The Life of the Lab: Creating Collaborative Workspaces for Scientists

by

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To my Number One Fan, Ryan R. Dell

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TABLE OF CONTENTS

LIST OF FIGURES

Figures

LIST OF TABLES

Tables

LIST OF APPENDICES

Appendices

LIST OF ABBREVIATIONS

LSI	Life Sciences Institute
NSB	Natural Sciences Building
PI	Private Investigator
SSA	Space Syntax Analysis
SNA	Social Network Analysis

ABSTRACT

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A new generation of research laboratories have entered the academic community. These laboratories have physically co-located several scientific disciplines with the goal of encouraging interdisciplinary interaction, fostering new ideas and laying the groundwork for potential innovation. The purpose of this study is to investigate the relationship between use patterns/social behaviors (for the purpose of this study, social behaviors are defined to survey participants as those that involve physical presence, not interactions via email, text, IM, etc.) and the architectural design of these academic laboratories. The primary question examined is how the design and layout of space influence interaction and collaboration of the occupants. Other related questions arise in this investigation such as how the design and layout influences job satisfaction as well as how other workplace design aspects influence the interaction and collaboration of its occupants.

The Life Sciences Institute (LSI) at the University of Michigan and the Natural Sciences Building (NSB) at the University of California, San Diego were used as case studies to explore this issue. The LSI and NSB, both completed in 2003, were designed to enhance interdisciplinary collaboration. The buildings house several different science disciplines and also include such design features as open lab spaces, shared equipment, as well as shared group spaces (i.e. conference rooms, break areas).

The study focuses on the design characteristics of these two academic science buildings and the interaction and collaboration behaviors of the employees. Multiple methods of data collection are applied to understand these interrelationships. Space Syntax Analysis was used to explore the spatial layout and provide quantitative data explaining the interrelationship among spaces. Several methods were used to gather data regarding interaction within the environment: observations, surveys, and interviews. Social Network Analysis is used to understand the social connections between people working in the building. Collaborative information was obtained from the interviews and Social Network Analysis. Employees' perceptions and satisfaction with their jobs and the workspace were explored through survey questionnaires.

The research provides an understanding of the spatial layout properties of each building as well as the interaction and movement patterns of employees. The data shows an association between both the connectivity and integration of spaces with interaction levels. The more integrated spaces show an increased level of movement and the occupants' job role plays a significant part in their

interaction and collaboration. The research contributes to an understanding of the interrelationships between workplace design, employee perceptions, interaction patterns and collaboration. Conclusions are drawn from the results to offer suggestions for the design of future collaborative academic laboratories.

CHAPTER I

INTRODUCTION

1.1 Problem Statement: Interaction and Collaboration Influenced by Laboratory Design

This study focuses on the design characteristics of two academic science buildings and the interaction and collaboration behaviors of the employees. Interaction and collaboration is thought to be the foundation of the development of new ideas and processes of innovation. As such, these exchanges have been the focus of much research in office environments from the early work of Allen (1977) who demonstrated the effects of distance on the likelihood of interaction to more recent studies exploring productivity and innovation outcomes.

A recent trend on academic campuses is to design new science facilities to enhance interdisciplinary interaction. Both of the case study buildings were designed with the intent to enhance collaboration across a range of science disciplines: the Life Sciences Building and Natural Sciences Building both combine several chemistry and biology disciplines. This study explores the relationships between characteristics of spatial layout and employee behavior.

Specifically this investigation will address the relationship between employee perceptions, interaction and collaborative behaviors, and the building spatial layout.

Laboratory buildings are a unique subset of the workplace environment. More often than not, the majority of the occupants are in open spaces that are only separated by long tables and storage spaces. The scientists leading the project teams, the Principal Investigators (PIs), are commonly the only occupants with closed private offices. Therefore, what is "typical" behavior and design in the workplace may not be the same for the laboratory environment. The two laboratories chosen for this study were designed with the intent of enhancing interaction and collaboration between the scientists as they house different scientific disciplines in close proximity while sharing equipment.

1.2 Significance of Interaction and Collaboration in the Workplace

Interaction and collaboration are impactful behaviors in the workplace due to their influence on additional behaviors and perceptions that can affect the organization as a whole. Interaction can be beneficial due to its positive effects on innovation, performance and job satisfaction. Previous studies have examined the relationship between employees' levels of interaction (Sundstrom et al., 1980; Peponis & Wineman, 2002; Hua, 2010) and outcome variables that are of interest to an organization's management (i.e. performance). A greater amount of interaction has been associated with an increase in collaboration and

innovation (Penn et al., 1999; Toker, 2006; Peponis et al., 2007; Wineman et al., 2009).

1.3 Areas of Research Focus

This section summarizes the various research focuses, including the spatial layout and employee behaviors and perceptions, which are involved in the study. The section concludes with a conceptual model to summarize the hypothesized relationship between the variables.

1.3.1 Spatial Layout

The spatial layout of the workplace has evolved over time. With the introduction of innovative technology, workplace design has become more open and flexible. Walls have come down and a variety of spaces are made available to support the wireless and more team-based work styles. Laboratory design has followed this framework with more open lab group areas, smaller and shared equipment, and shared group spaces. The laboratory environment provides an interesting research subject due to its unique spaces. More specifically, the new trend in academic laboratories to enhance interdisciplinary exchange provides a unique setting to explore the interface between design and behavior.

1.3.2 Social Networks

Interaction in the workplace can be separated into two types of interaction, formal and informal. Formal interaction is work related and often occurs in pre-arranged meetings. Informal interaction entails engaging in non-work related discussions in unplanned meetings. Social network analysis (SNA) is an analysis method that examines communication relationships among people. SNA defines groups within an organization by recording ties between people based on who they interact with. Social networks within the workplace are often job-task based as employees engage in discussion with those they need to work with on a regular basis. Social networks can also include others outside the routine work group if someone reaches outside their group for a particular expertise or collaborative need, or simply interacts with a social colleague.

1.3.3 Employees Space Use Patterns

The interaction among employees is evaluated to gain an understanding of patterns of use within a space. Workplaces often provide a variety of spaces, from the traditional offices to shared break areas. Employees may use the different spaces for different tasks, and more importantly for this study, certain types of spaces or configurations of spatial layout may enhance interaction.

1.4 Conceptual Model

The relationship between the spatial layout, social networks and observed interactions, provides insight into the patterns of space use and their influence on outcome variables. The conceptual model of the relationship between the spatial layout, perceptions and behaviors explains the framework for this study (see Figure 1.1).

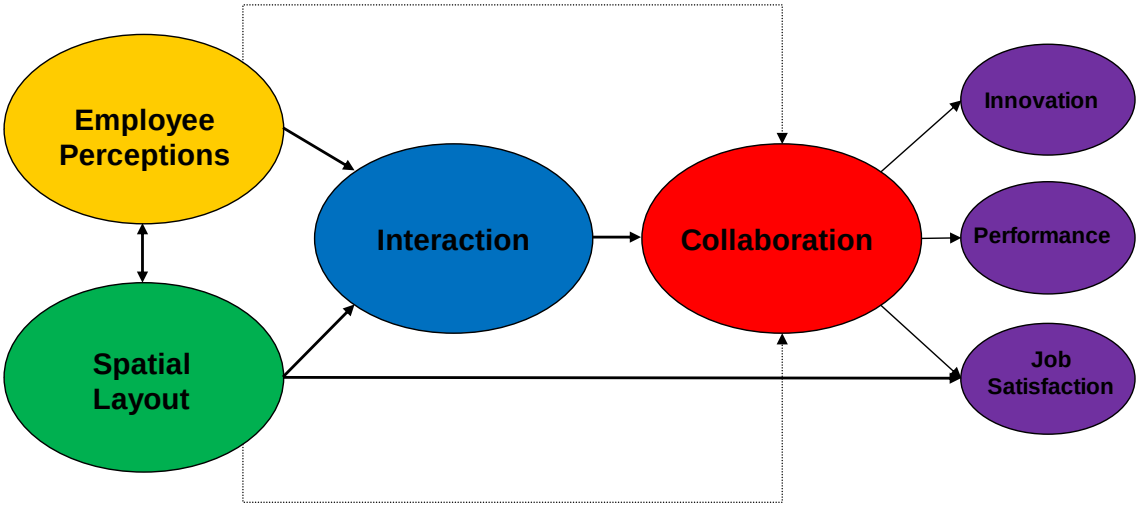

Figure 1.1 Conceptual Model

The focus of this research is to explore the ways in which spatial layout will enhance interaction, and to examine subsequent relationships with collaboration, innovation, performance and satisfaction of occupants. Innovation, performance, and job satisfaction are all possible outcomes of collaboration, but this study will only focus on job satisfaction as a potential outcome.

1.5 Research Questions and Objectives

As mentioned earlier, this study aims to look at the relationships between the spatial characteristics of laboratories and the interaction and collaboration behaviors that occur within the spaces. More specifically, this research is hoping to answer these following questions:

1. How does the design and spatial layout influence interaction and collaboration?
2. How does the design and spatial layout affect workspace and job satisfaction?
3. What are other important aspects of the workplace that influence interaction and collaboration?

The results of this study will provide guidance for the planning/design of academic laboratory environments that are designed specifically to enhance the collaborative behaviors of its occupants.

1.6 Methodology and Research Design: Case Study

This study uses the case study approach to gain an in-depth understanding of the selected science laboratories. The two environments were both designed to enhance interdisciplinary collaboration but have very different design and layout outcomes. Both buildings were designed to house multiple scientific disciplines with the hope that the occupants will share ideas and collaborate on projects.

The two case studies were both built in 2003 in different areas of the United States: the Life Sciences Institute (LSI) at the University of Michigan in Ann Arbor and the Natural Sciences Building (NSB) at the University of California, San Diego.

Several data gathering techniques were employed to obtain the range of information necessary to engage in meaningful analysis of the research variables. Space Syntax Analysis was used to explore the spatial layout and provide quantitative data explaining the relationship between the spaces. Several methods were used to gather data regarding interaction within the environment: observations, surveys, and interviews. Collaborative information was obtained from the interviews, as well as through internet research into co-authored projects. Employees' perceptions and satisfaction of the spaces and their jobs were explored through survey questions. A complete model of the variables and their data gathering method is found in Figure 1.2.

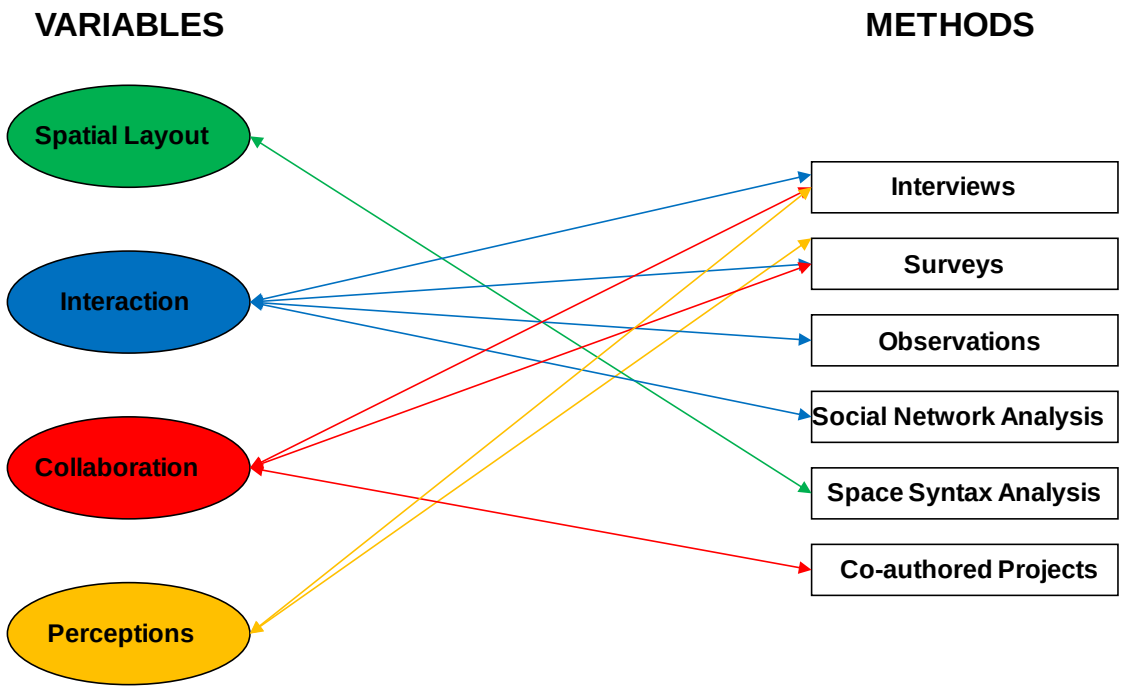

Figure 1.2 Research Variables and Data Gathering Methods

1.7 General Outline and Summary

This dissertation investigates its research questions over six chapters including this introductory chapter. The chapters are as follows: Chapter II provides background research of previous studies in relevant fields, Chapter III outlines the methodology that will be used to investigate the research questions, Chapter IV gives a background of the two case studies including their spatial layout properties, Chapter V summarizes the analysis results from each case study, and Chapter VI provides conclusions based on the results drawn from the analysis.

In more detail, Chapter II of this dissertation provides of a summary of research that is pertinent to the understanding of relationships between workplace design and behavior. It begins with a historical look at recent changes and growth in the

design of offices and laboratories. A review of research on workplace behavior including interaction behaviors follows. The chapter continues with a review of research of spatial layout analysis and social network analysis, including studies that have applied one or both to workplace research.

Chapter III outlines the methodology used for data collection. Both quantitative and qualitative methods were used to gather the relevant spatial and social data. The techniques used to gather interaction data included observations and survey questions that asked participants who they talked to and when they talked to others within their workplace. Spatial layout data was collected through space syntax analysis that quantifies the characteristics of spatial layout and the relationships among spaces with local and global measures. The chapter concludes with a description of the approach to data analysis.

Chapters IV and V give a background of the case studies: the Life Sciences Institute and the Natural Sciences Building. A written description of each floor layout provides a framework for understanding not only of the location of the spaces, but their relationships to each other. Space syntax analysis elaborates on this description by providing a visual as well as quantifiable explanation of the spatial layout relationships. The basic observed interaction behaviors are also reported in relation to their locations in laboratory spaces.

The summary of are presented in Chapter VI. Correlation and regression analysss are performed on the data to investigate the relationship and predictive qualities of the spatial and perceptive variables. The results are presented by

case study to illustrate how each individual layout relates to occupants' behavior. The chapter continues with a brief comparison of the two buildings.

The final chapter, Chapter VII, relates the results from Chapters VI to the results of previous studies summarized in Chapter II. Conclusions are drawn to offer suggestions for the design of future academic laboratories. The chapter addresses how the results of the study can influence the design of future laboratory spaces as well as research studies exploring the affects of environmental design on interactive and collaborative behavior.

CHAPTER II

BACKGROUND RESEARCH

2.1 Chapter Overview

This chapter provides an overview of research relevant to the topics in this dissertation. The chapter begins with a look at studies from the psychology field in workplace behavior, including interaction and collaboration. The chapter then follows with a look into both space syntax and social network theories and how they have been applied to workplace design research. The chapter concludes with an exploration into studies that have found connections between workplace interaction /collaboration and other workplace outcomes such as satisfaction and productivity.

2.2 Evolution of Workplace Design

Workplaces have been evolving throughout history and this change is still progressing today. Before the industrial age, offices were most commonly in

private homes or on the second floor above businesses. “For most of history, people worked near their homes” (O’Mara, 1999, 29). The requirements for office space were often just a large room with all necessary tools and documents in this space (Propst, 1968). When the industrial revolution began, offices began to grow. With the advancement of technology and industries, workplaces become more focused on spaces for large number of employees. During this time, Frederick Taylor founded the Work-Study and Scientific Management approach. Taylor’s ideas focused on the workplace being a tool in making a productive and efficient organization (Duffy & Tanis, 1993). In these workplaces, closed offices were located on the exterior with windows and access to natural light. The ‘corner office’ was a prime location with double the amount of windows. The employee’s status in the organization was represented through the size and location of their office. Higher positions were afforded larger offices near windows, while lower positions were located in the interior of the building. In the interior of the workplace were the bullpen type offices. These offices afforded minimal natural light with no walls, and desks often arranged in neat linear rows (Pile, 1984). These desks became a production line; Taylor believed this would make their work more efficient (Duffy & Tanis, 1993).

The workplace continued to change, and in the 1960s, employee hierarchy was no longer the primary basis for office location. The Quickborner Team, a German management team, created the term office landscaping to describe their proposed ideas of the new workplace. Quickborner studies found that office work was inhibited and confused by the illogical layout of the offices: status

expression and formal organizational charts determined office plans, while practical and logical needs were ignored. As a solution, the Quickborner Team proposed and then demonstrated a type of office that was a large space totally free of walls, partitions, and corridors. Employees could be placed as the flow of communication might require in this new "office landscape". Paper flow, and visual and spoken contact were made easy; managers' cohesiveness, and changes and replanning were facilitated (Pile, 1994, 8). Robert Propst, an inventor and researcher, contributed to the office landscaping concept with new ideas for furnishing the offices. Propst's furnishings included screen panels on desks and storage area in the place of walls (Pile, 1984). Propst's ideas provided an organization the flexibility in its interior design to change and grow with the needs of the organization. The value in the open plan design was not only in the use of flexible furniture, but the theory that this design would promote communication due to the lack of barriers and close proximity to others (Boje, 1971; Pile, 1978)

In the last twenty years, many large organizations have turned to using a university campus as an example for workplace design, bringing the features of the university to a workplace campus. The facility "should be suggestive of a university atmosphere – informal, relaxed, intimate, varied, suburban, dedicated to knowledge and new learning, and residential in character" (Black, 1986, 71). The Quickborner and Propst's ideas were transferred to the workplace campus as departments that work together are also physically located close to each other for ease of communication. The design of workplaces moved from department-

based to project-based with the idea that all resources are close by to complete tasks. In addition, amenity spaces, including gyms and break areas, provide employees opportunities outside traditional desks to interact. The variety of spaces not only allow a break from their traditional workspace, but allow the employees choices of where and how to work based on their current job tasks and needs.

Laboratories follow a similar design to project-based workplace design in that a laboratory group is a self-contained work group. All the resources, people and equipment, are physically located nearby. Historically, each lab group had their own room which was managed by a Principal Investigator (PI). The PI also had a private office to conduct administrative tasks not conducive to a laboratory environment. As traditional offices moved to be more open, so did laboratories. Labs also became furnished with flexible furniture systems that made it easier to configure the lab as a specific group needed. Laboratory groups are located near each other, often without floor to ceiling walls to designate each group from another. PI offices were still located in private closed offices most often in a separate area on the floor or building. Salk Institute, built in 1965, in San Diego is an example of how PI offices were (and currently still are) private offices located off exterior corridors from the laboratories.

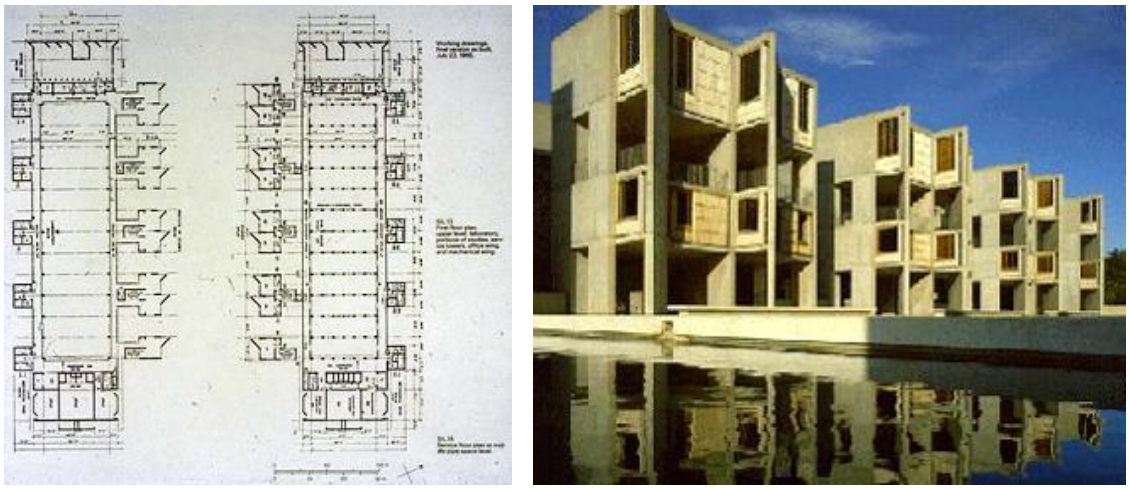

Figure 2.1 Salk Institute, San Diego, Floor Plan (left) and Exterior Photo (right) (ArchINFORM, 2012)

The new trend in laboratory design, more specifically, academic laboratory design, is an open facility with multiple disciplines housed near each other sharing common equipment. The purpose of this design is that it will enhance the scientific creativity and research through the interaction of its scientists with the hope of interdisciplinary collaboration. The following statements were found on the respective university's' website regarding new academic laboratory design's that have been completed (or in the process of completion) on university campuses since 2006.

> *Biorenewables Research Laboratory, Iowa State University*
>
> The [Biorenewables Research Laboratory] BRL complements and replaces labs and offices previously located across the Iowa State campus and provides affiliated faculty and staff a physical environment that promotes interdisciplinary, systems-level research and collaboration. (Ballstadt, 2010)

Jerry Yang and Akiko Yamazaki Environment and Energy Building, Stanford University

The vision for the environmental initiative can be realized by locating, within one building, researchers from Civil and Environmental Engineering, Earth Sciences, Conservation Biology and Ecology, Economics and Natural Resource Management, and Environmental Policy and Law. Achieving the vision for the Institute for the Environment requires that challenging research issues be addressed by multidisciplinary interactions. (Stanford University, n.d.)

Northwest Science Building, Harvard University

The building's design fosters the interdisciplinary nature of today's science, locating researchers by shared interests rather than by specific departmental affiliation to create opportunities for interdisciplinary collaboration.

The Northwest Science Building not only emphasizes collaborative learning and cross-disciplinary research, it also provides a new model for educational facilities that sensitively addresses environmental, social, and economic sustainability. (Harvard University, 2012)

Nanomaterials Characterization Facility, University of Colorado, Boulder

The facility supports collaboration among business, government, and academic researchers involved in nanotechnology development throughout the area. (CUEngineering, 2007)

Jordan Hall of Science, University of Notre Dame

The facility's spaces and equipment support the science education trend toward multidisciplinary study and support collaborative learning and teaching.

- Design spaces create an environment that offers students unprecedented opportunities for collaboration—ex, integration of engineering with life sciences
- Students from across the university—from chemistry and civil engineering and geological sciences to art, art history and design and architecture—can experience their studies in a whole new light (University of Notre Dame, 2008)

French Family Science Center, Duke University

French Family Science Center "will promote the kinds of interaction across scientific fields that are central to our strategic plan, 'Building on Excellence,'" Duke Provost Peter Lange said. "Its proximity to other facilities should encourage collaborative teaching and research programs and greater interaction between and among faculty and students." (Duke University, n.d.)

Indiana University Research and Teaching Preserve field lab, Indiana University

The field lab will be a hub for environmental research and teaching--fostering interdisciplinary collaboration among geologists, biologists, geographers, climatologists, and other environmental scientists. (Indiana University, 2011)

Science & Engineering II Building (Under Construction), University of California, Merced

In addition to offices and computational and wet labs on the upper levels, breakout rooms with adjacent balconies will provide collaboration space with sweeping vistas of the undeveloped landscape, and future campus expansion. (University of California, Merced, n.d.)

Cherokee Farms/ Oak Ridge National Laboratory (Under Construction), University of Tennessee

Cherokee Farm is the innovation campus of the University of Tennessee, positioning the university and the state as one of the world's most competitive areas for collaborative research. Drawing on established leadership in neutron research, materials science, computational science, and energy independence and sustainability, Cherokee Farm is a living laboratory where private and public research partners – including the Oak Ridge National Laboratory – work together to bring their resources to bear on the world's toughest challenges. (University of Tennessee, n.d.)

2.3 Relationship Between Workplace Spatial Layout and Employee Behavior and Perceptions

In the workplace, the design of the space can have an impact on the behavior of its occupants, the employees. Since the employees are an important commodity within an organization, the connection between the employees and workplace design is an important topic of research. It is documented that 92% of life cycle costs are in employee salaries and benefits versus cost of building and maintenance, so a small improvement in the built environment can significantly impact overall costs if it improves employee productivity only a small amount

(Romm, 1994). This section will outline studies that have focused on employee behavior in relation to workplace design, with a focus on interaction behaviors, as well as studies that have used Space Syntax Analysis and Social Network Analysis to investigate the spatial and social qualities of environments. This section concludes with a reflection on studies that have researched the implication of interaction and collaboration in relation to workplace design.

2.3.1 Field Studies of Workplace Behavior

As workplaces became more open, the focus of workplace design moved to employee work processes and behavior. At this time, there was also increased interest in studies that investigated the effects of space on behavior in these environments. Thomas Allen was a leader in investigating the specifics of how the space is related to workplace behavior. Allen recognized that the workplace itself could influence interaction within an organization. Thomas Allen's 1977 study of engineers is a classic study that addressed the relationships between interaction and workplace layouts. His "Allen Curve" illustrated his results that as the physical distance between work stations increased, the communication between those workers' decreased. Allen stated that as the distance between people increased, the less likely they will interact. After a distance of more than 30 meters, the probability of interaction between the occupants drops significantly. Allen's research was the beginning of a trend of studies that

recognized the importance of the relationship between workplace design and employee behavior.

Critical research on privacy focused on the balance between a desired level of privacy and an achieved level of privacy (Altman, 1975, 1976). Altman suggests that four different components influence a person's level of social interaction. These four components are privacy, personal space, territory and crowding. They are not independent, they intertwine and together they regulate social interaction. The belief is that if the achieved and desired levels of privacy are not balanced, people will either withdrawal from interaction or want more. Haans et al. (2007) explores Altman's theories further through the examination of the implications of two survey measures of privacy on interaction in open plan offices. The two measures are defined as Need-for-Privacy (NFP) and Need-for-Socializing (NFS) implying that NFP defines a worker experiencing a higher than desired degree of interaction and NFS, a lower than desired degree of interaction. The research survey, utilizing the NFP and NFS measures, was applied in a study of employees in an open plan office. Results confirm that open plan offices prompted some people to want more privacy and others to want more social interaction (Haans, 2007, 100). The obvious key is finding a design that will support both needs. Sundstrom et al. (1980) researched the relationship of privacy to job satisfaction and job performance. The research subjects and spaces included administrative employees in a government office, clerical employees in a hospital, and a wide-range of employees at a university. A questionnaire identified the features of their workspace (i.e. has a door,

partitions), perceptions of their workspace (i.e. private, pleasant), and job satisfaction and performance. In their correlation analysis, they found an association between privacy and job satisfaction, as well as a limited positive correlation between privacy and job performance.

There are several studies that have documented the failure of office environments to adequately support the need for privacy. With the introduction of open plan offices to workplace design, privacy became a popular research topic as the physical privacy barriers were removed for the employees. Hedge (1982) studied an open plan office to evaluate the privacy of its occupants. Through survey responses, Hedge concluded that there was a lack of perceived privacy and problems with disturbances. Zalesny and Farace (1987) found similar results in their study of employees that moved from a traditional office layout to an open plan office. The occupants reported less privacy after the move as well as lower satisfaction with their workplace environment.

Additional studies also took advantage of the design trend from more traditional closed offices to open offices by evaluating the impact of the change on employee behaviors as well as satisfaction with their environment (Brookes & Kaplan, 1972; Sundstrom, 1980; Wineman, 1986; Stokols, 1990). The theory behind the move to a more open office is to not only provide a more flexible cost-effective workplace, but also to enhance communication due to the closer proximity of employees to each other and the lack of physical barriers. Therefore, the majority of these studies focused on interaction and interaction-related behaviors of the employees. The studies have conflicting results, with

some reporting positive effects (Allen & Gerstberger, 1973; Hundert & Greenfield, 1969; Ives & Ferdinands, 1974), while others reporting an opposite negative effect (Sundstrom et al, 1980; Brennan, 2002).

A shortcoming in some of the older studies offices that found positive interaction results comparing the traditional to open is that the research subjects were surveyed soon after they moved into their new open facility. This result could be attributed to the novelty or excitement of the newness of a novel environment. Research studies that waited a longer period of time after move-in (6+ months), found different effects. Sundstrom et al. (1980) did his follow-up survey at the open plan office six months after the move. Their findings illustrate no change of interaction levels between the two environments (traditional to open). The researchers hypothesize that, although there may have been an initial positive change in interaction, results after six months suggest that the employees have acclimated to the new environment and have reverted back to their regular interaction routine. Brennan et al. (2002) took Sundstrom et al.'s (1980) results into consideration when designing their research study. The employees involved in the study were moving from a high rise downtown building with more traditional offices to a suburban industrial park with more open plan offices. A questionnaire was administered prior to their move, four weeks after, and six months after their move. Their hypothesis was that at the four week period there would be a rise in their perceived job and team-relation levels, but after 6 months, the levels would have evened out to the pre-move levels. The categories of questions included in their survey encompassed employee

satisfaction with their environment, team member relations and perceived performance. Brennan (2002) reported that on both post-move surveys (4 weeks and 6 months), “the data show that in all categories and for most questions, employees appear to be negatively affected by the relocation to open offices “(293).

Studies of research and development firms have shown that private enclosed offices provided more opportunities for interaction as compared to offices with fewer barriers (Hatch, 1987). Hatch surveyed 99 employees in two different high tech firms located in the San Francisco Bay Area. The employees worked in either enclosed or open offices, and their behavioral responses were correlated with their level of office openness. The study “provides evidence that interaction among professional-technical workers in research and development firms may be greater for workers who are given enclosed workspaces than for those lacking barriers” (396).

More recent trends in open office design have focused on the inclusion of different types of collaboration spaces within a workplace to accommodate a variety of uses. Hua et al. (2010) conducted a study that examined a typology of these collaborative spaces. Hua studied workspaces in eleven different public service office buildings. The occupants were surveyed as to their perception of collaboration support in the workplace environment. Three different types of collaborative spaces are defined: 1.) team-work related (i.e. conference rooms); 2.) service related (i.e. copier/printer room); 3.) amenity related (i.e. kitchen/coffee break area). Spatial variables used in the study included

distances from one's workstation to the three types of collaborative spaces (workstation scale), as well as the percentage of floor dedicated to these spaces (layout scale), and openness (percentage of floor space used as open plan offices). Hua et al. (2010) found a correlation between perceived collaboration support and workspace and layout variables. "A significantly higher level of perceived support was associated with a shorter distance from the workstation to meeting space, a lower level of floor plan openness, and a higher percentage of floor space dedicated to meeting, service, and amenity spaces" (440). It can be concluded that the presence of spaces dedicated to collaboration is important in occupants' perception of support for collaboration. Despite the presence of collaborative spaces, the survey results found that the individual workstations were the preferred location for casual interactions and collaborative work. Rashid et al. (2006 & 2009) found similar results in their research of government workplaces. Despite the design of collaborative spaces within the majority of their studied environments, the most interactions occurred in individual workstations (2006) and a lack of interaction was found in the corridors (2009). Results indicate that further research is needed regarding the most appropriate spaces to enhance communication.

A perspective regarding the effect of the physical environment on behavior, the social relations perspective, takes the stance that interaction increases when a physical environment is designed to support such behavior. For example, when an environment has space that all occupants must pass through, the social relations perspective suggests that interaction in this space will be high do to the

increased opportunity for interaction. The evaluation of the spatial layout can define its properties and use patterns to better understand if the physical environment is supporting behaviors such as interaction. Space syntax analysis is a method of analysis to define the properties of the spatial layout. This method is introduced in more detail in the following section.

2.3.2 Studies of Spatial Layout Properties

This section provides an overview and description of a spatial layout analysis tool, Space Syntax Analysis (SSA), and how it has been applied in the analysis of designed environments. Hiller and Hanson (1984) developed SSA as a rigorous way of quantifying the relationships of spaces to each other and the overall spatial layout. SSA has been used on several built scales, from city grids to individual floor plans. There are local and global measures of the relationships among spaces calculated to reflect their connections to other spaces within the evaluated environment.

The SSA process begins with a process of identifying the fattest convex spaces that cover the floor plan or street grid under study. An axial map is then created by drawing the longest possible straight lines to connect the convex spaces. These circulation lines represent how the spaces are connected and potential movement lines within the building/cityscape. The “distance” between spaces is defined as how many lines one must traverse to go from one space to another. This distance is referred to as “depth”. SSA examines the depth of a spatial

system through the analysis of the relationships between each space and every other space in the system. The more common SSA measures used in spatial relationship studies include connectivity, integration and intelligibility.

Integration

Integration is a global measure of a space, which takes into account the depth of a space from all other spaces in the building. Each space receives an integration value that is calculated as "the average depth of each node [representation of axial line] from all other nodes in the graph" (Bafna, 2003, 25). The fewer the number of spaces/lines that have to be traversed to reach another space, the higher the integration value. "Higher integration values of nodes, therefore, indicate that the node is less deep on an average from all other nodes, or in other words, that it is more integrated into the spatial system" (Bafna, 2003, 25).

Integration is a significant measurement as it has been found to correlate with the number of people in those spaces (Rashid et al, 2006; Backhouse & Drew, 1992). The more integrated a space, the more people should be found in those spaces and vice versa for segregated spaces. Highly integrated spaces are easy to gain access to from other spaces, whereas segregated spaces are more difficult to reach. Ideally, more integrated spaces are where shared facilities, such as break areas and restrooms, are located for ease of access from all spaces.

Connectivity

Connectivity is a local measure that represents the number of spaces that are directly connected to a particular space. Connectivity is related to choice as the larger number of spaces connected to a space, the more "choices" a person has in making a decision of where to go or what they see.

The visual field as seen from a space is of importance in the study of spatial relationships as it may influence the choice of movement based on what or who is seen. Benedikt (1979) coined the term "isovist" to describe a two-dimensional 360-degree polygon of visible space from the perspective of a single point. Research has taken Benedikt's concept of isovists and represented it in a global measure within an environment. Visibility Graph Analysis is a subset of SSA that involves the evaluation of the visual relationships among spaces (Turner et al., 2001). Turner et al. (2001) elaborated on Benedikt's isovist concept to develop a methodology of identifying relationships between spaces based on their visibility qualities. Similar to other SSA techniques, Turner et al.'s visibility graph analysis encompasses both local and global measures of spatial relationships. The local measure assesses the mean connectivity of each isovist to its neighbors while the global measure quantifies the mean depth of isovists from all other isovists within the space.

Several studies have used SSA as a method of analysis to establish spatial variables in their investigation of the connection between the environment and behavior patterns. SSA provides rigorous quantification of spatial layout. These spatial values can then be correlated with behavioral patterns to explore the relationships between the spatial layout of the built environment and occupant use patterns.

SSA is utilized in Hillier and Penn's (1991) study of two research laboratories and the advancement of knowledge. The authors believe that through interactions, knowledge is shared that contributes to advancements in science. One laboratory was observed to have interaction occurring in more shallow spaces (more integrated) near the main corridors, while the other laboratory was found to have the opposite, interaction occuring in the deeper spaces (less integrated) away from the corridors. It is suggested that the laboratory where interaction occurs near main corridors is more likely to enhance cross-group exchanges and thus support the cross-fertilization of new ideas.

Two studies of the Building Design Partnership (BDP) building in England are of interest to this research due to the collaborative nature of the organization (Hillier & Grajewski, 1990, 1992; Backhouse & Drew, 1991). The aim of Hillier & Grajewski's study of the BDP was to establish a connection between the spatial layout of the office environment and interaction patterns across multiple disciplines that collaborate on projects from design to build. The research entailed observations to record interactions and utilized SSA to analyze the spatial layout. The results showed relationships between the spatial layout and

interaction (1990, 1992). More specifically, the most integrated space, the central corridor, had the most occurrences of interaction (1990); and employees located in more segregated areas showed more movement (1992).

Backhouse & Drew's 1991 study of the BDP built on Hillier & Grajewski's studies with hopes of gaining more detailed information. Through video recordings of the office space, Backhouse & Drew aimed to understand not only where the interaction occurs (such as in Hillier & Grajewski's BDP studies), but also the who and why. The results of Hillier & Grajewski's 1990 study confirmed via the video recordings that highly integrated areas were also the areas of most interaction. The video footage also provided movement information with the "focus upon the movements within the office which results, to some degree or other, in interaction being initiated and sustained" (Backhouse & Drew, 1991, 578). An interesting outcome in the study of movement within the BDP was the "recruitment" task of interaction, which addresses the who and why of their original question. As people moved within the space, they were often stopped by someone working at the edge of their walking path or by another moving individual. This unplanned interaction or "recruitment" is a condition of visibility or "what an individual can see will condition his or her entry into, and extent of, collaborative participation" (Backhouse & Drew, 1991, 580). The researchers argue that senior staff, who are often the "recruiters" due to the job role, should be strategically located in a physical position where more people are likely to pass by them. This is counter to the belief and design philosophy that senior

staff be located in corner offices or offices lining the exterior walls; and therefore, less likely to encounter others.

Penn et al (1999) used SSA to research a possible relationship between spatial layout and interaction levels. Questionnaires were distributed at two companies to monitor their number of encounters. Observations recorded where people were located and interaction within the workplace. As other studies have also predicted, Penn et al. (1999) stated, "the more accessible spaces in the building have a greater number of people both visible and directly approachable" (207). In addition, they found that the more integrated a space, the more movement occurs with that space. Penn et al. (1999) also found that interaction often occurred in the corridors where a standing person is talking to a sitting person on the edge of the workspace area.

Rashid et al.'s (2006) study had a similar motive as Penn et al.: to link the spatial layout to face-to-face interaction while using space syntax analysis and observations as data collection methods. In addition, interviews provided information as to levels of interaction required by job type. Four government offices were evaluated, with three of the four providing spaces specifically designed for interaction and collaboration behaviors. It was hypothesized that environments with higher overall integration would exhibit greater levels of interaction. In contrast, the "spatial variables generally showed negative and very weak correlations with [observed] interaction" (840).

Another study that investigates the relationship of spatial layout and interaction behavior in open plan offices included a survey of individual perceptions (Rashid et al., 2009). The study was conducted within one organization as they moved from one open plan office to a newer open plan office designed to be more supportive of interaction. The research combines individual perceptions, spatial behaviors (movement, visible co-presence, face-to-face interaction) and spatial layout attributes. It was hypothesized that "an open plan office with better visibility and accessibility may help to generate more face-to-face interaction because of their positive effects on visible co-presence and movement" (433). Results indicate that there were significant increases in levels of face-to-face interaction (3 times as much) in the new office which had high levels of accessibility and visibility.

2.3.3 Studies of Social Network Properties

Social network analysis (SNA) is a quantifiable way of explaining the relationships between people within an organization and their patterns of communication. The network includes nodes and ties where the nodes represent a person or a group and ties represent the relationships between the nodes. The analysis shows who is the most connected and where there are connections between groups. Connections between groups show the potential for interdisciplinary collaboration. Wasserman and Faust (1994) provide a

description of the common measures used in SNA to identify the network relationships between individuals and groups.

Degree Centrality

Degree centrality is the simple measure in SNA that represents the number of ties linked to a node.

Closeness Centrality

Closeness centrality is the degree to which an individual is linked to others, whether it is directly or indirectly. Those with greater values of closeness are able to access other nodes (individuals) in the network more quickly than others with lower closeness values.

Betweenness Centrality

Betweenness Centrality represents the number of nodes to which a particular node is indirectly tied. A node with a high betweenness value is often a bridge between two different networks; therefore it represents a node (individual) who connects nodes that are not connected to each other. These individuals are often the gatekeepers of information; having access to information from one network and passing it to another network.

Studies using SNA in architecture research add another dimension to studies of spatial layouts' influence on social behaviors (Toker, 2006; Peponis et al., 2007; Wineman et al., 2009). Peponis et al.'s (2007) study of a Chicago

communication design firm, ThoughtForm, pre and post move to a new facility utilized SSA and SNA. The new office was designed to be a more effective workplace reflecting the organization's culture and needs. Therefore, the design was expected to positively support the networking and interaction needs of the employees. Peponis et al. (2007) "ask whether there is a correlation between the spatial connectedness of a person's workstation in the layout and their connectedness in the networks of interaction" (832). The researchers define three measures of social networks that are related to the SNA traditional values: hub value (degree), pulse-taker value (closeness), and gatekeeper (betweenness). The study evaluated the interactions at different length of time intervals, both short and long. SNA and SSA correlation results showed that the new workplace design better represented the networking needs of the employees. The data provided "statistically supported evidence that layout can contribute to the density [measure of reported interactions out of all possible interactions] of different networks of interaction at the shorter time intervals" (837). Additionally, the spatial layout required movement in key central core areas to get from point A to B, therefore providing opportunity for awareness of others, but interaction as well.

In Toker's 2006 study of a university research center investigates the impact the space has on face-to-face encounters which they define as a precursor for innovation. The research subjects kept activity logs to record their interactions throughout the day and completed a questionnaire as to their space use patterns. Toker's research indicates "that in order to facilitate coincidental consultations, it

is critical to locate informal common spaces in configurationally accessible, highly visible areas with close connections to" (2006, 197). He also argues to increase unscheduled office visits, offices should be highly visible and not segregated from other work areas (2006).

Additionally, another study on a university campus (Wineman et al., 2009), utilized SNA and SSA were used in identifying co-authorship networks among faculty. Results of this study showed that both social networks and spatial variables together influence the level of interaction within this particular academic environment. The school purposefully located faculty in the building without departmental grouping in hopes of increasing cross-disciplinary collaboration. Despite differences in disciplines, Wineman et al. (2009) found that the location of the faculty member's office influenced the degree of collaboration. Same department association was still found to be the most influential variable in predicting collaboration, but location played a role as well. "The extent to which a faculty member's office is located along a corridor that is well connected to all other corridors in the department, the greater likelihood of co-authorship within the department" (439).

2.4 Implications of Interaction and Collaboration

As mentioned previously, the study of interaction and collaboration has been the focus of workplace design research due to its potential impact on other important organizational outcomes. Interaction is not only important to the performance of

job tasks, but is relevant to outcomes that influence the success of the employee, work group and organization as a whole. Interaction can lead to a more productive and innovative work environment as well as increase an employee's job satisfaction, especially in an organization where the culture supports such collaborative behavior.

Research is still controversial as to whether open plan offices provide positive support for work tasks. Studies indicate that after a move from closed to open offices, employees had a higher stress level (Wineman, 1986; Brookes & Kaplan, 1972). Several studies have found a decrease or no change in overall satisfaction in open offices (Sundstrom et al (1980); Hedge, 1982; Zalesny & Farace, 1987; Stokols et al, 1990; Brennan, 2002).

It has been theorized that interaction can lead to creative and innovative solutions due to the sharing of knowledge across groups (Kanter, 1988; Toker 2006; Peponis et al. 2007; Wineman et al., 2009). Toker (2006) defines innovation as "outcomes of collaborative research processes, in which researchers or scientists share an existing stack of knowledge and generate and accumulate new knowledge" (183).

An implication of great interest to organizations and their success is productivity. Research has shown a connection between interaction and productivity in the workplace (Brill et al., 2001; Reagans & Zuckerman, 2001; Sparrowe et al., 2001; Rulke & Galaskiewicz, 2000; Rubinstein, 2000). A direct link between design and productivity is difficult to make as Haynes (2008) discovered during their

investigation of literature that researched the connection between office layout and productivity. The literature review included not only studies on productivity, but other behavioral variables such as satisfaction and interaction. Based on the review, Haynes (2008) concludes that there is no distinct link between productivity and design, and only through understanding the occupants work patterns and processes, can one understand the impact of the design on productivity. As it relates to work patterns, the conclusion states that "an area that needs further research is the balance between individual private working and collaborate team-based working" (199).

This study aims to add a research foundation to the current intents of laboratory design. This chapter summarizes the implications of workplace design on employee behavior, but there is a knowledge gap for research on new laboratory design and behavior. Despite the architect and administrator's intent for positive impact on interaction and collaboration, there is a lack of research to support their claims. As Haynes (2008) stated, more research needs to be conducted to evaluate the needs of collaborative work in relation to the needs of other work tasks. Research has shown that the location of key people in an organization (Hillier & Grajewski, 1990; Backhouse & Drew, 1991; Toker, 2006; Wineman et al., 2009) can influence interaction patterns. These results will provide an interesting comparison to the results of the current study as the PIs (key people) are strategically located near each other but away from their lab work-groups . Toker (2006) has touched on the subject by looking at academic

researchers as their test subjects, but the academic laboratory is a distinct physical structure as well as a unique organizational structure and network. To gain a better understanding of laboratory design, a new research design is needed that incorporates aspects of spatial layout, social networks, perceptions of the environment, and observed interactive behaviors. This research will build on techniques used in previous studies to accomplish the challenge of evaluating the connection between laboratory design and interaction and collaboration. A variety of methods will provide a well-rounded study to ideally capture data that will give a more extensive picture of the qualities of the laboratory environment and the behaviors of its occupants.

CHAPTER III

METHODOLOGY

3.1 Chapter Overview

This chapter provides an overview of the methodology of the study. The first part of the chapter addresses the research strategies as well as the data collection methods used, followed by the approach used to investigate the research problem.

3.2 Research Strategy

The purpose of this study is to investigate the relationship between use patterns/social behaviors and architectural design of academic laboratories, in particular, buildings that house multiple disciplines with the intent of encouraging interaction. The primary question examined is how the design and layout of space in academic laboratories influence interaction and collaboration of the occupants. Other related questions arise in this investigation such as how the

design and layout influences workspace satisfaction as well as how other workplace design aspects influence the interaction and collaboration of its occupants.

Field research gives a more accurate picture of behavior in real-world settings. Because these are unique settings with multiple factors affecting both design and behavior, a case study approach was selected for this research. The case study approach allows the researcher to obtain a detailed and insightful look into the characteristics and use of a particular environment. The data collection integrated both qualitative and quantitative techniques to gain a broad and thorough look into the environments. The following sections explain in more detail the research approach and techniques.

