

Livable Space: How Dense is *Too* Dense?

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How Dense is Too Dense?

What is the tipping point beyond which increased density impacts employees' satisfaction, well-being and engagement?



We are often asked to make office space as efficient as possible. Our clients want to know: What can we do in the least amount of space? At what point is it unlivable?

We know there are human limits to space reduction – from pushback and experience. The challenge was to expand our intuitive design thinking with quantitative, multi-disciplinary research about human behavior, space use and best practices.

Jacobs has collected benchmarking data on space use for more than 20 years with annual decreases in space per person and workstation sizes. For the first time in 2016, the Jacobs Benchmarking data showed slight increases in space use. What was happening? Had we reached the tipping point?

Our goal was to document the tipping point beyond which increasing density can threaten

engagement with work, performance and well-being – all of which are key business drivers.

It was much harder than we thought. We analyzed behavioral research, benchmarking trends, corporate real estate experience and our design experience for insights. The result came from design testing which showed a dynamic relationship between space factors of work settings, group space and circulation.

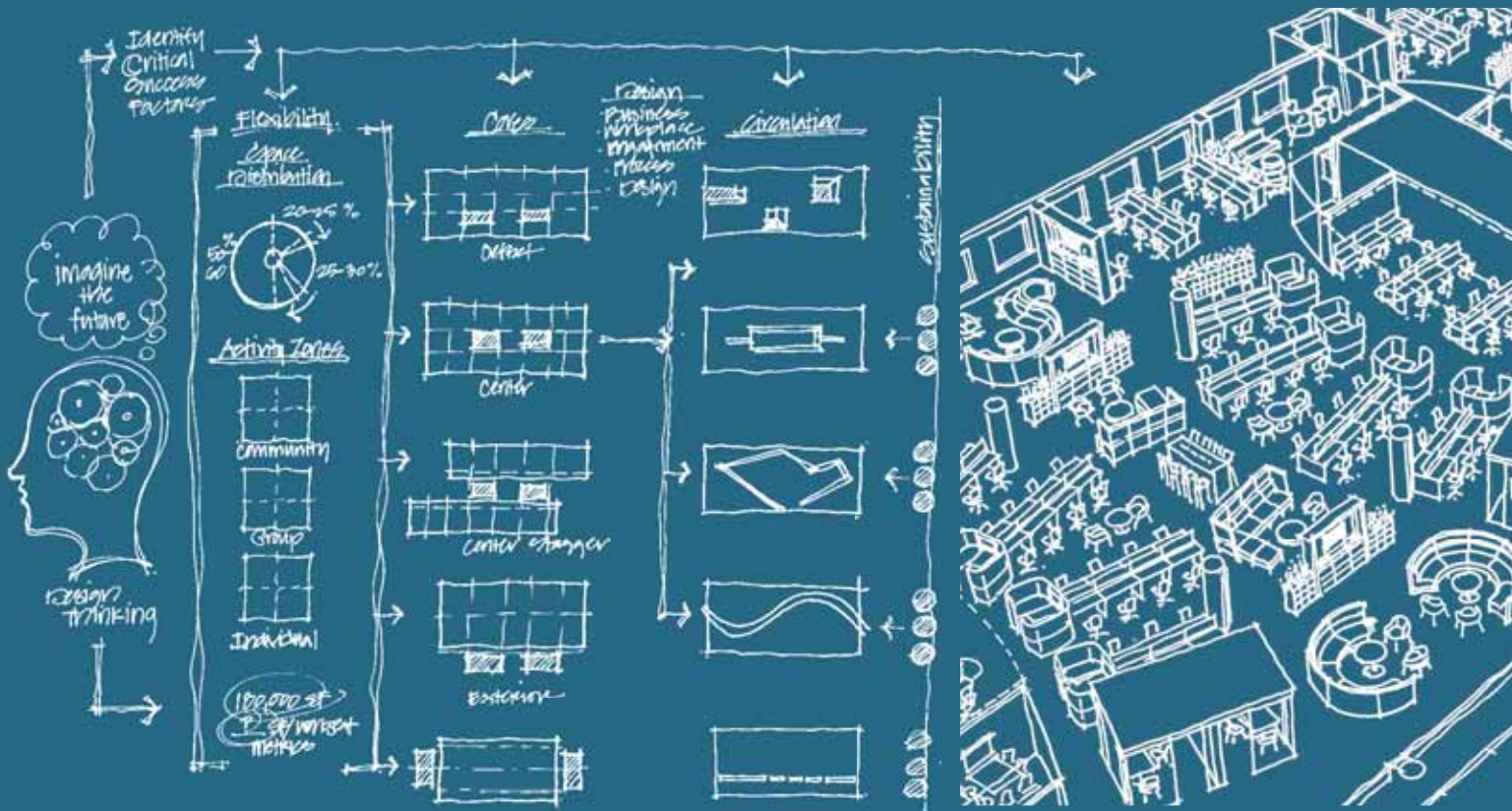


Figure 1. Design thinking for research, analysis, and ACTION!

Our research partners included Philadelphia University’s College of Architecture and the Built Environment, Department of Interior Design, the Building Owner and Managers’ Association (BOMA), participants from Jacobs’ annual Workplace Conference and our own senior designers. Working together as a unit allowed the experts to cultivate and bring new and interesting perspectives from design, business trends and academic research on how we “define” density limits.

Leveraging the research and our experience as designers and strategists, we developed a planning toolkit of minimum space recommendations for individual work seats, group and community space and circulation based on the research findings. We define the tipping points as:

- 125 to 135 usable square feet per work seat,
- 25 to 36 net square feet minimum for individual work seats,

- 1.8 minimum circulation factor (45 percent of the total usable square feet),
- 40 percent to 50 percent of the usable square feet dedicated to group and community spaces within the business unit area,
- 50 percent to 60 percent of the usable square feet dedicated to individual work areas within the business unit area.

The Power of Control

How do people experience density? How close can people be to each other? What are the effects if they are too close? We looked for answers in behavioral research, working with Luis Rindfleisch¹ and the faculty at Philadelphia University, Department of Interior Design.

DENSITY IS THE PHYSICAL CONDITION OF A SPACE.

We discovered that increasing workplace density without providing adequate control and workspace options leads to a sense of crowding, with negative impacts on employee performance, engagement and well-being. While people may say “I’m used to it” or “I can cope”, research measuring physical stress, patience, performance and job satisfaction says otherwise.

We found that density impacts our ability to control stimulation, interruptions, physical access and privacy. High density, open work environments increase physical, acoustic, and visual access to others while reducing control. Control is a biological human need – without it

people can feel overwhelmed and overloaded. Physical boundaries, mobility, choice and social norms for individual control are essential.

