Design Guidelines to Facilitate Creativity in Workplace

by

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Abstract

This thesis is aimed at helping designers to build a workplace that could facilitate creativity during work. It also tries to help readers to understand designers' creativity in the workplace. And through acquisition of such knowledge, a set of guidelines is developed to help designers to design such a place.

The guidelines are formed of an analysis on secondary research of cognitive science documents and a synthesis of research composed of qualitative interviews and observation shadowing. It gives ten general features to consider before setting up the floor plan when designing the workplace.

To apply the guidelines, a set of five pieces of furniture is introduced. They are designed based on different guidelines, and their layout configurations are also based on the guidelines.

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Chapter One: Introduction

1.1 Problem Statement

During the recent decades, many companies have realized that in a dynamic economic environment, producing more products in less time using fewer resources does not equal higher profit. That the economic-efficiency-oriented giant Nokia has been exceeded by Apple in cell phone market within only four years has elaborated that. At the same time, as much of the manufacturing process has been outsourced abroad, labor workers in the office have gradually been replaced by knowledge workers. Creativity, the key of innovation, is critical to keeping companies motivated to run in today's extremely competitive market.

As for companies, employees are its most precious assets, while the workplace is the second. The workplace provides a safe, supportive environment for people to work individually or interact with each other. It greatly influences the culture of the company, as well as the activity in the office. Unfortunately, even though many company leaders have realized the importance of a properly designed workplace, the application of the creative workplace is still far from widely spread. Many offices have carefully designed configurations that facilitate productivity, but not creativity. Productivity indeed is important, but merely fostering productivity in workplace will not necessarily facilitate creativity well, and in some ways may even impair it.

Designers are generally considered creative individuals, because they work most of their career in the innovation industry. It is a designer's job responsibility to be creative, thus their workplaces need to foster creativity more than other elements. Many designers use their offices

as showcases to convince their clients that they are innovative, and to show the creative culture of their company. In this way, designers' offices are an ideal subject to study creativity in the workplace. Nonetheless, it's easy to find many glamorous photos about designers' workplace, but rarely serious studies.

1.2 Need for Study

Scholars have noted the positive effects of creative activity in work. They have authored many books about managing skills and work style as well as the psychological and sociological patterns that may contribute to creativity. However, very few of them are mentioned relative to workplace design. Physical environmental factors have often been neglected in creativity psychological and sociological research as if all the subjective elements are counted for enough in building up a creative environment.

Generally the design of workplaces is focused on improving productivity; thus historically the main concern has been effective and convenient layout. Many issues on workplace design involving human activity are about dynamic workflow, organization arrangement, etc., which do not directly relate to creativity. Considering the current importance of creativity in the industry, there is a need to study about how to design a workplace that could facilitate creativity in addition to productivity.

1.3 Objectives of Study

This study examines designers' workplaces, to study their creative work patterns and workplace patterns. Research will be conducted to have a close view of designers' work patterns and workplace. Next, a synthesis work will be done to sort out the factors that may influence

creativity in designers' workplaces. Through understanding the factors that contribute to facilitating a creative culture in a company, guidelines will be developed to help build knowledge of design criteria for office furniture, which may foster creativity in designers' workplaces.

A set of office furniture will be designed as an example of applying these guidelines. Models will be built for better demonstration.

In addition, it may also be possible that the guidelines could be applied to contract furniture for companies other than design firms.

1.4 Definitions of Terms

Creativity is the ability to approach the situation at hand with a fresh perspective, and link together previously unrelated or uncombined concepts, to generate new and unexpected ideas that solve a problem or capture an opportunity (Stegmeier, 2008).

Collaboration is a the act of a group or a team in the organization working together for a shared objective.

Designers mentioned in this research are exclusively industrial designers.

Energy flow is the abstract energy stream existing in human activities. It is generated by group activities like collaboration, conflict, teamwork, and tension.

Organization is a social group that distributes tasks for a collaborative goal.

Work environment refers to the qualitative characteristics of the experience of working in certain agency. It includes employer-employee relationships as well as the physical work setting.

Workplace is a planned, designed and managed physical environment that supports and facilitates employees to do their work.

1.5 Assumptions

In many economies and innovative organizations, creativity has become a key factor for a wide range of productive activities, within large corporations or in small-scale social enterprises anywhere in the world. Creativity in today's economy has firmly 'arrived' and most businesses are recognizing that creativity has gained a strategic function in the innovation–competitiveness ladder. It has been noted as a type of 'survival skill' that will be required for the next decades (Mirranda, 2009).

The foundation of creative activity is that participants need to obtain creative characteristics. Studies on creativity show that it is not exclusively a cognitive phenomenon (Cropley, 1994); that is: it is not a divine gift of a given person presenting certain abilities. Rather, creativity, as a productive factor, involves high preparation, discipline and conscious effort by an individual (Mirranda, 2009).

Innovation is considered the successful implementation of creative ideas within an organization. In this view, creativity by individuals and teams is a starting point for innovation (West, 2000). Although creativity and innovation represent different stages in the process of developing novel solutions, most factors that influence the process at one stage are likely to have a similar impact at another stage (e.g. support for risk taking) (Shalley, 2000). Sometimes, these factors will be discussed as well as creativity, but they will not be the core issue of this thesis.

The workplace, on the other hand, is often considered an organization's second most costly asset (Becker, Steele, 1995). It needs to support the work of individuals and teams, as well as the whole organization. People find it difficult to overcome their surroundings, whether

conscious or unconscious. So it is important to design a positive working environment before the workers move in.