3.2.1 Selection of the Two Laboratories for the Case Study

Two academic laboratories were selected for this study: the Life Sciences Institute (LSI) completed in 2003 at the University of Michigan, Ann Arbor, MI designed by Venturi, Scott Brown and Associates (in association with SmithGroup) and the Natural Sciences Building (NSB) completed in 2003 at the University of California, San Diego CA designed by Bohlin, Cywinksi & Jackson. Venturi, Scott Brown and Associates (VSBA) were also involved in the design of the overall academic complex that the LSI is a part of. VSBA and its founding partners have been involved in numerous global projects that have been

recognized and rewarded for their innovative approach to design and contributions to the architecture field. This study is focused on the collaborative and interactive nature of academic laboratories; therefore it was ideal that the laboratories were conceived purposefully to integrate disciplines in the sciences, and to increase the interaction and collaboration of its occupants. Both labs were built in 2003 and are approximately similar in size. The NSB is approximately 180,000 total square feet with approximately 30,000 square feet per floor. The LSI is approximately 150,000 total square feet with approximately 25,000 square feet.

Figure 3.1 Life Science Institute (*left*) and Natural Sciences Building (*right*)

3.2.2 The Case Study Laboratories

The first case study is the Life Sciences Institute (LSI) at the University of Michigan, completed in 2003, and designed by Venturi, Scott Brown and Associates. The building houses several life sciences disciplines, ranging from Chemical Genomics to Structural Biology. The LSI describes its facility on their website as "a hub for collaboration among outstanding scientists from a variety of life science disciplines focusing on the biological problems of human health" ("Life Sciences", 2011).

At the time of data collection there were twenty-eight Principal Investigators (PIs) at the LSI with the potential of growing to thirty PIs. Each PI has approximately four to twenty people working with them on their projects. Project team members include lab technicians, post doctorate researchers, and graduate and undergraduate students. There are approximately 350 people working in the LSI building which includes lab staff as well as administrative and support staff. There are five floors with three of these five floors primarily used as lab and research spaces. This study will focus on the 5th and 6th floors of the LSI. Both of these 2 floors have the same basic design. There is a central corridor book-ended by break areas and Principal Investigator (PI) offices. The central corridors are lined with lockers for student researchers and assistants. Two parallel corridors are on each side of the central corridor and run through the lab areas. Secondary spaces, such as meeting rooms and storage, are located between the side corridors and the central corridor. The majority of the lab space

is open allowing research groups to work in close proximity to each other. Research groups also share the equipment that is located in the secondary spaces as well as share the break areas.

The second site included in this study is the Natural Sciences Building (NSB) at the University of California, San Diego that houses Biochemistry, Molecular Biology and Biophysics. The NSB was also completed in 2003 and was designed by Bohlin, Cywinksi & Jackson. "The Natural Sciences Building serves as the center for biochemistry, molecular biology and biophysics study at UCSD, bringing together students and faculty from all three departments to promote scientific collaboration" ("Division of", n.d.). The NSB building has six floors with the first two floors containing teaching lab areas and the higher floors housing the research labs. This study will focus on the 3rd, 5th and 6th floors of the building. Break areas that provide whiteboards and seating with tables are located in the elbow of each floor of the L-shaped building. Central corridors run down the center of each wing, leading from the elevator that is located near the break areas. Similar to the LSI, the lab areas are predominantly open with shared equipment located nearby.

This research focuses on the laboratory spaces, offices and shared group spaces, not the administrative offices. These areas are of interest because these are the spaces used by the potential collaborators, the principal investigators and their lab members.

The buildings each provide the same types of spaces (i.e. laboratories, group spaces, and offices), but they are configured differently. The NSB's laboratories are located on both wings of the L-shaped building, but only on one side of each wing, and can be accessed through the atrium or through the shared equipment areas. The laboratories in the LSI line each long side of the rectangular shaped building and have several openings that are accessible from different areas of the floor. Private offices are located on the other sides of each wing (opposite of laboratories) in the NSB; while in the LSI, they are located at the short ends/sides of the building. The group and kitchen area in the NSB is located at the elbow of the building which is easily accessed from the atrium. A similar type of area in the LSI is found on each short side of the building. As you can see, despite offering similar choices of spaces, the spatial layout is different in each building. Therefore, due to their similarities and differences, these environments will provide interesting insight into the relationships between social and spatial networks in academic laboratories.

	Life Sciences Institute (LSI)	Natural Sciences Building (NSB)
Year Completed	2003	2003
Shape	Rectangular	L-shaped
Square Feet	~ 150,00 total ~ 25,000 per floor	~ 180,000 total ~ 30,000 per floor
Floors to be examined	5th & 6th	3rd, 5th & 6th
Description of Spaces	Open Labs Shared Equipment 2 Break areas per floor 2 Conference rooms per floor 1 Privacy room per floor 2 Computer rooms per floor PI's offices at building ends Post Docs & Grad students have desks in the labs	Open Labs Shared Equipment 1 Break area per floor Break area doubles as mtg. area No Privacy rooms No Computer rooms PI's office on building sides Post Docs & Grad students have private offices

Table 3.1 Comparison Chart of the LSI and NSB

3.3 Data Collection using Quantitative and Qualitative Methods

This study's purpose is to gain understanding into the relationship between the built design and layout of academic laboratories and behavior, as well as other perceptions. Several questions are proposed to investigate the design and uses of the case study environments:

1. How does the design and spatial layout influence interaction and collaboration?

2. How does the design and spatial layout affect workspace and job satisfaction?

3. What are other important aspects of the workplace that influence interaction and collaboration?

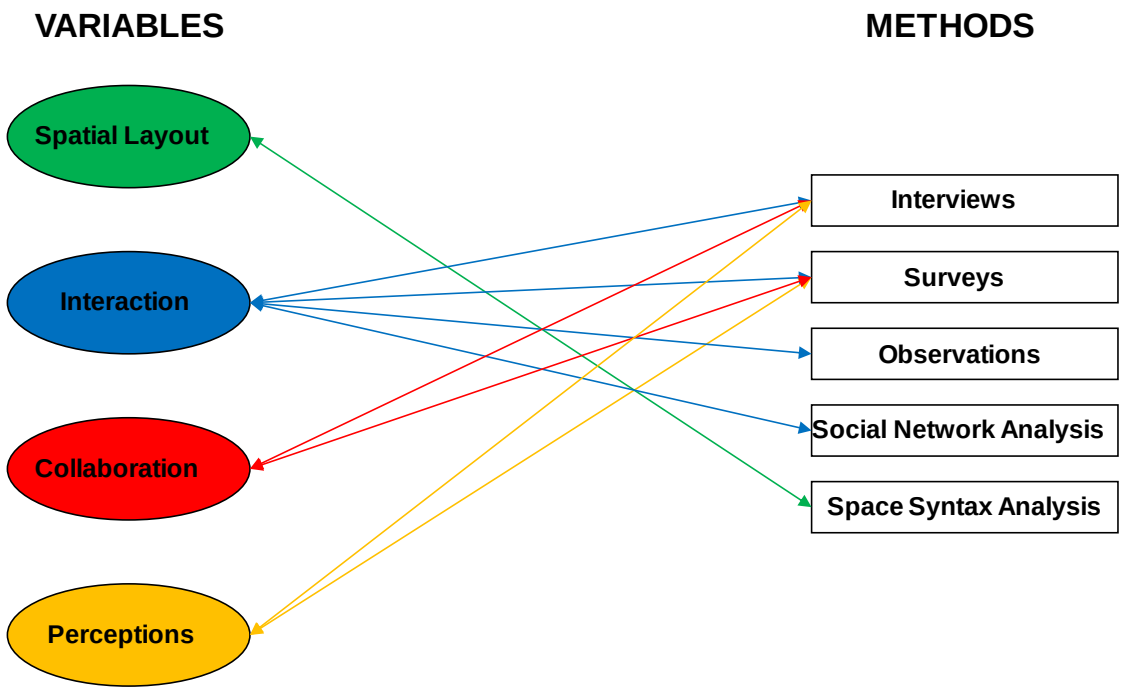

Figure 3.2 Research Variables and Methods

This study encompasses a broad range of data collection methods to establish a comprehensive database to explore both the social and spatial aspects of the environments. Space syntax analysis was used to gather data to describe the visibility relationships of the spaces. Detailed time-sampled observations were recorded of employees' locations and behaviors (sitting, standing, walking, talking) to illustrate employee space use patterns including their movement and interaction. The Principal Investigator interviews provide background into the PIs frequency of interaction and collaboration, as well as informing the author regarding questions to be asked in the surveys. Two surveys, the Workplace Survey and Communication Survey, were distributed to the research subjects.

The Workplace Survey asked participants their perceptions of and satisfaction with the environment, as well as frequency of interaction with others. Several of the survey responses are used in measurement scales. These scales have been tested in previous studies and proved to be valid measures. The research subjects identified other occupants in their building (NSB or LSI) that they interact and collaborate with in the Communications Survey. The focus of this study is on social behaviors (for the purpose of this study, social behaviors are defined to survey participants as those that involve physical presence, not interactions via email, text, IM, etc.). The observational and interview data was collected onsite at each building. The observations entailed repeated walk-throughs of the researched floors identifying the presence, movement and interaction of its occupants. The gathering of data was identical at each site, but was done during different time periods. The data collection at the LSI was conducted from the summer of 2006 (as part of a project in collaboration with Steelcase, Inc. under the direction of Jean Wineman) through 2008. The data collection at the NSB began in the winter of 2009 and was completed in the winter of 2010.

3.3.1 Space Syntax Analysis of the Layout

Space Syntax Analysis (SSA) was used to establish quantitative data regarding the relationships between spaces on both a local and global scale. The visibility properties of measurement were chosen because visibility is an important pre-

condition to communication and this unit provides a detailed subdivision of space appropriate to analyses of a building interior layout.

An individual isovist's (point isovist) visual properties of connectivity and integration are calculated using computational software (*Syntax2D*). Visibility graphs were used in the analysis to gather spatial descriptor values that characterize the visibility properties of the building floor plans. The visibility graphs were generated using *Syntax 2D* software which calculated the measures of connectivity and integration. *Syntax 2D* overlays a grid onto the entered floor plan and then calculates the measures for each cell within the grid.

Visual connectivity is a local measure of the degree of visual area a person has visual access to from one spatial unit (Hillier & Hanson, 1984). The greater the measured number, the more connected that point is to other units than other units with a lower measured number. As an occupant in a building, visual accessibility is informative to identify the visual presence of other people.

Integration is a global measure of a space, which takes into account the depth of a space from all other spaces in the building. Each space receives an integration value that is calculated as "the average depth of each node [or point isovist] from all other nodes in the graph" (Bafna, 2003, 25). The fewer the number of polygons that have to be traversed to reach another space, the higher the integration value (visual accessibility). "Higher integration values of nodes, therefore, indicate that the node is less deep on an average from all other nodes,

or in other words, that it is more integrated into the spatial system" (Bafna, 2003, 25).

Integration is a significant measurement as it has been found to correlate with the number of people occupying those spaces (Rashid et al., 2006; Penn et al., 1999; Peponis et al., 2007). The more integrated a space, the more people would be expected to occupy those spaces and vice versa for segregated spaces. Highly integrated spaces are easy to gain access to from other spaces, whereas segregated spaces are more difficult to reach. Ideally, more integrated spaces are where shared facilities, such as break areas and restrooms, are located for ease of access from all spaces. As integration is a global measure, connectivity is a local measure that represents the number of polygons that are connected to a particular point isovist. Connectivity can be used as a scale to show which spaces have more (or fewer) other spaces (or in this case visibility polygons) connected to them. Whereas integration calculates the relationship each space/polygon to all others, connectivity measures the number of other polygons directly attached to a space/polygon.

3.3.2 Employee Space Use Observations

Employee space use data was gathered by doing observations in the LSI and NSB. The author performed the unobtrusive observations by following the same path at relatively the same speed while recording the presence of people. The

paths were selected to follow the shortest path while being able to visually observe all spaces in the study. In both the NSB and LSI, the larger corridors were used in the paths as they covered the most ground and provided visibility into more spaces including the laboratories, closed offices, and shared equipment areas. The paths were relatively the same in both buildings due to their similar layout.

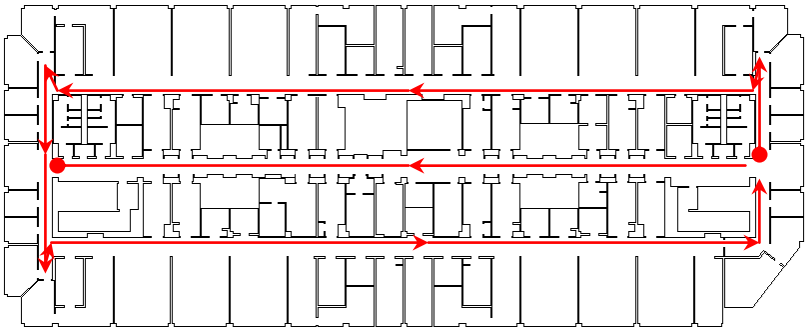

Figure 3.3 LSI 5th Floor Observation Route

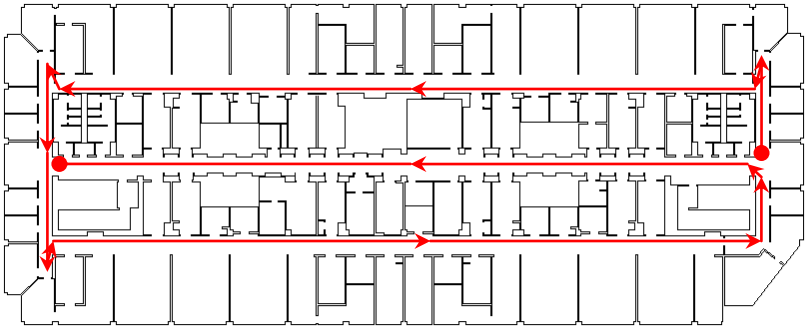

Figure 3.4 LSI 6th Floor Observation Route

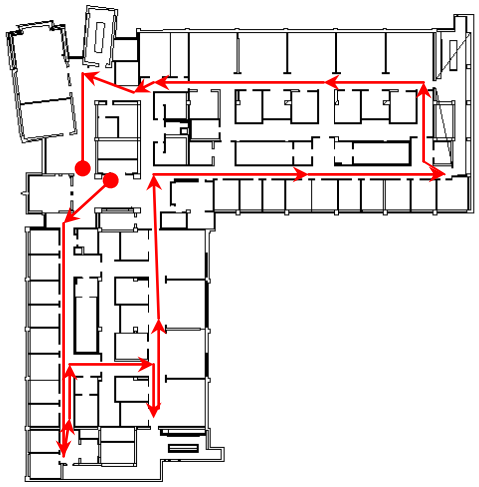

Figure 3.5 NSB 3rd Floor Observation Route

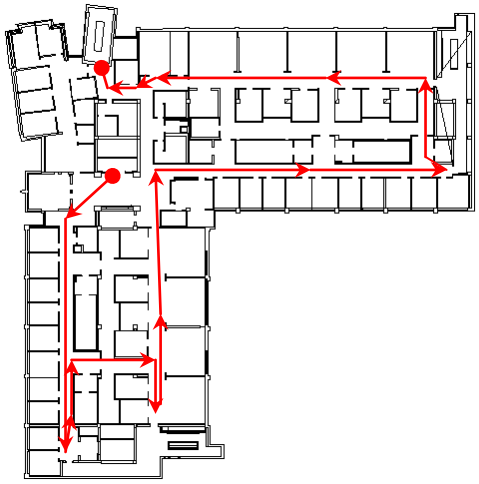

Figure 3.6 NSB 5th Floor Observation Route

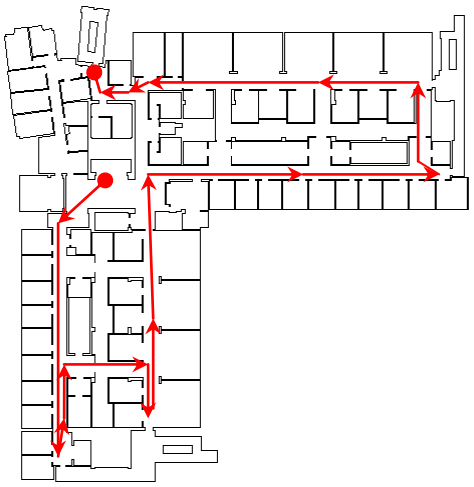

Figure 3.7 NSB 6th Floor Observation Route

Four different coded records were made for each person observed during the observation period: standing or sitting, standing or sitting while talking, moving (walking), moving while talking. The observations occurred on different days of the week over approximately four different weeks and totaling nine days of observations for each floor. The data was gathered at three different times of day to capture a range of usage over the day. The three times of day chosen were morning (approx. 9:30am), lunch time (noon), and afternoon (approx. 3pm). Each pass-through of each floor took approximately 10-15 minutes; once all floors in the building had been observed, the author started back at the original floor and continued the cycle for a total of 3 times per time period (therefore, equaling nine times per day each floor was observed). This observation data was analyzed to show (1) patterns of use, (2) patterns of interaction, and (3) patterns of movement. The researcher recorded each pass-through

observations on a separate floor plan carried on a clipboard. A legend of symbols was identified before any observations took place; for example, triangle for movement, filled in triangle for moving while interacting. When a behavior of interest was observed (presence, interaction, movement), the researcher drew the appropriate symbol for that behavior on the floor plan. Once all the completed observations were entered into the appropriate software program (*Syntax2D*), the number of observed behaviors could be identified for each cell on the grid.

3.3.3 Interviews and Surveys

In addition to the observation method mentioned in Section 3.3.2, interviews and surveys, were used to collect employee interaction and collaboration data. Interviews were performed with each Principal Investigator (PI) that agreed to be a part of the study. The interviews provided a background understanding of communication patterns in the building, as well as input to the communication survey. The interview questions focused on the communication patterns of the PIs (who they interact with, how often), as well as additional information that may inform the where/why/whom of interaction and collaboration patterns of the building as a whole. These questions then informed the author regarding the structure of survey questions for all participating employees. The survey questions were selected from a communications survey that had been developed and tested for other studies (Wineman et al., 2005, Rashid et al., 2009). Similar

to the interviews, the survey asked questions regarding who the respondent talks to within the building, how often, and how important it is for them to talk to a fellow employee to complete their job tasks. The survey responses were entered into *Ucinet* software to be analyzed using social network analysis (SSA). SSA measurements of degree and closeness are similar in properties to those of connectivity and integration in SNA. As connectivity in SNA measures the number of immediate spaces connected to a particular space, SSA's degree measures the number of immediate people to whom a particular person is connected. SSA's closeness measures the mean value of the shortest path from a person to all other people in the network (similar to SNA's integration which measures the mean value of the shortest path from one space to all other spaces). An additional survey, Workplace Survey, was distributed at the same time as the communications survey to gather information on the respondents' perceptions of their workspace, the spatial layout, and the amount of their informal and formal interaction.

3.4 Case Study Analysis

This section discusses the methods of analysis of the space use data and how they will be compared with the spatial layout of each case study.

3.4.1 Employee Perceptions and Behavior and their Relationship with Visibility Properties

Correlation and regression analyses will include identifying relationships between the spatial properties and the self-reported (from the workplace survey) interaction levels and employee perceptions of their workspace and organization. The SSA measures from the communications survey will also be correlated with the employee perceptions as well as the spatial layout visibility properties of connectivity and integration.

3.4.2 Space Use Patterns and their Relationship with Visibility Properties

This section explores the space use patterns of the employees that were gathered from the observation. The data was entered in to *Syntax 2D* to illustrate the distribution of people on each floor. Similar to the visual graph analysis, the map shows the number of people for each spatial unit (cell). The data will be examined in terms of different space use patterns, whether it is the simple presence of a person in a space or interacting (talking) with another person. These measures will be compared with the visibility properties mentioned in Section 3.3.1 to examine the effects of spatial properties on space use patterns. The spatial property levels of integration and connectivity will be correlated with the counts of people observed in the space, as well as the count of people communicating in the space.

3.4.3 Job Satisfaction Analysis

Analyses will be conducted to identify relationships between interaction and collaboration and the outcome variable, job satisfaction. The role of employee perceptions will be examined as potential mediators between the spatial layout variables and the outcome measure of job satisfaction,

3.5 Cross-Comparative Analysis of the Case Study Laboratories

After data was compared within each case study, the individual case study results were then compared with each other. The comparison will include the space use patterns, visibility properties, and the correlations between the space use and visibility properties. Due to the fact that each laboratory was designed with the same intent to enhance interdisciplinary collaboration, but had two quite different design outcomes, it will be interesting to see the similarities and differences between them.

CHAPTER IV

CASE STUDY 1: LIFE SCIENCES INSTITUTE

4.1 Chapter Overview

This Chapter provides an in-depth look into the background information to the design, layout and intent of the Life Sciences Institute (LSI) at the University of Michigan. Following the description of the layout and narrative, the chapter continues with a comparison of the spatial use patterns and the spatial layout of the research floors with the LSI.

4.2 Life Sciences Institute Building and Laboratories

The Life Sciences Institute at the University of Michigan was completed in 2003 and designed by Venturi, Scott Brown and Associates. The building is located on the University's Central Campus alongside a commons building with conference/meeting rooms and an undergraduate science building. The LSI is

located on the northeastern edge of Central Campus within close proximity to the Medical Center.

Figure 4.1 Location of LSI (in red circle) on the University of Michigan campus (Red Paw Technologies, 2012)

In 1998, the current University of Michigan president, Lee Bollinger, challenged the University's life sciences faculty and administrators to investigate the future of the life sciences at the University. The Life Sciences Commission was formed in 1999 to formally look into the role and presence of the life sciences on campus. What followed were several recommendations to the President and Board of the University, including the formation of the Life Sciences Institute. The commission agreed that the future of the life sciences was in inter-disciplinary and collaborative research, which became the goal of the Life Sciences Institute. The

report stated that advancement in life science education has been due to collaborative, interdisciplinary research, and serves as a useful tool for students when they graduate and start their careers (LS Commission, 1999). The commission's report suggested "Michigan's vision for life science must be broad and encompassing, and support for collaborative and integrative work is paramount" (LS Commission, 1999).

The Life Sciences Commission recommended that a physical structure would be beneficial in assisting the goals and intent of interaction and collaboration of the LSI. A dedicated space for scientists to conduct research and have opportunities and facilities to interact formally and informally was a priority. The formal recommendation stated, "In order to support these initiatives, the Life Sciences Commission recommends the *creation of several institutes or centers,* which are crossdisciplinary and link various aspects of the life science community at the University. These institutes or centers should be housed in new research facilities that are planned in such a way as to facilitate interactions both within each of the specific programs and across programs. (LS Commission, 1999, x) The commission also suggested that the location of the LSI on campus was also an integral part of its success, stating that the proximity should be close to both Central Campus and the Medical School to facilitate ease of interaction between faculties at all sites (LS Commission, 1999).

The Commission was specific in its recommendations for the LSI to promote interaction among the scientists. Their report states:

> Each research institute or center should be large enough to allow for a range of investigators with complementary interests, yet small enough to allow investigators who speak a common language to work together cooperatively, with minimal barriers to their interactions. Special consideration should be given to building design and architectural features that will facilitate interactions between investigators. To promote the exciting scientific interactions that will develop as a result of these initiatives, these buildings should have the following features: (1) state-of-the-art laboratory, computational, information and conference facilities; (2) physical connectivity between buildings, where feasible; (3) ample expansion room and both flexible space and flex space; and (4) readily accessible gathering places including a cafeteria. (LS Commission, 1999, 37)

Figure 4.2 Exterior photo of the LSI (University of Michigan, 2010)

There are twenty-eight Principal Investigators (PIs) at the LSI and each PI has approximately four to twenty people working with them on their projects. For this study, the research participants included three PIs and their project team members. Project team members include lab technicians, post doctorate researchers, and graduate and undergraduate students. There are approximately 350 people working in the LSI building which includes lab staff as well as administrative and support staff. There are five floors with three of these five floors primarily used as lab and research spaces. The entrance level includes all the administrative offices and support for the LSI as well as some lab areas. The building entrance level also includes a large conference room that is available for reservation by all occupants of the building. Additionally on the entrance level and off the entrance corridor is a library/resource room that could

be used as a group workspace, individual workspace, or presentation room. The basement level includes the maintenance for the laboratory equipment, as well as a break area that includes tables and chairs as well as a vending area.

4.3 The LSI's 5th and 6th Floor Layouts

This section provides a descriptive explanation of the floor layouts of each of the floors included in the study. The two floors, 5th and 6th, are relatively the same in layout. This section also offers an insight into the spatial properties of the floor plans using space syntax analysis.

4.3.1 Layout Characteristics and Spatial Properties

The floors used in the research are almost identical in design. There is a central corridor book-ended by break areas and Principal Investigator (PI) offices. When standing on one break area, you can look down the central corridor and see the other break area on the other side of the building. The central corridors are lined with lockers for student researchers and assistants. Two sets of elevators are located on both ends of the central corridors along with restroom facilities. Stairwells are located next to each set of elevators. Two parallel corridors are on each side of the central corridor and run through the lab areas. Secondary spaces, such as meeting rooms and storage, are located between the side

corridors and the central corridor. Each floor has 2 conference rooms located in the middle of the central corridor: a large conference room, which can hold approximately 20 people, and a small conference, which can hold approximately 10 people. Additional there is a privacy room with a couch and phone that is accessible from the central corridor. The majority of the lab space is open allowing research groups to work in close proximity to each other. Research groups also share the equipment that is located in the secondary spaces as well as share the break areas. The shared equipment is located in perpendicular breezeways that connect the central corridor to the parallel corridors in the laboratory areas.

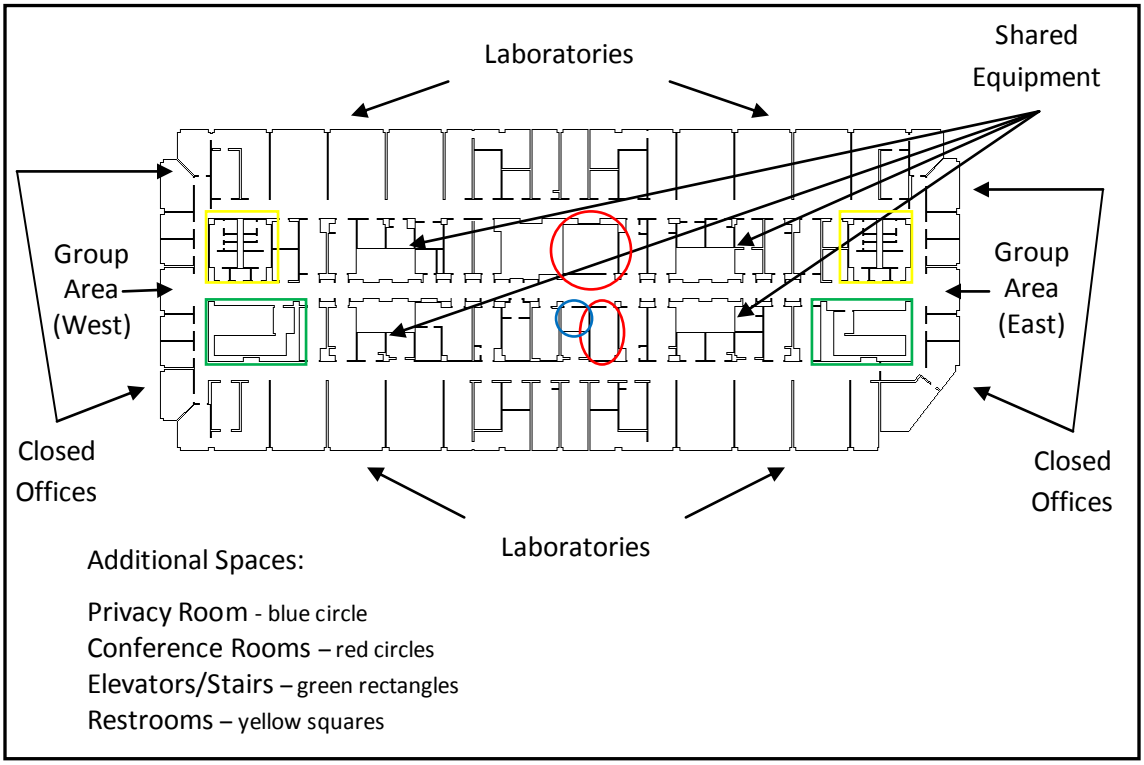

Figure 4.3 LSI 5th Floor Plan

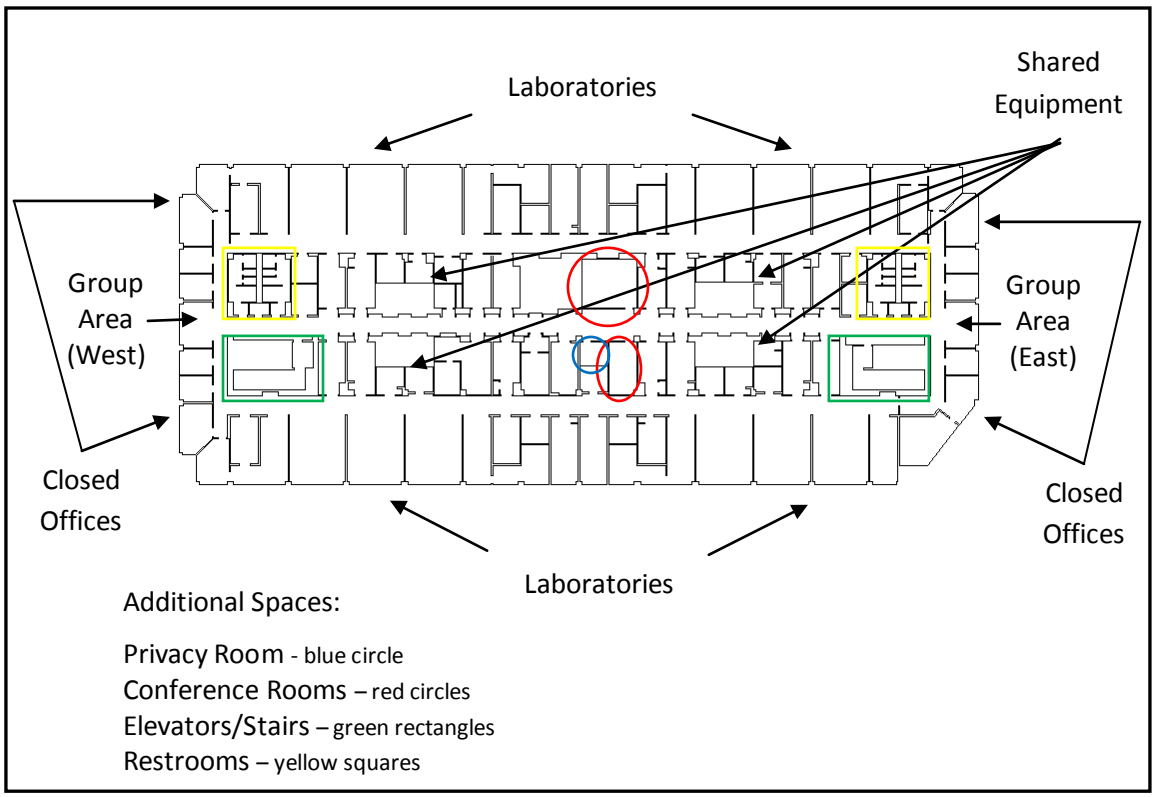

Figure 4.4 LSI 6th Floor Plan

4.4 The Spatial Layout and the Space Use Patterns

This section provides a descriptive overview of the layout of the LSI's 5th and 6th floors using space syntax analysis. Observed behavior data are analyzed to capture space use patterns. The spatial layout data and space use patterns are further researched to investigate relationships between the two.

4.4.1 The Spatial Layout Properties

Space syntax analysis provides two measurements to describe the spatial layout in the study. The researcher, using *Syntax2D* software, evaluated the floor plans with graph analysis to provide an outcome of the visibility properties of connectivity and integration. As mentioned in previous chapters, connectivity is a local measure and integration is a global measure.

The LSI's 5th and 6th floors have relatively the same levels and distribution of connectivity and integration.

	N	Minimum	Maximum	Mean	SD
Cell Connectivity Value					
5th Floor	1723	1.00	195.00	52.1497	54.18968
6th Floor	1724	1.00	195.00	51.8167	54.21762
Cell Integration Value					
5th Floor	1723	14.00	641.72	389.1822	96.08257
6th Floor	1724	14.00	637.45	387.3385	96.03957

Table 4.1 Connectivity and Integration Descriptive Statistics

As evidence by the color-coded drawings, the areas of higher connectivity are the three long parallel corridors that span almost the entirety of the floor from east to west. The highest values are in the corridors areas that can be visually seen by the other two parallel corridors through smaller corridors that run north/south. The area outside the two group areas are also high in connectivity,

the east more than the west. The lowest levels of connectivity are in the center of the building, excluding the corridors, to include the shared equipment areas, conference rooms, and closed offices. Additionally, the closed offices on the east and west edges of the floors have low levels of connectivity.

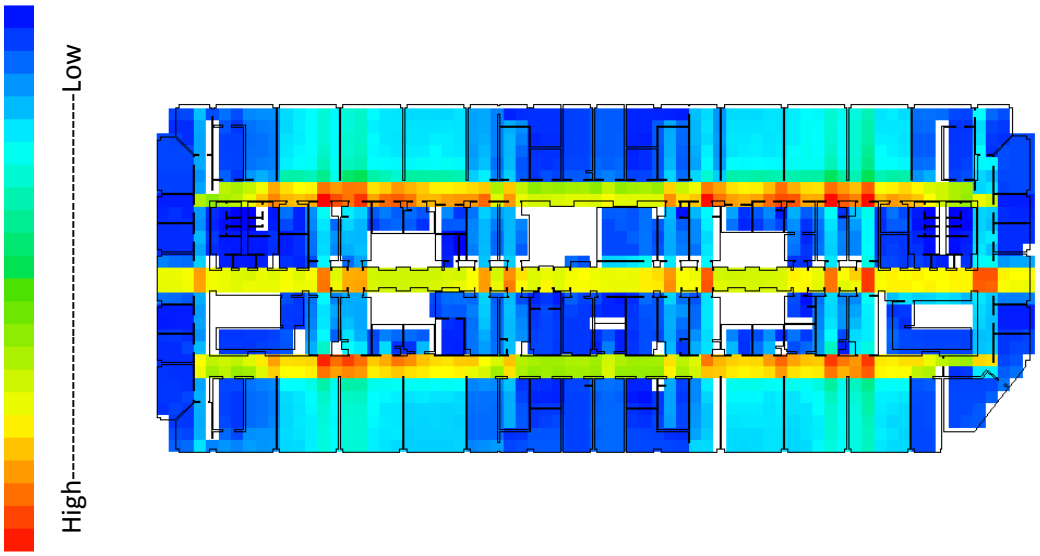

Figure 4.5 Connectivity on the 5th Floor of the LSI

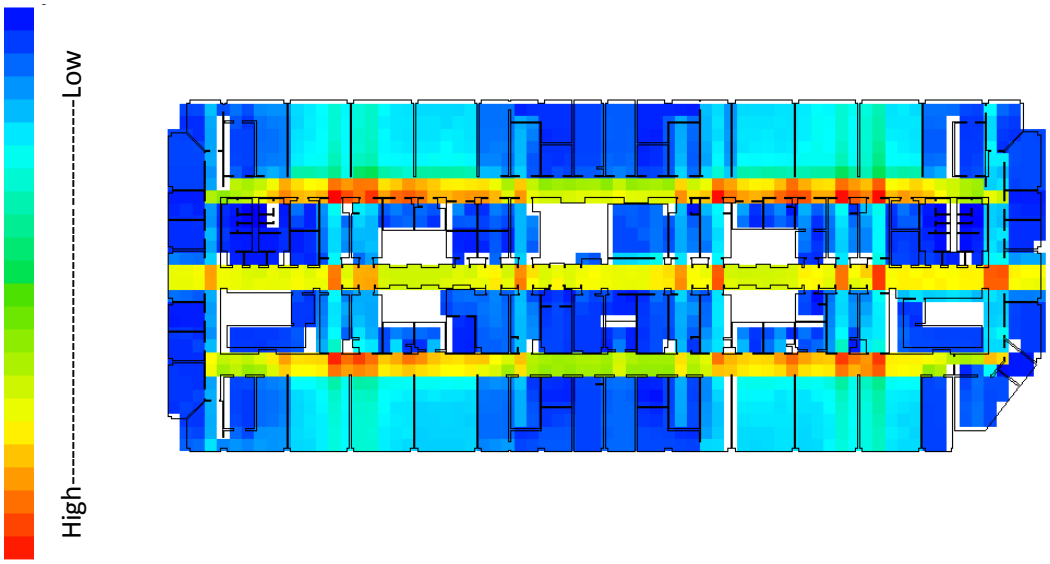

Figure 4.6 Connectivity on the 6th Floor of the LSI

The distribution of integration on the 5th and 6th floors is similar to the distribution of connectivity. The high levels of integration are in the corridors and particularly at the intersection of corridors. The closed offices and most lab areas carry a low level of integration. The lab areas that are near the corridor intersections have an elevated level of integration compared to other lab areas on the floors.

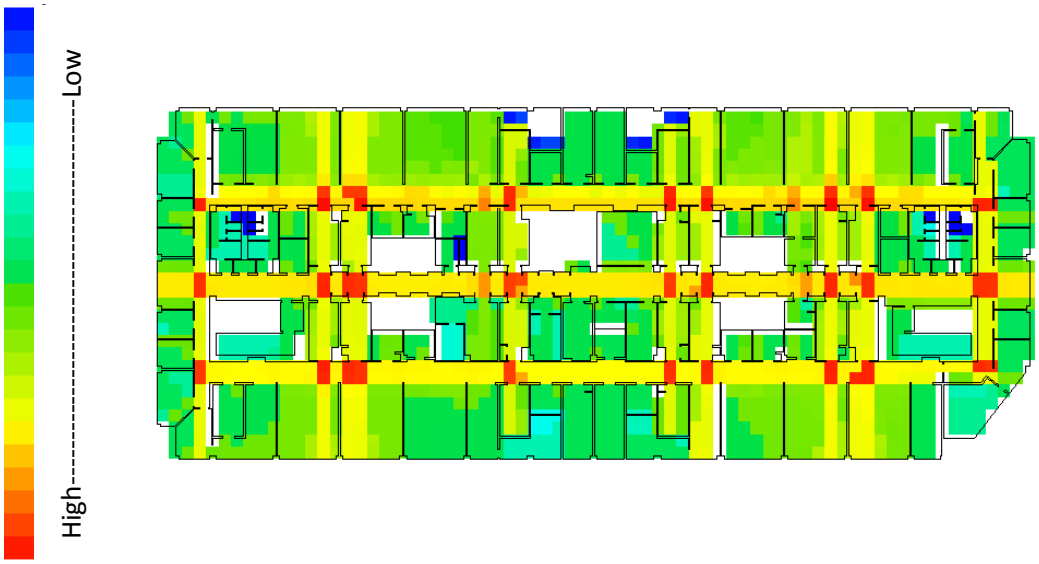

Figure 4.7 Integration on the 5th Floor of the LSI

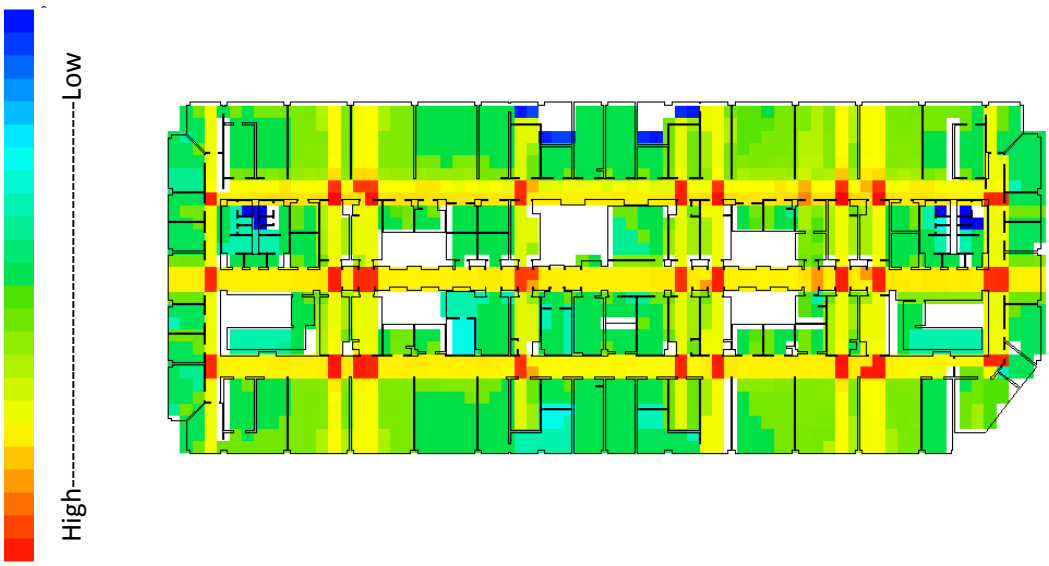

Figure 4.8 Integration on the 6th Floor of the LSI

The mission of the LSI is promote interaction among its scientists, and as you can see, the physical structure was designed with this purpose. In addition to the physical structure, the LSI provides social opportunities for its community to interact. The lab groups each hold a weekly meeting that is either held in the small or large conference room on their floor. Additionally, the building hosts a "Brown Bag Lunch" monthly series that involves a PI and/or their lab members presenting their research. This event is open to all LSI occupants and occurs during lunch time in the library room on the entrance level of the LSI.

A casual review of the observations and interviews of the LSI provides insight into the use and patterns of the occupants of the building. The lobby of the building is located on the third floor which is easily accessed from the science complex outdoor common area. An elevator and stairs are accessed by passing

the LSI's administrative area and entering the central corridor. It is observed from this vantage point that the elevator is used more often than the stairs. The individually assigned lockers lining the central corridor appear to only be used by a handful of people despite some of the observations occurring in cold-weather (jacket wearing) months. Additionally, the privacy room that each laboratory floor offers is rarely seen occupied. Conversations between lab scientists appear to occur in lab spaces near the windows as opposed to corridors and lab spaces near long corridors. The following section provides a quantitative insight into the patterns of use of the space.

4.4.2 The Distribution of the Space Use Patterns

The entered observed date shows patterns of what spaces occupants use and their frequency of use. The data, entered into *Syntax2D*, a space syntax analysis software, indicates the patterns of the presence of people as represented by recorded frequency on the grid system. A special program was written in *Syntax2D* for this research to allow each observed behavior (or "point") to be assigned to the nearest cell. Therefore, a count could be made in the cell level as to which cells (or "spaces") are used more frequently. The descriptive statistics below show that the 5th floor has overall more (based on the mean) total presence, movement and interaction that than the 6th floor.

	N	Minimum	Maximum	Mean	SD
Observed Total Presence					
5th Floor	1723	.00	25.00	1.5421	3.09450
6th Floor	1724	.00	31.00	1.1056	2.79797
Observed Movement					
5th Floor	1723	.00	6.00	.1259	.45447
6th Floor	1724	.00	4.00	.0864	.34755
Observed Interaction					
5th Floor	1723	.00	10.00	.3418	.93009
6th Floor	1724	.00	14.00	.2355	.87937

Table 4.2 Observed Behaviors Descriptive Statistics

Visually, the distribution of the overall presence of people can be seen on the color-coded gridded floor plan. Both floors show people observed in the deeper parts of the lab (closer to the windows), as well as the closed offices. Lesser presence was seen in the central corridor including the privacy room.

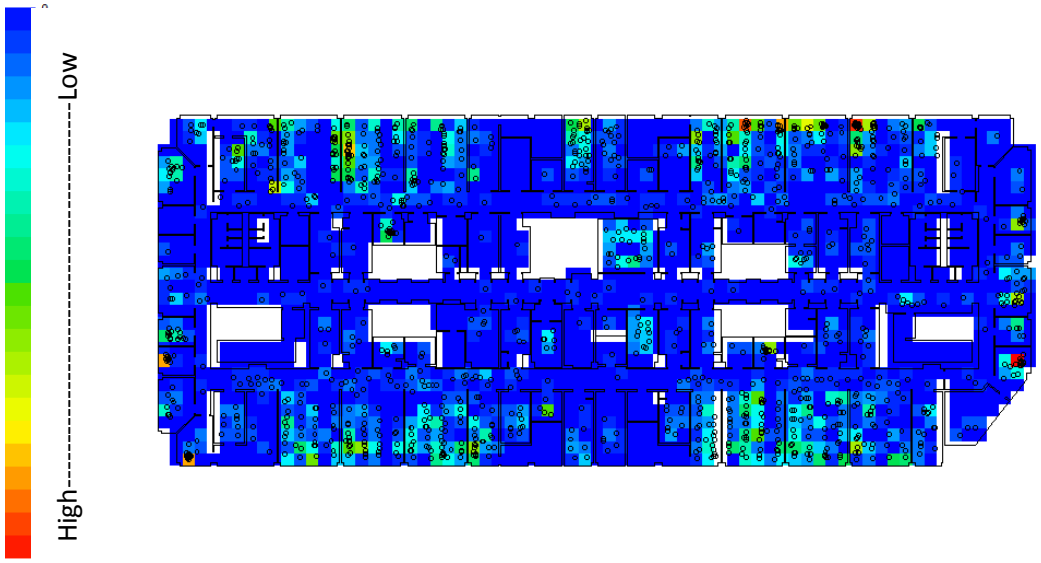

Figure 4.9 Total Observed Presence on the 5th Floor of the LSI

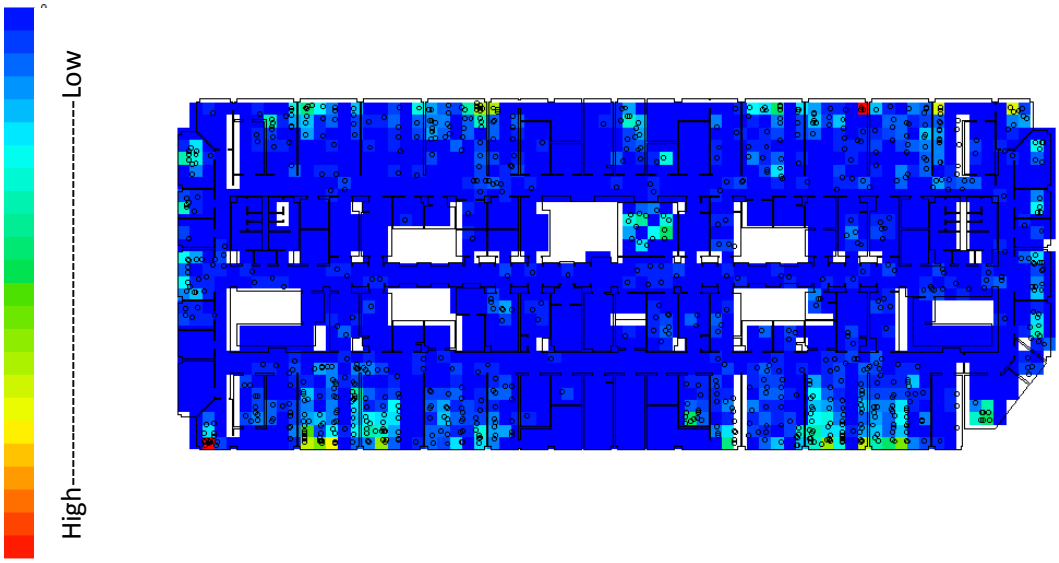

Figure 4.10 Total Observed Presence on the 6th Floor of the LSI

Using the same technique in *Syntax2D*, the frequency of movement and interactions are analyzed. The 5th floor lab corridors are used more frequently for movement than the central corridor. Additionally, the 5th floor's east elevator (the one easily accessed from the lobby on the 3rd floor) has a high level of movement. The 6th floor shows movement in the lab corridors, with more near the east and west ends, as well as movement in the east side of the central corridor. The 6th floor shows more movement within the lab themselves with clusters of movement around particular labs. Movement is also higher outside the east group area and elevator.