Increasing density can also hurt collaboration. When people feel crowded they often withdraw. Common behaviors include using headphones all day, avoiding eye contact, increasing email, working early or late hours to avoid people and working at home. These types of withdrawal can be useful for periods of focused work, but they can also counteract desired business goals for interaction and team building, inadvertently undermining business performance.

Personal Space

How close are we comfortable being with other people? When people are too close, sensory input can be distracting and psychologically stressful. Classic research on the social nature of space by Edward T. Hall, Robert Sommer and Irwin Altman² is still very relevant for office design.

Edward T. Hall, a cultural anthropologist, researched how hearing, sight, smell, and touch are affected by spatial distances, and the social nature of space in his book, *The Hidden Dimension* (1966). Subsequent research and

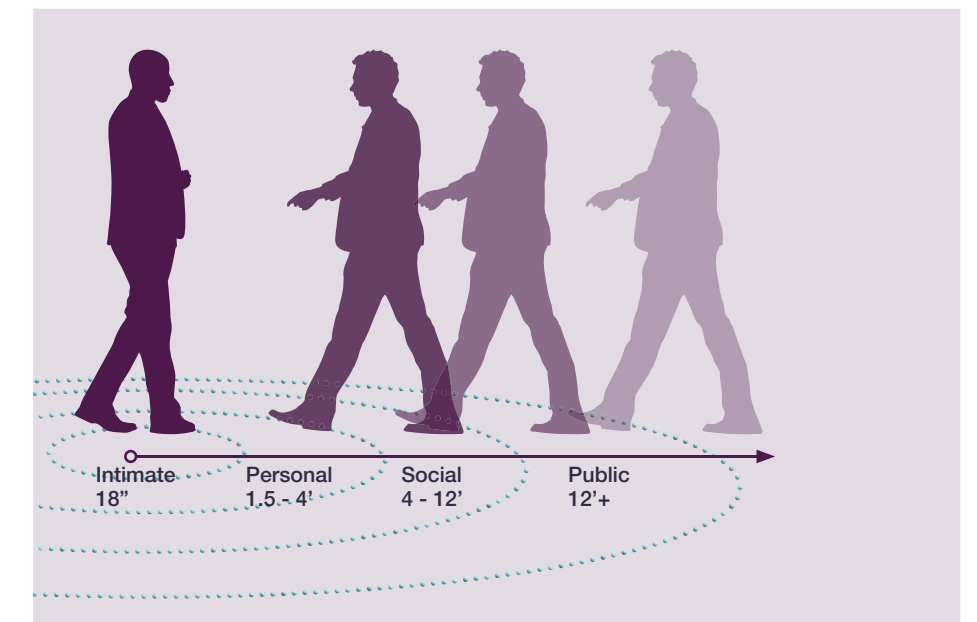


Figure 2. Personal space distance zones are relevant for office planning



design practice confirms Hall's space zones and their usefulness for planning office space.

Hall defined four distance zones as shown in Figure 2. When we are in the intimate distance zone (0 to 1.5 feet), we can easily touch each other, and can sense others' smell, breathing rate, and body heat. While common for temporary or special situations such as elevators, theater seating, and airplanes, the intimate zone is uncomfortable in the workplace. When interacting with friends, we often are in the personal distance zone (1.5 feet to 4 feet), where we can easily touch the other person if we extend both arms. We may be able to smell each other, feel body heat and hear breathing. It is very easy to understand conversations, emotions and work sounds such as mouse and keyboard clicks. Conference rooms seating falls in this zone, but is usually time limited. People describe that working this close "feels like someone is in my lap." The social distance zone (4 feet to 12 feet) is the normal distance for business and general social contact

in North American businesses. The minimum size of an individual work setting that provides social distance is 25 net square feet, which provides a five-foot distance between people, as shown in Figure 3. Inter-office discussions that are further than seven feet apart are more formal, and difficult to hear.

Applying insights from personal space research to office space planning, we concluded that office space should maintain social distances between people, with at least 4 feet between people to minimize stress and crowding. A 5 foot worksurface for individual work settings meets this space minimum.

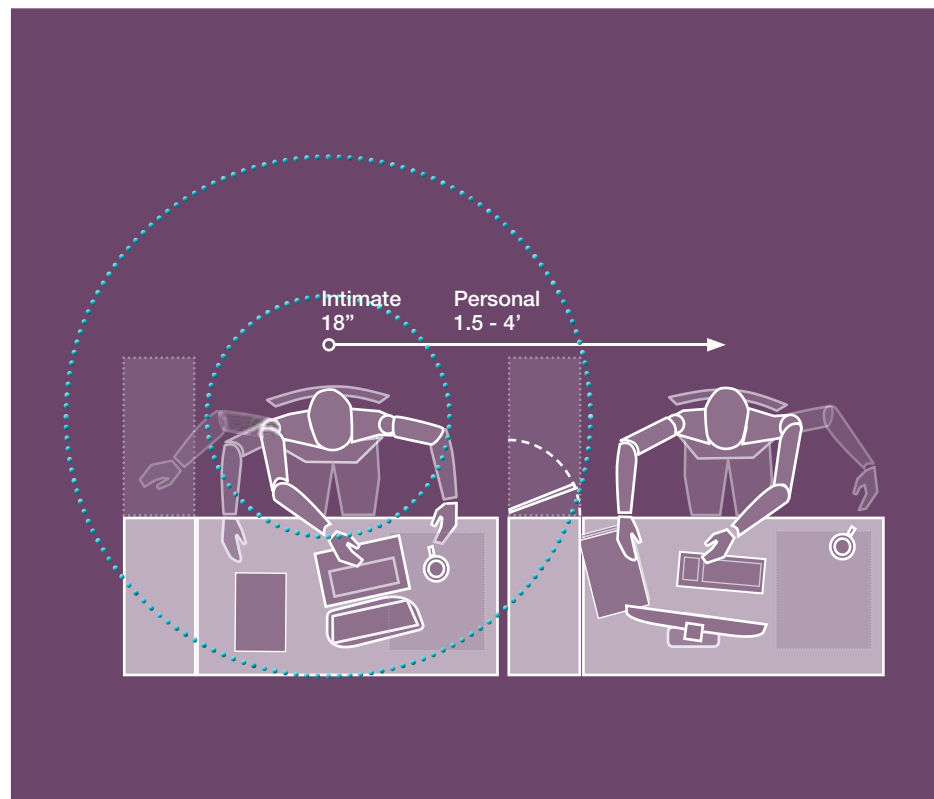


Figure 3. Social distance establishes a minimum for office planning

Privacy: Confidentiality and Distraction

In design discussions with our clients, employees are often concerned increasing density will compromise their needs for privacy. But we find the word "privacy" is inexact. Sometimes it relates to confidential information, other times to acoustic distractions and other times to physical interruptions from people coming into your space. We dive deeper into what privacy means for them and what they need to be effective in order to define specific visual, acoustic and spatial design requirements.