Despite this, well-designed facilities will not guarantee success, nor will poorly designed ones guarantee failure, similar to management, equipment and employees (Becker, Steele, 1995). They are each a part of an integrated system that needs to work in harmony. Hence, it is ineffective to only look at the office setting and ignore the subjective factors. The people and their activities need to be considered in context.

Designers often work in the innovative industry, and train themselves to be creative as a part of their job requirements. In this study, they are used as subjects since they represent a profession whose success is tied directly to creative outputs.

1.6 Scopes and Limits

The qualitative research conducted in this study covers some designers in the Midwest area of the US. Twenty-five designers participated in the research, which is a comparatively small amount of samples.

Designers' personalities, experiences and characteristics will greatly influence their creative output, which may cause inaccuracy of the results.

1.7 Procedure of study

Firstly, a literature review to gather information related to the creativity and workplace will help to better understand the needs and requirements of facilitating creativity in workplace. The hypothesis for later research use directly results from this research.

Secondly, research will be conducted to observe the designers' workplace by shadowing designers' work patterns. Subjects will be recruited for qualitative interviews at the same time.

Thirdly, data collected within last step will go through synthesis work, and a set of factors that contribute to creativity of the workplace will be sorted out and categorized.

Fourthly, the factors listed from last step will be used for building guidelines that may better facilitate creativity in workplace.

Fifthly, a design based on the guidelines will be executed to indicate how the guidelines will be used in real conditions.

Chapter Two: Introduction to Research

2.1 Pattern of Creativity

2.1.1 Definition of Creativity

The most common definition of creativity is that it "involves the production, conceptualization, or development of novel and useful ideas, processes, or procedures by an individual or by a group of individuals working together" (Amabile, 1988& Shalley, 1991). "The definition of a creative strategy or solution varies by the field or job involved, but all creative behaviors result to some degree in identifying original and better ways to accomplish some purpose" (Shalley, 2000).

Guilford (1967) proposed four basic categories of divergent thinking which have been generally accepted by the psychological field:

1) Fluency is the ability to generate a large number of ideas.

2) Flexibility is the ability to generate a wide variety of ideas.

3) Originality is the production of unusual ideas.

4) Elaboration involves developing or building on other ideas.

These categories are viewed as the main component of creative thinking.

2.1.2 Factors Affect Creativity

Because of its perceived unpredictability, creativity may seem difficult to study scientifically and systematically. However, psychological literature now reveals evidence of factors that contribute to creativity; "elements of personality, affect, cognition, and motivation

can either facilitate or impair creativity" (Amabile, 1996; Csikszentmihalyi, 1996; Sawyer, 2006).

According to the componential model of creativity and innovation in organizations, "five environmental components will affect creativity" (Amabile, 1999):

5) Encouragement of creativity (which encompasses open information flow and support for new ideas at all levels of the organization, from top management, through immediate supervisors, to work groups).

6) Autonomy or freedom (autonomy in the day-to-day conduct of work; a sense of individual ownership of and control over work).

7) Resources (the materials, information, and general resources available for work); pressures (including both positive challenge and negative workload pressure).

8) Organizational impediments to creativity (including conservatism and internal strife).

2.1.3 Individual Creativity

"Personality studies have demonstrated that creative people tend to be nonconforming, independent, intrinsically motivated, open to new experiences, and risk seeking" (Simonton, 2000, 2003). Large-scale studies and meta-analyses have found that intelligence, tolerance of ambiguity, self-confidence, and cognitive flexibility also tend to be found in creative people (Feist, 1998); MacKinnon, 1978).

West (2000) pointed out that innovative people have different thinking styles. There are people who have a preference of thinking in novel ways; who think globally instead of locally,

distinguishing the wood from the trees; who have intellectual abilities which include synthetic abilities (to see problems in new ways and escape the bounds of conventional thinking), "analytic abilities to recognize which ideas are worth pursuing, and the practical contextual abilities to persuade others of the value of their ideas" (Sternberg & Lubart, 1996). "People who are creative need to obtain sufficient knowledge of the field to be able to move it forward, they need to be confident about themselves." "Tolerance of ambiguity, widely associated with creativity, enables individuals to avoid the problems of following only mental ruts, and increases the chances of unusual Reponses and the discovery of novelty" (Barron & Harrington, 1981).

"Creative people tend to be self-directed, enjoying and requiring freedom in their work" (Mumford & Gustafson, 1988). "They have a high need of freedom, control and discretion in the workplace and appear to find bureaucratic limitations or the exercise of control by managers frustrating" (West, 1987). "Creative people require clear work objectives along with high autonomy to perform well in the work" (West, 2000).

Hemlin (2006) has developed a framework called Creative Knowledge Environment (CKE), which he used to explain the relationship between individual, team and work environment. He said:

> "Individuals are arguably the main components of CKEs; without them, no knowledge would be produced and creativity would not exist… Creativity is enhanced in environments where individual autonomy is stimulated (at least up to a certain degree, although generally linked to some collective goal), where individuals feel motivated and are rewarded (in some way), where communication with other individuals flows easily and an individual feels secure to express almost any view, where individuals have expert knowledge in at least one domain, and where individuals are left alone to fulfill tasks that

are not better done in a group. 'Individuals' creativity may also be enhanced by contact with researchers in neighboring research areas' (Hollingsworth & Hollingsworth, 2000).