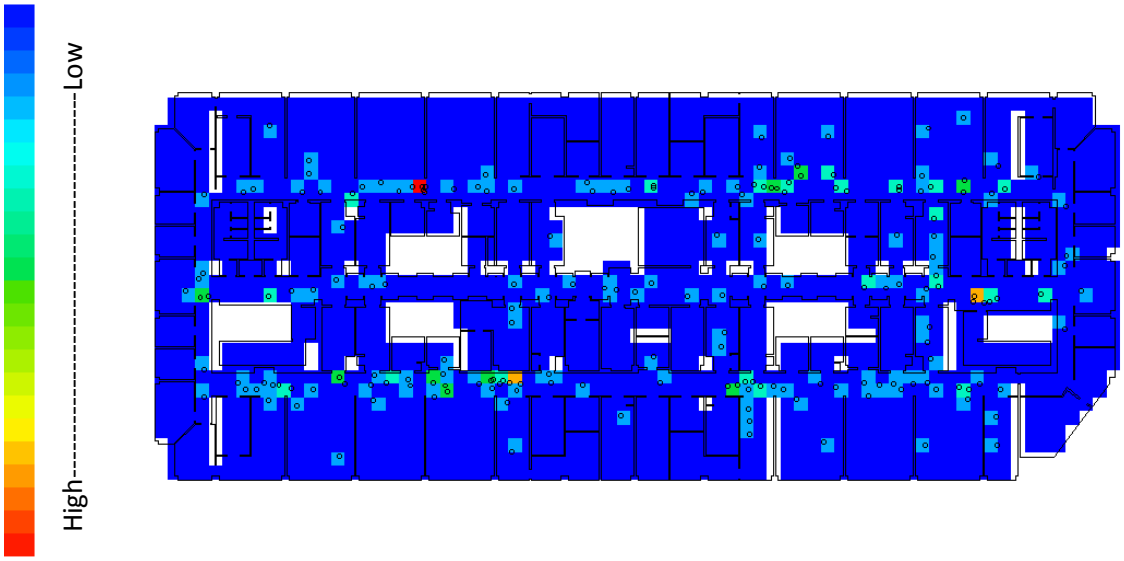

Figure 4.11 Total Observed Movement on the 5th Floor of the LSI

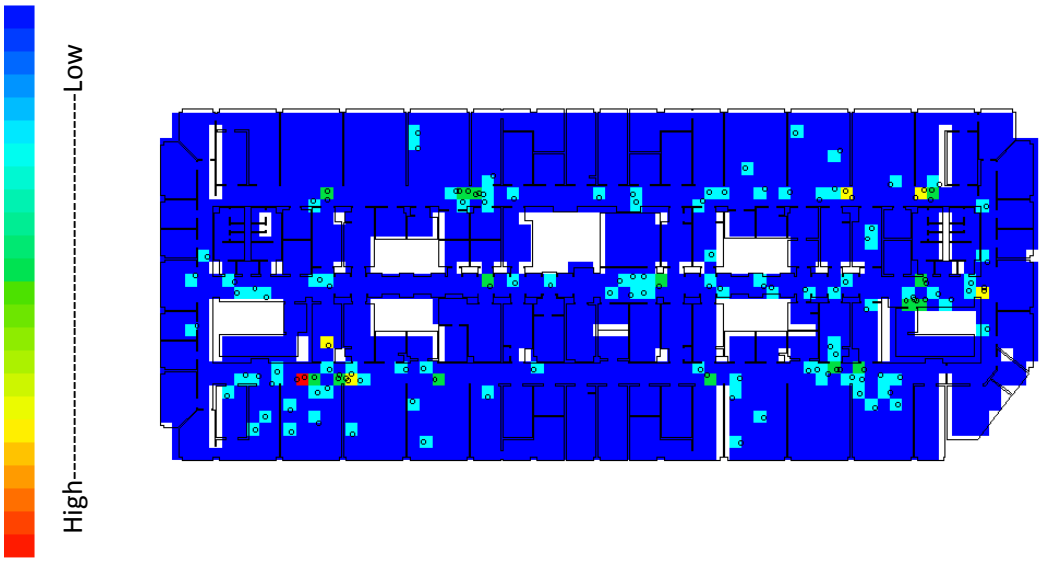

Figure 4.12 Total Observed Movement on the 6th Floor of the LSI

Interaction levels on both the 5th and 6th floor conference rooms are high. The small conference room on the 5th floor is used as an interaction area more often than the 6th floor. The east group area on the 5th floor is a popular interaction area on the floor, as are several of the lab spaces. 6th floor interactions are few

in number besides the large conference room area. The west group area and a few lab areas are seen as additional areas of interaction. The shared equipment areas on the 5th floor are places of interaction, whereas on the 6th floor they are not.

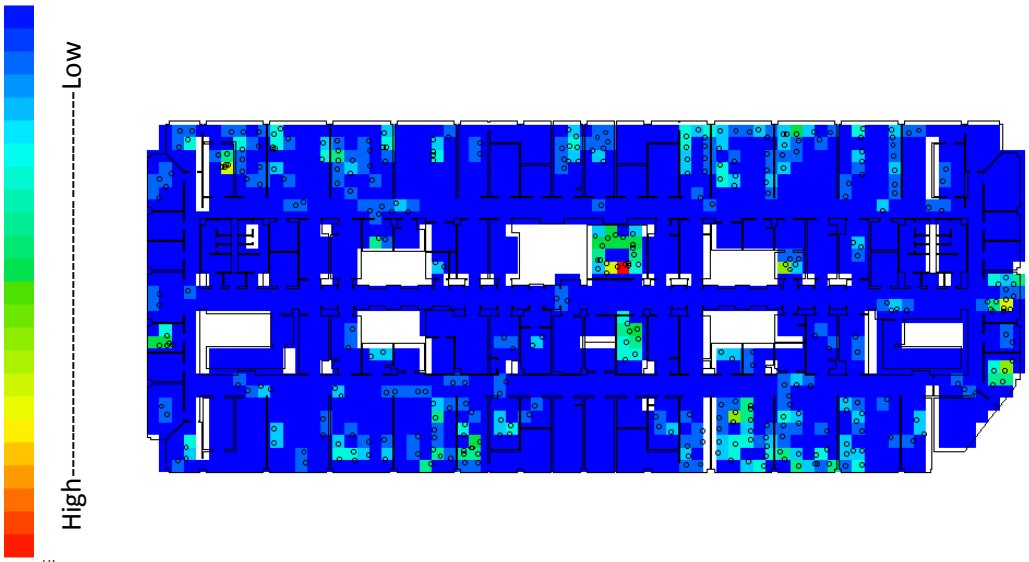

Figure 4.13 Total Observed Interaction on the 5th Floor of the LSI

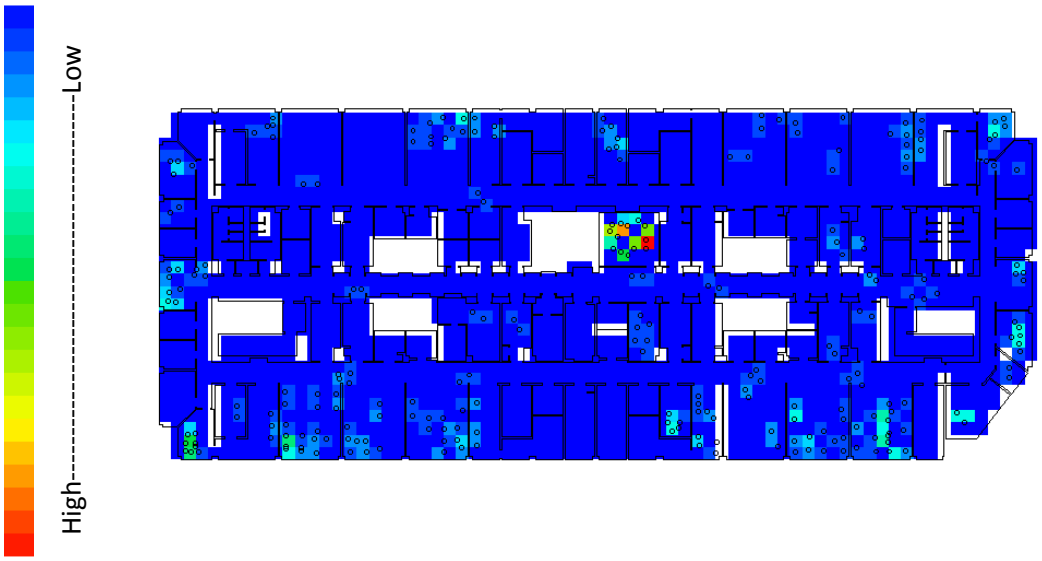

Figure 4.14 Total Observed Interaction on the 6th Floor of the LSI

4.5 The LSI Occupants' Survey Responses

The research subjects were distributed two online surveys, a Workplace Survey and Communication Survey, to evaluate their perceptions of the LSI as well as their interaction and collaboration within the space. Social Network Analysis from the Communication Survey provides a more detailed look in to the interaction and collaborative behaviors of the occupants.

4.5.1 Workplace Survey Responses

The Workplace Survey asked general questions as to the occupants' perceptions of the space as well as their satisfaction with the LSI. Their responses also included a self-reported amount of interaction, informal and formal, they partake in within the building.

The Workplace Survey responses show that the LSI research subjects slightly disagree (Mean=2.48 on 1-Disagree to 5-Agree Scale) that they have a sense of privacy in the LSI. The Job Interdependence Scale represents how much the respondents agree or disagree that their completion of job tasks is dependent on others. At the LSI, the responses were neutral (mean=2.95) on average meaning as a collective group they neither agree nor disagree that their job is dependent on others.

The research subjects responded that on average they 'somewhat agree' (mean=3.68) that they are pleased with the LSI's spatial layout. The respondents have a similar response (mean=3.50) when asked if the LSI provides sufficient

and appropriate space for interaction to occur as well as ease of access to those they need to interact with (Interaction Support Scale). The Workspace Satisfaction Scale shows that on average the respondents are satisfied with their workspace environment (mean=4.34). An additional question (not scale) asked if the occupants are satisfied with their job and most respondents most agreed that they were satisfied (mean=4.34). An additional variable of interest that was not based on a scale of questions, but one question, was the respondents' overall sense of community at the LSI. Most of the respondents agree (mean=4.36) that there is a sense of community.

	N	Minimum	Maximum	Mean	Std. Deviation
Spatial Layout (Scale)	12	3.0000	4.0000	3.679167	.3939649
Privacy (Scale)	12	1.0000	4.2500	2.479167	1.0998881
Interaction Support (Scale)	12	3.0000	4.1667	3.500000	.3692745
Job Interdependence (Scale)	11	1.7500	4.0000	2.954545	.7315923
Sense of Community	11	1.0000	5.0000	4.363636	1.2060454
Workspace Satisfaction (Scale)	12	3.7500	5.0000	4.343750	.4917646
Job Satisfaction	10	4.00	5.00	4.7000	.48305
Formal Interaction (Amount)	11	1.00	7.00	4.5455	1.86353
Informal Interaction (Amount)	11	.00	7.00	4.3636	2.15744

Table 4.3 LSI Workplace Survey responses descriptive

Two sets of questions evaluated how often (percentage scale) the occupants formally and informally interacted. The formal interaction questions asked the percentage of time in a work week they formally interacted with 1. Bosses, 2. Employees who report to them, 3. Fellow employees, and 4. Visitors. A total

count of all four responses provides an overall comparable count of how often a respondent formally interacts. LSI employees formally interact most with employees who report to them, followed closely by fellow employees. The four informal questions included how often (percentage scale) the respondents informally interact within a work week with 1. Bosses, 2. Employees who report to them, 3. Fellow employees within their department, and 4. Fellow employees outside their department. The average of the cumulative count of all informal interaction (mean=4.36) questions is similar to the amount of formal interaction (mean=4.55). The individual question results show that the respondents informally interact more with employees within the department than others (bosses, employees that report to them, or employees outside their department).

	N	Minimum	Maximum	Mean	Std. Deviation
Formal Interaction - Bosses	11	1.00	2.00	1.2727	.46710
Formal Interaction - Employees Report to you	7	1.00	2.00	1.7143	.48795
Formal Interaction - Fellow Employees	9	1.00	3.00	1.6667	.70711
Formal Interaction - Visitors	9	1.00	1.00	1.0000	.00000
Informal Interaction - Bosses	10	1.00	2.00	1.2000	.42164
Informal Interaction - Employees who report to you	7	1.00	2.00	1.1429	.37796
Informal Interaction - Fellow Employees in Department	11	1.00	2.00	1.4545	.52223
Informal Interaction - Fellow Employees outside department	6	1.00	1.00	1.0000	.00000

Table 4.4 LSI Workplace Survey formal and informal interaction response descriptives

4.5.2 Communication Survey Responses

The Communication Survey was distributed to research subjects to gather interaction and collaboration data that is used for social network analysis (SNA). The data was entered into *Ucinet* software for analysis. The research subjects were asked who: 1. They talk to within the LSI, 2. It is crucial for them to talk to perform their job, 3. They have collaborated with in the past, 4. They are collaborating with now, and 5. They informally interact with outside the LSI. The SNA measurements included in this study are degree and closeness. Degree is a local measure that measures the number of direct connections a person has to other people. Closeness is a global measure that measures the mean of the shortest path it takes one person to contact all other people within the environment (SNA). The data was normalized so it could be potentially compared to people in other environments.

The SNA degree data shows that the lab members talk to more colleagues in the SNA than do the Principal Investigators (PIs). But, in three other areas ('crucial people to talk to for job tasks', and past and current collaborations) the PIs have higher scores (larger mean degree). 'Crucial people to talk to for job tasks' refers to other respondents identifying a respondent as a crucial person they need to interact with to complete their jobs. Past and current collaborations refer to who the respondents have collaborated with before the survey was distributed and who they are collaborating with at the time of completing the survey. The data

also shows that lab members and PIs informally interact outside the LSU with a similar amount of people.

	N	Minimum	Maximum	Mean	Std. Deviation
SNA Degree Talk					
Lab Members	9	6.3490	57.1430	28.042333	18.0632462
Principal Investigators	3	9.5240	38.0950	23.809667	14.2855000
SNA Degree Crucial					
Lab Members	9	1.5870	7.9370	4.409222	2.0663659
Principal Investigators	3	3.1750	7.9370	5.820333	2.4246190
SNA Degree Past Collaboration					
Lab Members	9	3.1750	17.4600	9.876667	5.9270537
Principal Investigators	3	11.1110	19.0480	16.402333	4.5824291
SNA Degree Now Collaboration					
Lab Members	9	.0000	7.9370	4.233000	2.3809167
Principal Investigators	3	6.3490	12.6980	8.994667	3.3040043
SNA Degree Informal Outside					
Lab Members	9	.0000	6.3490	3.350889	2.6848581
Principal Investigators	3	.0000	9.5240	3.703667	5.1026319

Table 4.5 SNA Degree Descriptive Data for the LSI

The SNA closeness data is very similar, for some, almost identical, for both the lab members and PIs in the LSI.

	N	Minimum	Maximum	Mean	Std. Deviation
SNA Closeness Talk					
Lab Members	9	23.5070	29.4390	25.675333	2.1121280
Principal Investigators	3	24.6090	26.6950	25.672667	1.0436141
SNA Closeness Past Collaboration					
Lab Members	9	2.2500	2.4650	2.326222	.0776109
Principal Investigators	3	2.2620	2.3720	2.299667	.0626605
SNA Closeness Now Collaboration					
Lab Members	9	.0000	1.8490	1.571111	.5947032
Principal Investigators	3	1.6670	1.8510	1.737667	.0991430
SNA Closeness Informal Outside					
Lab Members	9	.0000	1.7840	1.359667	.7713663
Principal Investigators	3	.0000	1.7850	1.168667	1.0126008

Table 4.6 SNA Closeness Descriptive Data for the LSI

CHAPTER V

CASE STUDY 2: NATURAL SCIENCES BUILDING

5.1 Chapter Overview

This Chapter provides an in-depth look into the background information to the design, layout and intent of the second case study of this project, the Natural Sciences Building (NSB) at the University of California, San Diego (UCSD). Following the description of the layout and narrative, the chapter continues with a comparison of the spatial use patterns and the spatial layout of the research floors with the NSB.

5.2 Natural Sciences Building and Laboratories

The Natural Sciences Building was also completed in 2003 and was designed by Bohlin, Cywinksi & Jackson. The NSB is located on the main La Jolla campus next to additional classroom buildings and commons building and dormitory. The building is on the western edge of campus within close proximity to non-UCSD

research institutions such as the Neurosciences Institute and Scripps Institute of Oceanography.

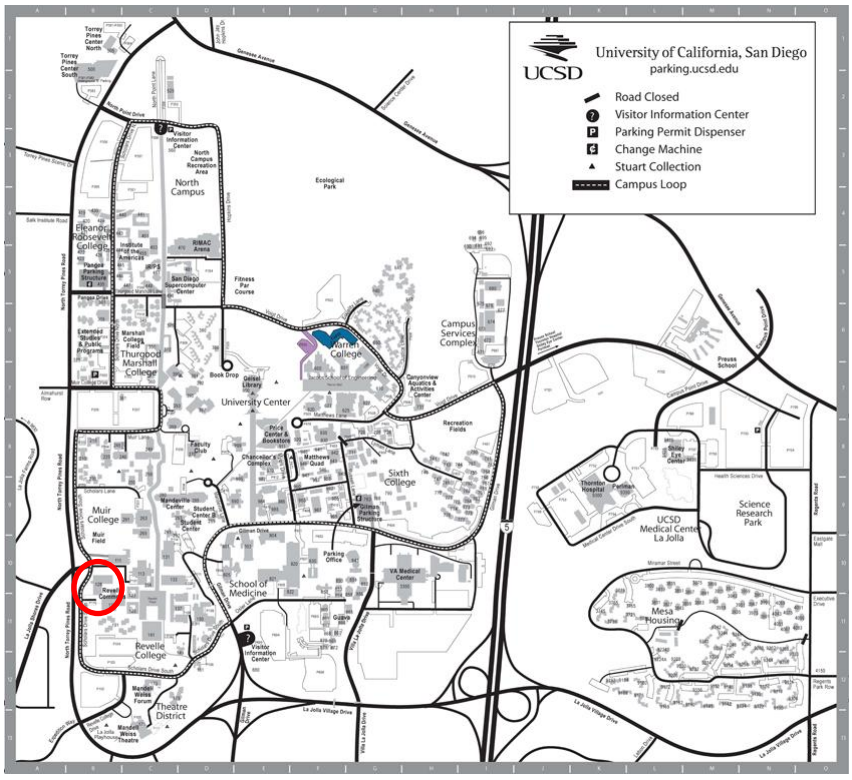

Figure 5.1 NSB (in red circle) on University of California, San Diego campus (University of California, San Diego, n.d.)

The NSB was designed with the same intent as the LSI: to provide an environment where interdisciplinary scientists can interact with the potential of collaboration on research projects. The NSB is the home to two Dean offices: the Dean of Physical Sciences and Dean of Biological Sciences. "The Natural Sciences Building serves as the center for biochemistry, molecular biology and biophysics study at UCSD, bringing together students and faculty from all three departments to promote scientific collaboration" ("Division of", n.d.).

Figure 5.2 Exterior photo (west façade) at NSB at the University of California, San Diego. (University of California, San Diego, 2004).

The NSB building has six floors with the first two floors containing teaching lab areas and the higher floors housing the research labs. The entrance lobby is two stories and provides enough space for gathering before a class, as well as tables for taking a break. The entrance floor also provides a large auditorium space that can be reserved through the Division of Physical Sciences by NSB occupants. The third and fourth floors provide two conference rooms of different sizes (one with a capacity of 20 and another with a capacity of 40). The conference rooms on the third floor are managed by the Department of Chemistry and Biochemistry, whereas the fourth floor rooms are managed by the Division of Biological Sciences. The Dean of Biological Sciences and the Dean's

support staff are located on the 6th floor. The Dean of Physical Sciences and the Dean's support staff are located on the 5th floor. There are 30 Principal Investigators in the NSB with approximately 4-20 lab members on their teams in addition to a support staff of approximately 50 additional people. This study's research participants include seven PIs and their lab groups that are located on three floors (3rd, 5th & 6th) with in the NSB.

5.3 NSB's 3rd, 5th and 6th Floor Layouts

This section provides a descriptive explanation of the floor layouts of each of the floors included in the study. The 3rd, 5th and 6th floors are described in terms of layout as well as their spatial properties defined by space syntax analysis.

5.3.1 Layout Characteristics

The three floors, 3rd, 5th and 6th, are relatively the same in layout, except that where the conference rooms are located on the third floor is where the Dean offices and staff are located on the fifth and sixth floors. Break areas that provide whiteboards and seating with tables are located in the elbow of each floor of the L-shaped building. The elevator bank (two) is located in the corner of the L or elbow of the building. An additional service elevator is located on the end of one corridor. There are three stairwells in the building (all outdoor and covered), one

located behind the elevators with the other two located on the exterior of the building at the end of the central corridors. Central corridors run down the center of each wing, leading from the elevator that is located near the break areas. Just like the LSI, the lab areas are predominantly open with shared equipment located nearby. Additionally, the third floor offers an outdoor patio as an alternative break area.

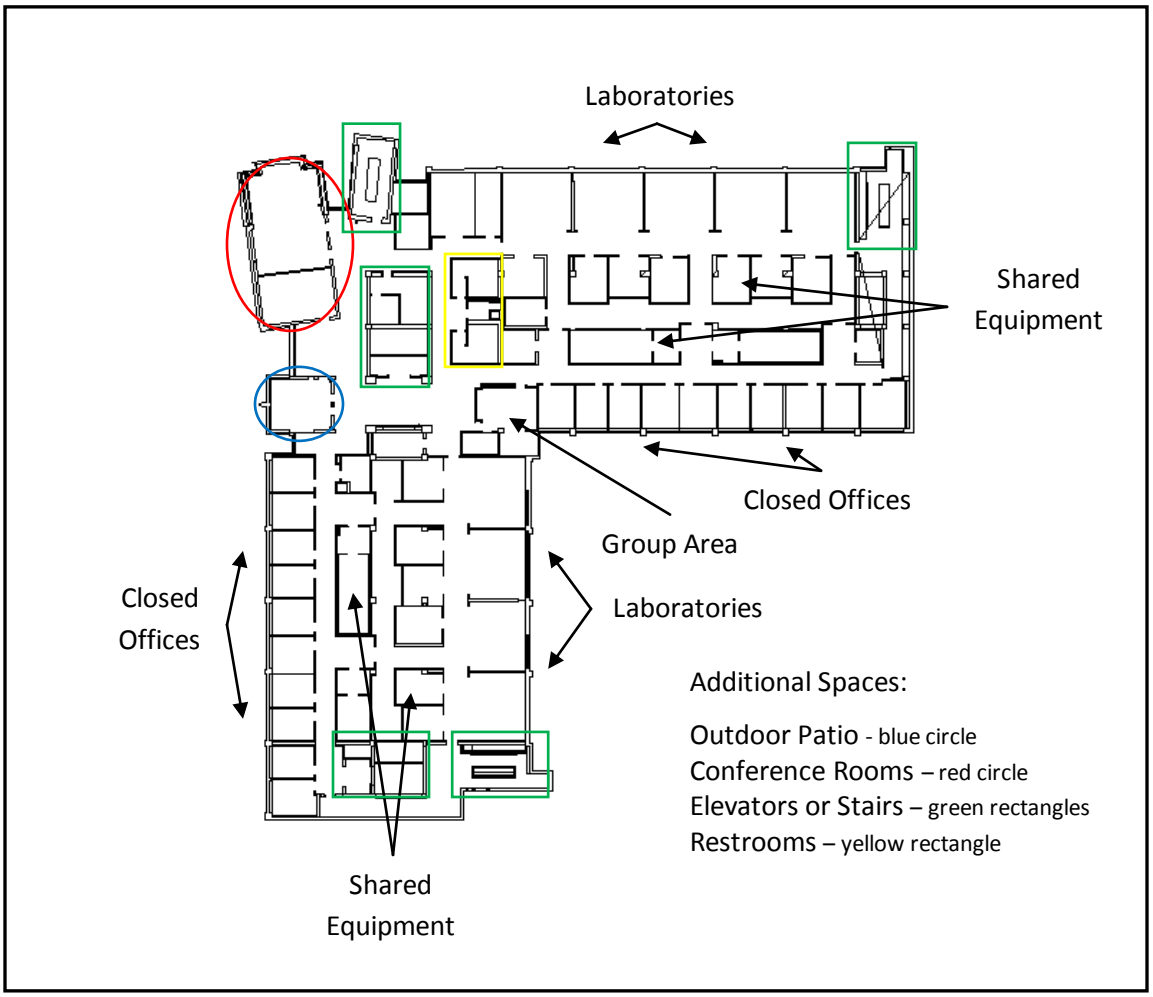

Figure 5.3 NSB's 3rd Floor Plan

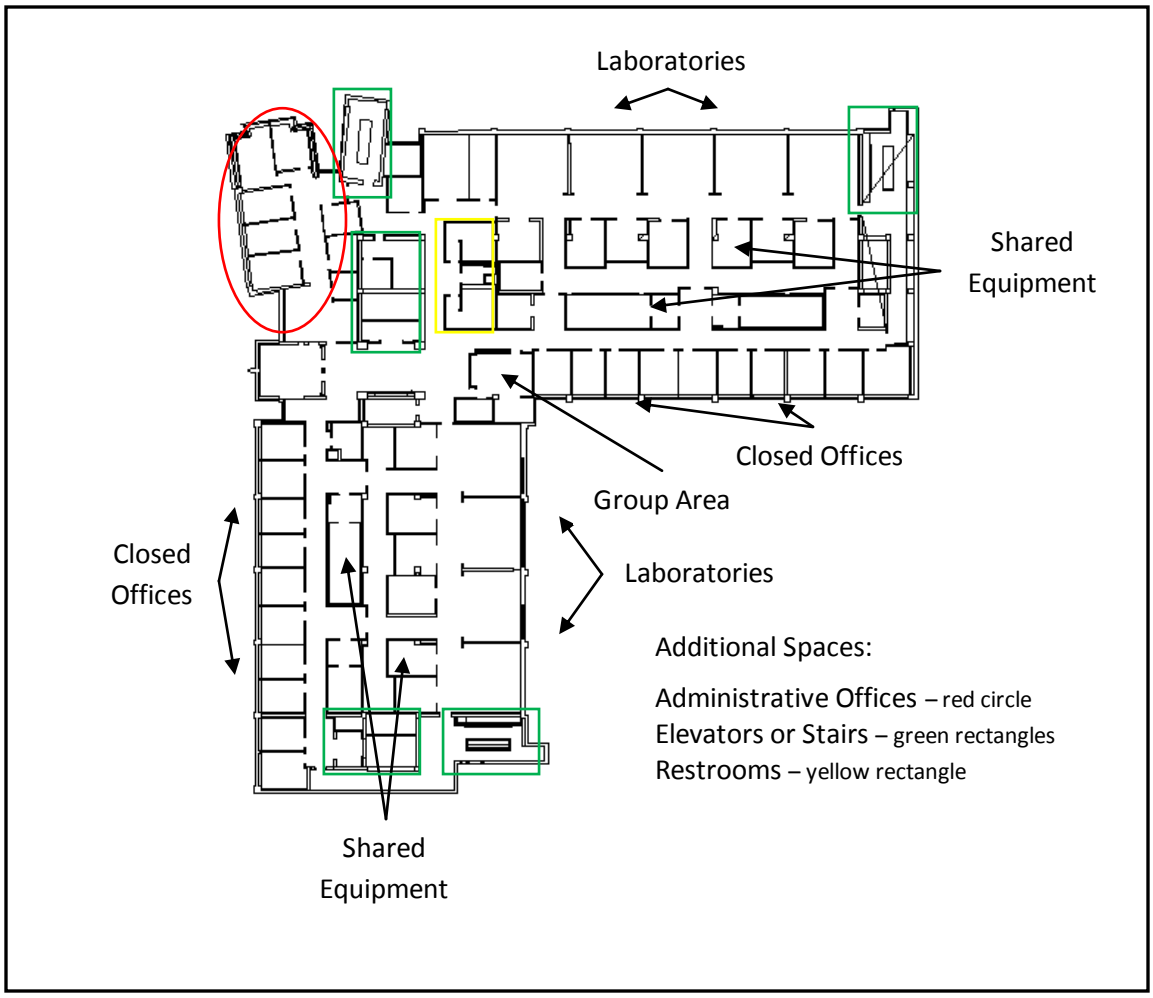

Figure 5.4 NSB's 5th Floor Plan

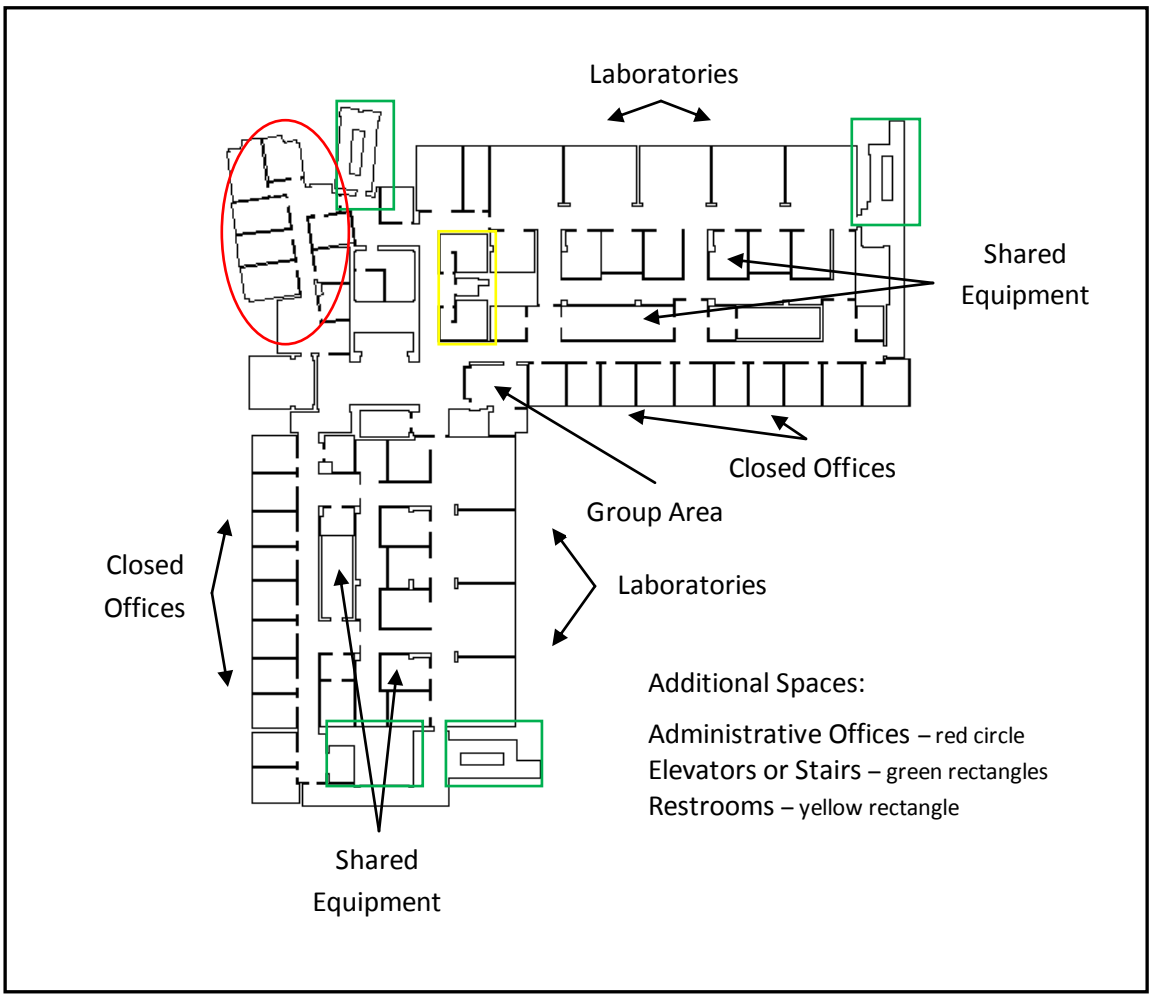

Figure 5.5 NSB's 6th Floor Plan

5.4 The Spatial Layout and the Space Use Patterns

This section outlines visibility properties of the spatial layout as well as the observed space use patterns and how they are related to the spatial layout within the NSB.

5.4.1 The Spatial Layout Properties

Graph analysis in *Syntax2D* provides descriptive and visual output of the connectivity and integration values of the NSB's three floors included in the study. Due to the floors being nearly identical in layout, the levels of connectivity and integration are similar between the floors.

	N	Minimum	Maximum	Mean	SD
Cell Connectivity Value					
3rd Floor	1280	2.00	128.00	40.7445	26.68555
5th Floor	1244	1.00	127.00	36.5957	26.31555
6th Floor	1241	1.00	127.00	37.3578	26.54332
Cell Integration Value					
3rd Floor	1280	6.00	481.33	266.6282	56.24283
5th Floor	1244	6.00	426.77	238.5680	51.35070
6th Floor	1241	6.00	422.82	237.9781	51.18628

Table 5.1 Connectivity and Integration Descriptive Statistics

The 5th and 6th floors are more similar to each other due to both having administrative offices where the 3rd floor as conference rooms.

The connectivity levels are highest on all three floors in the lab corridor on the north side of the building. The lab corridor on the south side on all floors is also comparatively strong as well as the area outside the large conference room and outdoor area on the 3rd floor. The lowest connectivity levels on all floors are the closed offices. The labs have a similar medium level of connectivity on all floors.

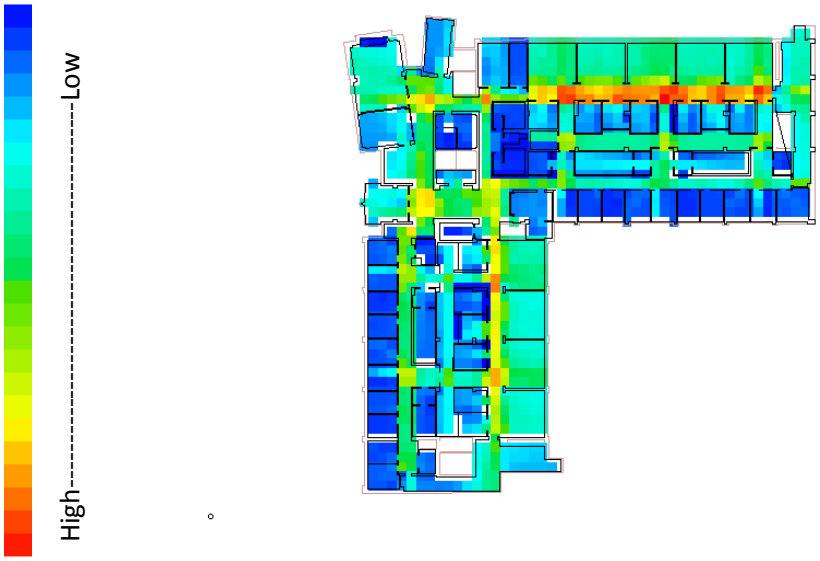

Figure 5.6 Connectivity on the 3rd Floor of the NSB

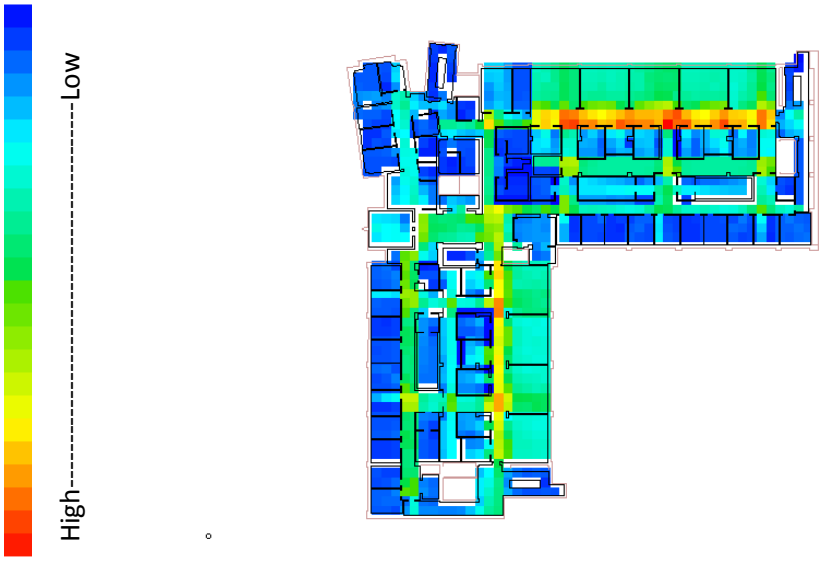

Figure 5.7 Connectivity on the 5th Floor of the NSB

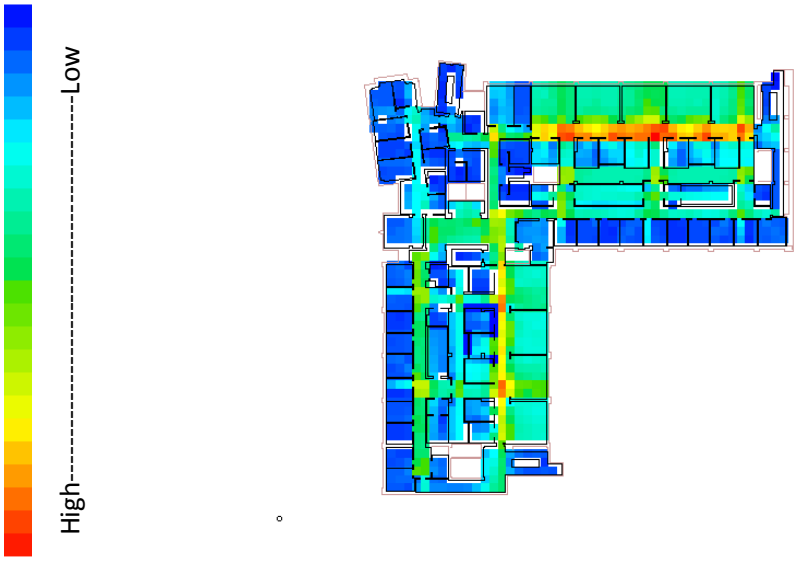

Figure 5.8 Connectivity on the 6th Floor of the NSB

Just at the connectivity is high in the lab corridors on all floors, so are the levels of integration. Integration is particularly high where corridors intersect as seen in the center of the building. Outside of the corridors, there is little fluctuation of levels of integration.

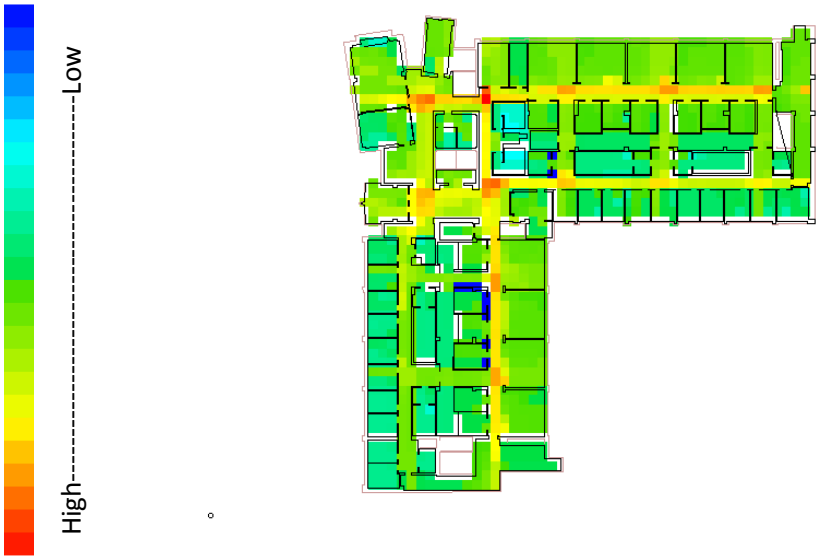

Figure 5.9 Integration on the 3rd Floor of the NSB

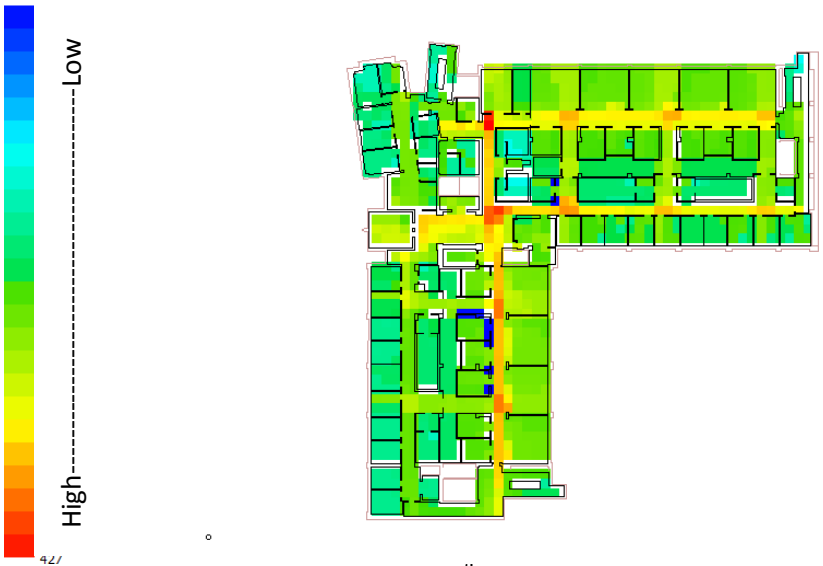

Figure 5.10 Integration on the 5th Floor of the NSB

Figure 5.11 Integration on the 6th Floor of the NSB

The researcher's observations and interviews revealed initial information as to the use of the NSB. It was observed that the laboratory floors' centrally located group area also doubles as a meeting area and this was confirmed through the interviews with the PIs. The meeting rooms on the 3rd floor appear to be not only used for lab meetings, but also for class lectures. Small group conservations concentrate around the window areas of the labs. The three stairwells (all exterior) are observed to be rarely used.

Similar to the LSI, the NSB offers several different opportunities for their PIs and lab members to socialize with each other. The NSB lab groups each host their own lab meetings, often weekly or bi-weekly, to discuss administrative matters, research updates and future plans. These meetings often take place in the floor's group area or a conference room located on either the third or fourth floor. Informally, the building occupants rotate (by lab group) hosting a weekly happy hour on one of the building's outdoor break area patios that is open to all NSB occupants. Additionally, both the Division of Biological Sciences and Division of Physical Sciences host seminars on a quarterly basis with speakers from all over the world. The events often take place during the lunch hour in the auditorium and are advertised to all NSB occupants via flyers in the elevator banks. The next section provides statistical insight into the use of the spaces.

5.4.2 The Distribution of the Space Use Patterns

The observation data recording the space use patterns was entered and analyzed using the same technique as with the LSI data. The space use patterns of total presence, movement and interaction are identified by looking at their frequencies.

	N	Minimum	Maximum	Mean	SD
Observed Total Presence					
3rd Floor	1280	.00	74.00	4.5313	9.72615
5th Floor	1244	.00	35.00	1.7315	4.25252
6th Floor	1241	.00	52.00	2.0669	4.93828
Observed Movement					
3rd Floor	1280	.00	5.00	.1945	.57750
5th Floor	1244	.00	5.00	.1342	.47848
6th Floor	1241	.00	5.00	.2039	.61396
Observed Interaction					
3rd Floor	1280	.00	29.00	.7977	2.32648
5th Floor	1244	.00	17.00	.3746	1.34942
6th Floor	1241	.00	12.00	.5189	1.32464

Table 5.2 Observed Behaviors Descriptive Statistics

The 3rd floor shows more presence in the closed offices and conference rooms versus the labs and group/shared spaces. Those observed in the labs are distributed along the windows and lab benches, with more presence in the north lab area versus the south. The 5th floor also shows a large presence in the closed offices, particularly by the windows. Additionally, the 5th floor's south labs show more presence than the north labs. The south shared equipment rooms also show more presence than the north, except for one shared equipment room on the north side near the office corridor. The group area appears to have low to

medium presence on this floor. The 6th floor has a similar level of presence of people in the closed offices, except for a select few. The 6th floor north labs have more presence than the 5th floor, but not more than the 3rd floor. The lab presence on all floors is distributed across the lab bench as opposed to being clustered near the windows or one area in particular.