Our review of the behavioral research defined privacy as a balance between isolation and crowding. Privacy is not about being alone! Irwin Altman's seminal research on space and social behavior defines privacy as having just the right amount of access to other people and stimulation.⁴ Having too little access and stimulation is isolating but too much stimulation is distracting and stressful. Altman defines crowding as a social condition that occurs when privacy mechanisms fail.

Confidentiality protects information from being seen or heard by others. We often hear people request privacy for confidentiality when their real concern is being able to concentrate and fear of distractions in open office settings. Acoustics are one of the most frequently mentioned causes of workplace dissatisfaction, and are highly influenced by density. A 2017 workplace effectiveness survey by the Leesman Index found that only 31 percent of people were satisfied with the noise levels in the office, which affect the ability to do focused work.⁵ But design solutions for acoustic distraction are different than solutions to protect confidential information. It is important to distinguish the real needs to find the right design solutions for visual and acoustic control.

We find that analysis of the work and the people is imperative to define privacy needs for designing effective, flexible space. Research by Irwin Altman⁶, Nigel Oseland⁷, and Sally Augustin⁸ confirmed our experience that privacy needs vary between people, organization and time. Factors

cited include task complexity, perceived control and predictability of distractions, personality and work style, mood and culture.

- **Complex tasks** often require more focus and more effort to "tune out" sounds, eye contact and awareness of activities around you. However, simple routine tasks can be boring and benefit from a more stimulating and social environment. Many people have both kinds of tasks in their work days and benefit from controls and spatial variety to meet their needs.

- **Visual access**, confidentiality and control of visual information are also affected by design. Visual openness provides more control by being able to see who can see you, but some people feel exposed. Being able to see others can be visually distracting, particularly if eye contact invites people to stop and chat. Layouts with variety of visual orientations are useful. Window views to the outside provide a sense of spaciousness and focal points outside the immediate office space.



- **Control** is important. When people feel they can control and predict distractions, they are able to tolerate and react more effectively.
- **Personality and work style** affects whether people get their energy and inspiration from each other, and how much they need to recharge and be alone. Personality also affects how easily they can “turn off” awareness and distraction of activities around them.
- **Mood and personal attitude** affects needs for and tolerance for stimulation, responses to pressure and protectiveness of information and others’ access. Having places for social access and focused withdrawal are important, as well as office etiquette and support for neighborly behaviors.
- **Social norms and behaviors** affect our ability to obtain the privacy we seek. In change management, we translate the work culture of an organization into “the way we do things here” for using the office space. We often have to consider multiple work cultures in the office

related to different types of work groups and professions, which can affect adjacencies, shared space use and social norms.

PRIVACY NEEDS VARY. WHAT IS ISOLATING TO ONE PERSON MAY BE OVERWHELMING TO ANOTHER.

Our designs need to address a variety of changing needs for individual focus and social connection. Work setting choices for different privacy needs and behavior protocols (such as quiet zones) allow

people to control and change access to stimulation and confidentiality in high density spaces. Zoning office space with a range of quiet focus areas and active collaboration zones address changing work needs as well as differences in work styles and personalities.

Crowding Impacts Performance, Well-Being and Engagement

Density is the physical condition of a space. Crowding is a negative experience of density. We feel crowded when we do not have enough personal privacy, there is too much sensory stimulation or when

we lack control over others’ access to us as shown in Figure 4. Whether we experience crowding depends on the situation, physical characteristics of the space, activities, cultural background, gender and personality. The probability of feeling crowded increases with density and encroachment into one’s personal distance zone (within 4 feet), particularly in individual work settings.

One of the reasons we did this research is based on our professional experience that workplace density impacts employees’ satisfaction, well- being and engagement with their work. The research findings on crowding support our experience.⁹ We found that crowding impacts physical and emotional well-being, mood, task performance, and stress.¹⁰ It increases distractions and reduces attention span, making it harder to focus and persevere with complex or difficult work tasks. Errors are more likely when under stress. People can also become less helpful, less tolerant of ambiguity and less collaborative. How frequently do we hear, “This new office drives me crazy”, “I can’t think here”, or “This place doesn’t feel good”? These perceptions are rooted in our

psychological experiences of space. Our research review found that chronic exposure to uncontrollable environmental stressors such as crowding can lead to learned helplessness, reduced motivation, depression and other mental health problems.¹¹ Crowding is also associated with physical health problems, including increased heart rate, blood pressure, respiration and cortisol levels.¹²

Crowding can also reduce organizational performance by affecting employee engagement – their involvement with, commitment to, enthusiasm, and satisfaction with their work. Employee engagement and workplace satisfaction are strongly related to job satisfaction, which in turn affects organizational reputation, employee retention and recruitment.¹³ Steelcase’s 2016 global research study on employee engagement and workplace design found that highly engaged employees had more choice and control over their workplace experience. Freedom of movement to control privacy was related to employee engagement, enabling people to concentrate more easily and work in teams without being interrupted.

As designers we often seek to increase communication and collaboration by bringing people closer together with fewer visual and physical barriers to increase access

CROWDING HAPPENS WHEN WE DO NOT HAVE ENOUGH PERSONAL SPACE, TOO MUCH SENSORY STIMULATION OR LACK CONTROL OVER OTHERS’ ACCESS. CROWDING CAN CAUSE STRESS, REDUCE PERFORMANCE AND HURT WELL-BEING.

and awareness. Space planning can reduce physical isolation and territorial silos by changing spatial relationships. However, increased density can also reduce control over access and distractions and cause social withdrawal to reduce engagement. We have to be careful when using design for social engineering, to not densify beyond the point of comfort and control.