2.1.4 Group and Team Creativity

According to Gulford's (1967) four categories of divergent thinking, "group creativity can be defined as divergent thinking in groups as reflected in ideational fluency" (Brown, Tumeo, Larey, & Paulus, 1998). "In groups, divergent thinking will be affected by both associational and social processes" (Paulus, Larey, & Dzindolet, 2000).

Pressman's (2009) research on the employees at his architecture firm concludes that architects who collaborate in the workplace create novel outcomes by engaging in constructive and inspiring conversations and creative brainstorming that reinforce respect, trust, and appreciation. "Working together in collaboration stimulates and develops individual creativity, which can significantly enhance the cost effectiveness and quality of the project" (Watson,2007).

West (2000) indicates that group creativity occurs when a diverse group, in terms of task relevant knowledge, skills and abilities, experiences both high external demands and high levels of internal integration and psychosocial safety. "These would largely be determined by the knowledge skills and abilities members have for working in terms. Groups will be creative primarily when their task is sufficiently interesting, motivating and challenging and when the group's internal environment or processes are experienced as safe" (West, 1994, 1996). "Diversity is necessary to ensure there is sufficient difference and richness of input to encourage creative and innovative outputs" (Jackson, 1996).

Current research has shown a shared objective in teams is also important to creativity, as is a high level of participation, for instance, transparent information sharing, shared influence over decision making, etc. Also, "team reflexivity is considered another key indicator, which is

the extent to whoever team member collectively reflect upon team's objectives, strategies and processes as well as their wider organizations, and adapt them accordingly" (West, 1996). As a consequence of reflexivity, the group needs to continually re-negotiate during team interaction. In fact, "the most creative discussion happened within those negotiations for transforming information as well as develops mental models" (West, 2000).

Leadership and management are also important to team performance and creativity. "It is easy but also dangerous for leader to influence group activities, like directive chairs inhibit teams from achieving shared mental models and inhibit innovation by restricting the multiplicity of interactions in free flowing teams" (West, 2000). However, in this thesis, we are not going to discuss management skills very much.

2.1.5 Designers' Creativity

"Design is one of the most promising areas in which to study creativity," says Simon (1981) because of the following features of design problems:

1) Designers tackling the same problem are likely to come up with different solutions (Jacob, 1977).
2) Good designers break rules all the time.
3) Design deals with ill-defined (Simon, 1981) and wicked problems (Rittel, 1984) (i.e. problems that are intrinsically open-ended, situation specific and controversial.)
4) In design there are no optimal solutions, but only trade-offs.

In the research of Fischer and Nakakoji (1994), they found out that for a typical design process,designers start with a vague design goal, and go back and forth between different

component in the environment. A typical cycle of events in the environment includes the following:

1) Designers create a partial specification or a partial construction;

2) They do not know how to continue, so

3) They switch and consult other components in the system that provide them with information that is relevant to the partially articulated task at hand; then

4) They refine their understanding by reflecting upon the situation

As designers move between components, the problem space is narrowed and different facets of the artifact are refined.

Frost and Cross (2001) tested a group of industrial design students and found the creative aspect of design can be described by introducing the notions of "default" and "surprise" problem/solution spaces. Surprise is what keeps a designer from routine behavior. They say that the creative event in design is not so much a "creative leap" from problem to solution but the building of a "bridge" between the problem space and the solution space by the identification of a key concept. Creative design involves a period of exploration in which problem and solution spaces are evolving and are unstable until (temporarily) fixed by an emergent bridge which identifies a problem-solving pairing. A creative event occurs as the moment of insight at which a problem-solution pair is framed.

2.2 Pattern of Workplace

2.2.1 Workplace Ecology

The influence of space on behavior is not always obvious, but it underlies many social and organizational puzzles. Steele and Becker (2004) had coined the term organizational ecology to capture the dynamic, independent view of the workplace as listed in Figure 1.

"The nature of physical workplace is only one set of elements to consider in designing the overall ecology of the workplace. Changes in any of these factors are likely to stimulate changes in the ecology itself" (Becker & Steele, 1995). The difference of organizations will reflect differently in the ecology. Under this ecology, the workplace is not merely an office, one's workstation in an office building. It's also the cafeteria, the conference and break room, corridors and water fountains. It's all the places in which one works. "Because of the increasing percentage of knowledge workers (different from labor workers), that is likely to encompass not just everywhere in the office building but everywhere one can think, write, talk or read" (Becker & Steele, 1995). To create a high performance workplace requires executive acknowledgement and a lot of managing help.