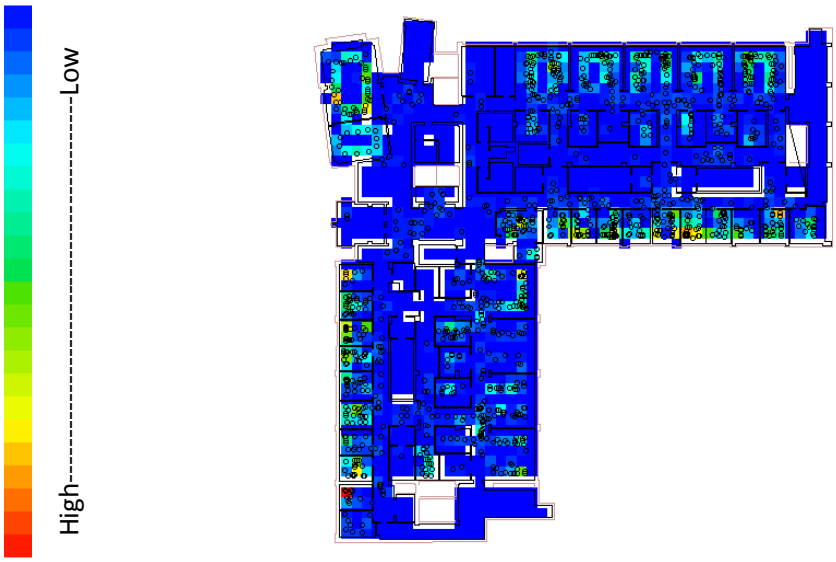

Figure 5.12 Total Observed Presence on the 3rd Floor of the NSB

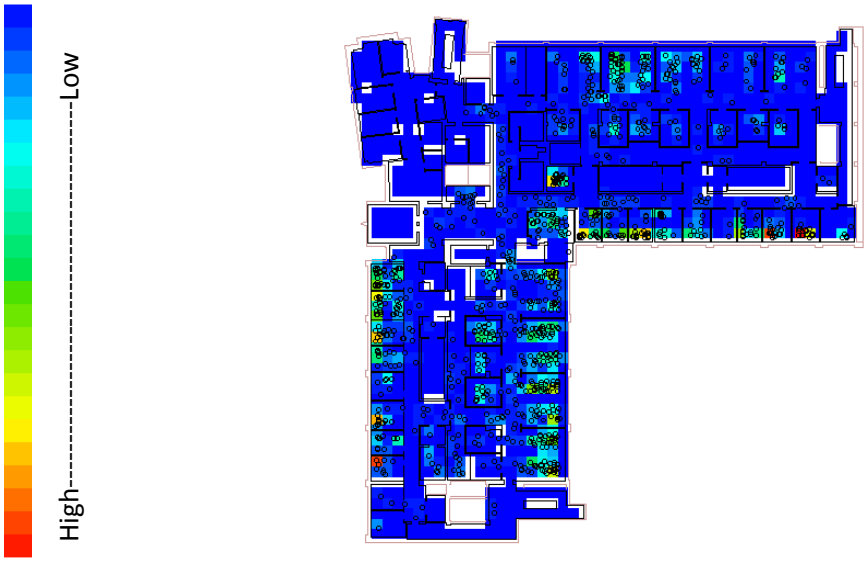

Figure 5.13 Total Observed Presence on the 5th Floor of the NSB

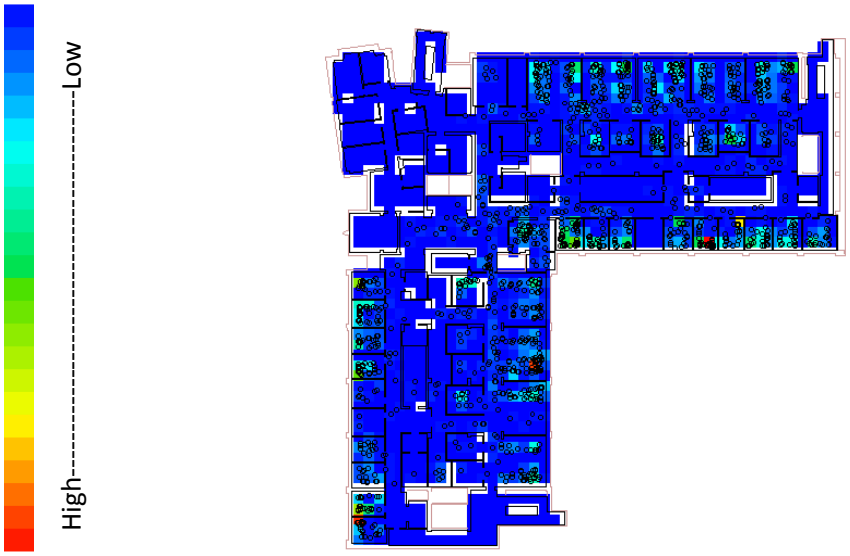

Figure 5.14 Total Observed Presence on the 6th Floor of the NSB

The graph analysis displays the similarities and differences between the floor's movement and interaction levels. Across all floor of the NSB, the main corridors are more popular areas for movement than any other spaces in the building. The 5th and 6th floors show a stronger movement presence in the south lab corridor, whereas the 3rd floor shows almost equal movement between the office and lab corridors. The 3rd and 6th floors show more movement in the corridors that attach the lab corridor to the office corridor in the north side of the building. The 5th floor has a significant amount of movement near the restrooms as the 3rd floor has a low amount.

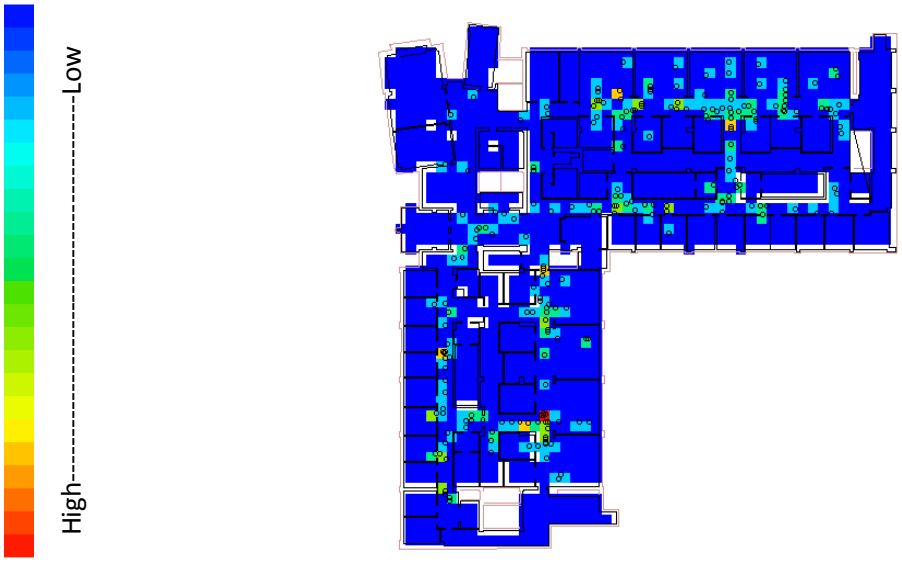

Figure 5.15 Total Observed Movement on the 3rd Floor of the NSB

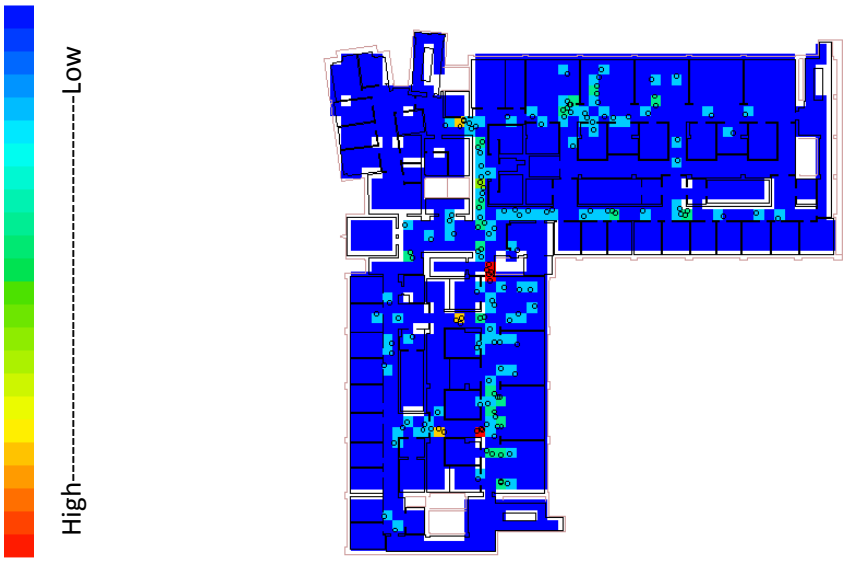

Figure 5.16 Total Observed Movement on the 5th Floor of the NSB

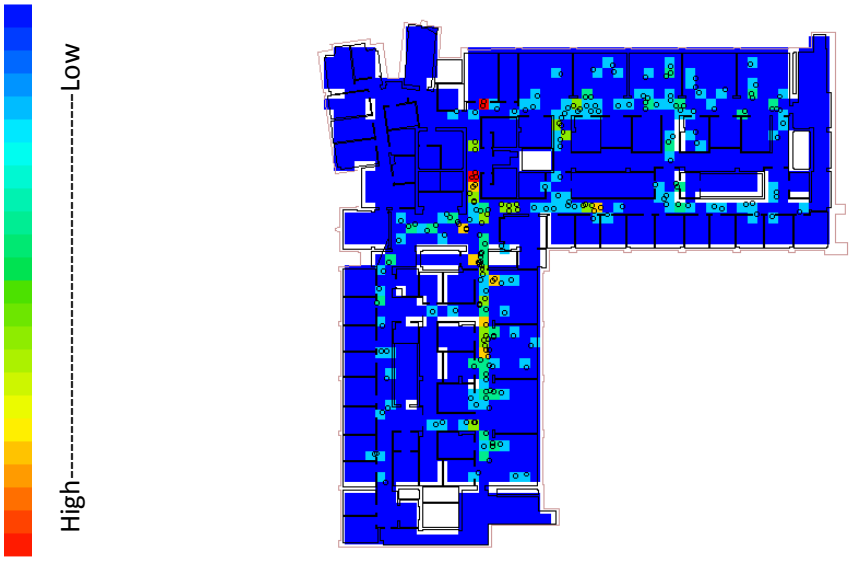

Figure 5.17 Total Observed Movement on the 6th Floor of the NSB

The highest levels of interaction on the 3rd floor are in the conference rooms (larger more than the smaller), followed by the group area, a few labs, and closed offices on the south side. The 5th floor's highest concentrations of interactions are in the group area and one closed office on the north side. Besides that one office, the north side labs and offices show little interaction on the 5th floor. The 5th floor south side has approximately equal interaction levels between the labs and offices. The 6th floor appears to have a large distribution of interaction, with the primary areas being the group area, one lab on the north side and an office on the south side.

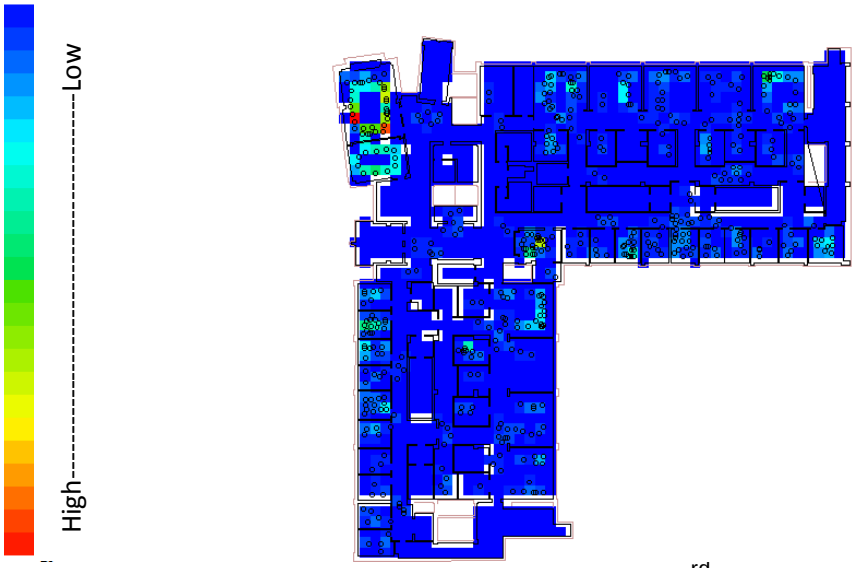

Figure 5.18 Total Observed Interaction on the 3rd Floor of the NSB

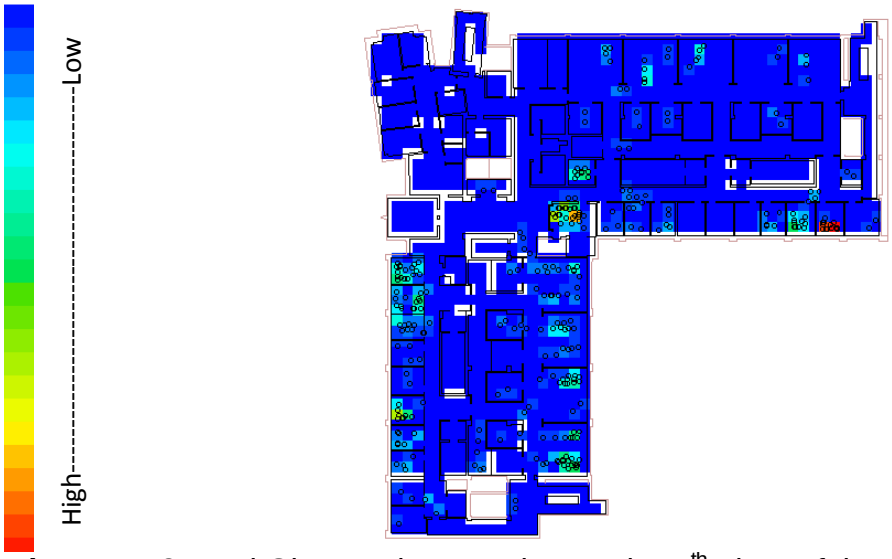

Figure 5.19 Total Observed Interaction on the 5th Floor of the NSB

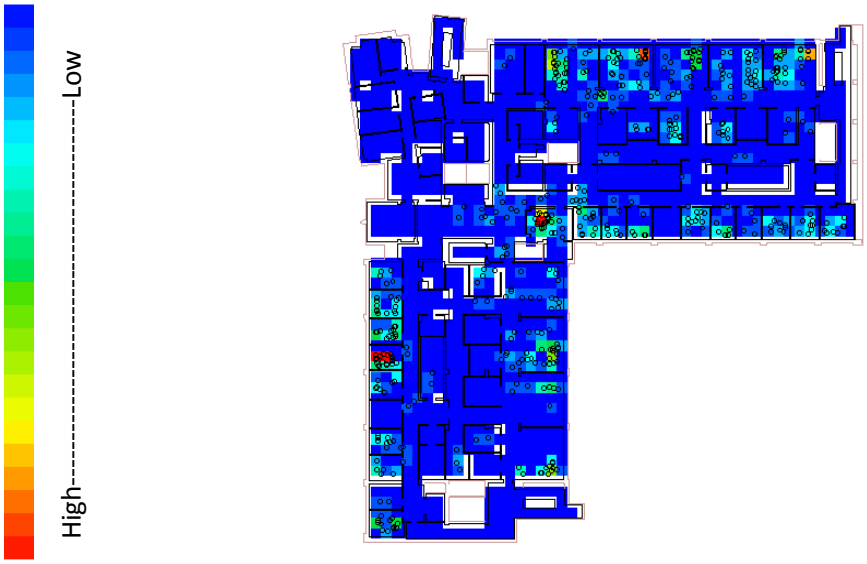

Figure 5.20 Total Observed Interaction on the 6th Floor of the NSB

5.5 The NSB Occupants' Survey Responses

The NSB research subjects' survey responses provide insight into their perceptions of the space as well as their behavior (interaction and collaboration in particular) within the space. A summary of pertinent questions and scales of the two surveys, Workplace Survey and Communications Survey, follows.

5.5.1 Workplace Survey Responses

The Workplace Survey responses indicate that the NSB occupants 'slightly disagree' that they have a sense of privacy in the NSB with a mean response rate of 2.47 (on a scale 1-Disagree, 5-Agree). The Job Interdependence Scale's

average response of 3.04 represents a neutral perception (neither agree nor disagree) of the respondents that their job requires working with others.

Additionally, the average response to the Spatial Layout Scale (measures degree of agreement the occupant is pleased with the space) is also neutral with a mean of 3.17. The respondents also neither agree nor disagree that their spatial layout supports interaction (mean=3.00). Although the respondents are neutral on their responses to the support they perceive the spatial layout provides, most agree they are satisfied with their workspace (mean=4.29). The one question response regarding their satisfaction with their job is high (mean=4.69) which can be interpreted that most agree that they are satisfied with their job. Most NSB occupants also are in agreement that there is a sense of community in the NSB (mean=4.23).

	N	Minimum	Maximum	Mean	Std. Deviation
Spatial Layout (Scale)	15	1.6000	4.0000	3.173333	.7478222
Privacy (Scale)	15	1.0000	3.7500	2.466667	.8806789
Interaction Support (Scale)	15	2.1667	4.0000	3.000000	.4318656
Job Interdependence (Scale)	13	1.5000	5.0000	3.038462	.8590581
Sense of Community	13	1.0000	5.0000	4.230769	1.3008873
Workspace Satisfaction (Scale)	15	2.8750	5.0000	4.291667	.6367935
Job Satisfaction	13	3.00	5.00	4.6923	.63043
Formal Interaction (Amount)	13	2.00	8.00	4.9231	1.65638
Informal Interaction (Amount)	13	1.00	9.00	5.0769	2.17798

Table 5.3 NSB Workplace Survey responses descriptive

The amount of interaction self-reported by the occupants is roughly the same for both formal and informal interaction in the NSB. The individual formal interaction

responses indicate that most formal interaction is with fellow employees while the least is with visitors. NSB respondents informally interact more with fellow employees within their department than others (bosses, employees that report to them, and employees outside their department).

	N	Minimum	Maximum	Mean	Std. Deviation
Formal Interaction - Bosses	11	1.00	3.00	1.5455	.93420
Formal Interaction - Employees Report to you	11	1.00	3.00	1.4545	.68755
Formal Interaction - Fellow Employees	11	1.00	4.00	1.7273	1.00905
Formal Interaction - Visitors	10	1.00	2.00	1.2000	.42164
Informal Interaction - Bosses	11	1.00	4.00	1.5455	.93420
Informal Interaction - Employees who report to you	10	1.00	2.00	1.2000	.42164
Informal Interaction - Fellow Employees in Department	13	1.00	3.00	1.6923	.85485
Informal Interaction - Fellow Employees outside department	12	1.00	3.00	1.2500	.62158

Table 5.4 NSB Workplace Survey formal and informal interaction response descriptive

5.5.2 Communication Survey Responses

The Communications Survey provides data as to who the respondents talk to and collaborate with. The responses were entered into *Ucinet* software to perform social network analysis. The research subjects were asked who: 1. They talk to within the NSB, 2. It is crucial for them to talk to in order to perform their job, 3. They have collaborated with in the past, 4. They have are collaborating with now, and 5. They informally interact with outside the NSB. The

SNA measurements included in this study are degree and closeness. Degree is a local measure that measures the number of direct connections a person has to other people. Closeness is a global measure that measures the mean of the shortest path it takes one person to contact all other people within the environment (NSB). The data was normalized so it could be potentially compared to people in other environments.

The SNA degree data shows that on average the Principal Investigators (PIs) talk to more people than their lab members. The mean degree data is roughly the same for lab members and PIs in reference to how crucial that person is for others to complete their jobs. The PIs have a higher mean degree in both past and current collaboration areas as well as who they informally interact with outside the NSB.

	N	Minimum	Maximum	Mean	Std. Deviation
SNA Degree Talk					
Lab Members	13	6.3830	47.8720	17.430385	10.5271699
Principal Investigators	3	29.7870	46.8090	40.071000	9.0480776
SNA Degree Crucial					
Lab Members	13	.0000	4.2550	2.291154	1.3625605
Principal Investigators	3	1.0640	4.2550	2.482333	1.6247413
SNA Degree Past Collaboration					
Lab Members	13	.0000	9.5740	3.436923	2.8528909
Principal Investigators	3	1.0640	8.5110	6.028667	4.2995275
SNA Degree Now Collaboration					
Lab Members	13	.0000	10.6380	3.273231	2.5493901
Principal Investigators	3	1.0640	8.5110	5.319333	3.8357519
SNA Degree Informal Outside					
Lab Members	13	.0000	10.6380	3.355000	2.6716974
Principal Investigators	3	1.0640	8.5110	5.319333	3.8357519

Table 5.5 SNA Degree Descriptive Data for the NSB

The SNA closeness data does not have a large variance between the lab members and PIs in the NSB. The PIs do have a larger mean in regards to who they talk to meaning they have easier access to everyone (need to contact less people to get to a particular person) in the building than the lab members.

	N	Minimum	Maximum	Mean	Std. Deviation
SNA Closeness Talk					
Lab Members	13	27.4850	38.5250	31.655308	2.7444882
Principal Investigators	3	36.5760	39.6620	38.047000	1.5480313
SNA Closeness Past Collaboration					
Lab Members	13	.0000	1.7980	1.455846	.6740191
Principal Investigators	3	1.0870	1.7950	1.556667	.4067583
SNA Closeness Now Collaboration					
Lab Members	13	.0000	1.2800	1.074154	.3329662
Principal Investigators	3	1.0870	1.2790	1.163333	.1018643
SNA Closeness Informal Outside					
Lab Members	13	.0000	1.2970	1.083692	.3367260
Principal Investigators	3	1.0870	1.2950	1.168667	.1109610

Table 5.6 SNA Closeness Descriptive Data for the NSB

CHAPTER VI

CASE STUDY RESEARCH RESULTS

6.1 Chapter Overview

This chapter explores the case study results through statistical relationships between the perceptions, space use patterns and spatial layout properties. The study's results are first discussed by case study. Each case study's results begin with correlational associations between variables, but not necessarily causal relationships. The correlational results help inform the regression models that provide more statistically significant predictive results. Regression models address the predictive qualities, if any, of the visibility properties of spatial layout on space use patterns. Additionally, the relationship between research subjects' Workplace Survey responses (perceptions and amount of interaction), Communication Survey responses (Social Network Analysis measurements), and Visibility Properties are evaluated.

Each section will refer back to the conceptual model introduced in Chapter 1. The conceptual model will highlight which variables will be addressed in that section.

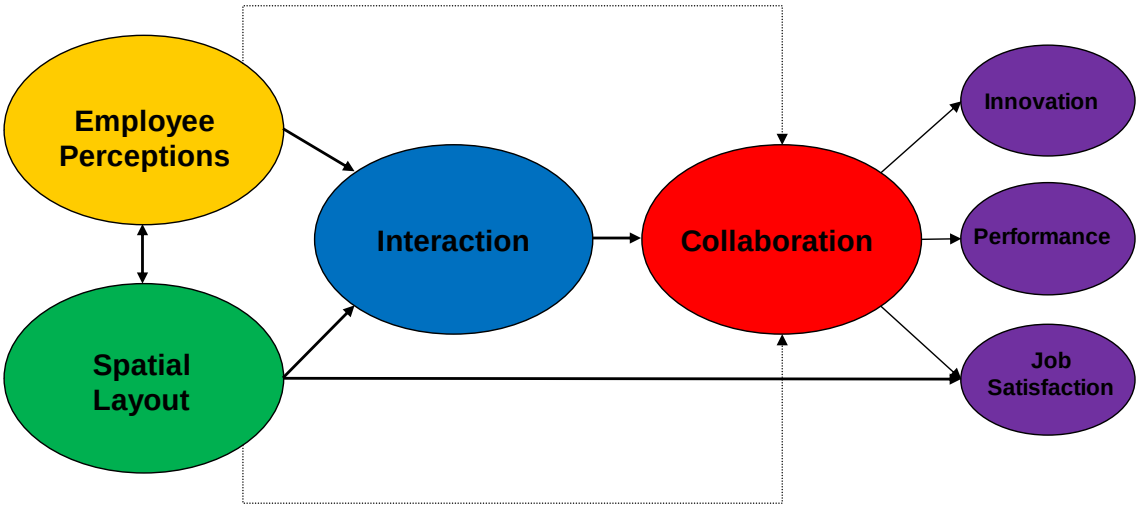

Figure 6.1 Conceptual Model

The following tables summarize the descriptive statistics at each case study site for the spatial (including observation data) and survey (including scales) variables. The LSI is overall a more connected and integrated environment, but has fewer observed interactions and movement. The survey responses for the two buildings are very similar.

		Minimum	Maximum	Mean	Std. Deviation
Cell Connectivity Value					
	NSB	1.00	128.00	38.2277	26.58186
	LSI	1.00	195.00	51.9832	54.19605
Cell Integration Value					
	NSB	2.00	481.33	247.7175	55.09131
	LSI	14.00	641.72	388.2601	96.05155
Observed Interactons					
	NSB	.00	29.00	.5658	1.74569
	LSI	.00	14.00	.2887	.90651
Observed Movement					
	NSB	.00	5.00	.1778	.56036
	LSI	.00	6.00	.1062	.40497

Table 6.1 Descriptive Statistics of Spatial Layout and Observations for NSB and LSI

		Minimum	Maximum	Mean	Std. Deviation
Spatial Layout (Scale)					
	NSB	1.6000	4.0000	3.173333	.7478222
	LSI	3.0000	4.0000	3.679167	.3939649
Privacy (Scale)					
	NSB	1.0000	3.7500	2.466667	.8806789
	LSI	1.0000	4.2500	2.479167	1.0998881
Interaction Support (Scale)					
	NSB	2.1667	4.0000	3.000000	.4318656
	LSI	3.0000	4.1667	3.500000	.3692745
Job Interdependence (Scale)					
	NSB	1.5000	5.0000	3.038462	.8590581
	LSI	1.7500	4.0000	2.954545	.7315923
Sense of Community					
	NSB	1.0000	5.0000	4.230769	1.3008873
	LSI	1.0000	5.0000	4.363636	1.2060454
Workspace Satisfaction (Scale)					
	NSB	2.8750	5.0000	4.291667	.6367935
	LSI	3.7500	5.0000	4.343750	.4917646
Job Satisfaction					
	NSB	3.00	5.00	4.6923	.63043
	LSI	4.00	5.00	4.7000	.48305
Formal Interaction (Amount)					
	NSB	2.00	8.00	4.9231	1.65638
	LSI	1.00	7.00	4.5455	1.86353
Informal Interaction (Amount)					
	NSB	1.00	9.00	5.0769	2.17798
	LSI	.00	7.00	4.3636	2.15744

Table 6.2 Descriptive Statistics of Survey Variables for NSB and LSI

Across both case studies, there was minimal variance between the job satisfaction responses. A histogram confirmed that a large number of respondents answered that they were “fully satisfied” with their job. Therefore, Job Satisfaction was dichotomized and re-coded to be a binary variable with “0” representing that they are not fully satisfied with their job and “1” representing they are “fully satisfied” with their job.

Additionally, during initial correlation analyses, it was found that the formal interaction and informal interaction scales from the Workplace Survey are highly correlated. Therefore, a new variable identified as “Total Interaction” was created as a single measurement variable of the amount of self-reported interaction. The Total Interaction variable is the sum of the Formal Interaction and Informal Interaction scales.

6.2 LSI

This section focuses on the statistical analysis of the data collected at the LSI from the various methods. The analysis will show if there is a relationship between the spatial layout variables, employee perceptions and behavior.

6.2.1 Correlation of Employee Perceptions and Spatial Layout

The initial section of the conceptual model identifies the possibility of relationships between spatial layout and employee's perception of their work environment and organization. The spatial layout properties are the visibility properties of integration and connectivity as calculated using space syntax analysis. For each respondent, the mean integration and connectivity values were calculated for of all the cells located in that particular respondent's workspace (office or lab). The employee perceptions include their view of sense of "Privacy", "Spatial Layout" support for their job, organizational "Interaction Support", "Job Interdependence", "Sense of Community, and "Workspace Satisfaction".

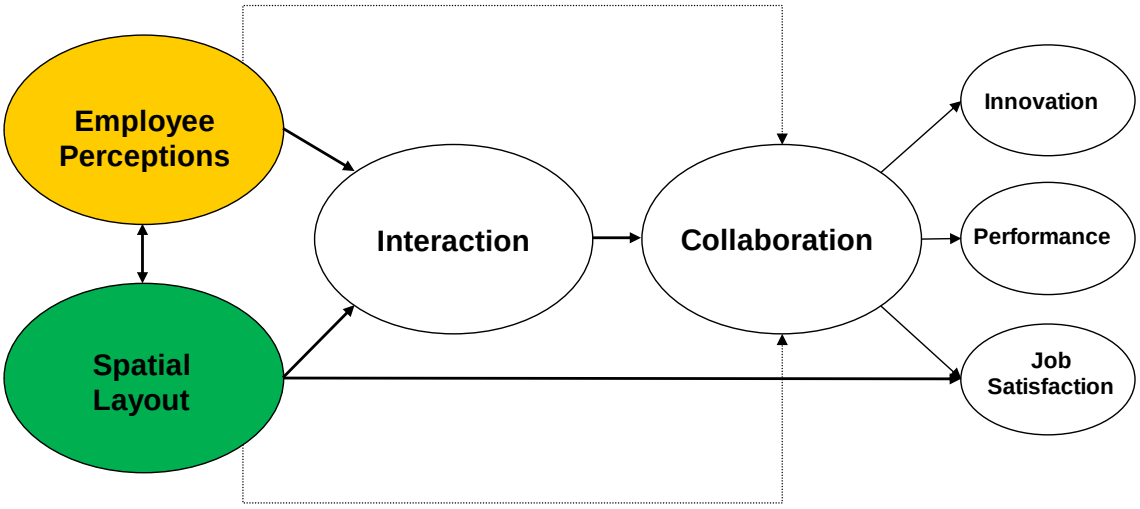

Figure 6.2 Conceptual Model variables correlated in this section at LSI

The LSI 's results show a negative correlation between integration and workspace satisfaction (-.689, .013). Similarly, Connectivity has a significant

negative correlation with Workspace Satisfaction (-.754, 005). A negative correlation is also seen between Integration and Privacy (-.590, .043).

		Spatial Layout Variables		Employee Perceptions Variables					
		Workspace Integration	Workspace Connectivity	Privacy	Interaction Support	Job Interdependence	Sense of Community	Spatial Layout Support	Workspace Satisfaction
Workspace Integration	Correlation	1	.948**	-.590*	-.251	.388	-.319	.517	-.689*
	Significance		.000	.043	.432	.238	.340	.085	.013
Workspace Connectivity	Correlation	.948**	1	-.545	-.193	.233	-.321	-.553	-.754**
	Significance	.000		.067	.548	.490	.335	.063	.005
Privacy	Correlation	-.590*	-.545	1	.485	-.365	.483	.508	.125
	Significance	.043	.067		.110	.270	.132	.092	.699
Interaction Support	Correlation	-.251	-.193	.485	1	-.528	.154	.526	-.073
	Significance	.432	.548	.110		.095	.651	.079	.822
Job Interdependence	Correlation	.388	.233	-.365	-.528	1	.304	-.484	-.185
	Significance	.238	.490	.270	.095		.364	.131	.586
Sense of Community	Correlation	-.319	-.321	.483	.154	.304	1	.045	-.103
	Significance	.340	.335	.132	.651	.364		.897	.764
Spatial Layout Support	Correlation	.517	-.553	.508	.526	-.484	.045	1	.536
	Significance	.085	.063	.092	.079	.131	.897		.072
Workspace Satisfaction	Correlation	-.689*	-.754**	.125	-.073	-.185	-.103	.536	1
	Significance	.013	.005	.699	.822	.586	.764	.072	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.3 Correlation Table for Spatial Layout and Employee Perception Variables at LSI

6.2.2 Correlation of Employee Perceptions, Interaction and Collaboration

This section looks at two different approaches to interaction measurement as well as one approach to collaboration measurement. The first,"Total Interaction", is the self-reported amount (percentage in a work week) the respondent interacts, both formally and informally, with others including bosses, fellow employees and visitors. Each of these individual questions was also correlated with employee perceptions. This information was collected via the Workplace Survey. The second approach to assessing interaction was through the Communication Survey. The respondents were asked to identify individuals with whom they talked and, using social network analysis (SNA), measurements of Degree, Closeness and Betweenness were calculated based on their responses.

The Communication Survey also asked additional interaction questions such as who it is crucial they talk to to get their job done and who they informally interact with (non-work related) outside the workplace. The Communication Survey also asked with whom respondents have collaborated currently and in the past.

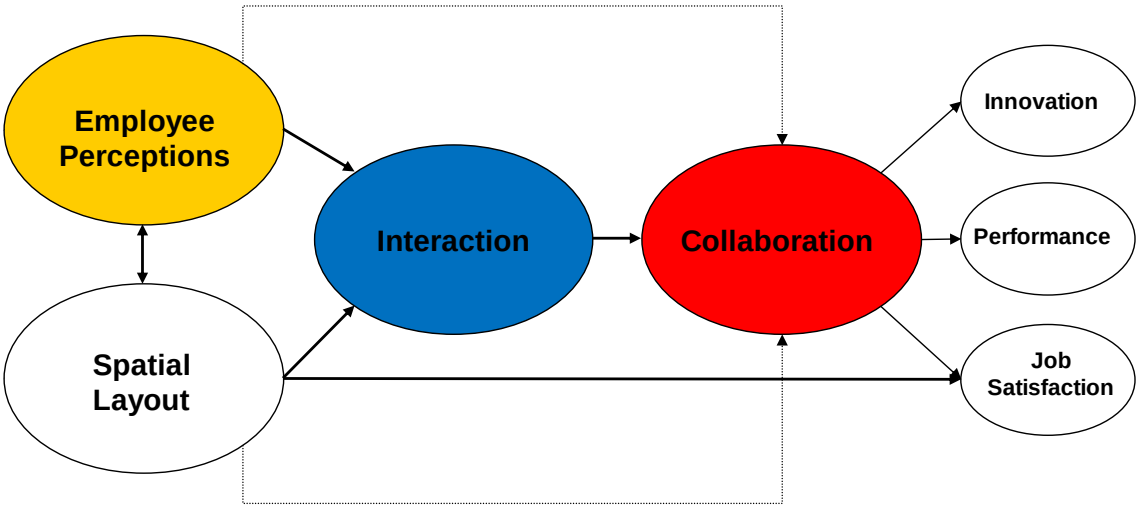

Figure 6.3 Conceptual Model variables correlated in this section at LSI

The correlation analysis shows no correlation between any of the perception variables and the respondents' self-reported amount of interaction.

		Employee Perceptions Variables						Interaction - Self Reported Amount
		Spatial Layout Support	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	Total Interaction
Spatial Layout Support	Correlation	1	.508	.526	-.484	.045	.536	.100
	Significance		.092	.079	.131	.897	.072	.770
Privacy	Correlation	.508	1	.485	-.365	.483	.125	-.054
	Significance	.092		.110	.270	.132	.699	.875
Interaction Support	Correlation	.526	.485	1	-.528	.154	-.073	.300
	Significance	.079	.110		.095	.651	.822	.371
Job Interdependence	Correlation	-.484	-.365	-.528	1	.304	-.185	-.053
	Significance	.131	.270	.095		.364	.586	.878
Sense of Community	Correlation	.045	.483	.154	.304	1	-.103	.152
	Significance	.897	.132	.651	.364		.764	.655
Workspace Satisfaction	Correlation	.536	.125	-.073	-.185	-.103	1	.014
	Significance	.072	.699	.822	.586	.764		.967
Total Interaction	Correlation	.100	-.054	.300	-.053	.152	.014	1
	Significance	.770	.875	.371	.878	.655	.967	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.4 Correlation Table for Employee Perception Variables and Self-Reported Total Interaction at LSI

The correlation analysis using the individual interaction questions from the Workplace Survey found a positive correlation between the amount respondents report formally interacting with employees that report to them and their sense of Privacy (.803, 030). For two of the interaction questions (Formal Interaction with Visitors and Informal Interaction with Fellow Employees Outside Department) there was not enough data (responses) to conduct the correlation analysis, meaning few respondents interact with visitors or with other employees outside the department.

		Employee Perceptions Variables						Interaction - Self Reported Amount						
		Spatial Layout Support	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	Formal Interaction - Bosses	Formal Interaction - Employees Report to you	Formal Interaction - Fellow Employees	Formal Interaction - Visitors	Informal Interaction - Bosses	Informal Interaction - Employees who report to you	Informal Interaction - Fellow Employees in Department
Spatial Layout Support	Correlation	1	.508	.526	-.484	.045	.536	-.137	.625	.016	IN	-.371	.295	-.058
	Significance		.092	.079	.131	.897	.072	.687	.134	.968		.291	.520	.866
Privacy	Correlation	.508	1	.485	-.365	.483	.125	.034	.803*	-.529	IN	-.401	.288	-.229
	Significance	.092		.110	.270	.132	.699	.921	.030	.143		.251	.531	.499
Interaction Support	Correlation	.526	.485	1	-.528	.154	-.073	.222	.645	.334	IN	-.255	-.125	.058
	Significance	.079	.110		.095	.651	.822	.511	.117	.380		.477	.789	.866
Job Interdependence	Correlation	-.484	-.365	-.528	1	.304	-.185	-.180	.225	.308	IN	.159	.402	.125
	Significance	.131	.270	.095		.364	.586	.597	.628	.420		.661	.371	.714
Sense of Community	Correlation	.045	.483	.154	.304	1	-.103	.339	.587	.134	IN	.250	.211	.188
	Significance	.897	.132	.651	.364		.764	.308	.166	.732		.486	.650	.581
Workspace Satisfaction	Correlation	.536	.125	-.073	-.185	-.103	1	-.535	.171	-.318	IN	-.257	.441	.005
	Significance	.072	.699	.822	.586	.764		.090	.714	.405		.474	.322	.989
Formal Interaction - Bosses	Correlation	-.137	.034	.222	-.180	.339	-.535	1	-.300	.267	IN	.764**	-.258	.261
	Significance	.687	.921	.511	.597	.308	.090		.513	.487		.010	.576	.438
Formal Interaction - Employees Report to	Correlation	.625	.803*	.645	.225	.587	.171	-.300	1	.091	IN	-.300	.258	-.300
	Significance	.134	.030	.117	.628	.166	.714	.513		.846		.513	.576	.513
Formal Interaction - Fellow Employees	Correlation	.016	-.529	.334	.308	.134	-.318	.267	.091	1	IN	.267	.354	.707*
	Significance	.968	.143	.380	.420	.732	.405	.487	.846			.487	.437	.033
Formal Interaction - Visitors	Correlation	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN
	Significance													
Informal Interaction - Bosses	Correlation	-.371	-.401	-.255	.159	.250	-.257	.764**	-.300	.267	IN	1	-.258	.102
	Significance	.291	.251	.477	.661	.486	.474	.010	.513	.487			.576	.779
Informal Interaction - Employees who report	Correlation	.295	.288	-.125	.402	.211	.441	-.258	.258	.354	IN	-.258	1	.645
	Significance	.520	.531	.789	.371	.650	.322	.576	.576	.437		.576		.117
Informal Interaction - Fellow Employees in	Correlation	-.058	-.229	.058	.125	.188	.005	.261	-.300	.707*	IN	.102	.645	1
	Significance	.866	.499	.866	.714	.581	.989	.438	.513	.033		.779	.117	
Informal Interaction - Fellow Employees	Correlation	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN
	Significance													

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). IN - Insufficient Data

Table 6.5 Correlation Table for Employee Perception Variables and Self-Reported Interaction Amounts at LSI

Only one social network analysis (SNA) interaction variable at the LSI is significantly correlated with an employee perception variable. Job interdependence is positively correlated (.624, .040) with the SNA Degree measurement of to whom they talk. This suggests that the more a respondent feels their job requires working with others, the more people they talk to within the building. Additional correlations were found within the SNA variables. Of note, is the significant positive correlation between SNA Degree Crucial and SNA Closeness Informal Outside (.739, .006). The more a respondent is crucial (based on their co-workers responses), the more they are integrated with those that informally interact outside the office.

		Employee Perceptions Variables						Interaction - Social Network Analysis Variables						
		Spatial Layout	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	SNA Degree Talk	SNA Betweeness Talk	SNA Closeness Talk	SNA Degree Crucial	SNA Degree Informal Outside	SNA Betweeness Informal Outside	SNA Closeness Informal Outside
Spatial Layout	Correlation	1	.508	.526	-.484	.045	.536	-.074	-.254	-.098	-.368	-.291	.158	-.489
	Significance		.092	.079	.131	.897	.072	.820	.425	.761	.239	.360	.623	.107
Privacy	Correlation	.508	1	.485	-.365	.483	.125	-.159	.024	.065	.215	.178	.398	.095
	Significance	.092		.110	.270	.132	.699	.621	.941	.842	.503	.580	.200	.769
Interaction Support	Correlation	.526	.485	1	-.528	.154	-.073	.090	.062	.139	-.213	.288	.383	-.082
	Significance	.079	.110		.095	.651	.822	.781	.848	.666	.506	.363	.219	.799
Job Interdependence	Correlation	-.484	-.365	-.528	1	.304	-.185	.624*	.592	.432	-.037	-.289	-.373	-.192
	Significance	.131	.270	.095		.364	.586	.040	.055	.184	.913	.390	.259	.573
Sense of Community	Correlation	.045	.483	.154	.304	1	-.103	.002	.039	-.048	.247	.130	.107	-.142
	Significance	.897	.132	.651	.364		.764	.995	.910	.888	.464	.703	.754	.676
Workspace Satisfaction	Correlation	.536	.125	-.073	-.185	-.103	1	-.218	-.358	-.146	.051	-.017	.308	-.195
	Significance	.072	.699	.822	.586	.764		.497	.253	.650	.874	.957	.330	.543
SNA Degree Talk	Correlation	-.074	-.159	.090	.624*	.002	-.218	1	.858**	.898**	-.488	-.343	-.273	-.286
	Significance	.820	.621	.781	.040	.995	.497		.000	.000	.108	.275	.391	.367
SNA Betweeness Talk	Correlation	-.254	.024	.062	.592	.039	-.358	.858**	1	.923**	-.122	-.030	-.002	.096
	Significance	.425	.941	.848	.055	.910	.253	.000		.000	.706	.927	.996	.767
SNA Closeness Talk	Correlation	-.098	.065	.139	.432	-.048	-.146	.898**	.923**	1	-.312	-.045	.079	-.037
	Significance	.761	.842	.666	.184	.888	.650	.000	.000		.324	.890	.806	.910
SNA Degree Crucial	Correlation	-.368	.215	-.213	-.037	.247	.051	-.488	-.122	-.312	1	.508	.309	.739**
	Significance	.239	.503	.506	.913	.464	.874	.108	.706	.324		.092	.328	.006
SNA Degree Informal Outside	Correlation	-.291	.178	.288	-.289	.130	-.017	-.343	-.030	-.045	.508	1	.807**	.665*
	Significance	.360	.580	.363	.390	.703	.957	.275	.927	.890	.092		.002	.018
SNA Betweeness Informal Outside	Correlation	.158	.398	.383	-.373	.107	.308	-.273	-.002	.079	.309	.807**	1	.323
	Significance	.623	.200	.219	.259	.754	.330	.391	.996	.806	.328	.002		.306
SNA Closeness Informal Outside	Correlation	-.489	.095	-.082	-.192	-.142	-.195	-.286	.096	-.037	.739**	.665*	.323	1
	Significance	.107	.769	.799	.573	.676	.543	.367	.767	.910	.006	.018	.306	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.5 Correlation Table for Employee Perception Variables and SNA Measurements of Interaction at LSI

The correlation analysis results between employee perceptions and SNA collaboration variables show a significant positive correlation between respondents' Workspace Satisfaction and SNA Betweenness Past Collaboration. Thus, the more satisfied an employee is with their workspace, the more likely they are "gatekeepers" in past collaborations. Additional significant correlations are found between the collaboration SNA variables.

		Employee Perceptions Variables						Collaboration - Social Network Analysis Variables					
		Spatial Layout	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	SNA Degree Past Collaboration	SNA Betweeness Past Collaboration	SNA Closeness Past Collaboration	SNA Degree Now Collaboration	SNA Betweeness Now Collaboration	SNA Closeness Now Collaboration
Spatial Layout	Correlation	1	.508	.526	-.484	.045	.536	.321	.518	-.175	-.016	-.002	-.296
	Significance		.092	.079	.131	.897	.072	.309	.085	.586	.960	.995	.350
Privacy	Correlation	.508	1	.485	-.365	.483	.125	.092	.193	-.429	.364	.154	.279
	Significance	.092		.110	.270	.132	.699	.777	.548	.164	.244	.633	.381
Interaction Support	Correlation	.526	.485	1	-.528	.154	-.073	-.074	.002	.050	-.119	-.199	-.172
	Significance	.079	.110		.095	.651	.822	.820	.996	.876	.712	.535	.593
Job Interdependence	Correlation	-.484	-.365	-.528	1	.304	-.185	.069	.073	.156	.058	.017	-.016
	Significance	.131	.270	.095		.364	.586	.840	.832	.646	.866	.960	.962
Sense of Community	Correlation	.045	.483	.154	.304	1	-.103	.280	.306	-.470	.273	.230	.009
	Significance	.897	.132	.651	.364		.764	.404	.361	.145	.417	.497	.979
Workspace Satisfaction	Correlation	.536	.125	-.073	-.185	-.103	1	.486	.719**	-.088	.350	.230	-.021
	Significance	.072	.699	.822	.586	.764		.109	.008	.787	.265	.472	.949
SNA Degree Past Collaboration	Correlation	.321	.092	-.074	.069	.280	.486	1	.820**	.304	.484	.501	-.262
	Significance	.309	.777	.820	.840	.404	.109		.001	.337	.111	.097	.412
SNA Betweeness Past Collaboration	Correlation	.518	.193	.002	.073	.306	.719**	.820**	1	.108	.506	.558	-.222
	Significance	.085	.548	.996	.832	.361	.008	.001		.738	.094	.060	.488
SNA Closeness Past Collaboration	Correlation	-.175	-.429	.050	.156	-.470	-.088	.304	.108	1	.246	.294	-.079
	Significance	.586	.164	.876	.646	.145	.787	.337	.738		.441	.354	.808
SNA Degree Now Collaboration	Correlation	-.016	.364	-.119	.058	.273	.350	.484	.506	.246	1	.842**	.577*
	Significance	.960	.244	.712	.866	.417	.265	.111	.094	.441		.001	.050
SNA Betweeness Now Collaboration	Correlation	-.002	.154	-.199	.017	.230	.230	.501	.558	.294	.842**	1	.246
	Significance	.995	.633	.535	.960	.497	.472	.097	.060	.354	.001		.442
SNA Closeness Now Collaboration	Correlation	-.296	.279	-.172	-.016	.009	-.021	-.262	-.222	-.079	.577*	.246	1
	Significance	.350	.381	.593	.962	.979	.949	.412	.488	.808	.050	.442	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.7 Correlation Table for Employee Perception Variables and SNA Measurements of Collaboration at LSI

6.2.3 Correlations of Spatial Layout, Interaction, and Collaboration

This section focuses on the correlations between the spatial layout variables with both interaction and collaboration. The interaction variables include interaction data from both surveys as well as the observations done by the researcher. The correlations begin with the Workplace Survey's "Total Interaction" variable and follows with the Communication Survey social network analysis (SNA) interaction and collaboration variables. The section concludes with the correlation of the spatial layout variables with the observed interaction, as well as observed presence and observed movement. Observed presence measures the total number of people observed in a cell and observed movement is the total number of moving people observed in a cell.