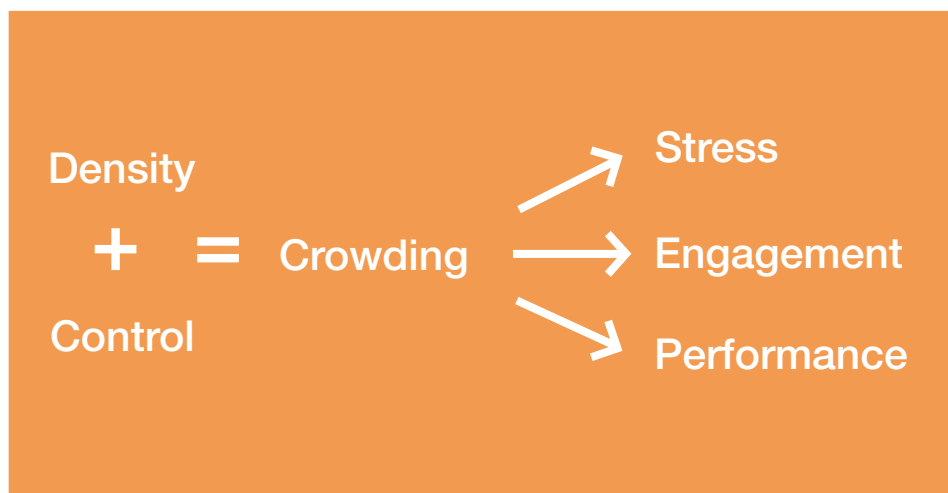


Figure 4. Crowding is negative experience of density



Design Inquiry

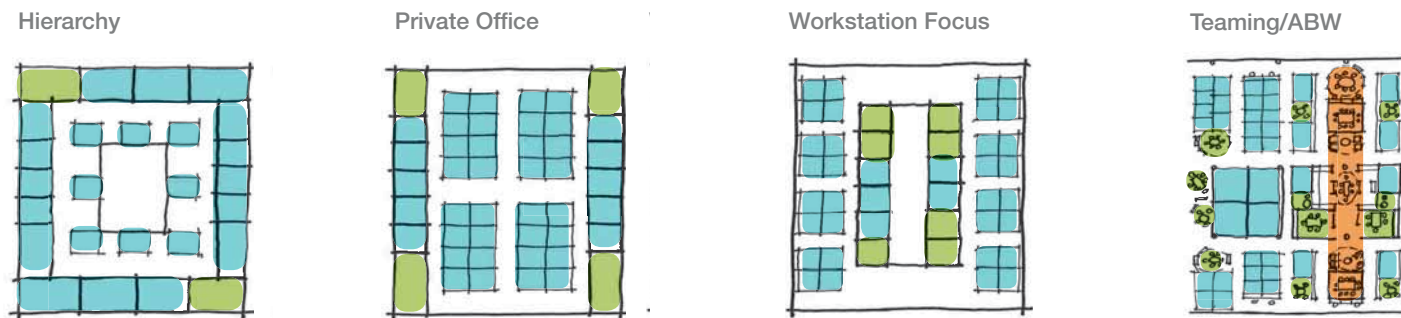


Figure 5. The evolving nature of work

Shrinking individual workspaces is only one factor in space reduction. Design thinking was needed for the next step in our research.

Our review of the behavioral research found it was far less specific about space sizes and densities than we needed to define a tipping point for livable density. Since we use design to solve problems and find solutions for our clients, could we leverage our expertise as designers and space planners to quantify physical space characteristics? Yes!

Our approach consisted of three steps: historical analysis and benchmarking, best practices analysis and design testing. We then analyzed best workplace practices from a number of clients which had successfully implemented

new workplace strategies across national real estate portfolios. We used these case studies to define design variables (such as individual work seats and support space), their distribution and contribution to overall density.

Density Measurement

Every discussion we have about density leads to questions about measurement. Many organizations use activity-based working (ABW) with a leveraged ratio of people to work seats. ABW provides fewer work seats than employees assigned to the space to capitalize on the agile, mobile, virtual work of today. For consistency, we analyzed space density by usable square feet per individual work seat, rather than usable square feet per person,

to reflect maximum occupancy when all work seats are in use. For example, if a 10,000 usable square feet office space provides 50 work seats for 100 people, the density metric is 200 usable square feet per work seat versus 100 usable square feet per person. An individual work seat is the net area of an individual workstation, bench or work setting including the appropriate area for an individual chair.

Usable square feet refer to the program usable area available for planning established program requirements in the general area. It excludes building core and shell elements. By using program usable area, we can develop workplace guideline metrics independent of site-specific variables.

IF A 10,000 SQUARE FOOT OFFICE SPACE PROVIDES 50 WORK SEATS FOR 100 PEOPLE THE DENSITY METRIC IS 200 USABLE SQUARE FEET PER WORK SEAT VERSUS 100 USABLE SQUARE FEET PER PERSON.

The Evolving Nature of Work

How we work has been impacted by the migration to a global economy and portable, pervasive technology. As designers and architects, we are acutely aware of how space design has changed to support workplace transformation and real estate portfolio optimization. There has been a shift from “I” to “we” in space allocation, with less space dedicated to individual spaces (workstations and private offices) and more space to shared spaces such as pantries, collaboration areas and meetings spaces.

At one time, most work environments had a significant number of private offices with very few workstations. Jacobs Benchmarking data base shows that for all individual work spaces, organizations that provide private offices allocate no more than 15 percent of their work seats to offices. Over the last 10 to 15 years, corporations have evolved their workplaces toward open plan, with fewer private offices and more workstations, both of which are smaller than in the past.

Private offices are no longer located on the window taking up prime views and real estate. Activity-based workplace shifts space distribution in favor of shared and collaborative spaces. Figure 5 shows the trends from the past hierarchy of private offices to activity-based workplace.

The transformation to open and collaborative work space has both associated challenges and benefits. Every employee pre-move survey we do cites auditory and visual distractions as key concerns.

As open workstations with low horizon panel heights have become the norm, being able to work without distractions can seem

impossible. Acoustical design incorporating sound masking and high NRC and STC materials is standard. On the flip side, as work space has become more open with fewer private offices, people benefit from increased awareness associated with tacit learning and increased collaboration to resolve problems more quickly. Task-based workplaces provide a wide variety of space types to give employees more choice, control and flexibility in where and how they work.

DESIGN OFTEN SEEKS TO INCREASE COMMUNICATION AND COLLABORATION BY BRINGING PEOPLE CLOSER TOGETHER WITH FEWER VISUAL AND PHYSICAL BARRIERS TO INCREASE ACCESS AND AWARENESS.



Benchmarking Trends

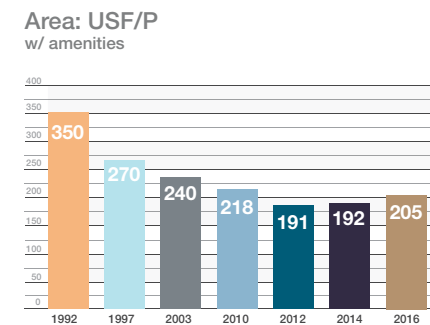
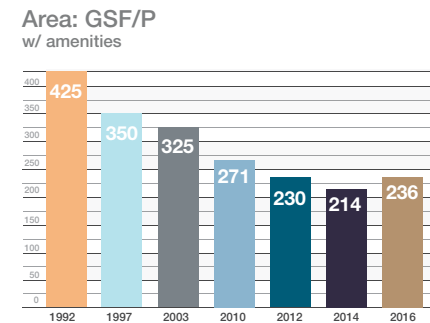
We have collected benchmarking data on how organizations use space for more than 20 years in our Jacobs Benchmarking database. We also hold an annual Workplace Conference for organizations to discuss trends in work space, corporate real estate and discuss challenges and opportunities they see with new ways of working. The Building Owners and Managers Association (BOMA) Workplace Transformation Committee was also investigating the impacts of densification on its members and their tenants in leasing and space management.¹⁵ BOMA shared their Experience Exchange Report (EER) benchmarking data with us and helped us conduct a survey to their members on tenant space densification to explore trends and challenges.