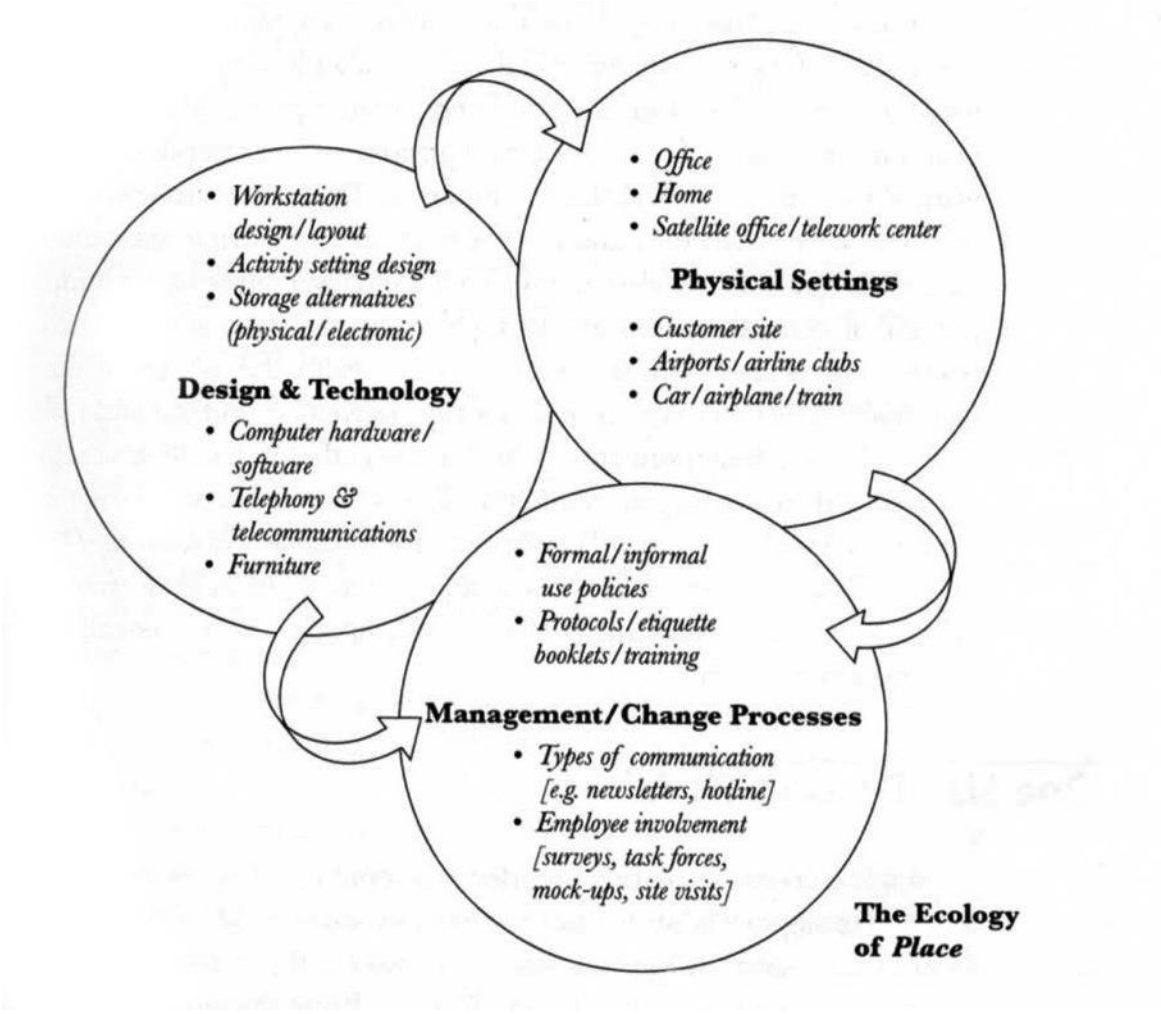

Figure 1 Organizational ecology: The basis of an integrated workplace strategy (Steele and Becker 2004)

Steele and Becker (1995) also have developed five key criteria to maintain organizational health and how facilities would influence them:

1) Sense of identity. A clear sense of the organization's mission, values, style, and culture. People from outside see a clear image of what it does and what it for. （Decorative style, space location, signs, artworks, etc.. These work settings are a powerful medium for expressing identity.)

2) Reality testing. Members of system are able to get timely and accurate information about what is happening, both inside the system and in the surrounding environment. (Workplace features that promote or block communication throughout the organization particularly influence this: communication technology, meeting facilities. It could be a big help but also could impede the process by reducing the probability of regular information sharing.)

3) Task accomplishment. The system fulfills its mission if it satisfies the expectation of both insiders and outsiders, therefore it receives sufficient inputs so as not to run down over time. (Many facility factors could have such kind of impact: size and quality of individual workplaces, ergonomics, joint activity place, information and communication settings, etc.)

4) Problem solving and adaptability. The system's members are able to make changes according to changing conditions that solve problems or seize opportunities created by the change. (This is heavily influenced by the flexibility of the workplace. It is encouraged by work settings that have a variety of different type of spaces that people can choose from based on what they are doing at any particular time. Settings that foster communication also help members spot problems earlier.)

5) Energy flow. Members manage the relations among the parts of the system so that the energy generated by collaboration, conflict, teamwork, tension, and so forth gets used productively rather than draining energy from tasks or splintering the system permanently. (This is influenced by relative locations of

parts, boundaries between groups, spaces that tend to promote cooperation or competition, and facility policies that decide how people use their facilities.)

2.2.2 Future Workplace Design

Workplace design is constantly changing. Steelcase Inc, the world's largest designer and manufacturer of office furniture, has developed seven characteristics of the new workplace:

1) When it comes to the working environment, what you do is more important than who you are.
2) You don't have to "go to work" to work. For many people, technology has made being there optional.
3) If and when you do go to work, chances are you won't sit in one place for every long.
4) There is an evolution toward one person occupying several seats as he or she moves from task to task throughout the day, several people sharing one chair, as in settings used over the course of a day or week by people who work outside the office as much (or more) than they do inside.
5) Group and team settings are becoming increasingly important.
6) There is no one identical model for what the work environment should be.
7) The focus of office design is moving from efficiency to effectiveness.