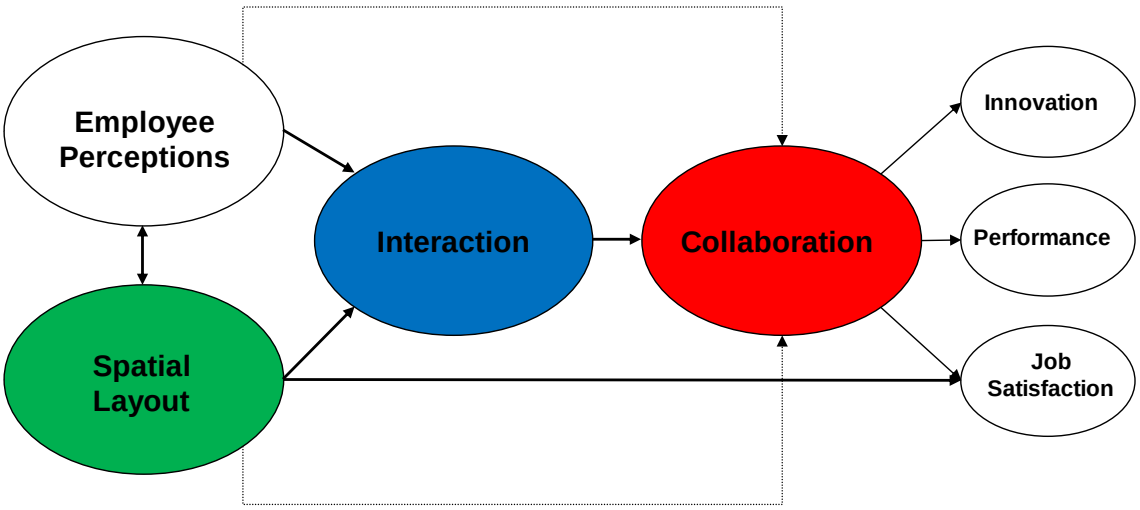

Figure 6.4 Conceptual Model variables correlated in this section at LSI

Correlation analysis shows no significant correlations between the spatial layout variables and self-reported interaction amounts including the “Total Interaction” scale as well as the individual questions regarding each employee’s formal and informal interaction.

		Spatial Layout		Interaction - Self Reported Amount								
		Workspace Integration	Workspace Connectivity	Total Interaction	Formal Interaction - Bosses	Formal Interaction - Employees Report to you	Formal Interaction - Fellow Employees	Formal Interaction - Visitors	Informal Interaction - Bosses	Informal Interaction - Employees who report to you	Informal Interaction - Fellow Employees in Department	Informal Interaction - Fellow Employees outside department
Workspace Integration	Correlation	1	.948**	-.326	.265	-.593	.391	IN	.167	-.125	.347	IN
	Significance		.000	.327	.430	.160	.299		.644	.790	.296	
Workspace Connectivity	Correlation	.948**	1	-.366	.330	-.657	.339	IN	.221	-.369	.265	IN
	Significance	.000		.269	.321	.109	.373		.539	.416	.431	
Total Interaction	Correlation	-.326	-.366	1	.228	.400	.527	IN	.544	.194	-.217	IN
	Significance	.327	.269		.500	.374	.145		.104	.677	.522	
Formal Interaction - Bosses	Correlation	.265	.330	.228	1	-.300	.267	IN	.764**	-.258	.261	IN
	Significance	.430	.321	.500		.513	.487		.010	.576	.438	
Formal Interaction - Employees Report to you	Correlation	-.593	-.657	.400	-.300	1	.091	IN	-.300	.258	-.300	IN
	Significance	.160	.109	.374	.513		.846		.513	.576	.513	
Formal Interaction - Fellow Employees	Correlation	.391	.339	.527	.267	.091	1	IN	.267	.354	.707*	IN
	Significance	.299	.373	.145	.487	.846			.487	.437	.033	
Formal Interaction - Visitors	Correlation	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN
	Significance											
Informal Interaction - Bosses	Correlation	.167	.221	.544	.764**	-.300	.267	IN	1	-.258	.102	IN
	Significance	.644	.539	.104	.010	.513	.487			.576	.779	
Informal Interaction - Employees who report to you	Correlation	-.125	-.369	.194	-.258	.258	.354	IN	-.258	1	.645	IN
	Significance	.790	.416	.677	.576	.576	.437		.576		.117	
Informal Interaction - Fellow Employees in Department	Correlation	.347	.265	-.217	.261	-.300	.707*	IN	.102	.645	1	IN
	Significance	.296	.431	.522	.438	.513	.033		.779	.117		
Informal Interaction - Fellow Employees outside department	Correlation	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN	IN
	Significance											

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). IN - Insufficient Data

Table 6.8 Correlation Table for Spatial Layout and Self-Reported Interaction Amounts at LSI

The correlation analysis between spatial layout and interaction measures from social network analysis shows one significant negative correlation. Cell Integration is negatively correlated with SNA Betweenness Informal Outside interaction (-.602, .038). The more integrated an employee's office location, the less likely the respondent is to be a gatekeeper among those that interact informally outside the office.

		Spatial Layout		Interaction - Social Network Analysis Variables						
		Workspace Integration	Workspace Connectivity	SNA Degree Talk	SNA Betweenes s Talk	SNA Closeness Talk	SNA Degree Crucial	SNA Degree Informal Outside	SNA Betweenes s Informal Outside	SNA Closeness Informal Outside
Workspace Integration	Correlation	1	.948**	.238	.241	.041	-.247	-.240	-.602*	.079
	Significance		.000	.456	.451	.899	.438	.452	.038	.808
Workspace Connectivity	Correlation	.948**	1	.147	.208	.034	-.237	-.036	-.393	.188
	Significance	.000		.649	.516	.915	.459	.912	.207	.559
SNA Degree Talk	Correlation	.238	.147	1	.858**	.898**	-.488	-.343	-.273	-.286
	Significance	.456	.649		.000	.000	.108	.275	.391	.367
SNA Betweeness Talk	Correlation	.241	.208	.858**	1	.923**	-.122	-.030	-.002	.096
	Significance	.451	.516	.000		.000	.706	.927	.996	.767
SNA Closeness Talk	Correlation	.041	.034	.898**	.923**	1	-.312	-.045	.079	-.037
	Significance	.899	.915	.000	.000		.324	.890	.806	.910
SNA Degree Crucial	Correlation	-.247	-.237	-.488	-.122	-.312	1	.508	.309	.739**
	Significance	.438	.459	.108	.706	.324		.092	.328	.006
SNA Degree Informal Outside	Correlation	-.240	-.036	-.343	-.030	-.045	.508	1	.807**	.665*
	Significance	.452	.912	.275	.927	.890	.092		.002	.018
SNA Betweeness Informal Outside	Correlation	-.602*	-.393	-.273	-.002	.079	.309	.807**	1	.323
	Significance	.038	.207	.391	.996	.806	.328	.002		.306
SNA Closeness Informal Outside	Correlation	.079	.188	-.286	.096	-.037	.739**	.665*	.323	1
	Significance	.808	.559	.367	.767	.910	.006	.018	.306	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.9 Correlation Table for Spatial Layout and SNA Measurements of Interaction at LSI

Spatial layout the SNA measurements for collaboration have significant correlations. Office integration and SNA betweenness for past collaboration have a negative correlation (-.656, .021). The lower the integration value of an employee's office location, the higher the respondents' likelihood of being a gatekeeper for collaborations in the past. Office Connectivity also has a significant negative relationship with SNA betweenness for past collaboration (-.790, .002). Employees with offices that are not well connected to immediate neighbors, are more likely to be gatekeepers for collaborations in the past. The SNA Degree for current collaboration (SNA Degree Now Collaboration) is negatively correlated with Connectivity (-.640, .025). Employees with locally more segregated offices, those not well connected to immediate neighbors, are likely to have higher levels of current collaboration.

		Spatial Layout		Collaboration - Social Network Analysis Variables					
		Workspace Integration	Workspace Connectivity	SNA Degree Past Collaboration	SNA Betweenness Past Collaboration	SNA Closeness Past Collaboration	SNA Degree Now Collaboration	SNA Betweenness Now Collaboration	SNA Closeness Now Collaboration
Workspace Integration	Correlation	1	.948**	-.573	-.656*	.213	-.556	-.374	-.127
	Significance		.000	.052	.021	.507	.061	.231	.695
Workspace Connectivity	Correlation	.948**	1	-.569	-.790**	.149	-.640*	-.510	-.138
	Significance	.000		.053	.002	.644	.025	.090	.669
SNA Degree Past Collaboration	Correlation	-.573	-.569	1	.820**	.304	.484	.501	-.262
	Significance	.052	.053		.001	.337	.111	.097	.412
SNA Betweeness Past Collaboration	Correlation	-.656*	-.790**	.820**	1	.108	.506	.558	-.222
	Significance	.021	.002	.001		.738	.094	.060	.488
SNA Closeness Past Collaboration	Correlation	.213	.149	.304	.108	1	.246	.294	-.079
	Significance	.507	.644	.337	.738		.441	.354	.808
SNA Degree Now Collaboration	Correlation	-.556	-.640*	.484	.506	.246	1	.842**	.577*
	Significance	.061	.025	.111	.094	.441		.001	.050
SNA Betweeness Now Collaboration	Correlation	-.374	-.510	.501	.558	.294	.842**	1	.246
	Significance	.231	.090	.097	.060	.354	.001		.442
SNA Closeness Now Collaboration	Correlation	-.127	-.138	-.262	-.222	-.079	.577*	.246	1
	Significance	.695	.669	.412	.488	.808	.050	.442	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.10 Correlation Table for Spatial Layout and SNA Measurements of Collaboration at LSI

6.2.4 Correlation of Job Satisfaction with Employee Perceptions, Spatial Layout, Interaction and Collaboration

The conceptual model suggests that employee perceptions, spatial layout, interaction and collaboration may affect Job Satisfaction.

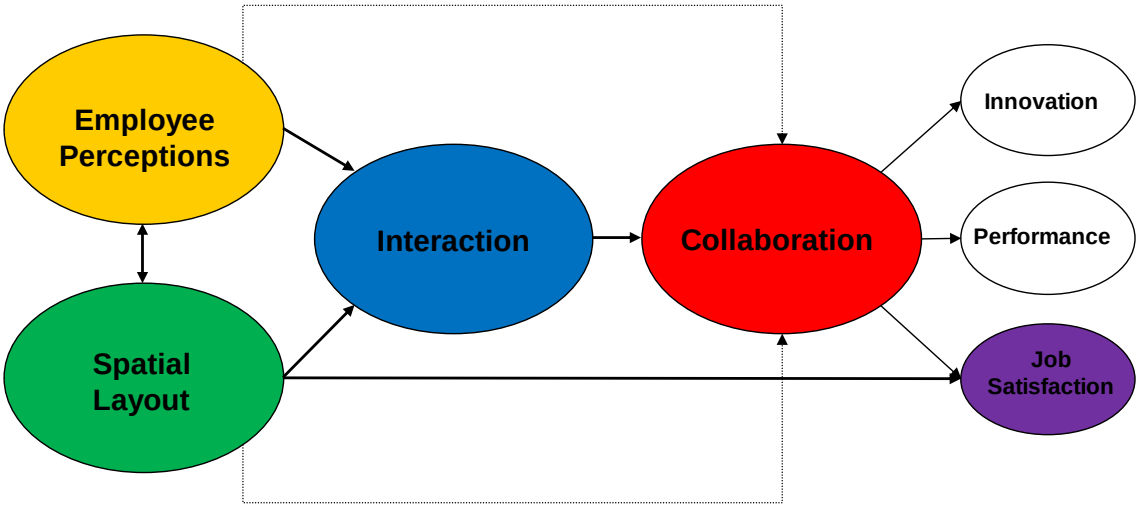

Figure 6.5 Conceptual Model variables correlated in this section at LSI

The correlation analysis shows no significance between job satisfaction and all variables including employee perceptions, spatial layout, and interaction and collaboration.

6.2.5 Correlation of Spatial Layout and Space Use Patterns

The observation data provides a larger database for the evaluation of the relationships between the spatial layout and the space use patterns including observed interaction, as well as observed presence and movement. Due to the large amount of data, the analysis was able to be accomplished at both the building level as well as floor level. The LSI building overall shows significant correlations between the spatial measures of connectivity and integration with all three observed measures (presence, interaction, and movement). Connectivity and Integration have positive significant correlations with Observed Presence (-.121, .000; -.046, .007) and Observed Interaction (-.093, .000; -.060, .000). This shows that the higher the connectivity and integration of the cells (space), the lower the observed presence and observed interaction in the cells. Alternatively, Observed Movement is positively correlated with Cell Connectivity and Cell Integration (.325, .000; .252, .000) in the LSI. The correlations are similar when the data is split by floors within the LSI except for the correlation between Cell Integration and Observed Presence on the 5th floor. This correlation was no longer significant (-.043, .071)

			Spatial Layout		Interaction - Observations		
			Integration	Connectivity	Observed Presence	Observed Interaction	Observed Movement
Building Overall	**Integration**	Correlation	1	.759**	-.046**	-.060**	.252**
		Significance		.000	.007	.000	.000
	Connectivity	Correlation	.759**	1	-.121**	-.093**	.325**
		Significance	.000		.000	.000	.000
	Observed Presence	Correlation	-.046**	-.121**	1	.561**	.077**
		Significance	.007	.000		.000	.000
	Observed Interacton	Correlation	-.060**	-.093**	.561**	1	.009
		Significance	.000	.000	.000		.590
	Observed Movement	Correlation	.252**	.325**	.077**	.009	1
		Significance	.000	.000	.000	.590	
5th Floor	**Integration**	Correlation	1	.763**	-.043	-.065**	.273**
		Significance		.000	.071	.007	.000
	Connectivity	Correlation	.763**	1	-.130**	-.103**	.348**
		Significance	.000		.000	.000	.000
	Observed Presence	Correlation	-.043	-.130**	1	.565**	.069**
		Significance	.071	.000		.000	.004
	Observed Interaction	Correlation	-.065**	-.103**	.565**	1	.008
		Significance	.007	.000	.000		.744
	Observed Movement	Correlation	.273**	.348**	.069**	.008	1
		Significance	.000	.000	.004	.744	
6th Floor	**Integration**	Correlation	1	.756**	-.050*	-.056*	.230**
		Significance		.000	.037	.020	.000
	Connectivity	Correlation	.756**	1	-.113**	-.084**	.301**
		Significance	.000		.000	.000	.000
	Observed Presence	Correlation	-.050*	-.113**	1	.552**	.081**
		Significance	.037	.000		.000	.001
	Observed Interaction	Correlation	-.056*	-.084**	.552**	1	.004
		Significance	.020	.000	.000		.856
	Observed Movement	Correlation	.230**	.301**	.081**	.004	1
		Significance	.000	.000	.001	.856	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.11 Correlation Table for Spatial Layout and Space Use Patterns including Interaction at LSI

6.3 NSB

This section provides the statistical analysis results for the Natural Sciences Building. The variables are correlated to determine if there are any significant relationships between the variables in the conceptual model.

6.3.1 Correlation of Employee Perceptions and Spatial Layout

The first portion of the conceptual model focuses on the employee perceptions of their environment and organization as well as the spatial layout. The employee perception data was gathered from the Workplace Survey while the spatial layout data of visibility properties was identified through space syntax analysis.

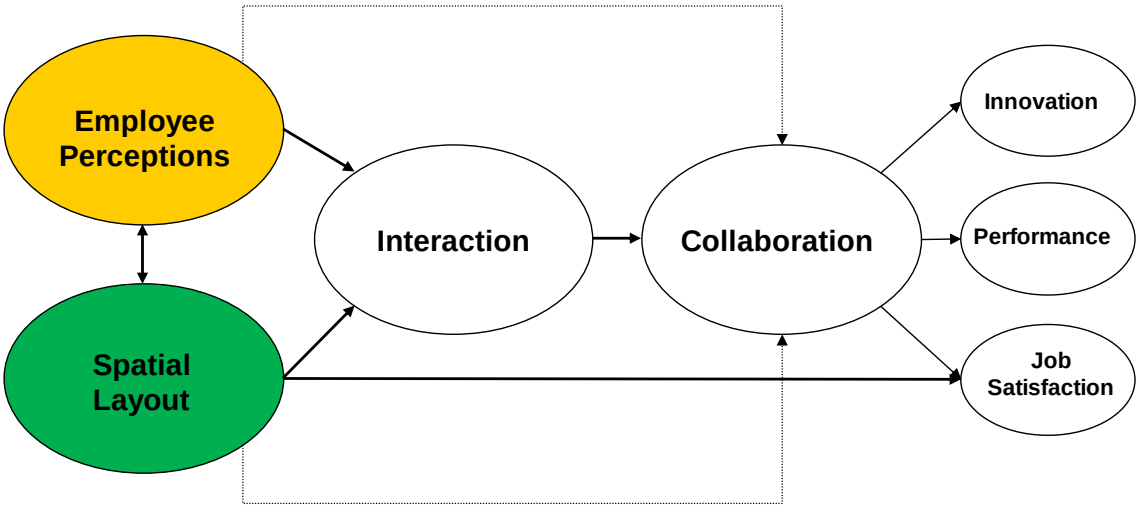

Figure 6.6 Conceptual Model variables correlated in this section at NSB

The integration value at the NSB is negatively correlated to employees' perception of their job interdependence (-.619, .024). The more highly integrated a respondent's office , the less the respondents' job requires them to work with others. Sense of community is negatively correlated with connectivity (-.581, .037). Employees with offices that are more highly connected to their immediate neighbors, are likely to have a lower sense of community. However, sense of community is positively correlated with job interdependence (.588, .035).

		Spatial Layout Variables		Employee Perceptions Variables					
		Workspace Integration	Workspace Connectivity	Privacy	Interaction Support	Job Interdependence	Sense of Community	Spatial Layout Support	Workspace Satisfaction
Workspace Integration	Correlation	1	.292	-.355	.430	-.619*	-.215	.166	.192
	Significance		.256	.194	.110	.024	.481	.555	.494
Workspace Connectivity	Correlation	.292	1	-.072	-.008	-.482	-.581*	-.300	-.050
	Significance	.256		.799	.977	.096	.037	.277	.860
Privacy	Correlation	-.355	-.072	1	-.164	-.264	-.255	-.321	-.284
	Significance	.194	.799		.558	.383	.400	.243	.305
Interaction Support	Correlation	.430	-.008	-.164	1	-.315	.271	-.164	.216
	Significance	.110	.977	.558		.294	.371	.558	.438
Job Interdependence	Correlation	-.619*	-.482	-.264	-.315	1	.588*	-.264	.409
	Significance	.024	.096	.383	.294		.035	.383	.165
Sense of Community	Correlation	-.215	-.581*	-.255	.271	.588*	1	-.255	.409
	Significance	.481	.037	.400	.371	.035		.400	.165
Spatial Layout Support	Correlation	.166	-.300	-.321	-.164	-.264	-.255	1	-.050
	Significance	.555	.277	.243	.558	.383	.400		.860
Workspace Satisfaction	Correlation	.192	-.050	-.284	.216	.409	.409	-.284	1
	Significance	.494	.860	.305	.438	.165	.165	.305	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.12 Correlation Table for Spatial Layout and Employee Perception Variables at NSB

6.3.2 Correlation of Employee Perceptions, Interaction and Collaboration

This section is identical to Section 6.2.2, but discusses the correlation analysis at the NSB. Discussed are the correlations between employee perceptions, the different measurement outcomes of interaction, and collaboration.

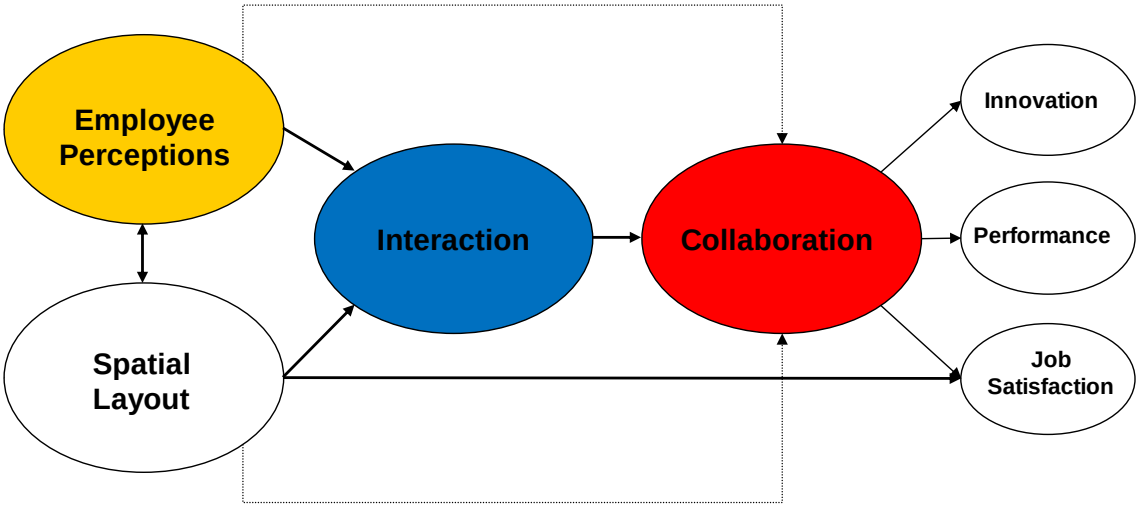

Figure 6.7 Conceptual Model variables correlated in this section at NSB

The employees' perception of their Job Interdependence is positively correlated with their self-reported amount of Total Interaction (.606, .028). The respondents with higher needs to interact with others to get their job done also report that they interact more with others.

		Employee Perceptions Variables						Interaction - Self Reported Amount
		Spatial Layout Support	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	Total Interaction
Spatial Layout Suppprt	Correlation	1	-.321	-.133	.248	-.010	-.050	.240
	Significance		.243	.637	.415	.975	.860	.429
Privacy	Correlation	-.321	1	-.164	-.264	-.255	-.284	-.430
	Significance	.243		.558	.383	.400	.305	.142
Interaction Support	Correlation	-.133	-.164	1	-.315	.271	.216	-.286
	Significance	.637	.558		.294	.371	.438	.343
Job Interdependence	Correlation	.248	-.264	-.315	1	.588*	.409	.606*
	Significance	.415	.383	.294		.035	.165	.028
Sense of Community	Correlation	-.010	-.255	.271	.588*	1	.175	.316
	Significance	.975	.400	.371	.035		.567	.292
Workspace Satisfaction	Correlation	-.050	-.284	.216	.409	.175	1	.194
	Significance	.860	.305	.438	.165	.567		.524
Total Interaction	Correlation	.240	-.430	-.286	.606*	.316	.194	1
	Significance	.429	.142	.343	.028	.292	.524	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.13 Correlation Table for Employee Perception Variables and Self-Reported Total Interaction at NSB

The individual questions that are included in the total interaction variable mentioned above are correlated separately with employee perceptions. The employees' perception of Privacy is negatively correlated (-.666, .035) with the amount they informally interact with employees that report to them. If they interact often, they have a lower perception of privacy. A higher need for the respondents' to interact with others to get their job done (Job Interdependence), the more they both formally and informally interact with their bosses (.634, .036; .826, .002).

		Employee Perceptions Variables						Interaction - Self Reported Amount						
		Spatial Layout Support	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	Formal Interaction - Bosses	Formal Interaction - Employees Report to you	Formal Interaction - Fellow Employees	Formal Interaction - Visitors	Informal Interaction - Bosses	Informal Interaction - Employees who report to you	Informal Interaction - Fellow Employees in Department
Spatial Layout Support	Correlation	1	-.321	-.133	.248	-.010	-.050	.123	-.047	.348	.051	.113	.529	.427
	Significance		.243	.637	.415	.975	.860	.719	.891	.294	.888	.742	.116	.145
Privacy	Correlation	-.321	1	-.164	-.264	-.255	-.284	-.135	.106	.029	-.116	-.114	-.666*	-.388
	Significance	.243		.558	.383	.400	.305	.693	.755	.932	.750	.739	.035	.190
Interaction Support	Correlation	-.133	-.164	1	-.315	.271	.216	-.109	-.198	-.053	-.043	-.565	-.109	.116
	Significance	.637	.558		.294	.371	.438	.749	.559	.877	.906	.070	.764	.706
Job Interdependence	Correlation	.248	-.264	-.315	1	.588*	.409	.634*	.552	.335	.277	.826**	.152	.273
	Significance	.415	.383	.294		.035	.165	.036	.078	.314	.439	.002	.674	.367
Sense of Community	Correlation	-.010	-.255	.271	.588*	1	.175	.425	.481	.452	.295	.425	-.186	.294
	Significance	.975	.400	.371	.035		.567	.193	.134	.163	.408	.193	.606	.330
Workspace Satisfaction	Correlation	-.050	-.284	.216	.409	.175	1	.378	-.108	.092	-.192	.226	.197	.136
	Significance	.860	.305	.438	.165	.567		.251	.751	.789	.594	.505	.585	.658
Formal Interaction - Bosses	Correlation	.123	-.135	-.109	.634*	.425	.378	1	.048	.745*	-.250	.592	-.378	.617*
	Significance	.719	.693	.749	.036	.193	.251		.896	.013	.516	.072	.316	.043
Formal Interaction - Employees Report to	Correlation	-.047	.106	-.198	.552	.481	-.108	.048	1	-.043	.745*	.808**	.075	-.033
	Significance	.891	.755	.559	.078	.134	.751	.896		.912	.013	.008	.836	.924
Formal Interaction - Fellow Employees	Correlation	.348	.029	-.053	.335	.452	.092	.745*	-.043	1	-.339	.413	-.408	.677*
	Significance	.294	.932	.877	.314	.163	.789	.013	.912		.411	.236	.315	.022
Formal Interaction - Visitors	Correlation	.051	-.116	-.043	.277	.295	-.192	-.250	.745*	-.339	1	.143	.661	.250
	Significance	.888	.750	.906	.439	.408	.594	.516	.013	.411		.736	.052	.486
Informal Interaction - Bosses	Correlation	.113	-.114	-.565	.826**	.425	.226	.592	.808**	.413	.143	1	-.031	.075
	Significance	.742	.739	.070	.002	.193	.505	.072	.008	.236	.736		.937	.826
Informal Interaction - Employees who report	Correlation	.529	-.666	-.109	.152	-.186	.197	-.378	.075	-.408	.661	-.031	1	.192
	Significance	.116	.035	.764	.674	.606	.585	.316	.836	.315	.052	.937		.595
Informal Interaction - Fellow Employees in	Correlation	.427	-.388	.116	.273	.294	.136	.617*	-.033	.677*	.250	.075	.192	1
	Significance	.145	.190	.706	.367	.330	.658	.043	.924	.022	.486	.826	.595	
Informal Interaction - Fellow Employees	Correlation	-.046	-.718	.051	.194	.273	-.053	.375	-.047	-.016	.134	.226	.156	.464
	Significance	.888	.008	.876	.546	.390	.869	.286	.897	.966	.732	.505	.667	.128

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.14 Correlation Table for Employee Perception Variables and Self-Reported Interaction Amounts at NSB

Job interdependence and sense of community are correlated with SNA measurements. Job interdependence is positively correlated with SNA Betweenness for informally interacting outside (SNA Betweenness Informal Outside) the NSB (.770, .002). The more the respondents' job requires them to work with others; the more likely their role is as gatekeeper with those that informally interact outside their work environment. Sense of Community is positively correlated with SNA Closeness for informally interacting outside the NSB (.750, .003); meaning higher values of Sense of Community are correlated with close connections (in the social network) between professionals that informally interact outside the NSB. Additionally, two SNA variables, SNA Degree Crucial and SNA Betweenness Talk, are negatively correlated with each other (-.615, .011). The more a respondent is crucial to others to complete their job task, the more likely that respondent is a gatekeeper within the NSB.

		Employee Perceptions Variables						Interaction - Social Network Analysis Variables						
		Spatial Layout	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	SNA Degree Talk	SNA Betweenness Talk	SNA Closeness Talk	SNA Degree Crucial	SNA Degree Informal Outside	SNA Betweenness Informal Outside	SNA Closeness Informal Outside
Spatial Layout	Correlation	1	-.321	-.133	.248	-.010	-.050	-.170	.004	-.223	-.067	.157	.144	-.007
	Significance		.243	.637	.415	.975	.860	.545	.989	.424	.813	.575	.610	.981
Privacy	Correlation	-.321	1	-.164	-.264	-.255	-.284	.153	.175	-.014	-.408	.073	.210	-.215
	Significance	.243		.558	.383	.400	.305	.586	.533	.959	.131	.796	.452	.441
Interaction Support	Correlation	-.133	-.164	1	-.315	.271	.216	.157	.297	.255	-.083	-.098	-.364	.194
	Significance	.637	.558		.294	.371	.438	.575	.283	.359	.767	.727	.182	.488
Job Interdependence	Correlation	.248	-.264	-.315	1	.588*	.409	.323	.249	.333	.098	.793**	.770**	.591
	Significance	.415	.383	.294		.035	.165	.282	.413	.266	.750	.001	.002	.033
Sense of Community	Correlation	-.010	-.255	.271	.588*	1	.175	.070	.252	.163	.116	.498	.314	.750**
	Significance	.975	.400	.371	.035		.567	.820	.406	.594	.707	.083	.296	.003
Workspace Satisfaction	Correlation	-.050	-.284	.216	.409	.175	1	.131	.064	.144	.361	.307	.261	.353
	Significance	.860	.305	.438	.165	.567		.641	.822	.608	.186	.266	.347	.197
SNA Degree Talk	Correlation	-.170	.153	.157	.323	.070	.131	1	.861**	.936**	-.354	.356	.268	.080
	Significance	.545	.586	.575	.282	.820	.641		.000	.000	.179	.175	.315	.769
SNA Betweeness Talk	Correlation	.004	.175	.297	.249	.252	.064	.861**	1	.783**	-.615*	.329	.259	.182
	Significance	.989	.533	.283	.413	.406	.822	.000		.000	.011	.214	.333	.501
SNA Closeness Talk	Correlation	-.223	-.014	.255	.333	.163	.144	.936**	.783**	1	-.253	.377	.205	.101
	Significance	.424	.959	.359	.266	.594	.608	.000	.000		.345	.150	.447	.709
SNA Degree Crucial	Correlation	-.067	-.408	-.083	.098	.116	.361	-.354	-.615*	-.253	1	.106	-.059	.123
	Significance	.813	.131	.767	.750	.707	.186	.179	.011	.345		.696	.829	.649
SNA Degree Informal Outside	Correlation	.157	.073	-.098	.793**	.498	.307	.356	.329	.377	.106	1	.801**	.474
	Significance	.575	.796	.727	.001	.083	.266	.175	.214	.150	.696		.000	.064
SNA Betweeness Informal Outside	Correlation	.144	.210	-.364	.770**	.314	.261	.268	.259	.205	-.059	.801**	1	.307
	Significance	.610	.452	.182	.002	.296	.347	.315	.333	.447	.829	.000		.248
SNA Closeness Informal Outside	Correlation	-.007	-.215	.194	.591	.750	.353	.080	.182	.101	.123	.474	.307	1
	Significance	.981	.441	.488	.033	.003	.197	.769	.501	.709	.649	.064	.248	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.15 Correlation Table for Employee Perception Variables and SNA Measurements of Interaction at NSB

The correlation analysis between employee perceptions and SNA collaboration measurements show significant correlations between job interdependence and sense of community with several SNA measurements. Job Interdependence is positively correlated with past and current SNA collaboration measurements of Degree (.678, .011; .782, .002) and Betweenness (.774, .002; .799, .002). The more a respondents' job requires them to interact with others, the more people they collaborate(d) with as well as the more likely they are/were the gatekeeper among collaborators. Both Job Interdependence and Sense of Community are positively correlated with SNA Closeness for current collaborations (.590, .034; .747, .003). If you are close (in the social network) to those you currently work with, you have a stronger sense of community and job interdependence. Additionally, Sense of Community is also positively correlated with SNA Closeness for past collaborations (.565, .044).

		Employee Perceptions Variables						Collaboration - Social Network Analysis Variables					
		Spatial Layout	Privacy	Interaction Support	Job Interdependence	Sense of Community	Workspace Satisfaction	SNA Degree Past Collaboration	SNA Betweeness Past Collaboration	SNA Closeness Past Collaboration	SNA Degree Now Collaboration	SNA Betweeness Now Collaboration	SNA Closeness Now Collaboration
Spatial Layout	Correlation	1	-.321	-.133	.248	-.010	-.050	.083	.260	-.022	.070	.069	-.014
	Significance		.243	.637	.415	.975	.860	.767	.349	.939	.805	.806	.962
Privacy	Correlation	-.321	1	-.164	-.264	-.255	-.284	.036	-.132	-.046	.141	.230	-.227
	Significance	.243		.558	.383	.400	.305	.899	.639	.871	.616	.409	.415
Interaction Support	Correlation	-.133	-.164	1	-.315	.271	.216	.027	-.352	.102	-.192	-.413	.192
	Significance	.637	.558		.294	.371	.438	.924	.198	.717	.492	.126	.493
Job Interdependence	Correlation	.248	-.264	-.315	1	.588*	.409	.678*	.774**	.350	.782**	.799**	.590*
	Significance	.415	.383	.294		.035	.165	.011	.002	.241	.002	.001	.034
Sense of Community	Correlation	-.010	-.255	.271	.588*	1	.175	.422	.353	.565*	.449	.311	.747**
	Significance	.975	.400	.371	.035		.567	.151	.237	.044	.123	.302	.003
Workspace Satisfaction	Correlation	-.050	-.284	.216	.409	.175	1	.379	.267	.267	.307	.283	.356
	Significance	.860	.305	.438	.165	.567		.163	.336	.337	.265	.307	.193
SNA Degree Past Collaboration	Correlation	.083	.036	.027	.678*	.422	.379	1	.765**	.563*	.919**	.700**	.476
	Significance	.767	.899	.924	.011	.151	.163		.001	.023	.000	.003	.063
SNA Betweeness Past Collaboration	Correlation	.260	-.132	-.352	.774**	.353	.267	.765**	1	.292	.776**	.811**	.240
	Significance	.349	.639	.198	.002	.237	.336	.001		.272	.000	.000	.371
SNA Closeness Past Collaboration	Correlation	-.022	-.046	.102	.350	.565*	.267	.563*	.292	1	.442	.234	.703**
	Significance	.939	.871	.717	.241	.044	.337	.023	.272		.087	.383	.002
SNA Degree Now Collaboration	Correlation	.070	.141	-.192	.782**	.449	.307	.919**	.776**	.442	1	.844**	.482
	Significance	.805	.616	.492	.002	.123	.265	.000	.000	.087		.000	.059
SNA Betweeness Now Collaboration	Correlation	.069	.230	-.413	.799**	.311	.283	.700**	.811**	.234	.844**	1	.273
	Significance	.806	.409	.126	.001	.302	.307	.003	.000	.383	.000		.306
SNA Closeness Now Collaboration	Correlation	-.014	-.227	.192	.590*	.747**	.356	.476	.240	.703**	.482	.273	1
	Significance	.962	.415	.493	.034	.003	.193	.063	.371	.002	.059	.306	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.16 Correlation Table for Employee Perception Variables and SNA Measurements of Collaboration at NSB

6.3.3 Correlations of Spatial Layout, Interaction, and Collaboration

This section discusses the relationships between spatial layout visibility properties and the various measurements of interaction and collaboration. As mentioned in section 6.1.3, interaction measurements were derived from surveys as well as observations.

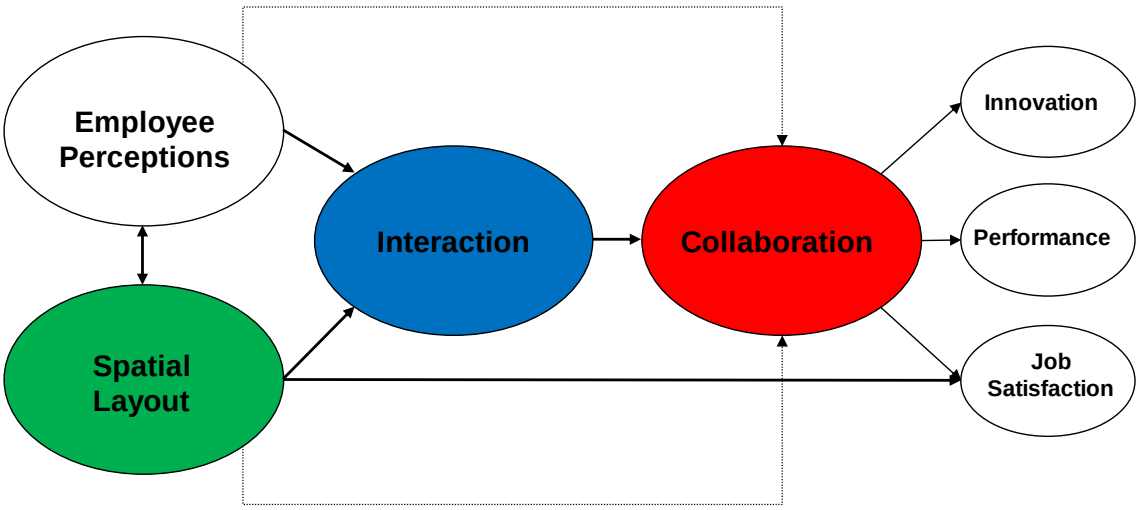

Figure 6.8 Conceptual Model variables correlated in this section at NSB

Correlation analysis does not show a significant relationship between the spatial layout and self-reported total interaction, but does show some correlation to a few individual interaction questions. Integration and Connectivity are both negatively correlated with the amount of formal interaction the respondents have with employees that report to them (-.689, .019; -.622, .041). The less the respondents' workspace is connected and integrated (ie. the more segregated it is), the more they formally interact with employees that report to them. Integration is also significantly negatively correlated with the amount of informal interaction with the respondents' bosses (-.644, .032). The more integrated your office, the less likely you are to informally interact with your bosses.

		Spatial Layout		Interaction - Self Reported Amount								
		Workspace Integration	Workspace Connectivity	Total Interaction	Formal Interaction - Bosses	Formal Interaction - Employees Report to you	Formal Interaction - Fellow Employees	Formal Interaction - Visitors	Informal Interaction - Bosses	Informal Interaction - Employees who report to you	Informal Interaction - Fellow Employees in Department	Informal Interaction - Fellow Employees outside department
Workspace Integration	Correlation	1	.292	-.292	-.467	-.689*	.322	-.458	-.644*	.206	.114	.089
	Significance		.256	.332	.148	.019	.335	.183	.032	.568	.711	.784
Workspace Connectivity	Correlation	.292	1	.046	-.125	-.622*	-.222	-.375	-.374	.028	-.002	.292
	Significance	.256		.881	.714	.041	.511	.286	.257	.939	.994	.357
Total Interaction	Correlation	-.292	.046	1	.771**	-.013	.334	.145	.532	.120	.662*	.686*
	Significance	.332	.881		.005	.971	.316	.690	.092	.742	.014	.014
Formal Interaction - Bosses	Correlation	-.467	-.125	.771**	1	.048	.745*	-.250	.592	-.378	.617*	.375
	Significance	.148	.714	.005		.896	.013	.516	.072	.316	.043	.286
Formal Interaction - Employees Report to you	Correlation	-.689*	-.622*	-.013	.048	1	-.043	.745*	.808**	.075	-.033	-.047
	Significance	.019	.041	.971	.896		.912	.013	.008	.836	.924	.897
Formal Interaction - Fellow Employees	Correlation	.322	-.222	.334	.745*	-.043	1	-.339	.413	-.408	.677*	-.016
	Significance	.335	.511	.316	.013	.912		.411	.236	.315	.022	.966
Formal Interaction - Visitors	Correlation	-.458	-.375	.145	-.250	.745*	-.339	1	.143	.661	.250	.134
	Significance	.183	.286	.690	.516	.013	.411		.736	.052	.486	.732
Informal Interaction - Bosses	Correlation	-.644*	-.374	.532	.592	.808**	.413	.143	1	-.031	.075	.226
	Significance	.032	.257	.092	.072	.008	.236	.736		.937	.826	.505
Informal Interaction - Employees who report to you	Correlation	.206	.028	.120	-.378	.075	-.408	.661	-.031	1	.192	.156
	Significance	.568	.939	.742	.316	.836	.315	.052	.937		.595	.667
Informal Interaction - Fellow Employees in Department	Correlation	.114	-.002	.662*	.617*	-.033	.677*	.250	.075	.192	1	.464
	Significance	.711	.994	.014	.043	.924	.022	.486	.826	.595		.128
Informal Interaction - Fellow Employees outside department	Correlation	.089	.292	.686*	.375	-.047	-.016	.134	.226	.156	.464	1
	Significance	.784	.357	.014	.286	.897	.966	.732	.505	.667	.128	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.17 Correlation Table for Spatial Layout and Self-Reported Interaction Amounts at NSB

The analysis of the social network data identifies significant negative relationships between both spatial layout variables, integration and connectivity, with the SNA measure of Degree of informal interaction with employees outside the NSB (-.664, .005; -.556, .025). The more a respondents' workspace is integrated and connected, the lower the number of people the respondent informally interacts with outside the NSB. Integration is also negatively correlated with the SNA Betweenness informal outside (-.727, .001). The more integrated a respondents' workspace, the less they play a role as gatekeeper among those that informally interact outside the NSB. The SNA measure of Degree Crucial is negatively correlated with the SNA Degree for informal interaction outside the NSB (-.556, .025). The more a respondent is crucial for

others to accomplish their job tasks, the lower the amount the respondent informally interacts outside the NSB.

		Spatial Layout		Interaction - Social Network Analysis Variables						
		Workspace Integration	Workspace Connectivity	SNA Degree Talk	SNA Betweenes s Talk	SNA Closeness Talk	SNA Degree Crucial	SNA Degree Informal Outside	SNA Betweenes s Informal Outside	SNA Closeness Informal Outside
Workspace Integration	Correlation	1	.292	-.477	-.379	-.444	.216	-.664**	-.727**	-.281
	Significance		.256	.062	.148	.085	.421	.005	.001	.293
Workspace Connectivity	Correlation	.292	1	-.236	-.305	-.193	.158	-.556*	-.419	-.406
	Significance	.256		.380	.251	.474	.559	.025	.106	.119
SNA Degree Talk	Correlation	-.477	-.236	1	.861**	.936**	-.354	.356	.268	.080
	Significance	.062	.380		.000	.000	.179	.175	.315	.769
SNA Betweeness Talk	Correlation	-.379	-.305	.861**	1	.783**	-.615*	.329	.259	.182
	Significance	.148	.251	.000		.000	.011	.214	.333	.501
SNA Closeness Talk	Correlation	-.444	-.193	.936**	.783**	1	-.253	.377	.205	.101
	Significance	.085	.474	.000	.000		.345	.150	.447	.709
SNA Degree Crucial	Correlation	.216	.158	-.354	-.615*	-.253	1	.106	-.059	.123
	Significance	.421	.559	.179	.011	.345		.696	.829	.649
SNA Degree Informal Outside	Correlation	-.664**	-.556*	.356	.329	.377	.106	1	.801**	.474
	Significance	.005	.025	.175	.214	.150	.696		.000	.064
SNA Betweeness Informal Outside	Correlation	-.727**	-.419	.268	.259	.205	-.059	.801**	1	.307
	Significance	.001	.106	.315	.333	.447	.829	.000		.248
SNA Closeness Informal Outside	Correlation	-.281	-.406	.080	.182	.101	.123	.474	.307	1
	Significance	.293	.119	.769	.501	.709	.649	.064	.248	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.18 Correlation Table for Spatial Layout and SNA Measurements of Interaction at NSB

SNA's collaboration measurements show significant correlations with integration, but not connectivity. Integration is negatively correlated with both the Degree and Betweenness measures for past (-.584, .018; -.701, .002) and current (-.565, .023, -.756, .001) collaborations. The more the respondents' workspace is integrated, the less people they collaborate(d) with as well as play(ed) a role as gatekeeper among those with whom they collaborate.

		Spatial Layout		Collaboration - Social Network Analysis Variables					
		Workspace Integration	Workspace Connectivity	SNA Degree Past Collaboration	SNA Betweenness Past Collaboration	SNA Closeness Past Collaboration	SNA Degree Now Collaboration	SNA Betweenness Now Collaboration	SNA Closeness Now Collaboration
Workspace Integration	Correlation	1	.292	-.584*	-.565*	-.171	-.701**	-.756**	-.277
	Significance		.256	.018	.023	.525	.002	.001	.299
Workspace Connectivity	Correlation	.292	1	-.371	-.395	-.212	-.460	-.382	-.395
	Significance	.256		.158	.130	.430	.073	.145	.130
SNA Degree Past Collaboration	Correlation	-.584*	-.371	1	.765**	.563*	.919**	.700**	.476
	Significance	.018	.158		.001	.023	.000	.003	.063
SNA Betweeness Past Collaboration	Correlation	-.565*	-.395	.765**	1	.292	.776**	.811**	.240
	Significance	.023	.130	.001		.272	.000	.000	.371
SNA Closeness Past Collaboration	Correlation	-.171	-.212	.563*	.292	1	.442	.234	.703**
	Significance	.525	.430	.023	.272		.087	.383	.002
SNA Degree Now Collaboration	Correlation	-.701**	-.460	.919**	.776**	.442	1	.844**	.482
	Significance	.002	.073	.000	.000	.087		.000	.059
SNA Betweeness Now Collaboration	Correlation	-.756**	-.382	.700**	.811**	.234	.844**	1	.273
	Significance	.001	.145	.003	.000	.383	.000		.306
SNA Closeness Now Collaboration	Correlation	-.277	-.395	.476	.240	.703**	.482	.273	1
	Significance	.299	.130	.063	.371	.002	.059	.306	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.19 Correlation Table for Spatial Layout and SNA Measurements of Collaboration at NSB

6.3.4 Correlation of Job Satisfaction with Employee Perceptions, Spatial Layout, Interaction and Collaboration

As with the LSI in Section 6.1, all previous variables (employees' perceptions, spatial layout, interaction, and collaboration) were correlated with job satisfaction of the respondents.

