or employee moves, changes in required adjacencies, or revised space needs and standards from the addition of new equipment.

Many CASP applications have business graphics features used for producing bar chart, pie chart, and line charts of the projected organizational space needs (see figure 5). CAD programs with space planning modules often provide forecasting capabilities using workstation space standards (easily created in CAD) that link to a personnel database where the personnel projections are performed. There are several methods used for these projections. The chosen method should present an appropriate level of detail required for a particular project or as desired by the organization. If only a broad level of detail is required, then simpler forecasting methods may be appropriate.

The most general method of forecasting is by annual growth rate based on historical trends. If a growth pattern of 1.5%, for example, has been experienced in the past with only slight variation, then an average growth of 1.5% can be projected for future years. This same growth rate would be applied to current building area totals to determine an estimate for space needs. When used for general space planning purposes this method provide a high degree of flexibility and can be used to establish a rough estimate of the size of a new building that might be required to house future staff. The approach cannot, however, be used to identify how much space individual work groups require. More detailed methods must be employed for this level of detail.

A second method of forecasting begins by dividing net useable area by the number of employees occupying the space. For example a department's total useable area, taking into account departmental circulation space and support areas such as filing and copy rooms, would be multiplied by the number of personnel in the department. The resulting average area/person figure is then multiplied by the projected personnel count for the department to yield a forecasted space requirement.

A third and even more detailed method of forecasting uses space standards associated to personnel levels to calculate space requirements. Space standards assign a specific area requirement for each category of personnel (e.g., data entry personnel might receive 80 sq. ft. of space). Projected personnel counts broken down by personnel levels and their individual space requirements are then determined and matched to appropriate categories of space standards. To utilize the full capability of developing space standards, furniture and equipment can be assigned to each standard. When projections are calculated, furniture and equipment can also be tallied up, saving time for interior designers who can use the information for detailed layout and project cost estimation. Forecasting can be greatly enhanced by space planning applications. However, there is still room for improvement on the part of software vendors to provide a comprehensive analysis tool for accommodating the full range of variables (leasing information, economic analysis, cost estimating) that are integral to space planning.

4 KEYS TO SUCCESSFUL IMPLEMENTATION OF CASP

Cost effective implementation of an automated process for space planning should consider the space planning activities as one part in a cycle of facility management activities. The space planning program should ideally have a bi-directional link to information from other organizational areas such as personnel, finance, and real-estate.

It has been emphasized that the implementation of integrated CASP means dealing with administrative as well as technical data issues. Management must understand the financial and administrative commitments that must be made to have good data on which to make decisions. Security procedures must be addressed since financial and personnel data must be protected. Standards and procedures for data collection (what to track and at what scale), data updates, archiving, and reporting should be established. When possible it is best to use industry standards such as relational SQL databases or a CAD system with a reliable DWG porting capability to protect existing database investments as technology in the CAFM industry evolves. Technical issues such as integrating different data formats (graphic and non-graphic) that operate on a number of different computers (mainframes, PCs, workstations) should be considered.