The workplace will be changing from a productivity-oriented to a performance-oriented place. It will also change from organizational control more into personal control. More and more people will decide for themselves whether to be in the office or not, or where to be in the office. The organization will change its structure also, from vertical to horizontal, which will impact the

whole ecology drastically. Information will be transmitted more quickly from top to bottom; the whole environment will be more transparent. The workplace will become more informal, more flexible, and contain more freedom.

2.2.3 Creative Workplace

"Creative cognitions occur when individuals feel free from pressure, safe and positive" (Claxton, 1998).

It has been hypothesized that contextual factors of work environments can influence individuals' creative behavior (e.g., Amabile, 1988; Shalley, 1991, 1995; Woodman et al., 1993), and recent studies have found that perceptions of work environments do influence creative performance (Amabile, Conti, Coon, Lazenby, & Herron, 1996; Oldham & Cummings, 1996).

"In particular, facilities that make it easier for individuals to contact one another when needed are likely to be beneficial to creativity. Yet individuals also need facilities that offer solitude, where creative thoughts and ideas can be nurtured, and where reflections on other people's ideas can be arrived at. These two functions of providing space both for meeting others and for reflection are basic to creativity" (Hemlin, 2006).

Employees working in innovation-oriented cultures have been found to demonstrate higher levels of satisfaction, commitment, and intent to remain (Odom, Box, & Dunn, 1990; Quinn & Spreitzer, 1991). When creativity is important, it should be desirable for an organization to provide the type of work environment that facilitates rather than stifles the creative process. Specifically, "a work environment complementing the creativity requirements associated with a job should be positively related to satisfaction and intent to remain because this setting should facilitate rather than hinder meeting job requirements" (Shalley, 2000). Results

further indicated “individuals reported higher satisfaction and lower intentions to leave when their work environments complemented the creativity requirements of their jobs.” Shalley (2000).

However, no clear design criteria addressing creative workplace design were found during the literature review.

2.2.4 Designers’ Work Environment

Fischer (1994) mentioned that environments support four design themes that are important for supporting creative design:

1) Co-evolution of problem specification and solution construction;

2) Reflection in action;

3) Evolution of design environments;

4) Making relevant information available.

Catalogue Explorer, an innovative system designed by Fischer (1994), illustrates how integrated environments can amplify human creativity in terms of the four themes. The synergy of this integration enables the system to retrieve design objects that are relevant to the task at hand, as identified by a partial specification and a partial construction, thereby notifying designers of the existence of potentially relevant information. “By presenting information to designers that they may never have thought before, the mechanism amplifies their creativity by bringing existing design concepts into unseen and even unthought, yet valuable ways of usage. This emphasizes the basic assumption that creativity is not just a mental capacity, but is greatly enhanced by interacting—in the right way—with knowledge in the world”(Fischer,(1994).

"Design is a conversation with the materials of a design situation. This principle has been operationalized by creating domain-oriented design environments that support human problem-domain communication" (Fischer & Lemke, 1988). The materials of the design situation are not low-level computer abstractions but objects with which designer is familiar. The domain-oriented nature of the environments acknowledges the fact that knowledge does not exist by itself in the form of context-free information, but is part of the practice of specific professional communities (Ehn, 1988).

2.3 Hypothesis of Facilitating Creativity in Designers' Workplace

Based on the literature review above, it can be concluded that a hypothesis of an ideal workplace would help to contribute to creativity in designers' workplace. That is:

1) Fulfill the five criteria for maintaining organizational health. Thus the workplace could be supportive, and would not impede normal working activities.
2) Fulfill both individual and group creativity requirements. Thus the workplace would facilitate creative activities rather than inhibit them.
3) Fulfill the designers' workplace requirements as well as creativity requirements.

By combining all the requirements above, in a designer's workplace, there are multiple general values that may help to facilitate their creativity:

1) Providing diversity
2) Sharing a clear and achievable goal
3) Being properly rewarded

4) Satisfying self-identity

5) Being flexible and easy to change

6) Guarantee freedom

7) Easy and transparent communication

8) Presenting information in environments

9) Benefiting energy flows

Chapter Three: Research of Designers' Creativity in Workplace

3.1 Research Method

3.1.1 Research Subjects

Due to limitations of resources and time, 35 designers in United States were asked to participate in the research with 25 of them agreeing to execute the plan.

The subject offices were selected based on the scale outlined below. The research covers the whole range of design offices to obtain appropriate conclusions, which according to design facilitator experts, is: 1) corporation design department (scale unknown); 2) large design firm (scale above 25 employees); 3) medium design firm (scale between 5-25 employees); 4) small design firm (scale between 1-5 employees). It turns out the subjects fall into a table of configuration (see Table 1). Among all 25 designers, 15 are senior designers (over 5 years professional experience), and 10 are junior designers (1-5 year professional experience).

Table 1 Subjects Configuration

	Small	Medium	Large	Corporation
Organizations	3	2	1	1
Individual	3	8	6	8
Junior designer	0	4	3	3
Senior designer	3	4	3	5

To get consent from subjects, the researcher followed the below steps to ensure subjects be aware of the proper risks and understood the research plan.

1) A formal letter addressing the request to do on-site visits is sent to 30 potential subject companies (mostly through personal connections)

2) The letter informs them of the motivation and the objective of the research; the researcher is listed as primary contact if they have questions or are willing to help.