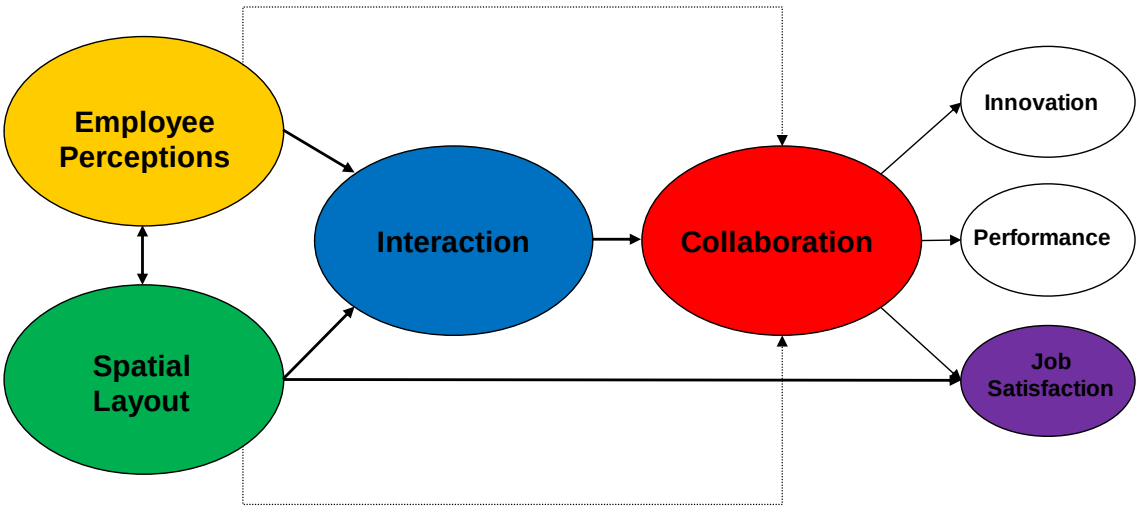

Figure 6.9 Conceptual Model variables correlated in this section at NSB

A significant positive correlation is found between employees' perception of Sense of Community within the NSB and their Job Satisfaction (.832, .000). The higher the respondents' sense of community, the higher their satisfaction with their job.

6.3.5 Correlation of Spatial Layout and Space Use Patterns

The observation data provides insight into the space use patterns of the work environment at the NSB. The space use patterns include the amount of people present, interacting, and moving within a particular cell. The statistical analysis was looked at for the overall building as well as for each individual floor to identify any differences between the floors. Overall, the NSB's Integration and Connectivity value is positively correlated with Observed Movement (.249, .000). The more integrated a cell within the NSB, the more movement observed in that

cell. Similar significant results were found for each of the three floors observed in the NSB. Connectivity is found to be negatively correlated with the amount of people present in that special location in the building (-.069, .000). This significant negative correlation is also present on all three floors. The only statistically significant difference in the floor data is the negative correlation between Connectivity and Observed interaction on the 5th floor (-.086, .002). On the 5th floor, the higher the level of connectivity, the less interaction.

			Spatial Layout		Interaction - Observations		
			Integration	Connectivity	Observed Presence	Observed Interaction	Observed Movement
Building Overall	**Integration**	Correlation	1	.760**	.009	.019	.249**
		Significance		.000	.562	.250	.000
	Connectivity	Correlation	.760**	1	-.069**	-.031	.268**
		Significance	.000		.000	.056	.000
	Observed Presence	Correlation	.009	-.069**	1	.626**	.054**
		Significance	.562	.000		.000	.001
	Observed Interacton	Correlation	.019	-.031	.626**	1	-.001
		Significance	.250	.056	.000		.958
	Observed Movement	Correlation	.249**	.268**	.054**	-.001	1
		Significance	.000	.000	.001	.958	
3rd Floor	**Integration**	Correlation	1	.786**	-.043	.020	.314**
		Significance		.000	.117	.479	.000
	Connectivity	Correlation	.786**	1	-.103**	-.022	.382**
		Significance	.000		.000	.418	.000
	Observed Presence	Correlation	-.043	-.103**	1	.628**	.077**
		Significance	.117	.000		.000	.005
	Observed Interaction	Correlation	.020	-.022	.628**	1	-.013
		Significance	.479	.418	.000		.639
	Observed Movement	Correlation	.314**	.382**	.077**	-.013	1
		Significance	.000	.000	.005	.639	
5th Floor	**Integration**	Correlation	1	.745**	-.008	-.033	.308**
		Significance		.000	.765	.244	.000
	Connectivity	Correlation	.745**	1	-.076**	-.086**	.313**
		Significance	.000		.007	.002	.000
	Observed Presence	Correlation	-.008	-.076**	1	.626**	.083**
		Significance	.765	.007		.000	.003
	Observed Interaction	Correlation	-.033	-.086**	.626**	1	.022
		Significance	.244	.002	.000		.441
	Observed Movement	Correlation	.308**	.313**	.083**	.022	1
		Significance	.000	.000	.003	.441	
6th Floor	**Integration**	Correlation	1	.768**	-.019	-.012	.131**
		Significance		.000	.493	.683	.000
	Connectivity	Correlation	.768**	1	-.066*	-.021	.120**
		Significance	.000		.020	.448	.000
	Observed Presence	Correlation	-.019	-.066*	1	.615**	-.011
		Significance	.493	.020		.000	.690
	Observed Interaction	Correlation	-.012	-.021	.615**	1	-.011
		Significance	.683	.448	.000		.689
	Observed Movement	Correlation	.131**	.120**	-.011	-.011	1
		Significance	.000	.000	.690	.689	

** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed)

Table 6.20 Correlation Table for Spatial Layout and Space Use Patterns including Interaction at NSB

6.4 Relationships of Employee Perceptions, Social Network, and Spatial Layout

This section focuses on more complicated statistical models to elaborate on the relationships between the variables in the dataset. The data from both buildings were combined for a larger and more significant database for regression analysis. The combined dataset provides more variance among the variables, therefore providing a stronger basis for analysis.

Backwards stepwise linear regression is used in this study to identify what the most significant variables are in predicting the target dependent variables of interaction and collaboration. Backwards stepwise linear regression starts with a group of independent variables and eliminates the least significant variable at each step while keeping the other variables constant. The probability of stepwise removal was set at 0.1. The final step leaves the most significant variable(s) in the model to predict the dependent variable. All regression models included the Building ID variable (identifies LSI or NSB) to determine if the respondents' building location plays a role in predicting the dependent variables since all respondents data from both buildings were included in the dataset. The models also included the PI variable (identifies if they are a PI or not) to determine if the respondents' job plays a significant role as well. Only the final steps of the regression models are presented in this chapter to identify the most significant variables; the entire regression models can be found in the Appendix.

The multiple interaction variables are first used as dependent variables to determine if Employee Perceptions and Spatial Layout variables are significantly related to interaction within the buildings. The first linear regression model used Employee Perception variables as well as the Spatial Layout variables as the independent variables to predict self-reported Total Interaction amount. The model found that three variables, Privacy, Integration, and Building ID, were the most significant in predicting Total Interaction. Privacy (-.459, .065) and Integration (-1.128, .044) are both negatively associated with Total Interaction. The higher your perceived privacy, the lower your total reported interaction; the more integrated your office location, the lower your total reported interaction. Building ID (.915, .087) is positively associated with Total Interaction (LSI has higher Total Interaction due to its value of 2 compared to NSB's value of 1).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
9	**(Constant)**	18.024	3.775		4.775	.000
	Workspace Integration	-.045	.021	-1.128	-2.158	.044
	Privacy	-1.535	.782	-.459	-1.961	.065
	1=NSB, 2=LSI	6.236	3.457	.915	1.804	.087
Dependent Variable: Total Interaction						

Table 6.21 Backwards stepwise regression model predicting self-reported Total Interaction

The SNA measure of Degree for interaction (SNA Degree Talk) which measures the number of people the respondents interact with within the building is used as

the dependent variable in the next regression model. Four Employee Perceptions variables, Interaction Support, Job Interdependence, Sense of Community, and Workspace Satisfaction, are significantly associated with the number of people with whom respondents talk. Interaction Support (.764, .001) and Job Interdependence (.996 .000) are positively associated, whereas Sense of Community (-.710, .003) and Workspace Satisfaction (-.348, .048) are negatively associated. The role of PI is also significant in the model recognizing that the PIs talk to more people within the buildings (.360, .039).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
7	(Constant)	-33.143	22.241		-1.490	.154
	Interaction Support	21.702	5.332	.764	4.070	.001
	Job Interdependence	18.150	3.816	.996	4.757	.000
	Sense of Community	-8.009	2.285	-.710	-3.506	.003
	Workspace Satisfaction	-8.368	3.931	-.348	-2.129	.048
	PI	12.054	5.390	.360	2.236	.039
Dependent Variable: SNA Degree Talk						

Table 6.22 Backwards stepwise regression model predicting SNA Degree Talk

SNA's Betweenness measure for Interaction (SNA Betweenness Talk) is used as the dependent variable in the next regression model. The higher a respondents level of SNA Betweenness Talk, the more likely they are the gatekeeper within an environment, acting as a bridge between groups. The model identifies four Employee Perception variables as the most significant as well as the spatial variable Integration. Interaction Support (1.147, .000) and Job Interdependence (1.010, .000) are positive associated with SNA Betweenness Talk, while Sense

of Community (-.652, .009), Workspace Satisfaction (-.412, .024), and Integration (-.497, .035) are negatively associated.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
7	(Constant)	-39.262	16.889		-2.325	.033
	Workspace Integration	-.060	.026	-.497	-2.297	.035
	Interaction Support	23.812	5.512	1.147	4.320	.000
	Job Interdependence	13.447	3.022	1.010	4.449	.000
	Sense of Community	-5.375	1.821	-.652	-2.951	.009
	Workspace Satisfaction	-7.237	2.931	-.412	-2.469	.024
Dependent Variable: SNA Betweennes Talk						

Table 6.23 Backwards stepwise regression model predicting SNA Betweenness Talk

The third measure of SNA in this study, Closeness, is used as the dependent variable in the next regression model. SNA Closeness Talk measures the mean social link distance between everyone in the building. Three Employee Perception variables are related to SNA Closeness Talk: Interaction Support (.590, .001), Job Interdependence (.509, .001), and Sense of Community (-.427, .000). The data also shows that the NSB has a higher level of closeness (-1.117, .000) as does the job role of PI (.361, .002).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
7	(Constant)	23.138	4.291		5.392	.000
	Interaction Support	5.510	1.366	.590	4.033	.001
	Job Interdependence	3.050	.760	.509	4.012	.001
	Sense of Community	-1.584	.485	-.427	-3.266	.005
	1=NSB, 2=LSI	-10.227	1.145	-1.117	-8.934	.000
	PI	3.972	1.119	.361	3.549	.002
Dependent Variable: SNA Closeness Talk						

Table 6.24 Backwards stepwise regression model predicting SNA ClosenessTalk

The amount of people the respondents informally interact with outside the building (SNA Degree Informal Outside) is used as the dependent variable in the following regression model. Only one variable, Job Interdependence, was found to be positively associated (.386, .069) with SNA Degree Informal Outside.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
11	(Constant)	-.832	2.522		-.330	.745
	Job Interdependence	1.585	.826	.386	1.918	.069
Dependent Variable: SNA Degree Informal Outside						

Table 6.25 Backwards stepwise regression model predicting SNA Degree Informal Outside

Social Network Analysis' measure of Betweenness for informally interacting outside the building (SNA Betweenness Informal Outside) is identified as the independent variable in the next regression model. Employees Perception of Job Interdependence (.447, 003) is positively associated with the dependent variable. The spatial variable Integration is negatively associated with SNA Betweenness

Informal Outside (-2.157, .000). The Building ID also was significant (1.932, .000) meaning that the LSI has a higher SNA Betweenness Informal Outside value or more people acting as gatekeepers among people that informally interact outside the office. The regression model also showed that respondents who are no PIs are more likely to be gatekeepers (-.645, .003).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
8	(Constant)	.668	.452		1.477	.157
	Workspace Integration	-.015	.003	-2.157	-5.244	.000
	Job Interdependence	.338	.097	.447	3.480	.003
	1=NSB, 2=LSI	2.232	.475	1.932	4.696	.000
	PI	-.895	.259	-.645	-3.455	.003
Dependent Variable: SNA Betweennes Informal Outside						

Table 6.26 Backwards stepwise regression model predicting SNA Betweeness Informal Outside

The regression model with SNA Closeness Informal Outside, measuring shortest mean path to all people that informally interact outside their building, as the dependent variable shows no significant results.

The collaboration measures from Social Network Analysis were used in the following models as the dependent variable. Employee Perceptions, Spatial Layout, and Building ID were all used as the independent variables for the regression models. The collaboration measures used were for current collaborations, not collaborations in the past because they may have taken place before the respondents occupied the case study buildings.

The first correlation regression model used the SNA measure of Degree for current Collaborations (SNA Degree Now Collaboration). Four Employee Perception variables, Spatial Layout support, Job Interdependence, Sense of Community and Job Satisfaction, as well as the spatial variable Connectivity, Building ID and PI are all significant in predicting SNA Degree Now Collaboration. Spatial Layout support (-.388, .035), Sense of Community (-.436, .046), and Connectivity (-.706, .009) are all negatively associated with the dependent variable. Job Interdependence (.446, .006) and Job Satisfaction (.311, .072) are positively associated with SNA Degree Now Collaboration. These results suggests that the more you feel your job is dependent upon others, the greater the number of your collaborations. Additionally, the less you feel there is a Sense of Community within the workplace, but the more you are satisfied with your job, the more people you collaborate with. The more satisfied you are with the building spatial layout and the more connected your office location to your immediate neighbors, the fewer the number of you people you collaborate with. The Building ID and PI variables show that people in the LSI (.736, .005) and PIs (.313, .084) are currently collaborating with more people.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	6.403	3.878		1.651	.120
	Workspace Connectivity	-.117	.039	-.706	-2.999	.009
	Spatial Layout	-2.168	.934	-.388	-2.320	.035
	Job Interdependence	1.862	.587	.446	3.174	.006
	Sense of Community	-1.128	.518	-.436	-2.178	.046
	Job Satisfaction	2.239	1.159	.311	1.932	.072
	1=NSB, 2=LSI	4.701	1.409	.736	3.337	.005
	PI	2.403	1.300	.313	1.848	.084
Dependent Variable: SNA Degree Now Collaboration						

Table 6.27 Backwards stepwise regression model predicting Degree Now Collaboration

The following regression model uses SNA's measure of Betweenness for current collaboration which measures the likelihood the respondent acts as a bridge, or gatekeeper, between groups that are currently collaborating. The stepwise regression identifies two Employee Perception variables, Privacy (.493, .005) and Job Interdependence (.767, .000), that are both highly significant in predicting the value of SNA Betweenness Now Collaboration.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
10	(Constant)	-2.001	.457		-4.382	.000
	Privacy	.265	.084	.493	3.144	.005
	Job Interdependence	.547	.112	.767	4.883	.000
Dependent Variable: SNA Betweennes Now Collaboration						

Table 6.28 Backwards stepwise regression model predicting SNA Betweenness Now Collaboration

The next regression model for Collaboration uses the SNA measure of Closeness for current collaboration. Building ID is the most significant predictor

(.496, .016) of the respondents' social integration among current collaborators. The positive correlation illustrates that the LSI has higher values of SNA Closeness Now Collaboration.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
11	(Constant)	.595	.286		2.082	.050
	1=NSB, 2=LSI	.493	.188	.496	2.618	.016
Dependent Variable: SNA Closeness Now Collaboration						

Table 6.29 Backwards stepwise regression model predicting SNA Closeness Now Collaboration

Collaboration is directly associated with the act of interacting, one must talk to people to be able to collaborate with people. Therefore, the next regression models focus on only the different measures of Interaction (survey and SNA measures) as the independent variables and Collaboration as the dependent variable. As with the other models above, Building ID and PI are also included as an independent variable.

The first regression model identifying the relationship between interaction and collaboration is the amount of people the respondents interact with within their respective building (SNA Degree Now Collaboration). SNA Betweenness Informal Outside (.407, .003), SNA Closeness Informal Outside (.317, .015) and PI (.597, .000) were both found to be the most significant in predicting SNA Degree Now Collaboration. The Building ID significance suggests that LSI occupants collaborate with a greater amount of people in their building.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
7	(Constant)	.897	.825		1.087	.290
	SNA Betweennes Informal Outside	2.232	.657	.407	3.399	.003
	SNA Closeness Informal Outside	1.668	.627	.317	2.661	.015
	PI	4.555	.890	.597	5.118	.000
Dependent Variable: SNA Degree Now Collaboration						

Table 6.30 Backwards stepwise regression model predicting SNA Degree Now Collaboration with Interaction

The SNA measure of Betweenness Informal Outside is also found to be one of the most significant interaction measures to predict SNA Betweenness Now Collaboration (.723, .000). Respondents that are gatekeepers between those that informally interact outside the office are more likely to be the gatekeepers for current collaboration. PIs are also more likely to be the gatekeepers for current collaboration (.261, .064).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
8	(Constant)	-.018	.087		-.210	.836
	SNA Betweennes Informal Outside	.682	.126	.723	5.412	.000
	PI	.342	.175	.261	1.951	.064
Dependent Variable: SNA Betweennes Now Collaboration						

Table 6.31 Backwards stepwise regression model predicting SNA Betweenness Now Collaboration with Interaction

The following regression model utilizes SNA Closeness Now Collaboration as the dependent variable with the Interaction variables as the independent variables. The SNA measure of Closeness for informally interacting outside the building

(SNA Closeness Informal Outside) and Building ID are both most significantly associated with SNA Closeness Now Collaboration. Respondents who are closer to all others that informally interact outside, are closer to all others that collaborate (.557, .001). Additionally, the LSI occupants have a higher value of SNA Closeness for current collaboration (.426, .007).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
8	(Constant)	.144	.237		.606	.551
	SNA Closeness Informal Outside	.480	.118	.577	4.082	.001
	1=NSB, 2=LSI	.418	.139	.426	3.013	.007
Dependent Variable: SNA Closeness Now Collaboration						

Table 6.32 Backwards stepwise regression model predicting SNA Closeness Now Collaboration with Interaction

Additional regression analyses were performed with Employee Perceptions as the dependent variables because they may be impacted by the Spatial Layout, other Employee Perceptions, Interaction and Collaboration. The first Employee Perception dependent variable used in the regression analysis is Sense of Community, with Employee Perceptions, Spatial Layout and Interaction as the independent variables. In the regression model, eght independent variables are identified as significant in predicting Sense of Community. Three of these variables are Employee Perceptions: Interaction Support (.639, .000), Job Interdependence (.913, .000), and Privacy (.359, .032). The Spatial layout variable Connectivity has a negative relationship with the dependent variable (-.301, .042). Interaction measurements, SNA Degree Talk (-.619, .001) and Total

Interaction (.320, .038), are significant as well. Of note, is that the two interaction measures have different directions of correlation (one positive and one negative). Despite both being measures of interaction, one assesses the amount (Total Interaction) of interaction while the other reflects how many people to whom a respondent talks (SNA Degree Talk). Therefore, because they gather different types of data, it is understandable that they may suggest opposing effects. Two additional SNA interaction measures are also significantly related: SNA Degree Informal Outside (.357, .083) and SNA Betweenness Informal Outside (-.566, .024).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
10	(Constant)	-6.150	1.727		-3.561	.003
	Workspace Connectivity	-.019	.009	-.301	-2.241	.042
	Privacy	.435	.183	.359	2.374	.032
	Interaction Support	1.609	.348	.639	4.622	.000
	Job Interdependence	1.474	.292	.913	5.042	.000
	Total Interaction	.158	.052	.435	3.041	.009
	SNA Degree Talk	-.055	.013	-.622	-4.299	.001
	SNA Degree Informal Outside	.140	.075	.357	1.869	.083
	SNA Betweennes Informal Outside	-1.209	.479	-.566	-2.524	.024

Table 6.33 Backwards stepwise regression model predicting Sense of Community with Interaction

The following regression analysis is similar to the one above, but adds Collaboration instead of Interaction in the analysis of Sense of Community. The model finds six variables are the most significant. Three of the variables are Employee Perceptions: Spatial Layout support (-.366, .079), Job

Interdependence (.411, .023), and Job Satisfaction (.523, .002). In the model, the spatial measure Connectivity is negatively associated with Sense of Community (-.845, .003) as is the SNA Degree measurement of current collaboration (-.479, .052). This suggests that employees with office locations that are more segregated from their nearby neighbors, and those that have lower numbers of current collaborators, are likely to have a higher Sense of Community. Building ID is also significant which means that the LSI has a higher sense of community in the model (.763, .009).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
8	(Constant)	3.954	1.507		2.624	.018
	Workspace Connectivity	-.054	.016	-.845	-3.436	.003
	Spatial Layout	-.791	.422	-.366	-1.874	.079
	Job Interdependence	.663	.263	.411	2.524	.023
	Job Satisfaction	1.456	.403	.523	3.612	.002
	SNA Degree Now Collaboration	-.185	.088	-.479	-2.097	.052
	1=NSB, 2=LSI	1.884	.639	.763	2.949	.009
Dependent Variable: Sense of Community						

Table 6.34 Backwards stepwise regression model predicting Sense of Community with Collaboration

The final regression analyses used Job Satisfaction as the dependent variable as it appears in the Conceptual Model as a potential outcome of the other variables. The type of regression used is logistic regression instead of linear regression due to Job Satisfaction being a binary variable (0-Not Fully Satisfied and 1-Fully Satisfied).

The regression model from the analysis of Employee Perception and Spatial Layout variables as the independent variables shows no significant predictors of Job Satisfaction.

The following Job Satisfaction regression model uses Spatial Layout variables and Interaction (survey & SNA measures) as the independent variables. Two SNA variables, SNA Degree Talk and SNA Betweenness Talk, have a significant but weak relationship with Job Satisfaction. Employees who interact with fewer people (SNA Degree Talk -.129, .116) and those that act as the bridge between groups that interact (SNA Betweenness Talk .224, .168) are more likely to be fully satisfied with their job.

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 9a	**SNA Degree Talk**	-.129	.082	2.474	1	.116	.879
	SNA Btwn Talk	.224	.162	1.900	1	.168	1.251
	Constant	2.953	1.552	3.617	1	.057	19.155
Dependent Variable: Job Satisfaction							

Table 6.35 Backwards stepwise regression model predicting Job Satisfaction with Spatial Layout and Interaction

The final regression analysis of Job Satisfaction is similar to the one above, but replaced Collaboration with Interaction. The model did not come up with any variables that were significant in predicting Job Satisfaction.

6.5 Relationships of Employee Perceptions, Social Network, and Spatial Layout for Non-PIs

The regression models were all run again with only the non-PI data to research any significant relationships between variables among employees that are not the lead investigators (PI). The models predicting Interaction and Collaboration (separately) with Employee Perceptions and Spatial Layout showed significant results for non-PIs. Integration is a significant predictor of one Interaction variable (SNA Closeness Talk -1.228, .000) and two Collaboration variables (SNA Degree Collaboration SNA .871, .005; SNA Betweenness Collaboration -1.722, .025). Job Interdependence is also a common predictor of the same three Interaction and Collaboration variables (SNA Closeness Talk .438, .008; SNA Degree Collaboration .993, .000; SNA Betweenness Collaboration .466, .023). Several other Employee Perceptions variables are also found to be related to the three variables (see Tables 6.33, 6.34. 6.35).

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
7	(Constant)	25.611	3.675		6.970	.000
	Workspace Integration	-.055	.006	-1.228	-8.552	.000
	Interaction Support	6.152	1.247	.809	4.932	.000
	Job Interdependence	2.236	.716	.438	3.124	.008
	Sense of Community	-1.501	.432	-.505	-3.475	.004
Dependent Variable: SNA Closeness Talk						

Table 6.36 Backwards stepwise regression model predicting SNA Closeness Talk with Spatial Layout and Employee Perceptions for non-PIs

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
4	(Constant)	-8.449	3.895		-2.169	.055
	Workspace Integration	.024	.007	.871	3.635	.005
	Workspace Connectivity	-.084	.030	-.640	-2.765	.020
	Spatial Layout	-1.998	.691	-.456	-2.891	.016
	Privacy	1.505	.366	.568	4.115	.002
	Job Interdependence	2.982	.533	.933	5.597	.000
	Sense of Community	-.751	.292	-.403	-2.574	.028
	Workspace Satisfaction	1.264	.584	.296	2.165	.056
Dependent Variable: SNA Degree Now Collaboration						

Table 6.37 Backwards stepwise regression model predicting SNA Degree Now Collaboration with Spatial Layout and Employee Perceptions for non-PIs

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	-1.435	.843		-1.703	.114
	Workspace Integration	-.010	.004	-1.722	-2.559	.025
	Privacy	.178	.085	.314	2.108	.057
	Job Interdependence	.319	.122	.466	2.608	.023
	Workspace Satisfaction	.262	.126	.286	2.069	.061
	1=NSB, 2=LSI	1.653	.694	1.545	2.382	.035
Dependent Variable: SNA Betweenness Now Collaboration						

Table 6.38 Backwards stepwise regression model predicting SNA Betweenness Now Collaboration with Spatial Layout and Employee Perceptions for non-PIs

6.6 Summary

The correlation and regression analyses illustrate that there are significant relationships between the Employee Perceptions, Spatial Layout, Interaction and Collaboration. The results provide insight into how the design of the building can influence not only the behavior and use patterns of its occupants, but also occupants' perceptions of the space and their organization. The levels of

integration at both sites proved to be correlated with the respondents' perceptions of their workspace and job. The employee perceptions of their job tasks are also related to their interaction and collaboration behaviors. The regression models provide further evidence of the relationship between the variables. The models show that job role and perception of their workspace both predict respondents' interaction; and respondents' interaction outside of their work environment (but with building occupants) predicts their collaboration behaviors. The following chapter provides a deeper discussion into the relationships among the variables based on the results found in this chapter.

CHAPTER VII

DISCUSSION AND CONCLUSION

7.1 Chapter Overview

This chapter summarizes the results from Chapter 6 and draws conclusions based on the data. The author provides insight into how this research can contribute to informing laboratory planning/design as well as to advancing knowledge in the field. The key issues of laboratory design are addressed with respect to their impacts on occupants' behaviors and perceptions, interaction and collaboration. Limitations to this study are discussed in terms of their possible effect on the results. The limitations also lead to the discussion of proposed future research studies that could address and overcome the limitations. The chapter concludes with a discussion of the potential of future studies in this area.

7.2 Discussion of Findings & Conclusions

This section discusses the results from Chapter 6 to illustrate how the findings address the questions posed in Chapter 1. The relationships between the

variables are discussed as they were defined and organized in the conceptual model. Insight into these relationships provides an understanding of the effects of spatial layout on the perceptions and behaviors of building occupants.

The initial data illustrating the correlations between the spatial layout and employee perceptions of their office and organization represents the initial section of the conceptual model. These relationships are of interest because of their potential impact on an occupant's perceived and actual interaction. The only significant correlational relationship between the spatial layout and perceptions was found with the LSI data showing a negative correlation between integration and privacy. The more integrated a respondent's workspace, the less privacy they feel. Highly integrated areas are, based on SSA research, more easily accessible from all other areas in a building and exhibit higher movement of people. Therefore, these more integrated workspaces at the LSI are more likely to be in spaces where more people either are present or moving through. The reported perception, or lack of privacy, is understandable given the assumed increased number of people visiting this area.

Similar to the results of other studies (Penn et al, 1999; Wineman et al., 2009), the correlation analyses between both buildings' integration and observed movement values are positive. Therefore, the more integrated a space, the more movement in the space. This confirms the above theory that those located in more integrated workspaces are located in spaces in which more movement occurs, thereby impinging on privacy.

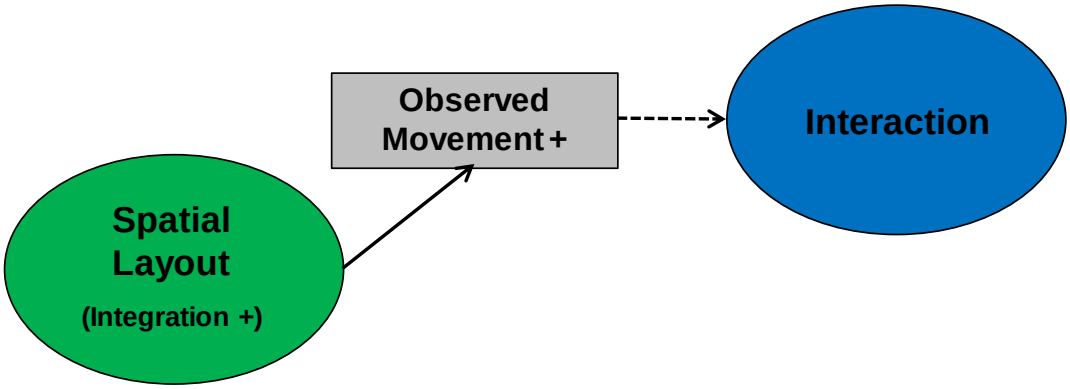

Figure 7.1 Relationship between Spatial Layout and Observed Movement

Additionally, this positive correlation between movement and integration is likely to support innovation. Research has shown that movement is essential in establishing connections and interactions outside one's local area (Wineman et al., 2009). These connections are essential to the shared knowledge and ideas that cultivate innovation.

The observation data visibility graphs demonstrate that the majority of the interactions occur in the labs or offices. The correlation data further explores this relationship identifying a significant negative relationship between integration and observed interaction in the LSI (a negative relationship at the NSB as well, but not statistically significant). This result is likely due to the location of labs and

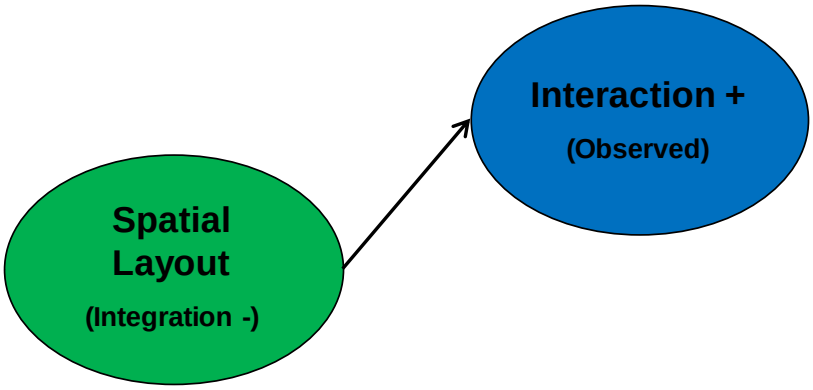

Figure 7.2 Relationship between Spatial Layout and Observed Interaction

offices (where people were often observed talking) in less integrated places. Offices were most often located along the window wall and at corner locations away from the most integrated central spaces. These results suggest that, despite research (Grajewski, 1990) that hypothesizes that more integrated areas will most likely have more interaction; this is not the case at the LSI nor NSB. This confirms previous research (Rashid et al., 2006; Wineman & Serrato, 1999) that showed negative correlations with [observed] interaction.

Conversely, the group break areas are located in highly integrated spaces. Therefore, the group spaces location and availability is evident to people due to more movement in the surrounding integrated areas. The group areas were observed to be used not only for lunch breaks, but for meetings. The availability of white boards and sufficient space, sends a message (confirmed via focus groups and interviews) to the occupants that these areas are available for interaction. Although the number of observed interactions in these integrated locations, such as the circulation areas and group break areas, were fewer than

the conversations in the labs or offices, these are more likely than office or lab interactions to be conversations that cross group affiliations and therefore may be critical to the generation of new ideas and overall innovation. A limitation of the observations is that the group affiliation of participants is not known.

Regression models provided a more in-depth look into the relationships between the occupants perceptions and behavior and their relationship to each other and the spatial layout. Several regression analysis models illustrate that employees' perception of interaction support is a predictor of not only how many people they interact with (Degree Talk), but also their social closeness (Closeness Talk) to everyone, and their role as gatekeeper (Betweenness Talk).

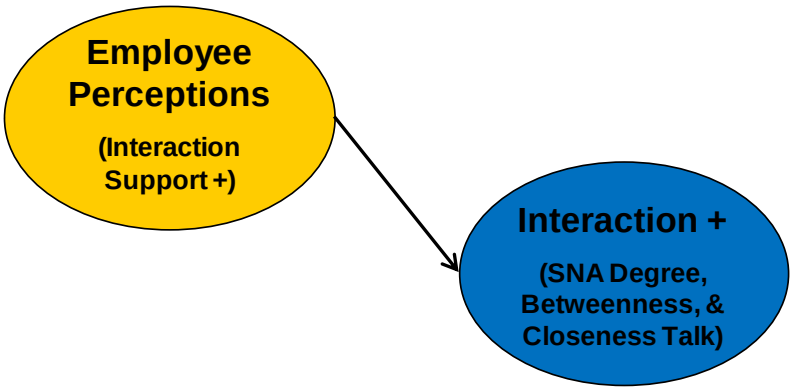

Figure 7.3 Relationship between Interaction Support and Interaction measures

A respondent who perceives that their job requires them to interact with other people, the higher the majority of all their SNA values. The assumption is that if a job requires you to talk to people to complete your job, then you will have increased levels of social network values.

Only SNA measures for informally interacting (non-work related) outside of work (Degree and Betweenness Informal Outside) are associated with one's perception of job interdependence. Job interdependence is the sole variable related to the number of people one interacts with outside the office.

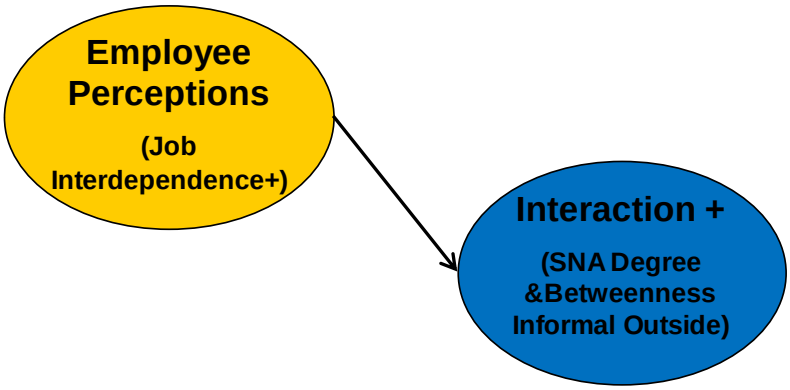

Figure 7.4 Relationship between Job Interdependence and Interaction measures

The assumption could be made that due to their job requiring them to interact with others, the more connections and friendships are developed, therefore carrying over to interaction outside work.

The employees' perception of sense of community is negatively associated with all SNA measures of how many people the respondents interact with (Degree Talk).

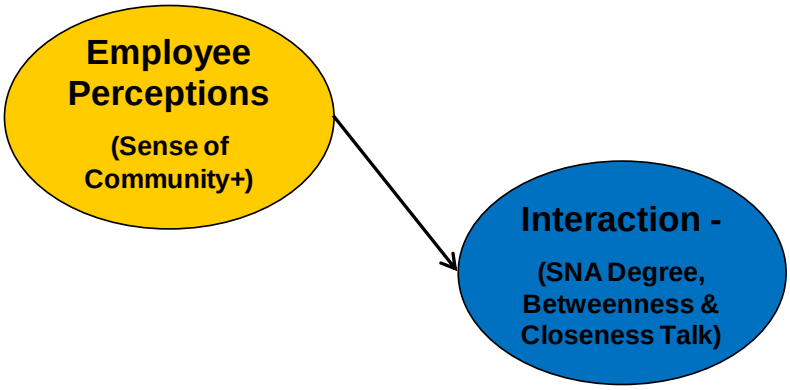

Figure 7.5 Relationship between Sense of Community and Interaction measures

This suggests that it's not the number of people that one interacts with that creates a perceived sense of community, but a small core group of people. The negative association with the other two SNA measures (Betweenness and Closeness Talk) also suggests that being a gatekeeper or being socially close to all others is not important to establishing a feeling of community.

Job Satisfaction used as an independent variable to predict collaboration (along with perceptions and spatial layout) is of significance. The higher level of perceived job satisfaction, the more people one collaborated with (Degree Now Collaboration). This suggests that the more workers are satisfied with their job,

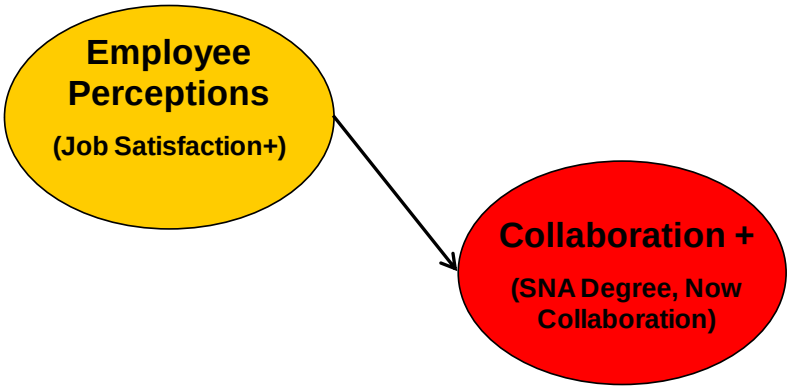

Figure 7.6 Relationship between Job Satisfaction and Collaboration measures

the more open they are to share their knowledge and work with others outside their lab group. Job Satisfaction as an outcome of collaboration (as proposed in the conceptual model) was not significant. But, Job Satisfaction is a significant outcome of two interaction measures representing the number of people one talks with (Degree and Betweenness Talk).

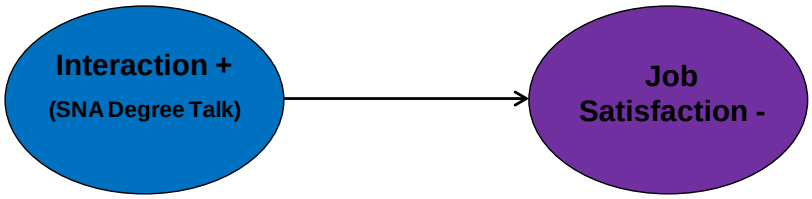

Figure 7.7 Relationship between Interaction measure SNA Degree Talk and Job Satisfaction

Similar to another perception, Sense of Community, the fewer the number of people a respondent talks to (Degree Talk), the more one is satisfied with their

job. Alternatively, the role of gatekeeper for interaction (Betweenness Talk) is positively associated with Job Satisfaction. Therefore, being in control of

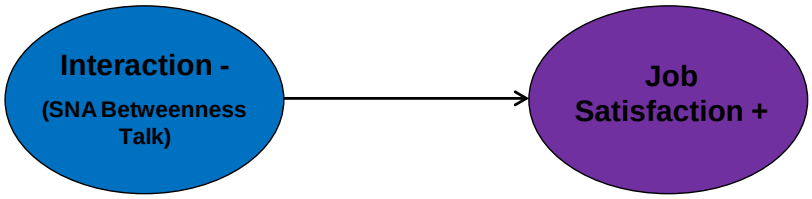

Figure 7.8 Relationship between Interaction measure SNA Betweenness Talk and Job Satisfaction

information that is passed from one group to another increases one's satisfaction with their job.

The Building ID (identifying LSI or NSB) entered as a variable to determine if the building itself had any influence on the outcomes, revealed interesting significance with interaction and collaboration. The self-reported amount of interaction (Total Interaction) is greater at the LSI as well as the likelihood a person is the gatekeeper of information (SNA Betweenness Talk). Additionally, being an occupant in the LSI is also significant in predicting all three SNA collaboration measures, and is the sole predictor of Closeness for collaboration. These regression models suggest that potentially differences in the design and availability of spaces at the LSI (compared to the NSB), positively influences social behaviors. The LSI offers a variety of amenity spaces, including two group break areas per floor. These break areas are near highly integrated corridors which have shown to have higher movement. Due to the higher levels of

collaboration, a presumption could be made that occupants of the LSI interact with other lab members in these group areas and then take back the shared knowledge to their own lab. It is also possible that this difference is due to social/organizational culture differences.

Just as the Building ID was used in all regression models, so was the job role (PI or not) to reveal if one's job role has predictive qualities of interaction and collaboration. The data in fact shows that being a PI is significantly associated with several SNA interaction and collaboration measures. PI's talk to more

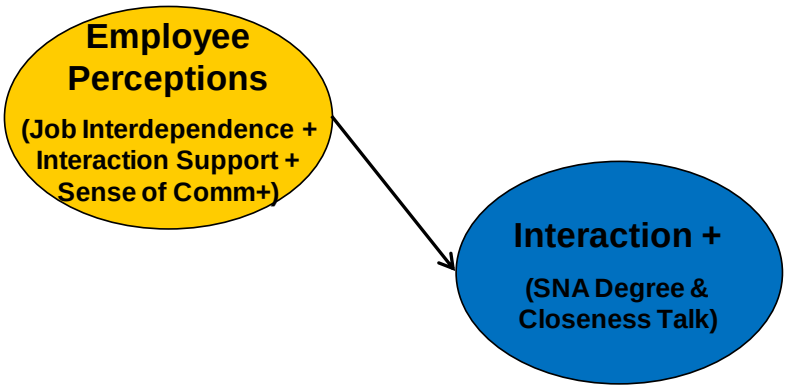

Figure 7.9 Relationship between Employee Perceptions and Interaction measures for PIs

people (Degree Talk) as well as having easier social access to everyone within the building (Closeness Talk). This is of no surprise due to PI's involvement in department and faculty functions and exposure to all PIs, therefore providing closer access to all lab members working under other PIs. Alternatively, not being a PI is positively associated with being a gatekeeper among those who

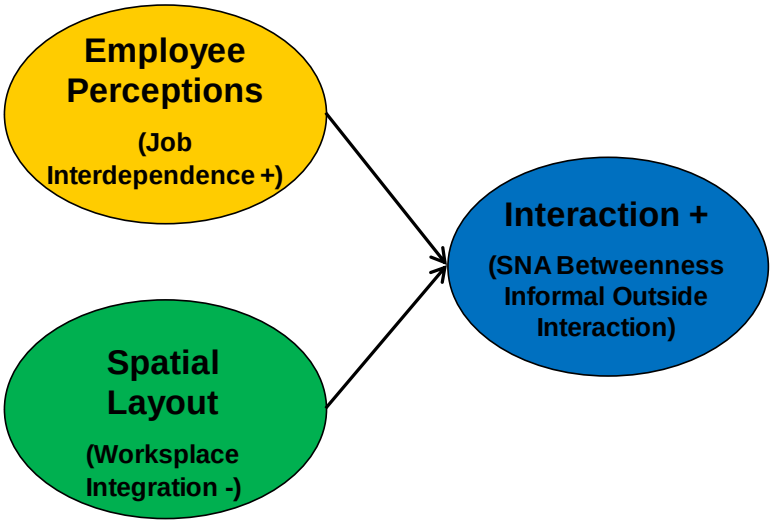

Figure 7.10 Relationship between Employee Perceptions, Spatial Layout and Interaction measures for occupants that are not PIs

informally interact outside the building (Betweenness Informal Outside). This suggests that lab members have built friendships that reach across work groups and that extend to outside work interactions. On the other hand, PIs are more likely to collaborate with more people (Degree Now Collaboration) as well as being the gatekeeper among those with whom they collaborate (Betweenness Now Collaboration) within the workplace and those they socialize with outside of work.

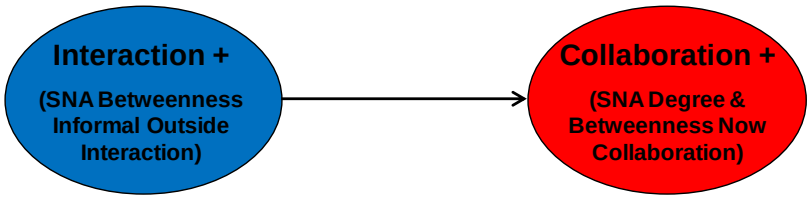

Figure 7.11 Relationship between Interaction and Collaboration measures for PIs

The assumption could be made that due to their job requiring them to interact with others, the more connections and friendships are developed, therefore carrying over to interaction outside work. Fostering interaction within the workplace so it overflows outside the physical environment becomes an important aspect of workplace design to facilitate collaboration.

7.3 Contributions of the Dissertation

This study provides a foundation of understanding of a particular category of work environments, science laboratories, which were designed to positively influence interaction and collaboration.

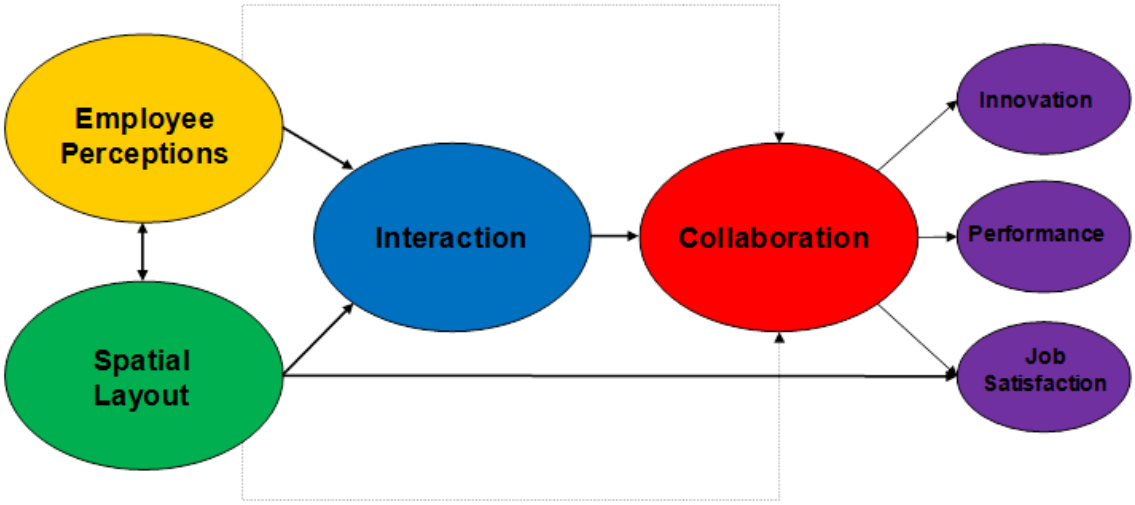

Figure 7.12 Conceptual Model

Employee perceptions and the spatial layout are associated with occupants' interaction. Two employee perceptions that are directly related to interaction

needs, interaction support and job interdependence, are found to be statistically significantly related to occupants interaction. The data shows that highly integrated areas have more movement. Movement is important to not only bring people together, but also in bringing people past other workers' offices.