Benchmarking trends from Jacobs' database are shown in Figure 6. It shows that the overall gross and usable square feet per person have been declining. Office and workstation sizes have been declining, while the number of collaborative seats and spaces has increased.

The 2016 data collection was most intriguing. Our Workplace Conference participants' projects and our own projects showed a plateau in space reductions. In some cases, there was a tick back up in space allocations per person, the size of individual spaces and the number of collaborative settings as shown in Figure 6.

So what happened? It appeared as though we may have reached a tipping point. To better evaluate, we took a deeper dive into the projects from 2016 conference attendees to look at the usable square feet per work seat rather than per person and the size of the individual workstations. We plotted each project to show net square feet per individual work seat in the X axis and the business unit usable square feet in the Y axis.

Figure 7 shows the findings. There is a cluster of projects within the range from 125 USF to 150 USF per work seat, with the sizes of individual workstations hovering between 30 NSF and 42 NSF. Did this mean that we were nearing an answer? How and why were these organizations aligning to this extent?



Square Footage Workstation

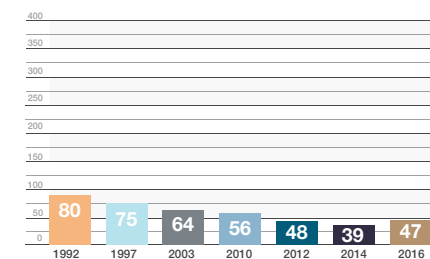


Figure 6. Jacobs Benchmarking data trends

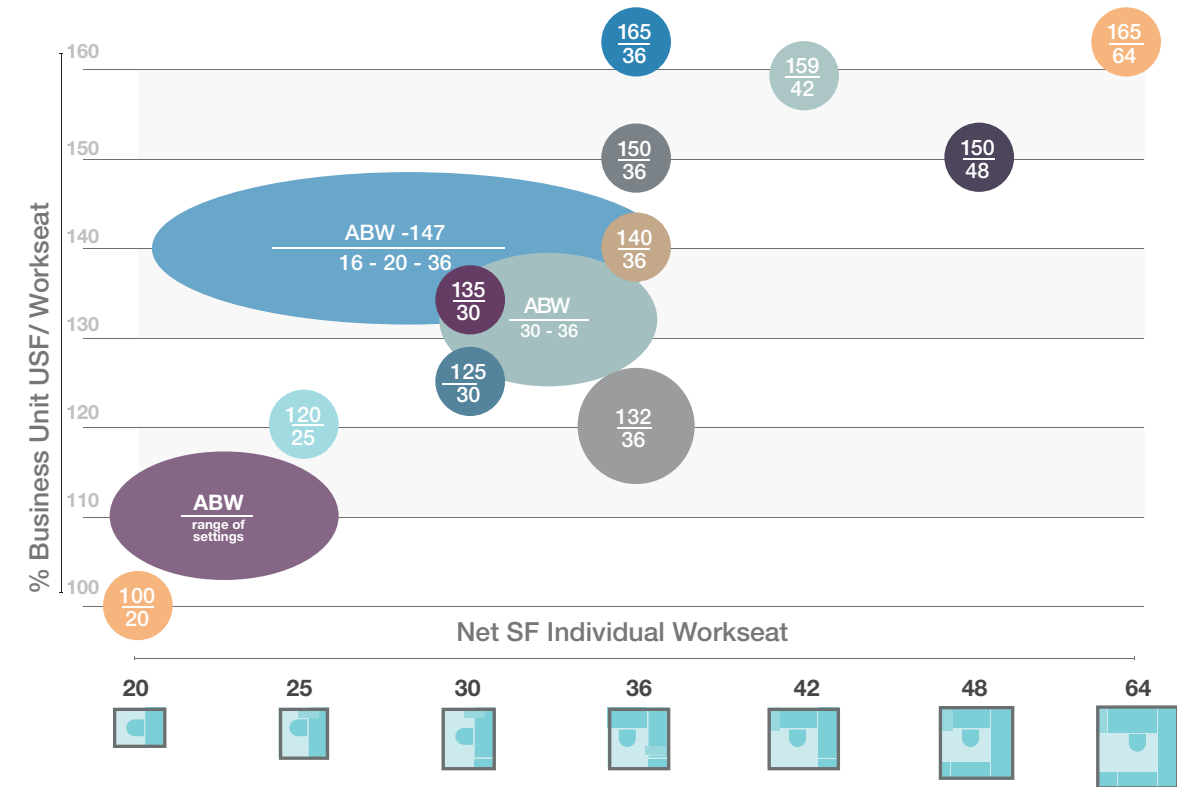


Figure 7: Benchmarking work seat size relationship to usable square feet

Design Testing – Application of Variables and Work Styles

Best Practice Analysis

Our next step was to look at a number of best practice projects from one company which had successfully implemented new workplace strategies across its national real estate portfolios. The goal was to evaluate how they addressed the work support needs

of different organizational functions, user groups, and work styles and their range of office space density.

We looked specifically at the design variables of individual work seats, group space and community space.

We found that within this company's guidelines, the type of organizational function or user group defined their space allocations and densities. The headquarters groups had larger individual work settings with less

dense space and an increased ratio of the shared group and community space to support the work styles of people leaders. As the type of work became more individual with less frequent collaboration, the individual work seats became smaller. A decreased ratio group and community spaces resulted in higher densities as well. Figure 8 illustrates the differences in space allocations and densities.



Our analysis found that the density, size of individual work seats, and the proportional mix of group and community space in best practices are dependent on the work that people do. Their workplace guidelines addressed these differences with different space allocations by organizational functions and user groups.

Strategic Distribution of Space

Using a process similar to our best practice analysis, we sought to define an ideal mix of individual space to group and community space for a range of livable density.

For the purposes of this study, we defined space by the following activity zones in alignment with benchmarking categories:

- **Individual:** Space designated for groupings of individual work seats and work settings.
- **Group:** Distributed shared spaces supporting neighborhoods or group including: collaborative meeting spaces (four to six people), huddle (four to six people), phone/focus rooms (one to two people), lockers for personal storage and team storage.