3) Those who are interested in participating in the research email the researcher back and the researcher explains to them the detailed research procedures.

4) If subjects are still willing to help, the researcher sets up a time to meet them.

3.1.2 Research Procedures

To better understand the circumstances and verify hypothesis, the researcher made up the following questions to be considered during research:

- What environments make designers creative?
- What are designers' work processes?
- How do designers use their workspace?
- Do all designers have similar work pattern?
  - If so, what are the similarities?
- What are the differences in the workplace relative to the scale of design organizations?
- What prevents designers from working more creatively in the office?
- What is the ideal workspace for a designer?
- How can the current workspace be improved?
- Do designers prefer furniture they designed themselves or manufactured furniture?
- How can we facilitate creativity from what we have learned?

- Can we apply designers' working processed and environments to commercial work environments in order to stimulate creativity? If yes, how can we do that?

To understand these questions, the research was composed of three separate parts:

1) Observation shadowing

(Observe both individual and team work patterns to help to answer research questions; photos were taken under permission.)

2) Qualitative interview

(Approximately 30-45 minutes interview with each subject. An audio recorder was used to record the conversation for later transcription.)

3) Photo journal

(A set with instructions and a jump driver were sent out via mail to respondents, asking the subjects to follow the instructions and fill out the blank sheets by taking pictures themselves.)

The interview questions were listed as below. However, during the qualitative interview, the conversation was loose, trying to capture more deep thoughts from designers rather than strictly follow the questions.

1. What made you decide to be an industrial designer?
2. Why have you been a successful industrial designer?
3. Can you describe your team's work process?
4. As a designer, how do you define creativity?
5. What (generally) makes you creative? Please explain.
6. What environments (furniture) support your creativity best?
7. How/Where do you maintain your creativity?

8. How do you use your personal work station? (chair, storage, monitor, table, others)
    - Did you customize it?
9. How do you use your team workspace?
    - What furniture/room do you use?
10. What aspect of the firm environments do you like best/least?
11. What holds you back from being more creative in your firm?
12. What else do you think might help you to be more creative?
13. Can you describe/draw an ideal workspace for your firm?
14. If you want to design something that can stimulate creativity, what would you do?

For the on-site visit (mainly containing observation shadowing and qualitative interviews), the researcher used a schedule to conduct the research:

- 8:00/8:30-10:00 Observation: workspace facilities

Researcher walks around the office with permission, to understand the layout of the workplace as well as working facilities. Pictures of team workplaces, personal workstations and other work environment are to be be taken, but no current projects or people.

- 10:00-11:00 Observation: interaction, work process and workspace utilization

Researcher stays in the office watching people work, observing their individual and interactive activities as well as how they utilize their work facilities. It will be non-disturbing shadowing. No pictures will be taken, while researcher will take notes for later synthesis work.

- 11:10-12:00 1-2 Interviews

According to the suggestions of subject organizations, they would provide 1-2 designers that are willing to take the interviews. Interviews will be taken in their personal workstations, while researcher willuse an interview sheet to ask questions. An audio recorder will be used for

recording the interview for later transcription. While taking interviews, if there are some explanations for certain equipment, pictures will be taken. No people or current projects will be included in the pictures.

- 13:00-15:30 2-3 Interviews

Same as the earlier step.

- 15:30- 17:00 Observation: interaction, work process and workspace utilization

Researchers will stay in the background doing non-disturbing shadowing of working activities. Notes will be taken. No pictures will be taken.

Unfortunately, at the end of the research, the photo journal session only accumulated three samples, which was not enough to draw solid conclusions; thus were not be considered in later synthesis work.

In the end, 25 potential subjects sent out positive responses for later research execution. The general research happened periodically in that period as well.

3.2 Synthesis Results

The research collected 806 minutes of interview in audiotape and 198 pictures. The observation shadowing lasted seven full working days.

Based on the research questions listed in last session, the synthesis will focus on extracted commonalities of the data, trying to look for repetitives pattern that may be concluded to be general patterns of designer's creativity in workplace.

3.2.1 Qualitative interviews results

The following results are summaries of each question in the interview sheets based on the most commonly appearing answers.

1. **What made you decide to be an industrial designer?**

   Design itself fascinates people. The mere creative process of problem solving, the mixture of aesthetic and function, and having something manufactured in the end inspires designers, keeps them motivated. Half the designers admitted they were born creative.

2. **Why have you been a successful industrial designer?**

   Being a successful industrial designer was more or less linked with their personal characteristics or experiences—persistent, confident, curious, knowledgeable, thinking differently, ease of communication both visually and verbally, ability to persuade people. None of them directly mentioned creativity as an essential quality to be a successful designer.

3. **Can you describe your team's work process?**

   All the designers emphasized the importance of collaborative work both with clients or colleagues. Most (84%) designers started from all kinds of exploration (research mainly), and then individual contemplative work with team collaboration work alternately. The ways each firm does its collaboration work vary. During the process, temporary teams were formed. Normally the demands of a project will decide the scale of a temporary team. For a medium or larger scale firm, an ordinary project asks for two to three designers to work in a team for a certain amount of time (for individual or small firms, designers work with outsiders). It is noticed that the small team usually is constituted of a mentor who is more experienced (senior designer) and apprentices who produce various ideas (junior designer or intern). The constitution of the team is fluid, changing from time to time even within the same project. The firms require all teams to be open and transparent about sharing information.