Collaboration is influenced by the occupant's perception of their job satisfaction. This research shows that the more a person is satisfied with their job, the more people they collaborate with. Additionally, job role and informal interaction outside the workplace are significant in predicting collaboration as well. Informal interaction outside the workplace is also significant as the outcome of not being a PI and job interdependence. The results draw attention to the significance of interaction, including informal interaction, and their impact on fostering collaboration as well as being fostered by employee perceptions and the spatial layout. Academic research and laboratory design can use the results of this study to inform more complete research and design.

7.4 Key Issues of Laboratory Design

Laboratory design is a unique area of work environment design. The traditional work environment concept of designated workspaces is only for a select few (PIs and administrators) while everyone else predominantly shares not only the lab, but the equipment and amenity spaces. To foster interaction and collaboration in this type of workplace, attention has to be given to the location of spaces, both workspaces and shared spaces. The shared areas should be near highly

integrated corridors to increase the number of people using the spaces as well as their visibility from people moving in the adjacent corridors. Corridors should be highly integrated areas as this study shows that more movement occurs in those areas. As mentioned earlier, movement is key in fostering interaction and collaboration.

Both case study sites were designed with shared group spaces and shared equipment. The shared group spaces (conference rooms, break areas, etc.) require the building occupants to either coordinate the use of the spaces or occupy the space at the same time. This provides opportunities for interaction that may not have occurred if the space(s) were not designed to be shared. Additionally, the shared equipment also provides opportunity for interaction as lab members have to coordinate their use of the equipment based on their needs and availability. Therefore, the placement of the shared equipment areas is of interest due to the potential of several lab groups using the space and moving to those areas. The NSB and LSI's shared equipment areas are located off the lab corridors (highly integrated) which allows for easy access and movement (with the potential for interaction).

The LSI offers two break areas per floor whereas the NSB only has one per floor. Based on the shape and structure of the building, both buildings succeed in providing easy access (via hghly integrated corridors) to these break areas. Due to the NSB's L-shaped structure, the break area is located in the elbow (inner corner). The LSI's two break areas are at opposite ends of the long liner-shaped building, therefore providing access to all regardless of what side of the building

you are located. Additionally, break areas in both buildings are near elevators which allows occupants and visitors to be aware of the areas when coming or going from the floor.

PIs talk to more people, collaborate with more people, and have easier social access to others. As discussed above, this is likely due to their organizational role in department and faculty functions. For employees that are not PIs, the shared spaces in both LSI and NSB (labs, shared equipment, break areas) support social interaction. Both shared equipment and break areas, and the open floor plan for labs, bring people together across workgroups. These spatial features encourage the development of friendships that extend beyond one's immediate workgroup. Thus, spatial layout appears to be more critical to collaboration for non-PIs who do not have the extent of organizational support for such activities than it is for PIs.

The organizational culture including the organization's stance on interaction is an important factor in not only accommodating interaction but also the perception of acceptance of interaction within the workplace. The NSB and LSI both host formal presentations in a large group space (NSB=auditorium; LSI=library). The design of these larger spaces allow for these types of events to occur and knowledge to be shared. The NSB also organizes weekly happy hours hosted on rotation by lab groups. The happy hour occurs on an outdoor patio if the weather permits, otherwise, inside in one of the group break areas. These planned interaction events are made possible by the organization, but could not occur unless the space supported such events.

As observed, interaction occurs most often in the laboratories at both sites. The conference rooms and group break areas are also popular for interaction possibly due to their close proximity to highly integrated corridors. The private offices at the NSB were observed to have high levels of interaction (more than the LSI). There are several potential reasons for this: 1. organizational culture, 2. more people than PIs with offices (grad students, post docs), and/or 3. offices are near highly integrated corridors. Despite the level of observed interaction being higher at the LSI, interaction at the NSB is more dispersed across the variety of spaces as compared with the LSI. Additionally, the regression model predicting collaboration shows that the LSI is significantly associated with collaboration. Therefore, a greater variety of locations of interaction is not necessarily beneficial to collaboration.

7.5 Limitations and Future Studies

This section addresses potential limitations this study had as well as ideas for future studies that this dissertation can inform. The first potential limitation is the overall research approach, case study analyses. A case study enables more attention to be focused on environmental and behavioral details that may not be possible to address in a larger study. However, this focus on one or two environments could pose issues when trying to use case study results to generalize to other environments (or a subset of design types) since they may just be unique to that one environment. The dissertation addresses this issue by

having more than one case study, but additional cases with a similar design focus would add to the validity. Additionally, adding case studies that were not built with the similar intention to enhance interaction and collaboration might provide greater variability on both the characteristics of the built environment and different levels of social behaviors. Research might address the issue of whether *employees* own motivation overcomes the lack of *design* intent for interaction for collaboration.

Another limitation is the sample size. A larger number of respondents would have allowed more substantial data analysis, and potentially more significant results. A larger dataset would likely provide a greater variability of responses for certain variables where significance may have been limited by a lack of differentiation. This would then allow for more definite results and conclusions on how the space is influencing behavior. A limitation of the observation data is that we don't know who is conversing from which lab groups. Knowledge of this information could allow for more accurate data as to who interacts with whom and where.

Future studies could include additional measures and data in regards to the spatial layout. This study included a basic observation of the visibility graphs to identify comparable values of the spaces (i.e. lab v. group areas) based on the observations and SSA analysis. Alternatively, categorizing the different spaces, such as labs and group spaces, would illustrate the differences in integration and connectivity values for each category of space. The observation data could then be correlated with these values to identify the relationship between the spatial

layout variables and observed behaviors and the similarities and/or differences between the type(s) of spaces. An additional spatial layout measure of distance between one's workspace to other spaces within the building could add more to the discussion of the location of spaces and their influences on social behaviors. The metric closeness to a space could influence the space use patterns of the occupants. This measure of metric distance was not included in this study.

This study focuses on only one type of interaction: face-to-face communication. Future studies could benefit from evaluating a broader range of communication to include email, IM, and texting communications. These types of communications are becoming more prominent as technology advances; therefore it would be beneficial to study their impact and relationship with the spatial layout of work environments. Additionally, future studies could benefit from evaluating a work force's performance and innovation level as related to the spatial layout and interaction/collaboration behaviors. These two outcomes (performance and innovation) were not included in this study due to the difficulty of measuring these variables.

This study's data and results are a springboard for further research in understanding the characteristics of building design that influence social behaviors.

APPENDICES

Appendix 1. PI Interview Scripts

LIFE SCIENCES INSTITUTE INTERVIEW QUESTIONS

(Principal Investigators only)

1. How long have you worked at the Life Sciences Institute?

2. Have you been in the same office your entire time at the LSI or have you moved offices? If moved, please tell me about the other offices.

3. How many hours a week on average do you spend in the LSI building?

4. What is the percentage of hours you spend in your private office versus in the laboratory spaces?

5. What spaces does your workgroup occupy? Does this spatial layout/design support work tasks?

6. ? How well does the relationship between your office and your staff's work area support work tasks?

7. Are there spaces that are shared with other labs?

8. What informal spaces does your lab use?

9. Is there collaboration between your research staff and other staff? Where does this collaboration occur?

10. Is there informal interaction between your research staff and other staff? Where does this interaction occur?

11. How often does other LSI research staff come in your office to discuss work (daily, hourly, etc.)?

12. How often does other LSI research staff come in your office to discuss non-work related issues (hourly, daily, weekly, monthly)?

13. Are there spaces in this building where you meet colleagues (other PI's/other staff) for informal conversation (snack/coffee area/hallway, etc.)?

14. Are there events in this building where you meet colleagues (other PI's/other staff)? If yes, where are these events located?

15. Have you been approached by other LSI staff suggesting collaborating on a project? If yes, who? If yes, did you agree and where are you in the process (done, in process, development, etc.)

16. Have you approached other LSI staff suggesting collaborating on a project? If yes, who? If yes, did they agree and where are you in the process (done, in process, development, etc.)

If they have collaborated on a project:

17. Can you recall how the collaboration began:
    - Were you acquainted with this colleague from another project (please describe)?
    - From events at LSI or elsewhere (please describe)?
    - Just running into them in the building?
    - As a social acquaintance?
    - Acquainted through a third party (if so did they work in this building)?
    - Other?

18. Would you describe where your initial discussions for this collaboration took place (informal discussions in hallway or snack/coffee area, your office, their office, laboratory)?

19. How well does this building work to support collaboration? What are the best/worst aspects of this building in enhancing collaboration?

20. Any additional comments about the building (successes/failures)?

NATURAL SCIENCES BUILDING INTERVIEW QUESTIONS

(Principal Investigators only)

21. How long have you worked at the Natural Sciences Building?

22. Have you been in the same office your entire time at the NSB or have you moved offices? If moved, please tell me about the other offices.

23. How many hours a week on average do you spend in the NSB?

24. What is the percentage of hours you spend in your private office versus in the laboratory spaces?

25. What spaces does your workgroup occupy? Does this spatial layout/design support work tasks?

26. ? How well does the relationship between your office and your staff's work area support work tasks?

27. Are there spaces that are shared with other labs?

28. What informal spaces does your lab use?

29. Is there collaboration between your research staff and other staff? Where does this collaboration occur?

30. Is there informal interaction between your research staff and other staff? Where does this interaction occur?

31. How often does other NSB research staff come in your office to discuss work (daily, hourly, etc.)?

32. How often does other NSB research staff come in your office to discuss non-work related issues (hourly, daily, weekly, monthly)?

33. Are there spaces in this building where you meet colleagues (other PI's/other staff) for informal conversation (snack/coffee area/hallway, etc.)?

34. Are there events in this building where you meet colleagues (other PI's/other staff)? If yes, where are these events located?

35. Have you been approached by other NSB staff suggesting collaborating on a project? If yes, who? If yes, did you agree and where are you in the process (done, in process, development, etc.)

36. Have you approached other NSB staff suggesting collaborating on a project? If yes, who? If yes, did they agree and where are you in the process (done, in process, development, etc.)

If they have collaborated on a project:

37. Can you recall how the collaboration began:
    - Were you acquainted with this colleague from another project (please describe)?
    - From events at NSB or elsewhere (please describe)?
    - Just running into them in the building?
    - As a social acquaintance?
    - Acquainted through a third party (if so did they work in this building)?
    - Other?

38. Would you describe where your initial discussions for this collaboration took place (informal discussions in hallway or snack/coffee area, your office, their office, laboratory)?

39. How well does this building work to support collaboration? What are the best/worst aspects of this building in enhancing collaboration?

40. Any additional comments about the building (successes/failures)?

Appendix 2. Workplace Survey

WORKPLACE SURVEY

This survey is being conducted to explore the links between workplace qualities and organizational effectiveness at the Natural Sciences Building. Your responses to this survey will help designers and administrators to provide more effective workspaces in the future.

A. Let us know about how well other spaces in the building work for you

	Question #1						Question #2					
	In a typical week, how often do you use these facilities? (*Please circle/mark the appropriate response.*) 5 = Eleven or more times 4 = Six to ten times 3 = Three to five times 2 = One to two times 1 = Never 0 = N/A						In your opinion, how IMPORTANT are these facilities for getting your job done? (*Please circle/mark the appropriate response.*) 5 = Crucial 4 = Very important 3 = Important 2 = Somewhat important 1 = Rarely important 0 = N/A					
Break Area on your floor	0	1	2	3	4	5	0	1	2	3	4	5
Conference Room - 4209	0	1	2	3	4	5	0	1	2	3	4	5
Conference Room - 4211	0	1	2	3	4	5	0	1	2	3	4	5
Auditorium on 1st Floor	0	1	2	3	4	5	0	1	2	3	4	5
Other Conference Rooms	0	1	2	3	4	5	0	1	2	3	4	5
Your Project Team Lab	0	1	2	3	4	5	0	1	2	3	4	5

Area												
Other Project Team Lab Area	0	1	2	3	4	5	0	1	2	3	4	5
Shared Lab Facilities Areas	0	1	2	3	4	5	0	1	2	3	4	5
Service area (Fax, Photocopier, Mail, etc.)	0	1	2	3	4	5	0	1	2	3	4	5

	Question #3	Question #4
	In your opinion, is this space a good place to when looking to spur your (individual) creative work processes? (*Please circle/mark the appropriate response.*) 5 = Agree 4 = Somewhat agree 3 = Neutral 2 = Somewhat disagree 1 = Disagree 0 = N/A	In your opinion, is this space a good place to when looking to spur team (two or more people) creative work processes? (*Please circle/mark the appropriate response.*) 5 = Agree 4 = Somewhat agree 3 = Neutral 2 = Somewhat disagree 1 = Disagree 0 = N/A
Break Area on your floor	0 1 2 3 4 5	0 1 2 3 4 5
Conference Room - 4209	0 1 2 3 4 5	0 1 2 3 4 5
Conference Room - 4211	0 1 2 3 4 5	0 1 2 3 4 5
Auditorium on 1st Floor	0 1 2 3 4 5	0 1 2 3 4 5
Other Conference Rooms	0 1 2 3 4 5	0 1 2 3 4 5
Your Project Team Lab Area	0 1 2 3 4 5	0 1 2 3 4 5

Other Project Team Lab Area	0	1	2	3	4	5	0	1	2	3	4	5
Shared Lab Facilities Areas	0	1	2	3	4	5	0	1	2	3	4	5
Service area (Fax, Photocopier, Mail, etc.)	0	1	2	3	4	5	0	1	2	3	4	5

	Question #5		Question #6		Question #7	
	Have you used this space for formal 'brain-storming' activities? *Circle Yes or No as appropriate (If not applicable, leave blank).*		Have you used this space for informal 'brain-storming' activities? *Circle Yes or No as appropriate (If not applicable, leave blank).*		Have you used this space for activities that require un-interrupted concentration? *Circle Yes or No as appropriate (If not applicable, leave blank).*	
Break Area on your floor	YES	NO	YES	NO	YES	NO
Conference Room - 4209	YES	NO	YES	NO	YES	NO
Conference Room - 4211	YES	NO	YES	NO	YES	NO
Auditorium on 1st Floor	YES	NO	YES	NO	YES	NO
Other Conference Rooms	YES	NO	YES	NO	YES	NO
Your Project Team Lab Area	YES	NO	YES	NO	YES	NO
Other Project Team Lab Area	YES	NO	YES	NO	YES	NO
Shared Lab Facilities Areas	YES	NO	YES	NO	YES	NO
Service area (Fax, Photocopier, Mail, etc.)	YES	NO	YES	NO	YES	NO

8. Please describe the two or three features you LIKE most about the entire office space of your project team area:

   a. _____
   b. _____
   c. _____

9. Please describe the two or three features you DISLIKE most about the entire office space of your project team area:

   a. _____
   b. _____
   c. _____

10.

	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	N/A
I often stop and talk to others I meet in the corridors or circulation areas of this building.	☐	☐	☐	☐	☐	☐
I often stop and talk to others I meet in the lounge/breakroom of this building.	☐	☐	☐	☐	☐	☐
This building provides many opportunities for informal conversations with others.	☐	☐	☐	☐	☐	☐
The people I need to work with most often are located close to my workspace.	☐	☐	☐	☐	☐	☐
This office provides shared spaces for teamwork and/or impromptu meetings.	☐	☐	☐	☐	☐	☐
I often have difficulty finding the people I need to get my work done.	☐	☐	☐	☐	☐	☐
So long as I get my job done, I can choose where in the building I do it.	☐	☐	☐	☐	☐	☐
I have access to the equipment and material I need to get my job done well.	☐	☐	☐	☐	☐	☐
When I need information from co-workers in order to do my work, I have to go out of my way to get it.	☐	☐	☐	☐	☐	☐

The office support equipment (fax, photocopy machine, mail, etc.) is convenient to my workspace.	☐	☐	☐	☐	☐	☐
I often use the stairs instead of the elevator.	☐	☐	☐	☐	☐	☐
I often use the stairwell entrance to the NSB instead of the front lobby door entrance when entering the building.	☐	☐	☐	☐	☐	☐
The shared lab facilities are convenient to my workspace.	☐	☐	☐	☐	☐	☐
The layout of the group workspace supports teamwork.	☐	☐	☐	☐	☐	☐
The layout of the group workspace supports impromptu meetings.	☐	☐	☐	☐	☐	☐
This office lacks informal meeting spaces.	☐	☐	☐	☐	☐	☐
The conference rooms support work tasks.	☐	☐	☐	☐	☐	☐
When I need to schedule a conference space, there is one available.	☐	☐	☐	☐	☐	☐
The sizes of conference spaces fit our needs.	☐	☐	☐	☐	☐	☐
This office space is flexible to accommodate change.	☐	☐	☐	☐	☐	☐
All things considered, I am pleased with the location of my personal workspace within this department.	☐	☐	☐	☐	☐	☐
All things considered, I am pleased with the layout of this department.	☐	☐	☐	☐	☐	☐

11. Please describe the two or three features you LIKE most about the building:
    a. _____
    b. _____
    c. _____

12. Please describe the two or three features you DISLIKE most about the building:
    a. _____
    b. _____
    c. _____

B. Here are some questions about your work tasks.

13.

	0-10 percent	11-25 percent	26-50 percent	51-75 percent	76-100 percent	N/A
On an average working day, about how much time (percent of time) is spent at your desk or workstation?	☐	☐	☐	☐	☐	☐

14.

	Never	1-2 times	3-4 times	5 + times
During your average working day, how many times do you leave the building in connection with your work?	☐	☐	☐	☐

15. How many hours a week do you work? _____

16.

	0-2 Hours	2-6 Hours	6-12 Hours	12-20 Hours	20 + hours	N/A
How many hours in a typical work week do you spend in formal planned meetings?	☐	☐	☐	☐	☐	☐

17.

	0-10%	11-25%	26-50%	51-75%	76-100%	N/A
In a typical work week, how much time do you spend working away from this office building?	☐	☐	☐	☐	☐	☐

18. In a typical work week, how much time do you spend in the following spaces:

	0-10%	11-25%	26-50%	51-75%	76-100%	N/A
Your office/workspace	☐	☐	☐	☐	☐	☐
Co-worker's office	☐	☐	☐	☐	☐	☐

Group workspace	☐	☐	☐	☐	☐	☐
Your laboratory space	☐	☐	☐	☐	☐	☐
Other laboratory space	☐	☐	☐	☐	☐	☐
Shared laboratory spaces	☐	☐	☐	☐	☐	☐
Other:	☐	☐	☐	☐	☐	☐

19. In a typical work week, how much time do you spend doing the following activities:

	0-10%	11-25%	26-50%	51-75%	76-100%	N/A
Attend scheduled meetings with your bosses, supervisors or superiors	☐	☐	☐	☐	☐	☐
Attend scheduled meetings with employees who report to you	☐	☐	☐	☐	☐	☐
Attend scheduled meetings with your fellow employees	☐	☐	☐	☐	☐	☐
Attend scheduled meetings with visitors	☐	☐	☐	☐	☐	☐
Get together informally with your bosses, supervisors or superiors	☐	☐	☐	☐	☐	☐
Get together informally with employees who report to you	☐	☐	☐	☐	☐	☐
Get together informally with fellow employees in your department	☐	☐	☐	☐	☐	☐
Get together informally with fellow employees from outside your department	☐	☐	☐	☐	☐	☐

20. Here are some statements about working with others – how would you respond for your job?

	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	N/A
There is a "sense of community" in my department.	☐	☐	☐	☐	☐	☐
I frequently must coordinate my efforts with others.	☐	☐	☐	☐	☐	☐
The way I perform my job has a significant impact on others.	☐	☐	☐	☐	☐	☐

Co-workers interrupt my work.	☐	☐	☐	☐	☐	☐
I rarely have to obtain information from others to complete my work.	☐	☐	☐	☐	☐	☐
Informal conversations with others are discouraged in this organization.	☐	☐	☐	☐	☐	☐
The people I work with treat me well.	☐	☐	☐	☐	☐	☐
I can plan my own work with little need to coordinate with others.	☐	☐	☐	☐	☐	☐
There is too much bickering and fighting at work.	☐	☐	☐	☐	☐	☐
I collaborate closely with others in doing my work.	☐	☐	☐	☐	☐	☐
The opportunity to talk informally with others is one of the reasons I enjoy my work.	☐	☐	☐	☐	☐	☐
I enjoy my co-workers	☐	☐	☐	☐	☐	☐
My own performance is dependent on receiving accurate information from others.	☐	☐	☐	☐	☐	☐
My job requires that I use office resources that are shared with others.	☐	☐	☐	☐	☐	☐
My work requires me to consult with others fairly frequently.	☐	☐	☐	☐	☐	☐
Communications seem good within this organization.	☐	☐	☐	☐	☐	☐
I work fairly independently of others in my work.	☐	☐	☐	☐	☐	☐

C. Let us know about yourself and your experience.

21. How long have you worked in this particular building? _____

22. How long have you worked in this particular workspace? _____

23. How would you describe yourself?

	Agree	Somewhat Agree	Neutral	Somewhat Disagree	Disagree	N/A

I work well when there are people around me.	☐	☐	☐	☐	☐	☐
I prefer to work alone, with few distractions.	☐	☐	☐	☐	☐	☐
Having social time with co-workers is important to me.	☐	☐	☐	☐	☐	☐

24. How important are these job characteristics to you?

	Not At All				Quite A Lot	N/A
Good salary	☐	☐	☐	☐	☐	☐
Pleasant surroundings	☐	☐	☐	☐	☐	☐
The workstation-office space	☐	☐	☐	☐	☐	☐
Having the latest technology to work with	☐	☐	☐	☐	☐	☐
Organizational climate	☐	☐	☐	☐	☐	☐
The team of people I work with	☐	☐	☐	☐	☐	☐
Opportunity to learn new skills	☐	☐	☐	☐	☐	☐
Location of the office	☐	☐	☐	☐	☐	☐

25. Your name: _____

26. Your title/position: _____

Thank you for participating in this workplace survey!

Appendix 3. Communication Survey

ORGANIZATIONAL COMMUNICATIONS SURVEY

A. BACKGROUND INFORMATION

Please respond to the questions in this section by filling in the blanks as appropriate. For some questions, you may check the most appropriate response. If a question is not applicable, please write 'N/A' and skip to the next question.

27. Your name: _____
28. Your title/position: _____
29. What is your sex?
    [ ] male [ ] female
30. What is your age range?
    [ ] 18-22 [ ] 23-25 [ ] 26-30 [ ] 31-35 [ ] 36-40
    [ ] 41-45 [ ] 46-50 [ ] 51-60 [ ] over 60
31. What is your marital status?
    [ ] single [ ] married [ ] remarried [ ] divorced [ ] widowed
32. When did you being working at LSI/NSB?
    _____
    (*month/year*)
33. Where did you work before joining the LSI/NSB?
    _____
34. Which Lab Group do you currently work for?
    [ ] A [ ] B [ ] C
35. What is your highest educational degree?
    _____
36. What was the subject(s) of your highest educational degree?
    _____
37. Overall, how many years of experience do you have in the industry?
    _____
38. What do you like best about working at the Life Sciences Institute/Natural Sciences Building?
    _____
39. If there is one thing that you could change at the Life Sciences Institute/Natural Sciences Building, what would it be?
    _____

B. ORGANIZATIONAL COMMUNICATIONS

The next 4 pages contain questions about your communications with other members of the Life Sciences Institute lab groups. Please circle your response or fill in the box next to each person's name using the codes listed under each question.

	Question #1	Question #2
	About HOW OFTEN do you have discussions with this person in order to get your work done? 5 = Several times a day 4 = Daily 3 = Several times a week 2 = Weekly 1 = Several times a month 0 = Monthly or less *Please circle/mark the appropriate response.*	How IMPORTANT are these discussions for getting your job done? 5 = Crucial 4 = Very helpful 3 = Helpful 2 = Somewhat helpful 1 = Rarely helpful 0 = Not at all *Please circle/mark the appropriate response.*
1 John Doe	0 1 2 3 4 5	0 1 2 3 4 5
2 Jane Doe	0 1 2 3 4 5	0 1 2 3 4 5
3 Joe Public	0 1 2 3 4 5	0 1 2 3 4 5
4 Jane Public	0 1 2 3 4 5	0 1 2 3 4 5
5 Even Stevens	0 1 2 3 4 5	0 1 2 3 4 5
6 Roger Rabbit	0 1 2 3 4 5	0 1 2 3 4 5
7 Sally Ranger	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5

	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5

	Question #3	Question #4
	How strong of a work relationship do you have with this person? 5 = Strong 4 = Somewhat strong 3 = Somewhat weak 2 = Weak 1 = I prefer to avoid this person 0 = I do not know this person *Please circle/mark the appropriate response.*	How IMPORTANT is a strong work relationship with this person for getting your job done? 5 = Crucial 4 = Very helpful 3 = Helpful 2 = Somewhat helpful 1 = Rarely helpful 0 = Not at all *Please circle/mark the appropriate response.*
1 John Doe	0 1 2 3 4 5	0 1 2 3 4 5
2 Jane Doe	0 1 2 3 4 5	0 1 2 3 4 5
3 Joe Public	0 1 2 3 4 5	0 1 2 3 4 5
4 Jane Public	0 1 2 3 4 5	0 1 2 3 4 5
5 Even Stevens	0 1 2 3 4 5	0 1 2 3 4 5
6 Roger Rabbit	0 1 2 3 4 5	0 1 2 3 4 5
7 Sally Ranger	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5
	0 1 2 3 4 5	0 1 2 3 4 5

	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5
	0	1	2	3	4	5	0	1	2	3	4	5

	Question #5	Question #6	Question # 7
	Have you discussed crucial project-related decisions with this person? *If yes, place an X in the box.* (*If not applicable, skip to next question*).	Have you approached this person regarding the possibility of collaborating on a project? *If yes, place an X in the box.* (*If not applicable, skip to next question*).	Has this person approached you regarding collaborating on a project? *If yes, place an X in the box.* (*If not applicable, skip to next question*).
1 John Doe	☐	☐	☐
2 Jane Doe	☐	☐	☐
3 Joe Public	☐	☐	☐
4 Jane Public	☐	☐	☐
5 Even Stevens	☐	☐	☐
6 Roger Rabbit	☐	☐	☐
7 Sally Ranger	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐
	☐	☐	☐

	□ □ □ □ □	□ □ □ □ □	□ □ □ □ □
	□ □ □ □ □	□ □ □ □ □	□ □ □ □ □
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	□ □ □ □ □	□ □ □ □ □	□ □ □ □ □
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	Question #8	Question #9	Question #10	Question #11
	During the past few weeks, did you socialize with this person after work or on a weekend? *If yes, place an X in the box.* (*If not applicable, skip to next question*).	Have you collaborated on a project with this person? *If yes, place an X in the box.* (*If not applicable, skip to next question*).	Are you currently collaborating on a project with this person? *If yes, place an X in the box.* (*If not applicable, skip to next question*).	Has this person come to you for advice on handling a difficult business or project decision? *If yes, place an X in the box.* (*If not applicable, skip to next question*).
1 John Doe	☐	☐	☐	☐
2 Jane Doe	☐	☐	☐	☐
3 Joe Public	☐	☐	☐	☐
4 Jane Public	☐	☐	☐	☐
5 Even Stevens	☐	☐	☐	☐
6 Roger Rabbit	☐	☐	☐	☐
7 Sally Ranger	☐	☐	☐	☐
	☐	☐	☐	☐
	☐	☐	☐	☐
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Appendix 4. Regression Models

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: Total Interaction

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	2.942	12.966		.227	.825
	Workspace Integration	-.076	.042	-1.898	-1.812	.097
	Workspace Connectivity	.148	.091	.836	1.626	.132
	Spatial Layout	2.129	1.896	.357	1.123	.285
	Privacy	-1.020	1.063	-.305	-.960	.358
	Interaction Support	1.887	2.772	.271	.681	.510
	Job Interdependence	1.546	1.592	.347	.971	.352
	Sense of Community	1.048	1.107	.380	.946	.364
	Workspace Satisfaction	-.786	1.524	-.134	-.515	.616
	Job Satisfaction	-2.109	2.372	-.274	-.889	.393
	1=NSB, 2=LSI	6.371	6.022	.935	1.058	.313
	PI	.240	2.868	.029	.084	.935
2	(Constant)	3.162	12.160		.260	.799
	Workspace Integration	-.078	.036	-1.939	-2.189	.049
	Workspace Connectivity	.146	.085	.827	1.720	.111
	Spatial Layout	2.115	1.807	.355	1.170	.265
	Privacy	-1.036	1.002	-.310	-1.034	.322
	Interaction Support	1.908	2.644	.274	.722	.484
	Job Interdependence	1.539	1.523	.345	1.011	.332
	Sense of Community	1.051	1.060	.381	.992	.341
	Workspace Satisfaction	-.792	1.458	-.135	-.543	.597
	Job Satisfaction	-2.120	2.268	-.276	-.935	.368
	1=NSB, 2=LSI	6.679	4.562	.980	1.464	.169
3	(Constant)	.360	10.708		.034	.974
	Workspace Integration	-.072	.033	-1.802	-2.182	.048
	Workspace Connectivity	.147	.083	.830	1.775	.099
	Spatial Layout	2.159	1.756	.362	1.230	.241
	Privacy	-.931	.956	-.278	-.974	.348
	Interaction Support	1.518	2.475	.218	.613	.550
	Job Interdependence	1.316	1.426	.295	.923	.373
	Sense of Community	1.199	.996	.434	1.204	.250
	Job Satisfaction	-2.303	2.181	-.299	-1.056	.310
	1=NSB, 2=LSI	5.817	4.160	.854	1.398	.185
4	(Constant)	4.133	8.567		.482	.637
	Workspace Integration	-.065	.030	-1.626	-2.148	.050
	Workspace Connectivity	.137	.079	.776	1.729	.106
	Spatial Layout	2.093	1.713	.351	1.222	.242
	Privacy	-.923	.935	-.276	-.987	.340
	Job Interdependence	.872	1.201	.196	.726	.480
	Sense of Community	1.378	.931	.499	1.480	.161
	Job Satisfaction	-1.952	2.057	-.254	-.949	.359
	1=NSB, 2=LSI	5.758	4.065	.845	1.416	.179
5	(Constant)	7.169	7.358		.974	.345
	Workspace Integration	-.070	.029	-1.747	-2.406	.029
	Workspace Connectivity	.137	.078	.775	1.753	.100
	Spatial Layout	2.126	1.685	.357	1.262	.226
	Privacy	-1.272	.788	-.380	-1.613	.127
	Sense of Community	1.604	.864	.581	1.857	.083
	Job Satisfaction	-1.934	2.024	-.251	-.956	.354
	1=NSB, 2=LSI	6.297	3.933	.924	1.601	.130
6	(Constant)	8.258	7.250		1.139	.271
	Workspace Integration	-.068	.029	-1.706	-2.359	.031
	Workspace Connectivity	.120	.076	.679	1.583	.133
	Spatial Layout	2.021	1.677	.339	1.205	.246
	Privacy	-1.360	.781	-.406	-1.741	.101
	Sense of Community	1.083	.668	.392	1.621	.125
	1=NSB, 2=LSI	6.552	3.914	.962	1.674	.114
7	(Constant)	14.801	4.868		3.041	.007
	Workspace Integration	-.058	.028	-1.456	-2.074	.054
	Workspace Connectivity	.067	.062	.378	1.069	.300
	Privacy	-1.483	.785	-.443	-1.890	.076
	Sense of Community	.830	.643	.301	1.292	.214
	1=NSB, 2=LSI	7.051	3.943	1.035	1.788	.092
8	(Constant)	15.209	4.872		3.122	.006
	Workspace Integration	-.039	.022	-.984	-1.797	.089
	Privacy	-1.483	.788	-.443	-1.883	.076
	Sense of Community	.536	.583	.194	.920	.370
	1=NSB, 2=LSI	5.323	3.611	.781	1.474	.158
9	(Constant)	18.024	3.775		4.775	.000
	Workspace Integration	-.045	.021	-1.128	-2.158	.044
	Privacy	-1.535	.782	-.459	-1.961	.065
	1=NSB, 2=LSI	6.236	3.457	.915	1.804	.087

Dependent Variable: Total Interaction

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Degree Talk

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-50.933	41.258		-1.234	.243
	Workspace Integration	-.037	.134	-.225	-.276	.788
	Workspace Connectivity	.091	.289	.126	.315	.759
	Spatial Layout	-.497	6.032	-.020	-.082	.936
	Privacy	1.578	3.384	.115	.466	.650
	Interaction Support	28.699	8.821	1.010	3.254	.008
	Job Interdependence	20.850	5.066	1.144	4.115	.002
	Sense of Community	-8.185	3.524	-.725	-2.323	.040
	Workspace Satisfaction	-8.179	4.849	-.340	-1.687	.120
	Job Satisfaction	-4.410	7.546	-.140	-.584	.571
	1=NSB, 2=LSI	-2.963	19.163	-.106	-.155	.880
	PI	11.943	9.126	.357	1.309	.217
2	(Constant)	-52.736	33.503		-1.574	.141
	Workspace Integration	-.039	.126	-.237	-.310	.762
	Workspace Connectivity	.105	.224	.145	.468	.648
	Privacy	1.612	3.215	.118	.501	.625
	Interaction Support	28.727	8.441	1.011	3.403	.005
	Job Interdependence	20.850	4.852	1.144	4.297	.001
	Sense of Community	-8.114	3.272	-.719	-2.480	.029
	Workspace Satisfaction	-8.159	4.638	-.339	-1.759	.104
	Job Satisfaction	-4.459	7.205	-.142	-.619	.548
	1=NSB, 2=LSI	-3.192	18.159	-.115	-.176	.863
	PI	12.014	8.701	.359	1.381	.193
3	(Constant)	-50.147	28.949		-1.732	.107
	Workspace Integration	-.059	.051	-.360	-1.164	.265
	Workspace Connectivity	.111	.213	.154	.521	.611
	Privacy	1.339	2.707	.098	.495	.629
	Interaction Support	28.954	8.025	1.019	3.608	.003
	Job Interdependence	20.797	4.659	1.141	4.464	.001
	Sense of Community	-8.140	3.145	-.721	-2.589	.022
	Workspace Satisfaction	-8.404	4.256	-.350	-1.975	.070
	Job Satisfaction	-4.410	6.926	-.140	-.637	.535
	PI	11.085	6.650	.331	1.667	.119
4	(Constant)	-43.440	24.878		-1.746	.103
	Workspace Integration	-.061	.049	-.372	-1.242	.235
	Workspace Connectivity	.095	.205	.131	.463	.651
	Interaction Support	29.008	7.805	1.021	3.717	.002
	Job Interdependence	19.910	4.182	1.093	4.760	.000
	Sense of Community	-8.050	3.053	-.713	-2.636	.020
	Workspace Satisfaction	-8.525	4.132	-.355	-2.063	.058
	Job Satisfaction	-4.079	6.705	-.130	-.608	.553
	PI	11.680	6.362	.349	1.836	.088
5	(Constant)	-40.490	23.409		-1.730	.104
	Workspace Integration	-.046	.036	-.281	-1.280	.220
	Interaction Support	28.486	7.518	1.002	3.789	.002
	Job Interdependence	19.747	4.057	1.084	4.868	.000
	Sense of Community	-8.517	2.805	-.755	-3.036	.008
	Workspace Satisfaction	-8.583	4.021	-.357	-2.135	.050
	Job Satisfaction	-3.332	6.335	-.106	-.526	.607
	PI	10.460	5.637	.312	1.856	.083
6	(Constant)	-37.586	22.228		-1.691	.110
	Workspace Integration	-.042	.034	-.255	-1.220	.240
	Interaction Support	27.713	7.204	.975	3.847	.001
	Job Interdependence	19.663	3.961	1.079	4.964	.000
	Sense of Community	-9.180	2.448	-.814	-3.750	.002
	Workspace Satisfaction	-8.855	3.896	-.368	-2.273	.037
	PI	11.120	5.369	.332	2.071	.055
7	(Constant)	-33.143	22.241		-1.490	.154
	Interaction Support	21.702	5.332	.764	4.070	.001
	Job Interdependence	18.150	3.816	.996	4.757	.000
	Sense of Community	-8.009	2.285	-.710	-3.506	.003
	Workspace Satisfaction	-8.368	3.931	-.348	-2.129	.048
	PI	12.054	5.390	.360	2.236	.039

Dependent Variable: SNA Degree Talk

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Betweenness Talk

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-38.907	31.441		-1.237	.242
	Workspace Integration	-.030	.102	-.252	-.296	.773
	Workspace Connectivity	-.049	.220	-.093	-.224	.827
	Spatial Layout	-1.721	4.596	-.097	-.375	.715
	Privacy	1.739	2.578	.174	.675	.514
	Interaction Support	22.841	6.722	1.101	3.398	.006
	Job Interdependence	14.743	3.861	1.108	3.819	.003
	Sense of Community	-6.589	2.685	-.800	-2.454	.032
	Workspace Satisfaction	-7.678	3.695	-.437	-2.078	.062
	Job Satisfaction	1.765	5.751	.077	.307	.765
	1=NSB, 2=LSI	-.941	14.603	-.046	-.064	.950
	PI	3.341	6.955	.137	.480	.640
2	(Constant)	-38.004	26.953		-1.410	.184
	Workspace Integration	-.036	.051	-.299	-.706	.494
	Workspace Connectivity	-.049	.211	-.092	-.231	.821
	Spatial Layout	-1.764	4.355	-.099	-.405	.692
	Privacy	1.657	2.148	.166	.772	.455
	Interaction Support	22.904	6.368	1.104	3.597	.004
	Job Interdependence	14.728	3.690	1.107	3.991	.002
	Sense of Community	-6.603	2.563	-.801	-2.576	.024
	Workspace Satisfaction	-7.750	3.371	-.441	-2.299	.040
	Job Satisfaction	1.784	5.500	.078	.324	.751
	PI	3.066	5.268	.125	.582	.571
3	(Constant)	-41.219	22.225		-1.855	.086
	Workspace Integration	-.045	.031	-.374	-1.438	.174
	Spatial Layout	-1.162	3.359	-.065	-.346	.735
	Privacy	1.737	2.042	.174	.851	.410
	Interaction Support	23.123	6.063	1.114	3.814	.002
	Job Interdependence	14.816	3.534	1.113	4.193	.001
	Sense of Community	-6.373	2.274	-.773	-2.802	.015
	Workspace Satisfaction	-7.723	3.244	-.440	-2.381	.033
	Job Satisfaction	1.473	5.135	.064	.287	.779
	PI	3.437	4.831	.141	.711	.489
4	(Constant)	-42.459	21.075		-2.015	.064
	Workspace Integration	-.046	.030	-.386	-1.559	.141
	Spatial Layout	-1.254	3.233	-.070	-.388	.704
	Privacy	1.774	1.969	.178	.901	.383
	Interaction Support	23.462	5.749	1.131	4.081	.001
	Job Interdependence	14.884	3.408	1.119	4.367	.001
	Sense of Community	-6.088	1.978	-.739	-3.078	.008
	Workspace Satisfaction	-7.600	3.108	-.433	-2.445	.028
	PI	3.158	4.574	.129	.690	.501
5	(Constant)	-45.256	19.233		-2.353	.033
	Workspace Integration	-.050	.027	-.416	-1.821	.089
	Privacy	1.745	1.911	.175	.913	.376
	Interaction Support	23.422	5.583	1.129	4.196	.001
	Job Interdependence	14.774	3.299	1.110	4.478	.000
	Sense of Community	-6.048	1.919	-.734	-3.152	.007
	Workspace Satisfaction	-7.607	3.019	-.433	-2.520	.024
	PI	2.706	4.296	.111	.630	.538
6	(Constant)	-47.900	18.412		-2.602	.019
	Workspace Integration	-.051	.027	-.426	-1.905	.075
	Privacy	2.051	1.814	.205	1.131	.275
	Interaction Support	23.476	5.476	1.131	4.287	.001
	Job Interdependence	14.822	3.235	1.114	4.581	.000
	Sense of Community	-5.824	1.850	-.707	-3.149	.006
	Workspace Satisfaction	-7.247	2.908	-.413	-2.492	.024
7	(Constant)	-39.262	16.889		-2.325	.033
	Workspace Integration	-.060	.026	-.497	-2.297	.035
	Interaction Support	23.812	5.512	1.147	4.320	.000
	Job Interdependence	13.447	3.022	1.010	4.449	.000
	Sense of Community	-5.375	1.821	-.652	-2.951	.009
	Workspace Satisfaction	-7.237	2.931	-.412	-2.469	.024

Dependent Variable: SNA Betweennes Talk

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Closeness Talk

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	26.919	7.434		3.621	.004
	Workspace Integration	-.038	.024	-.700	-1.565	.146
	Workspace Connectivity	.062	.052	.260	1.183	.262
	Spatial Layout	-.028	1.087	-.003	-.025	.980
	Privacy	-.197	.610	-.044	-.323	.753
	Interaction Support	6.953	1.589	.745	4.375	.001
	Job Interdependence	3.682	.913	.615	4.034	.002
	Sense of Community	-1.631	.635	-.440	-2.568	.026
	Workspace Satisfaction	-1.498	.874	-.190	-1.714	.114
	Job Satisfaction	-.221	1.360	-.021	-.163	.874
	1=NSB, 2=LSI	-5.908	3.453	-.645	-1.711	.115
	PI	3.595	1.644	.327	2.186	.051
2	(Constant)	26.819	6.035		4.444	.001
	Workspace Integration	-.038	.023	-.702	-1.669	.121
	Workspace Connectivity	.062	.040	.263	1.544	.149
	Privacy	-.195	.579	-.043	-.336	.742
	Interaction Support	6.955	1.521	.745	4.573	.001
	Job Interdependence	3.682	.874	.615	4.213	.001
	Sense of Community	-1.627	.589	-.439	-2.760	.017
	Workspace Satisfaction	-1.497	.836	-.189	-1.791	.098
	Job Satisfaction	-.224	1.298	-.022	-.172	.866
	1=NSB, 2=LSI	-5.921	3.271	-.647	-1.810	.095
	PI	3.599	1.567	.327	2.296	.040
3	(Constant)	27.111	5.572		4.866	.000
	Workspace Integration	-.037	.022	-.695	-1.726	.108
	Workspace Connectivity	.061	.038	.256	1.610	.132
	Privacy	-.205	.554	-.046	-.370	.717
	Interaction Support	6.899	1.430	.739	4.825	.000
	Job Interdependence	3.668	.837	.613	4.382	.001
	Sense of Community	-1.676	.496	-.452	-3.377	.005
	Workspace Satisfaction	-1.517	.796	-.192	-1.907	.079
	1=NSB, 2=LSI	-5.899	3.144	-.645	-1.876	.083
	PI	3.617	1.505	.329	2.404	.032
4	(Constant)	25.918	4.404		5.886	.000
	Workspace Integration	-.034	.018	-.623	-1.825	.089
	Workspace Connectivity	.061	.037	.258	1.676	.116
	Interaction Support	6.841	1.376	.733	4.970	.000
	Job Interdependence	3.780	.757	.631	4.996	.000
	Sense of Community	-1.693	.479	-.456	-3.535	.003
	Workspace Satisfaction	-1.464	.758	-.185	-1.931	.074
	1=NSB, 2=LSI	-6.461	2.667	-.706	-2.423	.030
	PI	3.715	1.435	.338	2.590	.021
5	(Constant)	26.965	4.614		5.844	.000
	Workspace Integration	-.019	.017	-.354	-1.109	.285
	Interaction Support	6.562	1.446	.703	4.537	.000
	Job Interdependence	3.653	.797	.610	4.584	.000
	Sense of Community	-1.874	.494	-.505	-3.797	.002
	Workspace Satisfaction	-1.395	.801	-.177	-1.742	.102
	1=NSB, 2=LSI	-7.414	2.758	-.810	-2.688	.017
	PI	3.185	1.481	.290	2.150	.048
6	(Constant)	25.999	4.564		5.697	.000
	Interaction Support	5.972	1.355	.640	4.408	.000
	Job Interdependence	3.444	.780	.575	4.416	.000
	Sense of Community	-1.720	.477	-.464	-3.606	.002
	Workspace Satisfaction	-1.165	.779	-.148	-1.495	.154
	1=NSB, 2=LSI	-10.221	1.105	-1.117	-9.248	.000
	PI	4.293	1.102	.390	3.896	.001
7	(Constant)	23.138	4.291		5.392	.000
	Interaction Support	5.510	1.366	.590	4.033	.001
	Job Interdependence	3.050	.760	.509	4.012	.001
	Sense of Community	-1.584	.485	-.427	-3.266	.005
	1=NSB, 2=LSI	-10.227	1.145	-1.117	-8.934	.000
	PI	3.972	1.119	.361	3.549	.002