- **Community:** Common shared spaces supporting a typical floor or wing within a building including: pantry hub, business center, meeting rooms and collaborative spaces in a range of sizes and settings to accommodate eight to 10 people, 12 to 14 or 16 to 20 people.

Figure 9 compares the percentage of space allocation by activity zone within the business unit usable area, and the impact of size of individual work seats on group and community space requirements. We determined that as the size of the individual work seat increased to support dedicated individual work, less space was allocated to shared group and communal spaces. As individual work seats became smaller, organizations were providing employees with a wider variety of shared collaborative and communal spaces to offset the increased density.

We confirmed our findings against data from other forward leaning projects from peer organizations. We found a “sweet spot”. Workplaces with individual work seats ranging from 25 to 42 net square feet tended to dedicate 55 percent of usable

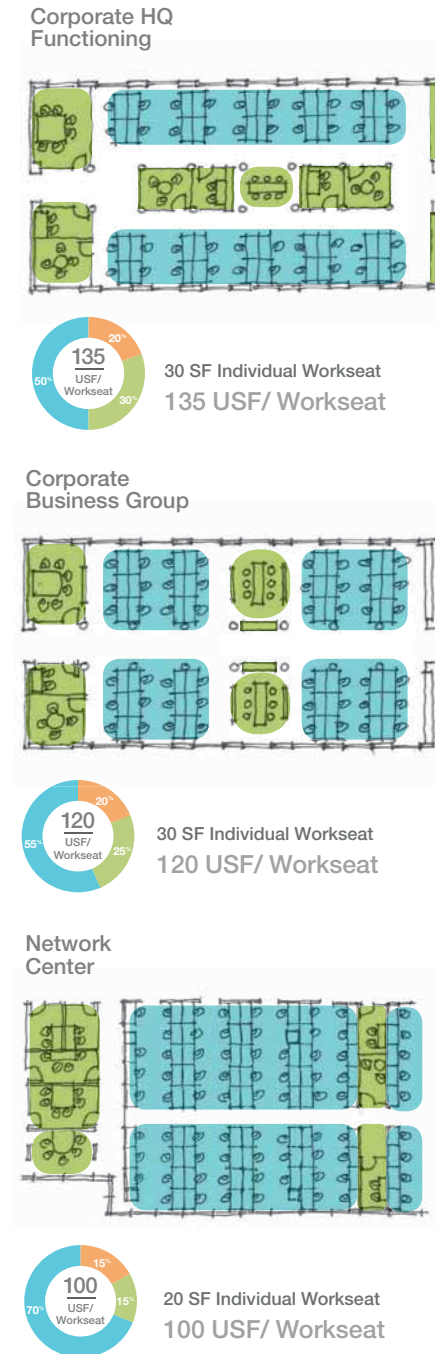


Figure 8: Workspace allocations relate to the work people do

square feet to individual seats and 45 percent to group and common spaces as shown in Figure 9.

We concluded that workplace strategies can increase density with smaller individual work settings and still be highly successful when there is an appropriate proportional mix of group and common space.

Circulation Impact to Area per Work

We noticed a trend for circulation in best practice projects. Circulation is no longer a path to get from point A to point B but rather a connective space and opportunity to enhance user experience by making circulation its own unique place. With increased variety and choices in work settings, space typology designs have become more dynamic in shape and size. As individual work settings become smaller, circulation needs to increase to allow for appropriate work setting configurations and orientation that influence individuals' views and perceptions of space.

By providing more circulation than historically allocated, these newer work environments provided more flexibility for space planning and increased overall space utilization and density. Figure 10 shows our finding of a “sweet spot” of 45 percent to 50 percent for circulation (add-on factor of 1.85 – 2.0) for dense workplaces of 125 to 135 usable square feet per work seat.

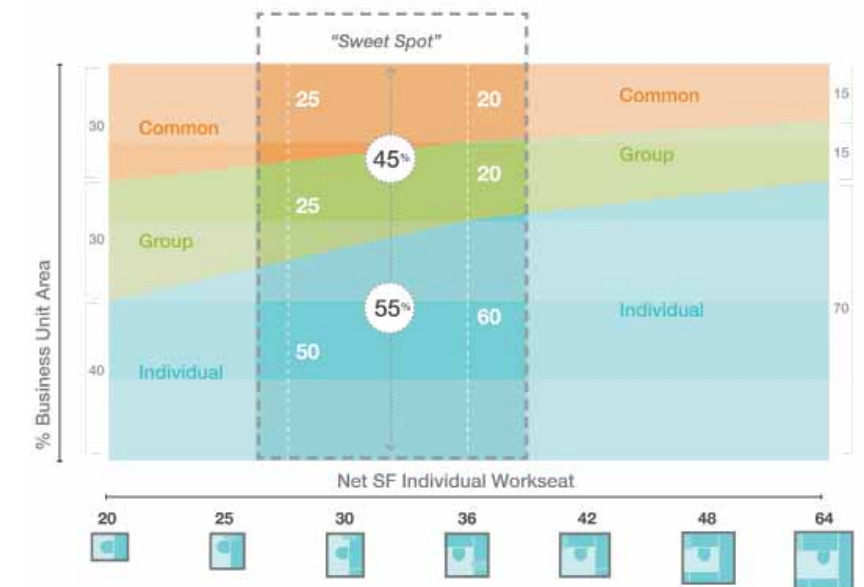


Figure 9: Design testing shows an optimum “sweet spot” for high density space distribution

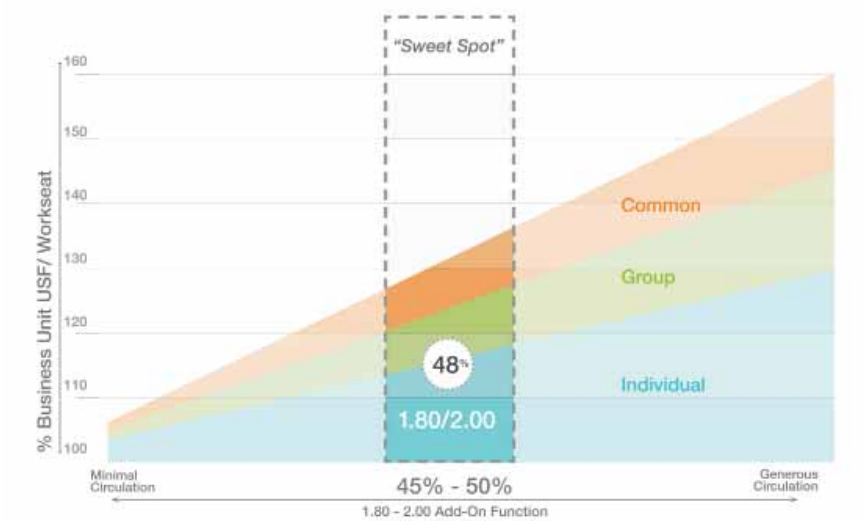


Figure 10: Do not skimp on circulation!