4. **As a designer, how do you define creativity?**

The most common answers for this question are to obtain a different vision/perspective (72%), effective yet attractive problem solving (48%), invent something new and different (32%), improve current conditions (24%). Additionally, some designers (20%) think creativity is a process to achieve the goal within disciplines in a way nobody thought of before (see Chart 1).

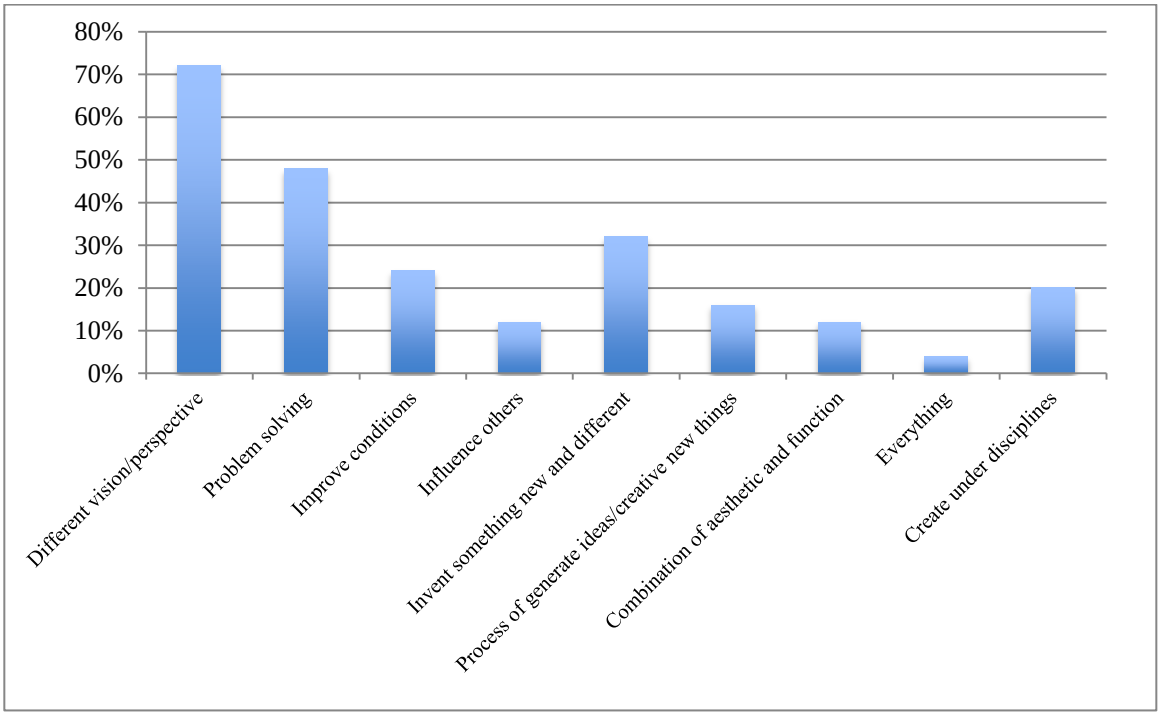

Chart 1 Percentage Distribution of Definition of Creativity from designers

5. **What (generally) makes you creative? Please explain.**

Most designers (84%) confirm they acquire creativity from outside inspiration, which includes surrounding environments, visual/acoustic stimuli, other art trends other than mere products, and outside energy flow.

At the same time many designers (68%) think collaboration helps them be creative, while nearly all of them think diversity helps with creativity during collaboration. The bounce

of ideas from different backgrounds during brainstorming and further creative sessions seems to inspire designers most.

Of all of the designers, some of them (36%) strictly believe effective problem solving is the best way of keeping creative. By identifying certain problems, all ideas could stream out creatively.

6. **What environments (furniture) support your creativity best?**

Interestingly, a total of 56% of the designers think they are most creative while they are in transit (in auto pilot condition 24%, in a trip 32%). Nearly half of the designers think they work best in their personal workstation, which means, in other words, they are satisfied with their current setting to support their work right now (see Chart 2).