Dependent Variable: SNA Closeness Talk

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Degree Informal Outside

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	3.239	12.638		.256	.802
	Workspace Integration	-.038	.041	-1.026	-.925	.375
	Workspace Connectivity	-.036	.089	-.222	-.407	.692
	Spatial Layout	-1.529	1.847	-.278	-.828	.425
	Privacy	.033	1.036	.011	.032	.975
	Interaction Support	1.887	2.702	.295	.698	.499
	Job Interdependence	1.900	1.552	.463	1.225	.246
	Sense of Community	-.479	1.079	-.188	-.444	.666
	Workspace Satisfaction	-.286	1.485	-.053	-.193	.851
	Job Satisfaction	1.116	2.311	.158	.483	.639
	1=NSB, 2=LSI	6.466	5.870	1.030	1.102	.294
	PI	-1.410	2.795	-.187	-.505	.624
2	(Constant)	3.463	10.070		.344	.737
	Workspace Integration	-.038	.035	-1.041	-1.088	.298
	Workspace Connectivity	-.036	.084	-.224	-.432	.673
	Spatial Layout	-1.536	1.755	-.280	-.875	.399
	Interaction Support	1.894	2.578	.296	.734	.477
	Job Interdependence	1.882	1.384	.458	1.360	.199
	Sense of Community	-.479	1.033	-.188	-.464	.651
	Workspace Satisfaction	-.296	1.394	-.055	-.212	.835
	Job Satisfaction	1.125	2.199	.159	.511	.618
	1=NSB, 2=LSI	6.559	4.889	1.045	1.342	.205
	PI	-1.426	2.634	-.189	-.542	.598
3	(Constant)	2.638	8.942		.295	.773
	Workspace Integration	-.037	.033	-.998	-1.109	.287
	Workspace Connectivity	-.036	.081	-.224	-.450	.660
	Spatial Layout	-1.527	1.689	-.278	-.904	.383
	Interaction Support	1.749	2.394	.273	.731	.478
	Job Interdependence	1.773	1.238	.432	1.433	.175
	Sense of Community	-.422	.961	-.166	-.440	.667
	Job Satisfaction	1.066	2.100	.150	.507	.620
	1=NSB, 2=LSI	6.308	4.566	1.005	1.382	.190
	PI	-1.419	2.535	-.188	-.560	.585
4	(Constant)	2.247	8.637		.260	.799
	Workspace Integration	-.038	.032	-1.035	-1.190	.254
	Workspace Connectivity	-.022	.072	-.136	-.307	.763
	Spatial Layout	-1.342	1.588	-.244	-.845	.412
	Interaction Support	1.444	2.224	.226	.649	.527
	Job Interdependence	1.529	1.073	.372	1.425	.176
	Job Satisfaction	.625	1.792	.088	.349	.732
	1=NSB, 2=LSI	6.252	4.431	.996	1.411	.180
	PI	-1.466	2.459	-.194	-.596	.560
5	(Constant)	.914	7.242		.126	.901
	Workspace Integration	-.044	.026	-1.186	-1.707	.108
	Spatial Layout	-1.078	1.294	-.196	-.833	.418
	Interaction Support	1.667	2.038	.260	.818	.426
	Job Interdependence	1.628	.992	.397	1.642	.121
	Job Satisfaction	.596	1.735	.084	.344	.736
	1=NSB, 2=LSI	6.442	4.253	1.027	1.515	.151
	PI	-1.287	2.315	-.171	-.556	.586
6	(Constant)	.378	6.874		.055	.957
	Workspace Integration	-.045	.024	-1.232	-1.858	.082
	Spatial Layout	-1.127	1.250	-.205	-.902	.381
	Interaction Support	2.014	1.722	.315	1.170	.259
	Job Interdependence	1.771	.875	.431	2.024	.060
	1=NSB, 2=LSI	6.518	4.128	1.039	1.579	.134
	PI	-1.355	2.242	-.180	-.604	.554
7	(Constant)	.206	6.739		.031	.976
	Workspace Integration	-.035	.016	-.941	-2.107	.050
	Spatial Layout	-1.173	1.224	-.214	-.958	.351
	Interaction Support	1.842	1.666	.288	1.106	.284
	Job Interdependence	1.727	.855	.421	2.019	.060
	1=NSB, 2=LSI	4.802	2.939	.765	1.634	.121
8	(Constant)	-2.906	5.891		-.493	.628
	Workspace Integration	-.033	.016	-.893	-2.018	.059
	Interaction Support	1.842	1.662	.288	1.108	.282
	Job Interdependence	1.671	.851	.407	1.963	.065
	1=NSB, 2=LSI	3.886	2.773	.619	1.401	.178
9	(Constant)	2.292	3.586		.639	.530
	Workspace Integration	-.030	.016	-.815	-1.854	.079
	Job Interdependence	1.375	.813	.335	1.691	.107
	1=NSB, 2=LSI	4.472	2.738	.713	1.633	.119
10	(Constant)	1.428	3.691		.387	.703
	Workspace Integration	-.006	.008	-.174	-.844	.409
	Job Interdependence	1.463	.845	.356	1.733	.099
11	(Constant)	-.832	2.522		-.330	.745
	Job Interdependence	1.585	.826	.386	1.918	.069

Dependent Variable: SNA Degree Informal Outside

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Betweenness Informal Outside

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.069	1.431		-.048	.963
	Workspace Integration	-.012	.005	-1.710	-2.508	.029
	Workspace Connectivity	-.007	.010	-.232	-.693	.503
	Spatial Layout	-.027	.209	-.026	-.127	.901
	Privacy	.101	.117	.177	.858	.409
	Interaction Support	.094	.306	.080	.308	.764
	Job Interdependence	.443	.176	.587	2.523	.028
	Sense of Community	-.133	.122	-.285	-1.091	.298
	Workspace Satisfaction	.046	.168	.047	.276	.787
	Job Satisfaction	.219	.262	.168	.838	.420
	1=NSB, 2=LSI	1.881	.665	1.629	2.831	.016
	PI	-.876	.316	-.631	-2.768	.018
2	(Constant)	-.165	1.162		-.142	.889
	Workspace Integration	-.012	.004	-1.727	-2.691	.020
	Workspace Connectivity	-.006	.008	-.207	-.797	.441
	Privacy	.103	.112	.181	.919	.376
	Interaction Support	.096	.293	.081	.327	.750
	Job Interdependence	.443	.168	.587	2.633	.022
	Sense of Community	-.130	.114	-.277	-1.141	.276
	Workspace Satisfaction	.048	.161	.048	.295	.773
	Job Satisfaction	.217	.250	.166	.867	.403
	1=NSB, 2=LSI	1.869	.630	1.618	2.966	.012
	PI	-.872	.302	-.628	-2.889	.014
3	(Constant)	-.004	.989		-.004	.997
	Workspace Integration	-.012	.004	-1.781	-3.006	.010
	Workspace Connectivity	-.006	.008	-.206	-.823	.425
	Privacy	.096	.106	.169	.911	.379
	Interaction Support	.120	.271	.102	.441	.667
	Job Interdependence	.457	.156	.604	2.918	.012
	Sense of Community	-.138	.106	-.295	-1.301	.216
	Job Satisfaction	.227	.239	.174	.952	.358
	1=NSB, 2=LSI	1.925	.579	1.666	3.322	.006
	PI	-.876	.291	-.631	-3.013	.010
4	(Constant)	.268	.751		.357	.726
	Workspace Integration	-.011	.004	-1.692	-3.129	.007
	Workspace Connectivity	-.007	.007	-.224	-.935	.365
	Privacy	.098	.102	.172	.954	.356
	Job Interdependence	.422	.132	.559	3.208	.006
	Sense of Community	-.123	.098	-.264	-1.262	.228
	Job Satisfaction	.255	.223	.195	1.141	.273
	1=NSB, 2=LSI	1.905	.561	1.650	3.397	.004
	PI	-.865	.281	-.623	-3.076	.008
5	(Constant)	.156	.738		.211	.836
	Workspace Integration	-.013	.003	-1.890	-3.815	.002
	Privacy	.104	.102	.184	1.025	.322
	Job Interdependence	.428	.131	.567	3.274	.005
	Sense of Community	-.087	.090	-.187	-.976	.345
	Job Satisfaction	.210	.217	.161	.967	.349
	1=NSB, 2=LSI	1.984	.552	1.717	3.592	.003
	PI	-.808	.273	-.582	-2.955	.010
6	(Constant)	.102	.735		.138	.892
	Workspace Integration	-.013	.003	-1.878	-3.799	.002
	Privacy	.112	.101	.197	1.105	.285
	Job Interdependence	.428	.131	.566	3.277	.005
	Sense of Community	-.038	.073	-.081	-.515	.614
	1=NSB, 2=LSI	1.957	.550	1.694	3.555	.003
	PI	-.835	.271	-.602	-3.078	.007
7	(Constant)	.088	.718		.122	.904
	Workspace Integration	-.013	.003	-1.893	-3.921	.001
	Privacy	.100	.097	.177	1.040	.313
	Job Interdependence	.395	.111	.523	3.544	.002
	1=NSB, 2=LSI	1.967	.538	1.703	3.656	.002
	PI	-.862	.260	-.621	-3.310	.004
8	(Constant)	.668	.452		1.477	.157
	Workspace Integration	-.015	.003	-2.157	-5.244	.000
	Job Interdependence	.338	.097	.447	3.480	.003
	1=NSB, 2=LSI	2.232	.475	1.932	4.696	.000
	PI	-.895	.259	-.645	-3.455	.003

Dependent Variable: SNA Betweennes Informal Outside

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Degree Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-1.629	6.934		-.235	.819
	Workspace Integration	.000	.022	-.012	-.019	.985
	Workspace Connectivity	-.087	.049	-.527	-1.795	.100
	Spatial Layout	-1.748	1.014	-.313	-1.725	.113
	Privacy	.721	.569	.230	1.267	.231
	Interaction Support	.012	1.482	.002	.008	.994
	Job Interdependence	2.123	.851	.508	2.493	.030
	Sense of Community	-.956	.592	-.369	-1.614	.135
	Workspace Satisfaction	.921	.815	.167	1.130	.283
	Job Satisfaction	1.682	1.268	.233	1.326	.212
	1=NSB, 2=LSI	3.886	3.221	.609	1.207	.253
	PI	2.205	1.534	.287	1.438	.178
2	(Constant)	-1.609	6.199		-.260	.800
	Workspace Integration	.000	.020	-.010	-.018	.986
	Workspace Connectivity	-.087	.046	-.527	-1.898	.082
	Spatial Layout	-1.748	.970	-.313	-1.803	.097
	Privacy	.721	.543	.230	1.329	.209
	Job Interdependence	2.119	.688	.507	3.079	.010
	Sense of Community	-.954	.534	-.369	-1.787	.099
	Workspace Satisfaction	.923	.750	.167	1.230	.242
	Job Satisfaction	1.684	1.186	.234	1.420	.181
	1=NSB, 2=LSI	3.882	3.050	.608	1.273	.227
	PI	2.206	1.462	.288	1.509	.157
3	(Constant)	-1.648	5.591		-.295	.773
	Workspace Connectivity	-.088	.040	-.529	-2.175	.049
	Spatial Layout	-1.752	.915	-.314	-1.915	.078
	Privacy	.725	.468	.231	1.548	.145
	Job Interdependence	2.122	.645	.508	3.287	.006
	Sense of Community	-.956	.504	-.370	-1.897	.080
	Workspace Satisfaction	.925	.708	.168	1.306	.214
	Job Satisfaction	1.685	1.139	.234	1.479	.163
	1=NSB, 2=LSI	3.833	1.411	.600	2.717	.018
	PI	2.219	1.237	.289	1.794	.096
4	(Constant)	2.454	4.741		.518	.613
	Workspace Connectivity	-.096	.041	-.580	-2.355	.034
	Spatial Layout	-1.874	.933	-.335	-2.008	.064
	Privacy	.655	.477	.209	1.373	.191
	Job Interdependence	2.287	.649	.548	3.525	.003
	Sense of Community	-1.101	.504	-.426	-2.187	.046
	Job Satisfaction	2.021	1.137	.280	1.777	.097
	1=NSB, 2=LSI	4.277	1.403	.670	3.049	.009
	PI	2.338	1.265	.305	1.849	.086
5	(Constant)	6.403	3.878		1.651	.120
	Workspace Connectivity	-.117	.039	-.706	-2.999	.009
	Spatial Layout	-2.168	.934	-.388	-2.320	.035
	Job Interdependence	1.862	.587	.446	3.174	.006
	Sense of Community	-1.128	.518	-.436	-2.178	.046
	Job Satisfaction	2.239	1.159	.311	1.932	.072
	1=NSB, 2=LSI	4.701	1.409	.736	3.337	.005
	PI	2.403	1.300	.313	1.848	.084

Dependent Variable: SNA Degree Now Collaboration

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Betweenness Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.418	1.425		-.293	.775
	Workspace Integration	-.002	.005	-.383	-.533	.605
	Workspace Connectivity	-.012	.010	-.415	-1.176	.264
	Spatial Layout	-.124	.208	-.130	-.598	.562
	Privacy	.159	.117	.297	1.363	.200
	Interaction Support	-.237	.305	-.213	-.778	.453
	Job Interdependence	.424	.175	.594	2.425	.034
	Sense of Community	-.133	.122	-.300	-1.089	.299
	Workspace Satisfaction	.161	.167	.171	.961	.357
	Job Satisfaction	.249	.261	.202	.956	.360
	1=NSB, 2=LSI	.767	.662	.703	1.160	.271
	PI	-.160	.315	-.122	-.508	.621
2	(Constant)	-.565	1.351		-.418	.684
	Workspace Integration	-.001	.004	-.211	-.344	.737
	Workspace Connectivity	-.011	.009	-.376	-1.128	.282
	Spatial Layout	-.114	.201	-.120	-.570	.579
	Privacy	.170	.111	.317	1.525	.153
	Interaction Support	-.251	.294	-.225	-.853	.410
	Job Interdependence	.429	.169	.601	2.534	.026
	Sense of Community	-.135	.118	-.305	-1.144	.275
	Workspace Satisfaction	.165	.162	.175	1.019	.328
	Job Satisfaction	.257	.252	.208	1.018	.329
	1=NSB, 2=LSI	.562	.507	.515	1.108	.290
3	(Constant)	-.597	1.302		-.459	.654
	Workspace Connectivity	-.013	.007	-.447	-1.771	.100
	Spatial Layout	-.133	.187	-.139	-.710	.490
	Privacy	.185	.098	.346	1.883	.082
	Interaction Support	-.291	.260	-.261	-1.119	.284
	Job Interdependence	.425	.163	.595	2.606	.022
	Sense of Community	-.135	.114	-.306	-1.190	.255
	Workspace Satisfaction	.181	.150	.192	1.206	.249
	Job Satisfaction	.265	.242	.215	1.093	.294
	1=NSB, 2=LSI	.420	.285	.385	1.472	.165
4	(Constant)	-1.119	1.055		-1.060	.307
	Workspace Connectivity	-.010	.006	-.348	-1.683	.114
	Privacy	.202	.094	.378	2.160	.049
	Interaction Support	-.303	.255	-.272	-1.190	.254
	Job Interdependence	.422	.160	.590	2.635	.020
	Sense of Community	-.115	.108	-.259	-1.062	.306
	Workspace Satisfaction	.195	.146	.207	1.334	.203
	Job Satisfaction	.254	.237	.206	1.069	.303
	1=NSB, 2=LSI	.302	.228	.277	1.325	.206
5	(Constant)	-1.156	1.059		-1.091	.292
	Workspace Connectivity	-.007	.005	-.250	-1.345	.199
	Privacy	.197	.094	.368	2.100	.053
	Interaction Support	-.405	.237	-.364	-1.706	.109
	Job Interdependence	.341	.141	.477	2.411	.029
	Workspace Satisfaction	.233	.142	.248	1.643	.121
	Job Satisfaction	.131	.208	.106	.629	.539
	1=NSB, 2=LSI	.275	.228	.252	1.208	.246
6	(Constant)	-1.395	.970		-1.437	.170
	Workspace Connectivity	-.007	.005	-.242	-1.330	.202
	Privacy	.210	.090	.392	2.340	.033
	Interaction Support	-.335	.206	-.301	-1.628	.123
	Job Interdependence	.378	.126	.530	3.008	.008
	Workspace Satisfaction	.239	.139	.254	1.721	.105
	1=NSB, 2=LSI	.227	.211	.208	1.079	.296
7	(Constant)	-1.763	.913		-1.932	.070
	Workspace Connectivity	-.004	.005	-.157	-.952	.355
	Privacy	.226	.089	.422	2.535	.021
	Interaction Support	-.212	.172	-.190	-1.231	.235
	Job Interdependence	.407	.124	.570	3.294	.004
	Workspace Satisfaction	.259	.139	.275	1.866	.079
8	(Constant)	-2.061	.855		-2.412	.027
	Privacy	.265	.079	.495	3.363	.003
	Interaction Support	-.244	.168	-.219	-1.450	.164
	Job Interdependence	.447	.116	.626	3.854	.001
	Workspace Satisfaction	.267	.138	.283	1.936	.069
9	(Constant)	-2.836	.686		-4.132	.001
	Privacy	.267	.081	.498	3.289	.004
	Job Interdependence	.509	.111	.713	4.597	.000
	Workspace Satisfaction	.218	.138	.232	1.586	.129
10	(Constant)	-2.001	.457		-4.382	.000
	Privacy	.265	.084	.493	3.144	.005
	Job Interdependence	.547	.112	.767	4.883	.000

Dependent Variable: SNA Betweennes Now Collaboration

Linear Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: SNA Closeness Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	-.086	1.971		-.043	.966
	Workspace Integration	.000	.006	.049	.044	.965
	Workspace Connectivity	-.006	.014	-.250	-.465	.651
	Spatial Layout	-.205	.288	-.235	-.710	.492
	Privacy	.043	.162	.088	.267	.794
	Interaction Support	.083	.421	.082	.196	.848
	Job Interdependence	.109	.242	.168	.450	.661
	Sense of Community	.076	.168	.188	.450	.661
	Workspace Satisfaction	.112	.232	.130	.483	.639
	Job Satisfaction	-.183	.361	-.163	-.506	.623
	1=NSB, 2=LSI	.613	.916	.617	.670	.517
	PI	-.075	.436	-.063	-.172	.866
2	(Constant)	-.072	1.864		-.039	.970
	Workspace Connectivity	-.006	.012	-.239	-.517	.615
	Spatial Layout	-.202	.271	-.233	-.746	.470
	Privacy	.040	.139	.082	.287	.779
	Interaction Support	.090	.371	.089	.243	.812
	Job Interdependence	.109	.232	.168	.473	.645
	Sense of Community	.076	.161	.189	.472	.646
	Workspace Satisfaction	.109	.213	.127	.511	.619
	Job Satisfaction	-.184	.343	-.164	-.537	.601
	1=NSB, 2=LSI	.648	.455	.652	1.424	.180
	PI	-.084	.369	-.071	-.229	.823
3	(Constant)	-.136	1.775		-.076	.940
	Workspace Connectivity	-.005	.010	-.183	-.485	.636
	Spatial Layout	-.189	.255	-.217	-.742	.471
	Privacy	.039	.134	.080	.291	.776
	Interaction Support	.100	.355	.099	.282	.783
	Job Interdependence	.114	.222	.175	.512	.617
	Sense of Community	.075	.155	.186	.484	.637
	Workspace Satisfaction	.104	.205	.122	.511	.618
	Job Satisfaction	-.184	.330	-.164	-.556	.588
	1=NSB, 2=LSI	.600	.389	.604	1.542	.147
4	(Constant)	.090	1.531		.059	.954
	Workspace Connectivity	-.004	.009	-.173	-.475	.642
	Spatial Layout	-.184	.246	-.212	-.750	.466
	Privacy	.035	.129	.071	.269	.791
	Job Interdependence	.079	.178	.121	.442	.665
	Sense of Community	.092	.139	.227	.660	.520
	Workspace Satisfaction	.115	.195	.134	.590	.564
	Job Satisfaction	-.166	.314	-.148	-.530	.605
	1=NSB, 2=LSI	.643	.346	.647	1.856	.085
5	(Constant)	.326	1.216		.268	.792
	Workspace Connectivity	-.006	.008	-.220	-.713	.487
	Spatial Layout	-.201	.230	-.231	-.874	.396
	Job Interdependence	.057	.154	.088	.372	.715
	Sense of Community	.089	.134	.221	.665	.516
	Workspace Satisfaction	.109	.187	.127	.582	.569
	Job Satisfaction	-.153	.300	-.136	-.509	.618
	1=NSB, 2=LSI	.670	.321	.674	2.089	.054
6	(Constant)	.332	1.183		.281	.783
	Workspace Connectivity	-.005	.008	-.209	-.699	.494
	Spatial Layout	-.192	.223	-.220	-.860	.402
	Sense of Community	.109	.119	.271	.914	.374
	Workspace Satisfaction	.128	.175	.149	.731	.475
	Job Satisfaction	-.164	.290	-.146	-.566	.579
	1=NSB, 2=LSI	.643	.304	.647	2.116	.050
7	(Constant)	.466	1.135		.411	.686
	Workspace Connectivity	-.006	.007	-.249	-.873	.395
	Spatial Layout	-.195	.218	-.224	-.894	.384
	Sense of Community	.067	.091	.166	.732	.474
	Workspace Satisfaction	.109	.168	.127	.648	.526
	1=NSB, 2=LSI	.680	.291	.685	2.341	.032
8	(Constant)	.938	.857		1.094	.288
	Workspace Connectivity	-.007	.007	-.277	-.999	.331
	Spatial Layout	-.204	.214	-.234	-.953	.353
	Sense of Community	.067	.090	.165	.742	.467
	1=NSB, 2=LSI	.720	.279	.725	2.577	.019
9	(Constant)	1.352	.642		2.106	.049
	Workspace Connectivity	-.010	.006	-.388	-1.688	.108
	Spatial Layout	-.244	.204	-.281	-1.196	.247
	1=NSB, 2=LSI	.795	.257	.800	3.092	.006
10	(Constant)	.664	.287		2.315	.031
	Workspace Connectivity	-.007	.005	-.265	-1.275	.217
	1=NSB, 2=LSI	.609	.207	.612	2.946	.008
11	(Constant)	.595	.286		2.082	.050
	1=NSB, 2=LSI	.493	.188	.496	2.618	.016

Dependent Variable: SNA Closeness Now Collaboration

Linear Regression
Independent Variables: Interaction
Dependent Variable: SNA Degree Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	14.100	11.001		1.282	.221
	Total Interaction	-.130	.133	-.147	-.980	.344
	SNA Degree Talk	.133	.088	.619	1.507	.154
	SNA Betweennes Talk	-.060	.085	-.220	-.707	.491
	SNA Closeness Talk	-.388	.300	-.557	-1.294	.217
	SNA Degree Informal Outside	-.149	.267	-.148	-.557	.586
	SNA Betweennes Informal Outside	3.254	1.173	.593	2.774	.015
	SNA Closeness Informal Outside	2.253	.998	.428	2.257	.041
	1=NSB, 2=LSI	-2.680	2.617	-.431	-1.024	.323
	PI	5.203	1.104	.682	4.714	.000
2	(Constant)	15.857	10.294		1.540	.144
	Total Interaction	-.115	.127	-.130	-.906	.379
	SNA Degree Talk	.133	.086	.618	1.541	.144
	SNA Betweennes Talk	-.051	.082	-.186	-.626	.541
	SNA Closeness Talk	-.439	.279	-.630	-1.572	.137
	SNA Betweennes Informal Outside	2.742	.712	.499	3.850	.002
	SNA Closeness Informal Outside	1.938	.803	.368	2.413	.029
	1=NSB, 2=LSI	-3.003	2.493	-.483	-1.205	.247
	PI	5.097	1.062	.668	4.800	.000
3	(Constant)	15.631	10.090		1.549	.141
	Total Interaction	-.091	.119	-.103	-.766	.455
	SNA Degree Talk	.091	.053	.423	1.705	.108
	SNA Closeness Talk	-.422	.273	-.605	-1.547	.141
	SNA Betweennes Informal Outside	2.710	.697	.494	3.889	.001
	SNA Closeness Informal Outside	1.702	.695	.323	2.448	.026
	1=NSB, 2=LSI	-2.728	2.407	-.439	-1.134	.274
	PI	5.179	1.034	.679	5.010	.000
4	(Constant)	14.297	9.817		1.456	.164
	SNA Degree Talk	.083	.052	.388	1.610	.126
	SNA Closeness Talk	-.412	.269	-.591	-1.532	.144
	SNA Betweennes Informal Outside	2.574	.666	.469	3.867	.001
	SNA Closeness Informal Outside	1.857	.657	.352	2.827	.012
	1=NSB, 2=LSI	-2.545	2.365	-.409	-1.076	.297
	PI	5.024	1.001	.659	5.017	.000
5	(Constant)	4.113	2.610		1.576	.132
	SNA Degree Talk	.035	.026	.163	1.355	.192
	SNA Closeness Talk	-.138	.087	-.198	-1.585	.130
	SNA Betweennes Informal Outside	2.527	.667	.460	3.788	.001
	SNA Closeness Informal Outside	1.601	.615	.304	2.603	.018
	PI	4.492	.875	.589	5.136	.000
6	(Constant)	3.944	2.663		1.481	.155
	SNA Closeness Talk	-.102	.085	-.146	-1.202	.244
	SNA Betweennes Informal Outside	2.476	.681	.451	3.638	.002
	SNA Closeness Informal Outside	1.554	.627	.295	2.477	.023
	PI	4.661	.885	.611	5.269	.000
7	(Constant)	.897	.825		1.087	.290
	SNA Betweennes Informal Outside	2.232	.657	.407	3.399	.003
	SNA Closeness Informal Outside	1.668	.627	.317	2.661	.015
	PI	4.555	.890	.597	5.118	.000

Dependent Variable: SNA Degree Now Collaboration

Linear Regression
Independent Variables: Interaction
Dependent Variable: SNA Betweenness Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.371	1.944		1.219	.243
	Total Interaction	-.015	.023	-.101	-.652	.525
	SNA Degree Talk	.038	.016	1.020	2.413	.030
	SNA Betweennes Talk	-.030	.015	-.634	-1.982	.067
	SNA Closeness Talk	-.071	.053	-.596	-1.345	.200
	SNA Degree Informal Outside	-.099	.047	-.571	-2.092	.055
	SNA Betweennes Informal Outside	1.055	.207	1.119	5.089	.000
	SNA Closeness Informal Outside	.408	.176	.451	2.314	.036
	1=NSB, 2=LSI	-.759	.463	-.711	-1.641	.123
	PI	.535	.195	.408	2.742	.016
2	(Constant)	2.237	1.896		1.180	.256
	SNA Degree Talk	.034	.014	.926	2.377	.031
	SNA Betweennes Talk	-.027	.014	-.565	-1.909	.076
	SNA Closeness Talk	-.071	.052	-.594	-1.367	.192
	SNA Degree Informal Outside	-.092	.045	-.534	-2.040	.059
	SNA Betweennes Informal Outside	1.012	.193	1.073	5.254	.000
	SNA Closeness Informal Outside	.404	.173	.447	2.339	.034
	1=NSB, 2=LSI	-.731	.452	-.684	-1.618	.126
	PI	.512	.188	.391	2.722	.016
3	(Constant)	-.322	.306		-1.055	.307
	SNA Degree Talk	.022	.012	.594	1.899	.076
	SNA Betweennes Talk	-.026	.014	-.551	-1.815	.088
	SNA Degree Informal Outside	-.112	.044	-.646	-2.527	.022
	SNA Betweennes Informal Outside	1.050	.196	1.114	5.369	.000
	SNA Closeness Informal Outside	.391	.177	.432	2.207	.042
	1=NSB, 2=LSI	-.146	.148	-.137	-.984	.340
	PI	.413	.178	.315	2.316	.034
4	(Constant)	-.427	.286		-1.491	.154
	SNA Degree Talk	.018	.011	.499	1.679	.111
	SNA Betweennes Talk	-.023	.014	-.487	-1.643	.119
	SNA Degree Informal Outside	-.105	.044	-.606	-2.404	.028
	SNA Betweennes Informal Outside	1.059	.195	1.123	5.422	.000
	SNA Closeness Informal Outside	.333	.167	.368	1.995	.062
	PI	.391	.177	.299	2.214	.041
5	(Constant)	-.078	.201		-.389	.702
	SNA Degree Talk	.002	.005	.056	.427	.674
	SNA Degree Informal Outside	-.096	.045	-.555	-2.121	.048
	SNA Betweennes Informal Outside	1.021	.203	1.083	5.034	.000
	SNA Closeness Informal Outside	.204	.154	.225	1.322	.203
	PI	.454	.181	.347	2.515	.022
6	(Constant)	-.024	.153		-.158	.876
	SNA Degree Informal Outside	-.095	.044	-.552	-2.157	.044
	SNA Betweennes Informal Outside	1.021	.198	1.083	5.147	.000
	SNA Closeness Informal Outside	.197	.150	.218	1.316	.204
	PI	.466	.175	.355	2.665	.015
7	(Constant)	.113	.114		.986	.336
	SNA Degree Informal Outside	-.059	.035	-.339	-1.679	.109
	SNA Betweennes Informal Outside	.919	.186	.974	4.946	.000
	PI	.415	.173	.317	2.391	.027
8	(Constant)	-.018	.087		-.210	.836
	SNA Betweennes Informal Outside	.682	.126	.723	5.412	.000
	PI	.342	.175	.261	1.951	.064

Dependent Variable: SNA Betweennes Now Collaboration

Linear Regression
Independent Variables: Interaction
Dependent Variable: SNA Closeness Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.379	2.329		.163	.873
	Total Interaction	.027	.028	.193	.959	.354
	SNA Degree Talk	-.009	.019	-.262	-.475	.642
	SNA Betweennes Talk	.012	.018	.287	.688	.503
	SNA Closeness Talk	-.011	.064	-.097	-.167	.869
	SNA Degree Informal Outside	-.010	.056	-.060	-.170	.868
	SNA Betweennes Informal Outside	.027	.248	.031	.108	.915
	SNA Closeness Informal Outside	.488	.211	.588	2.311	.037
	1=NSB, 2=LSI	.365	.554	.372	.659	.520
	PI	.205	.234	.171	.878	.395
2	(Constant)	.409	2.235		.183	.857
	Total Interaction	.028	.026	.200	1.086	.295
	SNA Degree Talk	-.009	.018	-.267	-.503	.622
	SNA Betweennes Talk	.013	.017	.295	.747	.466
	SNA Closeness Talk	-.012	.061	-.105	-.190	.852
	SNA Degree Informal Outside	-.005	.034	-.030	-.141	.890
	SNA Closeness Informal Outside	.481	.192	.579	2.502	.024
	1=NSB, 2=LSI	.358	.532	.366	.674	.511
	PI	.202	.224	.168	.902	.381
3	(Constant)	.507	2.057		.247	.808
	Total Interaction	.028	.025	.198	1.113	.282
	SNA Degree Talk	-.009	.017	-.259	-.506	.619
	SNA Betweennes Talk	.013	.017	.299	.783	.445
	SNA Closeness Talk	-.014	.056	-.130	-.256	.801
	SNA Closeness Informal Outside	.467	.160	.562	2.923	.010
	1=NSB, 2=LSI	.342	.503	.349	.680	.506
	PI	.199	.216	.165	.921	.371
4	(Constant)	-.010	.391		-.025	.980
	Total Interaction	.028	.024	.200	1.153	.265
	SNA Degree Talk	-.011	.013	-.339	-.861	.401
	SNA Betweennes Talk	.013	.016	.308	.832	.417
	SNA Closeness Informal Outside	.453	.146	.545	3.099	.007
	1=NSB, 2=LSI	.464	.160	.473	2.902	.010
	PI	.173	.185	.144	.933	.364
5	(Constant)	-.117	.366		-.320	.753
	Total Interaction	.022	.023	.157	.959	.350
	SNA Degree Talk	-.001	.005	-.040	-.250	.805
	SNA Closeness Informal Outside	.514	.126	.618	4.086	.001
	1=NSB, 2=LSI	.429	.153	.437	2.805	.012
	PI	.144	.180	.120	.797	.436
6	(Constant)	-.117	.356		-.330	.745
	Total Interaction	.020	.021	.145	.950	.354
	SNA Closeness Informal Outside	.515	.122	.620	4.207	.000
	1=NSB, 2=LSI	.417	.142	.425	2.941	.008
	PI	.141	.176	.117	.804	.431
7	(Constant)	-.166	.348		-.476	.639
	Total Interaction	.025	.020	.176	1.204	.243
	SNA Closeness Informal Outside	.521	.121	.627	4.298	.000
	1=NSB, 2=LSI	.437	.138	.446	3.165	.005
8	(Constant)	.144	.237		.606	.551
	SNA Closeness Informal Outside	.480	.118	.577	4.082	.001
	1=NSB, 2=LSI	.418	.139	.426	3.013	.007

Dependent Variable: SNA Closeness Now Collaboration

Logistic Regression
Independent Variables: Employee Perceptions & Spatial Layout
Dependent Variable: Job Satisfaction

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1a	**Workspace Integration**	.022	.045	.241	1	.623	1.022
	Workspace Connectivity	.004	.068	.003	1	.956	1.004
	SNADegreeTalk	-.349	.252	1.928	1	.165	.705
	SNABtwnTalk	.301	.231	1.687	1	.194	1.351
	SNACloseTalk	.395	.591	.446	1	.504	1.484
	SNADegreeInf	.408	.554	.542	1	.462	1.503
	SNABtwnInf	1.386	4.188	.110	1	.741	4.000
	SNACloseInf	-2.056	1.870	1.210	1	.271	.128
	BLDGID(1)	-1.794	8.564	.044	1	.834	.166
	PI(1)	-1.672	3.416	.240	1	.625	.188
	Constant	-7.374	19.818	.138	1	.710	.001
Step 2a	**Workspace Integration**	.023	.044	.259	1	.611	1.023
	SNADegreeTalk	-.350	.252	1.929	1	.165	.704
	SNABtwnTalk	.299	.228	1.721	1	.190	1.349
	SNACloseTalk	.411	.518	.630	1	.427	1.508
	SNADegreeInf	.409	.555	.542	1	.462	1.505
	SNABtwnInf	1.296	3.748	.120	1	.730	3.654
	SNACloseInf	-2.058	1.877	1.202	1	.273	.128
	BLDGID(1)	-1.888	8.416	.050	1	.823	.151
	PI(1)	-1.572	2.908	.292	1	.589	.208
	Constant	-7.835	18.049	.188	1	.664	.000
Step 3a	**Workspace Integration**	.030	.029	1.074	1	.300	1.030
	SNADegreeTalk	-.325	.214	2.294	1	.130	.723
	SNABtwnTalk	.284	.215	1.746	1	.186	1.329
	SNACloseTalk	.348	.429	.658	1	.417	1.417
	SNADegreeInf	.348	.478	.531	1	.466	1.417
	SNABtwnInf	1.712	3.342	.262	1	.608	5.540
	SNACloseInf	-1.895	1.700	1.243	1	.265	.150
	PI(1)	-2.041	2.069	.973	1	.324	.130
	Constant	-9.565	16.266	.346	1	.556	.000
Step 4a	**Workspace Integration**	.021	.024	.806	1	.369	1.022
	SNADegreeTalk	-.302	.206	2.147	1	.143	.739
	SNABtwnTalk	.310	.216	2.055	1	.152	1.364
	SNACloseTalk	.221	.355	.387	1	.534	1.247
	SNADegreeInf	.516	.374	1.898	1	.168	1.675
	SNACloseInf	-2.046	1.628	1.580	1	.209	.129
	PI(1)	-1.629	1.861	.766	1	.381	.196
	Constant	-4.278	13.175	.105	1	.745	.014
Step 5a	**Workspace Integration**	.009	.011	.637	1	.425	1.009
	SNADegreeTalk	-.238	.159	2.251	1	.134	.788
	SNABtwnTalk	.291	.203	2.056	1	.152	1.337
	SNADegreeInf	.501	.373	1.807	1	.179	1.651
	SNACloseInf	-1.788	1.519	1.386	1	.239	.167
	PI(1)	-1.115	1.562	.510	1	.475	.328
	Constant	3.830	3.151	1.478	1	.224	46.077
Step 6a	**Workspace Integration**	.007	.010	.439	1	.508	1.007
	SNADegreeTalk	-.198	.136	2.116	1	.146	.820
	SNABtwnTalk	.273	.212	1.661	1	.197	1.314
	SNADegreeInf	.453	.346	1.718	1	.190	1.573
	SNACloseInf	-1.498	1.404	1.138	1	.286	.224
	Constant	2.621	2.626	.996	1	.318	13.752
Step 7a	**SNADegreeTalk**	-.143	.093	2.341	1	.126	.867
	SNABtwnTalk	.211	.173	1.482	1	.223	1.235
	SNADegreeInf	.347	.288	1.452	1	.228	1.415
	SNACloseInf	-1.048	1.200	.763	1	.382	.351
	Constant	3.373	2.348	2.063	1	.151	29.172
Step 8a	**SNADegreeTalk**	-.111	.085	1.706	1	.191	.895
	SNABtwnTalk	.192	.179	1.147	1	.284	1.211
	SNADegreeInf	.195	.196	.998	1	.318	1.216
	Constant	2.043	1.732	1.392	1	.238	7.714
Step 9a	**SNADegreeTalk**	-.129	.082	2.474	1	.116	.879
	SNABtwnTalk	.224	.162	1.900	1	.168	1.251
	Constant	2.953	1.552	3.617	1	.057	19.155

Dependent Variable: Job Satisfaction

Linear Regression for non-PIs
Independent Variables: Employee Perceptions for Spatial Layout
Dependent Variable: SNA Closeness Talk

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	21.915	9.413		2.328	.053
	Workspace Integration	-.046	.040	-1.036	-1.167	.281
	Workspace Connectivity	.052	.055	.248	.942	.378
	Spatial Layout	.399	1.225	.057	.326	.754
	Privacy	-.057	.793	-.014	-.072	.944
	Interaction Support	6.509	1.690	.856	3.852	.006
	Job Interdependence	2.750	1.406	.539	1.956	.091
	Sense of Community	-1.163	.726	-.391	-1.601	.153
	Workspace Satisfaction	-.170	1.191	-.025	-.143	.891
	JobSatFull	-1.167	1.885	-.134	-.619	.556
	1=NSB, 2=LSI	-3.345	6.290	-.418	-.532	.611
2	(Constant)	21.469	6.667		3.220	.012
	Workspace Integration	-.045	.032	-1.004	-1.390	.202
	Workspace Connectivity	.052	.051	.248	1.010	.342
	Spatial Layout	.396	1.146	.057	.345	.739
	Interaction Support	6.507	1.581	.856	4.116	.003
	Job Interdependence	2.799	1.153	.548	2.427	.041
	Sense of Community	-1.160	.678	-.390	-1.710	.126
	Workspace Satisfaction	-.151	1.087	-.022	-.139	.893
	JobSatFull	-1.224	1.601	-.141	-.764	.467
	1=NSB, 2=LSI	-3.561	5.178	-.445	-.688	.511
3	(Constant)	21.067	5.670		3.715	.005
	Workspace Integration	-.046	.030	-1.022	-1.523	.162
	Workspace Connectivity	.052	.048	.247	1.066	.314
	Spatial Layout	.419	1.070	.060	.392	.704
	Interaction Support	6.457	1.453	.849	4.445	.002
	Job Interdependence	2.705	.883	.530	3.064	.013
	Sense of Community	-1.118	.575	-.376	-1.946	.084
	JobSatFull	-1.283	1.457	-.147	-.881	.401
	1=NSB, 2=LSI	-3.388	4.743	-.424	-.714	.493
4	(Constant)	22.330	4.463		5.003	.001
	Workspace Integration	-.044	.028	-.983	-1.548	.153
	Workspace Connectivity	.041	.038	.195	1.076	.307
	Interaction Support	6.455	1.390	.849	4.645	.001
	Job Interdependence	2.733	.842	.535	3.247	.009
	Sense of Community	-1.179	.529	-.397	-2.229	.050
	JobSatFull	-1.268	1.393	-.146	-.910	.384
	1=NSB, 2=LSI	-3.226	4.520	-.403	-.714	.492
5	(Constant)	23.494	4.061		5.786	.000
	Workspace Integration	-.063	.009	-1.411	-6.988	.000
	Workspace Connectivity	.044	.037	.212	1.211	.251
	Interaction Support	6.661	1.329	.876	5.013	.000
	Job Interdependence	2.478	.745	.485	3.328	.007
	Sense of Community	-1.164	.517	-.391	-2.252	.046
	JobSatFull	-1.183	1.357	-.136	-.872	.402
6	(Constant)	24.794	3.739		6.631	.000
	Workspace Integration	-.061	.009	-1.365	-7.077	.000
	Workspace Connectivity	.037	.035	.179	1.057	.311
	Interaction Support	6.299	1.250	.829	5.041	.000
	Job Interdependence	2.333	.718	.457	3.247	.007
	Sense of Community	-1.390	.443	-.467	-3.141	.009
7	(Constant)	25.611	3.675		6.970	.000
	Workspace Integration	-.055	.006	-1.228	-8.552	.000
	Interaction Support	6.152	1.247	.809	4.932	.000
	Job Interdependence	2.236	.716	.438	3.124	.008
	Sense of Community	-1.501	.432	-.505	-3.475	.004

Dependent Variable: SNA Closeness Talk

Linear Regression for non-PIs
Independent Variables: Employee Perceptions for Spatial Layout
Dependent Variable: SNA Degree Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-10.736	5.921		-1.813	.113
	Workspace Integration	.015	.025	.536	.600	.567
	Workspace Connectivity	-.076	.035	-.582	-2.204	.063
	Spatial Layout	-1.990	.771	-.455	-2.581	.036
	Privacy	1.575	.499	.594	3.158	.016
	Interaction Support	.714	1.063	.150	.672	.523
	Job Interdependence	3.091	.884	.967	3.496	.010
	Sense of Community	-.619	.457	-.332	-1.354	.218
	Workspace Satisfaction	1.408	.749	.329	1.879	.102
	JobSatFull	-.945	1.186	-.173	-.797	.452
	1=NSB, 2=LSI	1.115	3.957	.223	.282	.786
2	(Constant)	-11.477	4.991		-2.300	.050
	Workspace Integration	.022	.008	.772	2.664	.029
	Workspace Connectivity	-.076	.032	-.584	-2.351	.047
	Spatial Layout	-1.985	.725	-.454	-2.738	.026
	Privacy	1.642	.413	.619	3.977	.004
	Interaction Support	.674	.991	.142	.681	.515
	Job Interdependence	3.238	.672	1.013	4.821	.001
	Sense of Community	-.629	.428	-.338	-1.468	.180
	Workspace Satisfaction	1.386	.701	.324	1.977	.083
	JobSatFull	-1.017	1.090	-.187	-.933	.378
3	(Constant)	-10.248	4.511		-2.272	.049
	Workspace Integration	.024	.007	.870	3.575	.006
	Workspace Connectivity	-.080	.031	-.611	-2.569	.030
	Spatial Layout	-1.971	.703	-.450	-2.806	.021
	Privacy	1.628	.400	.614	4.072	.003
	Job Interdependence	2.984	.541	.934	5.513	.000
	Sense of Community	-.536	.394	-.288	-1.361	.207
	Workspace Satisfaction	1.503	.659	.352	2.280	.049
	JobSatFull	-.857	1.032	-.157	-.831	.428
4	(Constant)	-8.449	3.895		-2.169	.055
	Workspace Integration	.024	.007	.871	3.635	.005
	Workspace Connectivity	-.084	.030	-.640	-2.765	.020
	Spatial Layout	-1.998	.691	-.456	-2.891	.016
	Privacy	1.505	.366	.568	4.115	.002
	Job Interdependence	2.982	.533	.933	5.597	.000
	Sense of Community	-.751	.292	-.403	-2.574	.028
	Workspace Satisfaction	1.264	.584	.296	2.165	.056

Dependent Variable: SNA Degree Now Collaboration

Linear Regression for non-PIs
Independent Variables: Employee Perceptions for Spatial Layout
Dependent Variable: SNA Betweenness Now Collaboration

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.377	1.357		-1.015	.344
	Workspace Integration	-.006	.006	-1.004	-1.050	.328
	Workspace Connectivity	-.008	.008	-.281	-.993	.354
	Spatial Layout	-.100	.177	-.107	-.568	.588
	Privacy	.227	.114	.401	1.987	.087
	Interaction Support	-.092	.244	-.090	-.377	.717
	Job Interdependence	.395	.203	.579	1.951	.092
	Sense of Community	-.046	.105	-.116	-.441	.673
	Workspace Satisfaction	.285	.172	.312	1.659	.141
	JobSatFull	-.107	.272	-.092	-.393	.706
	1=NSB, 2=LSI	1.230	.907	1.149	1.356	.217
2	(Constant)	-1.512	1.237		-1.222	.256
	Workspace Integration	-.007	.005	-1.111	-1.287	.234
	Workspace Connectivity	-.007	.007	-.264	-1.000	.347
	Spatial Layout	-.102	.167	-.109	-.613	.557
	Privacy	.226	.108	.399	2.096	.069
	Job Interdependence	.423	.178	.620	2.378	.045
	Sense of Community	-.058	.094	-.146	-.618	.554
	Workspace Satisfaction	.270	.158	.296	1.710	.126
	JobSatFull	-.125	.253	-.108	-.496	.633
	1=NSB, 2=LSI	1.275	.849	1.191	1.502	.172
3	(Constant)	-1.189	1.008		-1.180	.268
	Workspace Integration	-.007	.005	-1.209	-1.504	.167
	Workspace Connectivity	-.008	.007	-.283	-1.130	.288
	Spatial Layout	-.106	.159	-.114	-.666	.522
	Privacy	.203	.093	.358	2.178	.057
	Job Interdependence	.408	.168	.598	2.431	.038
	Sense of Community	-.086	.072	-.217	-1.200	.261
	Workspace Satisfaction	.240	.139	.262	1.719	.120
	1=NSB, 2=LSI	1.378	.788	1.287	1.748	.114
4	(Constant)	-1.507	.863		-1.747	.111
	Workspace Integration	-.008	.005	-1.318	-1.722	.116
	Workspace Connectivity	-.005	.006	-.186	-.939	.370
	Privacy	.199	.090	.351	2.200	.052
	Job Interdependence	.390	.161	.571	2.422	.036
	Sense of Community	-.070	.065	-.175	-1.062	.313
	Workspace Satisfaction	.251	.135	.275	1.867	.092
	1=NSB, 2=LSI	1.374	.766	1.283	1.793	.103
5	(Constant)	-1.503	.858		-1.752	.108
	Workspace Integration	-.009	.004	-1.485	-2.006	.070
	Privacy	.201	.090	.354	2.233	.047
	Job Interdependence	.402	.160	.588	2.517	.029
	Sense of Community	-.051	.062	-.129	-.827	.426
	Workspace Satisfaction	.234	.133	.256	1.765	.105
	1=NSB, 2=LSI	1.414	.761	1.321	1.858	.090
6	(Constant)	-1.435	.843		-1.703	.114
	Workspace Integration	-.010	.004	-1.722	-2.559	.025
	Privacy	.178	.085	.314	2.108	.057
	Job Interdependence	.319	.122	.466	2.608	.023
	Workspace Satisfaction	.262	.126	.286	2.069	.061
	1=NSB, 2=LSI	1.653	.694	1.545	2.382	.035

Dependent Variable: SNA Betweenness Now Collaboration

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