Conclusion: How Dense is Too Dense?

Crowding is a Problem

Crowding affects focus, performance, engagement, and job satisfaction, with long term implications for organizational well-being. The probability of feeling crowded in the office increases with density and encroachment into one's personal distance zone. We must beware when people say "I'm used to it" or "I can cope. Their stress levels, performance, and engagement may say otherwise.

The Power of Control

Having control over your workplace use and experience is a key factor for successful dense, open environments. Being able to move and choose the best space for what you need is crucial. Physical boundaries and social norms to support individual control are essential for different tasks and personal needs for focus and collaboration.

The Power of Design

Good analysis, planning, design, and management become even more essential to do more with less space. Understanding the ecosystem of

space, human needs, and great design allows us to make the right business decisions about density to balance privacy, collaboration, and economy. We must address:

- **Physical characteristics** of the space: scale, proportion, ceiling height, windows, views and materials.
- **Work settings** with a variety of space types to give people more choice, control, and flexibility in where and how they work. Include features people can use to regulate their visual, acoustic and physical access and information flow.
- **Zoning** to separate activity levels, establish group territories, and enable appropriate soundscapes for focused and interactive work.
- **Barriers and boundaries** to reinforce people's sense of control over their space and send messages about appropriate uses.
- **Visual variety and focal points** with deliberate changes in orientation and circulation to create positive spatial experiences.
- **Acoustics and lighting** which affect focused

concentration, awareness and collaboration, perceptions of size, zoning and territory.

- **Social norms** for considerate space use and people's needs for focus, privacy and control.

WORK SETTING CHOICES FOR DIFFERENT PRIVACY NEEDS ALLOW PEOPLE TO CONTROL CONFIDENTIALITY, ACCESS AND STIMULATION.

- **Choices** about where and how we work as a way to control our own experience. Choices can be provided with access to different places in the office and opportunities to work off-site and at home.
- **Technology and leadership support for mobility.** Work setting variety and choice only work if people are enabled to use them.

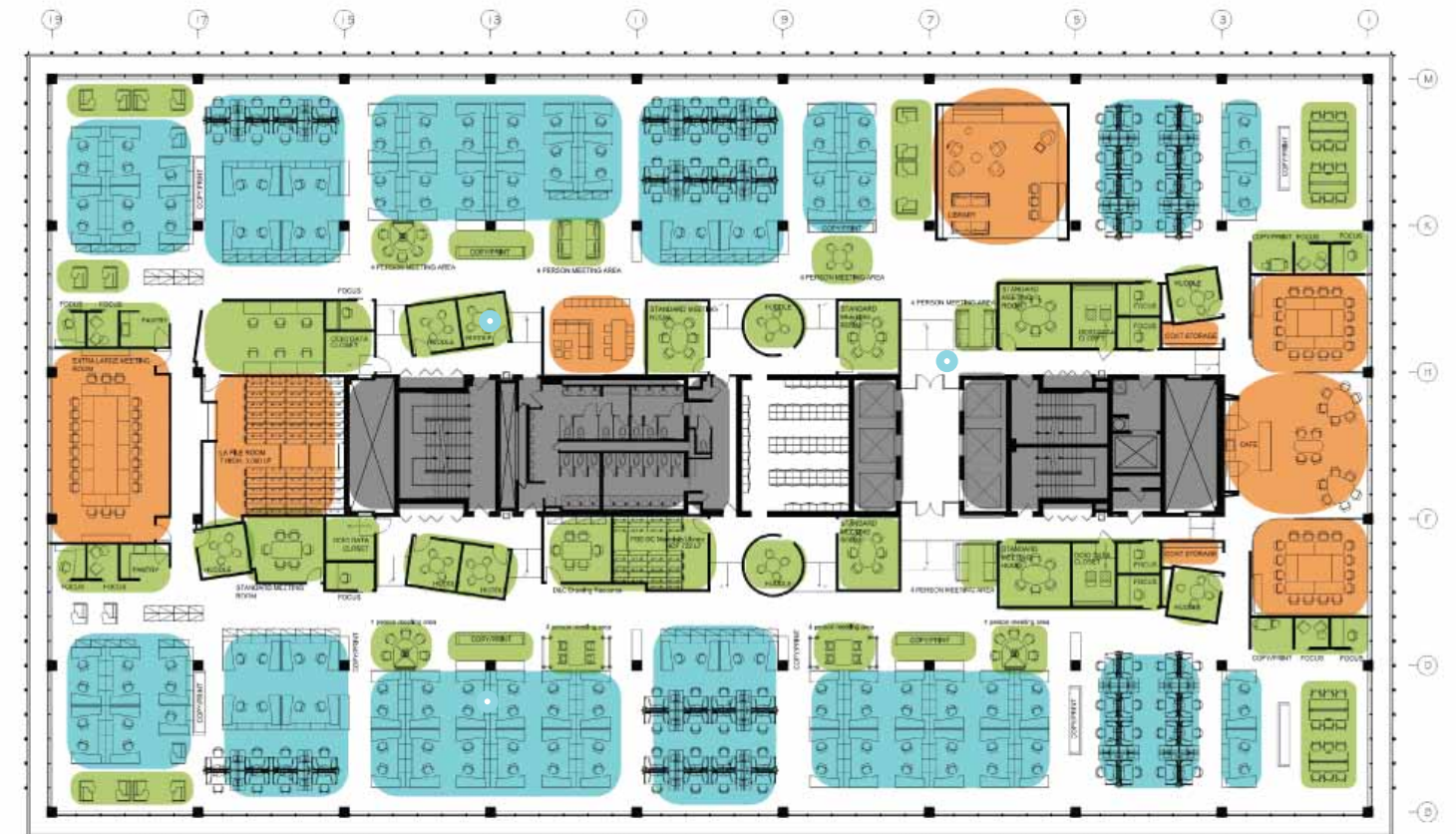


Figure 11: Design testing for livable density

Don't Go Too Low

We all want workspace that provides a positive human experience to do our best work. Densification seeks efficiency but must also meet needs for connection, focus, stimulation, privacy, community and personal space.

Leveraging our experience as designers and strategists, we developed a planning toolkit of minimum space recommendations.

Findings from analysis and design testing showed that with smaller work seats, 40 percent to 50 percent of the business unit's usable square feet should be dedicated to group and community space and about 50 percent to 60 percent to individual work areas.

- 125 to 135 usable square feet per work seat is the minimum threshold for corporate office, business unit space in the United States.

- 25 to 36 net square feet minimum for individual work seats. Five feet is the minimum worksurface dimension to maintain adequate personal space between people. It also enables layouts which vary orientation of the primary worksurface which influence views and perceptions of proximities to other people.
- 1.8 minimum circulation factor (45 percent of the total usable



square feet) for flexibility in the shape, layout, and orientation of work settings and consideration of human factors and personal space zone. More circulation is needed for smaller workstations in denser environments.

- 40 percent to 50 percent of the usable square feet dedicated to group and community spaces within the business unit area, depending on work styles and needs for collaborative space. Increased support space enables more variety and choices of work settings for group work and design of quiet versus active work zones.
- 50 percent to 60 percent of the usable square feet dedicated to individual work areas within the business unit area, depending on work styles.

These findings are guidelines and should be used as minimum thresholds for testing. The amount of space an organization needs depends on many factors which require specific analysis and programming.

Great Design is Possible in Less Space

Really well designed work spaces address the physical characteristics of the space, the right mix of work settings, activity zones, acoustics, visual variety and focal points, lighting and technology. Allowing time and care for great design is crucial to do more with less space.

Understanding the ecosystem of space and human needs – with great design thinking – enables us to help our clients make the right business decisions about density to balance privacy, collaboration, and economy.

Endnotes

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Glossary

1.1 Research Definitions and Metrics

Gross Square Footage: Overall building area, including core and shell elements.

Usable Square Footage: Refers to Program Usable area available for planning established program requirements, in general area excluding building core and shell elements. Program Usable area allows workplace guideline metrics to be developed independent of variables related to site specific context.

Business Unit Area: Area for typical Business Unit functions, in general representative of typical office areas, excluding centralized amenity functions such as lobby/reception, cafeteria, training, fitness center, etc.

Corporate Office Space: Fortune 500 companies, corporate functions (Administration, HR, Finance, IT) and Business Units within the corporation. Excludes law firms and higher education.

1.2 Space Elements – Activity Zones

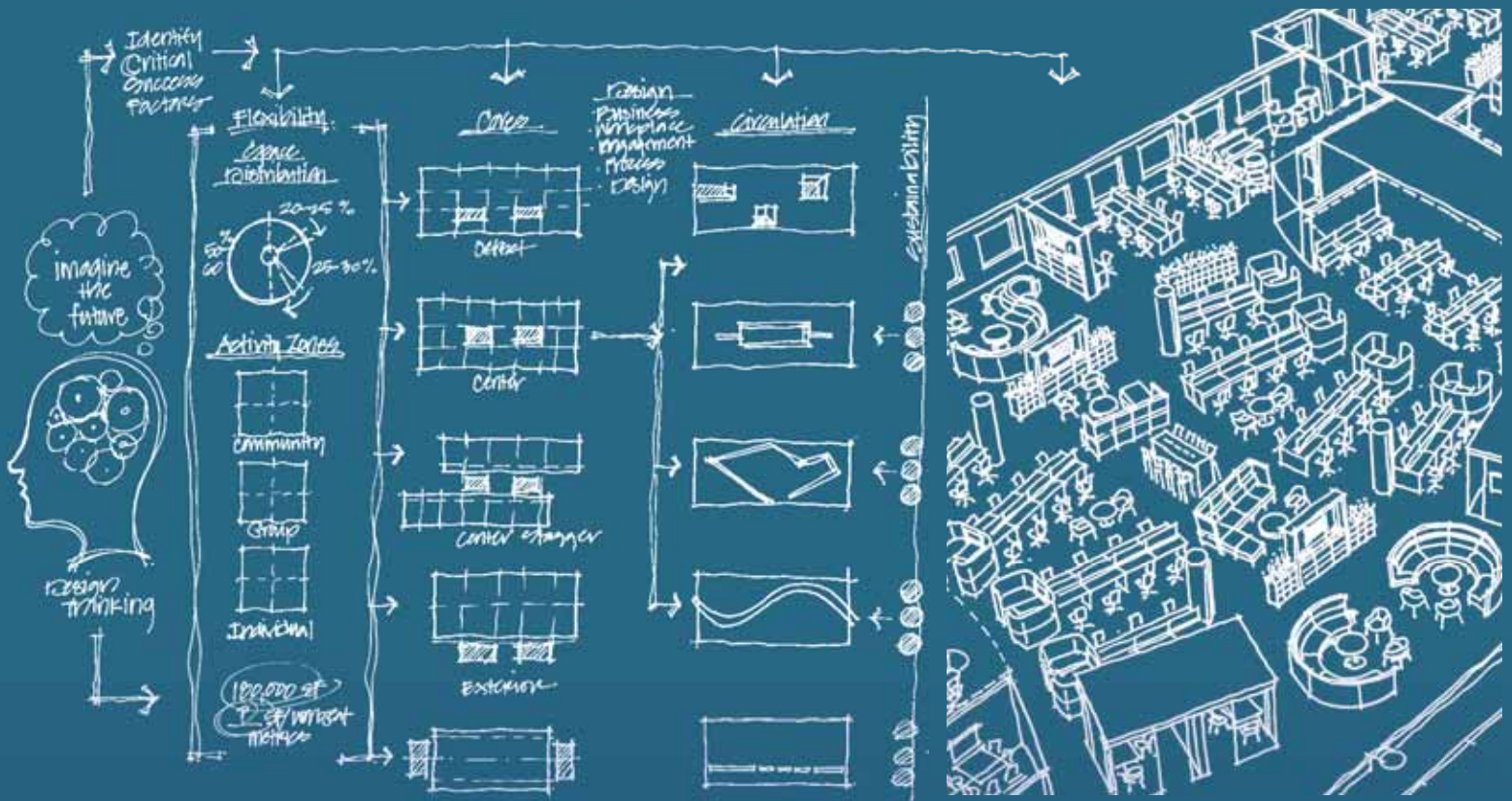
Community Zone: Common shared spaces supporting a typical floor or wing within a building. Ratios range from 1:100 through 1:50 per work seat

Group Zone: Distributed shared spaces supporting a neighborhood or group including collaborative meeting spaces (4-6 people), huddle (2-4 people), phone/focus (1 person), lockers, team storage, etc. Ratios range from 1:25 through 1:15 per work seat

Individual Zone: Space designated for groupings of individual work seats and work settings.

Individual Work seat: Net area of individual workstation, bench, or work setting including appropriate area for individual chair.

Circulation: Space required to access, egress, and circulate between net assignable community, group, and individual spaces. Circulation add-on factor / % circulation is averaged across activity zones.



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