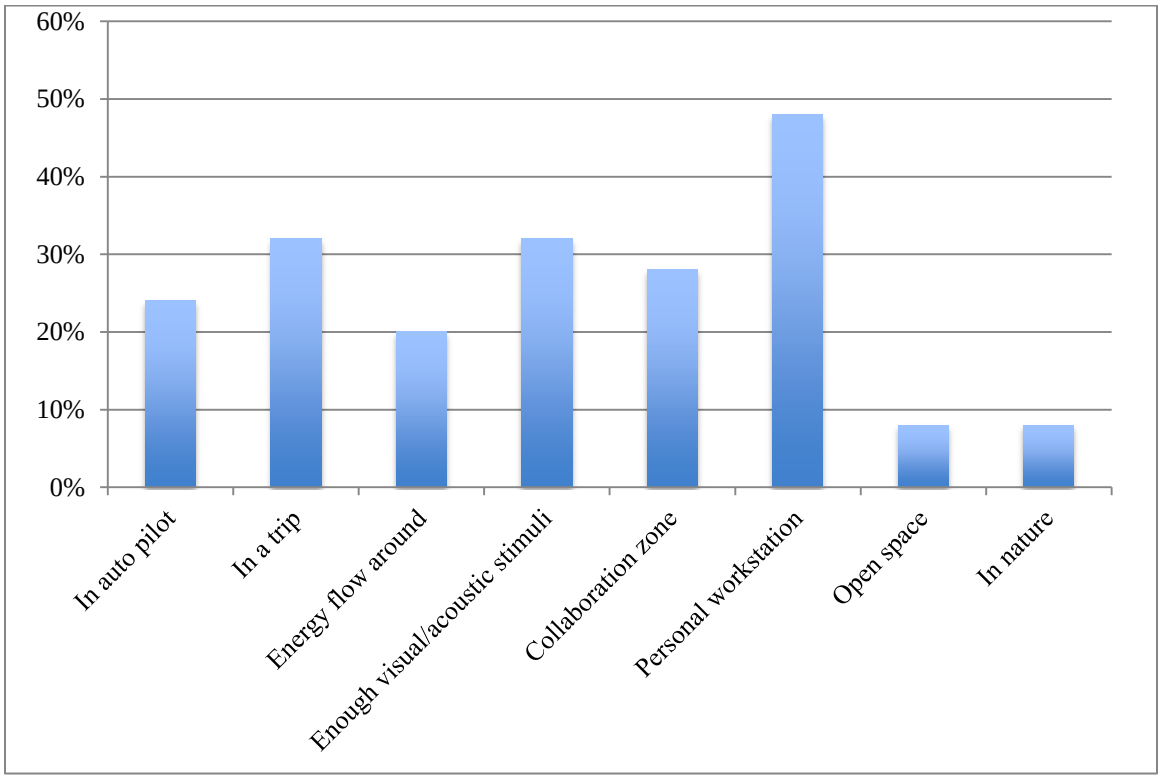

Chart 2 Work Environments that Support Creativity Best

7. **How/Where do you maintain your creativity?**

The main methods designers use for maintaining creativity has been listed in Chart 3. Many designers (64%) think exposure to different things rather than their own projects helps to maintain creativity. In this way, "different things" is somewhat similar to the answer of Question 5 of outside inspiration; that is, something different than the current projects—visual/acoustic stimuli, surrounding environments, other art forms, as well as communication to different people.

However, there are some designers (20%) who think creativity can not be maintained. Creativity is spontaneous, always comes and goes, thus is uncontrolled; even though it could be stimulated in certain ways, it could not spark long.

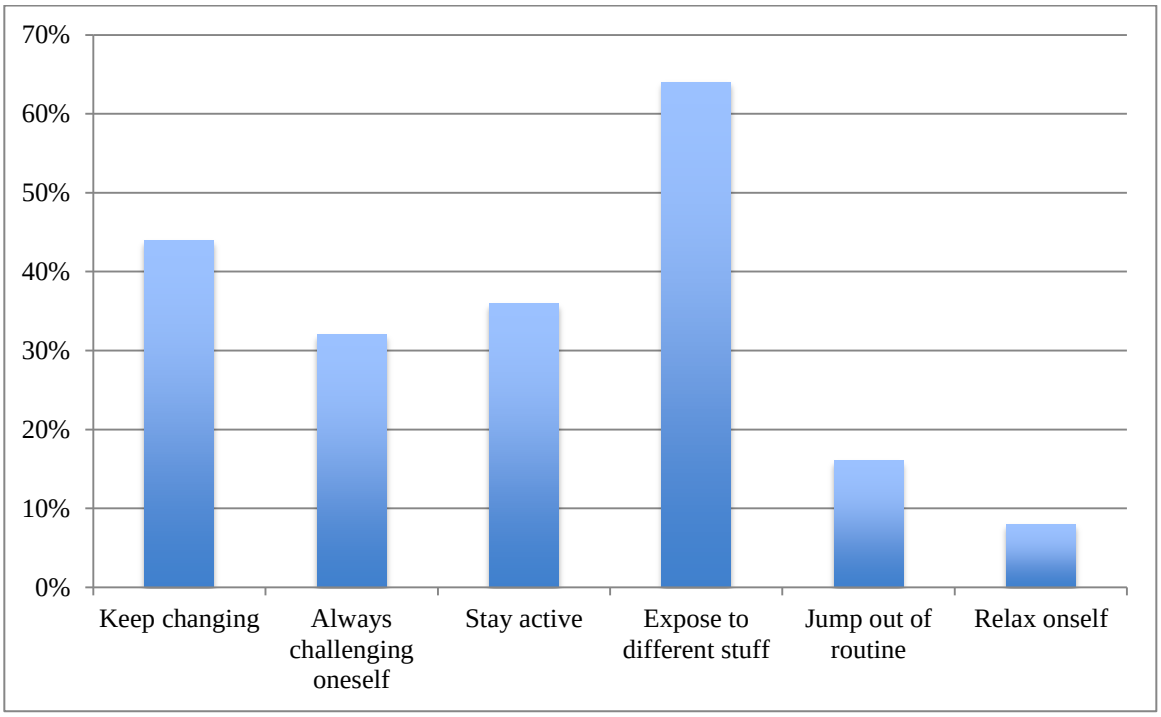

Chart 3 Methods of Maintain Creativity

8. **How do you use your personal workstation? (chair, storage, monitor, table, others)**

- **Did you customize it?**

Almost all designers have different answers for this question depending on their different workstation systems. Here are some repetitive answers: keep tools within hand reach, tape visual stimuli on the walls, switch from stools to chairs in different conditions, orient desks to facilitate collaborations, use two or more monitors, and keep everything organized. Basically, it seems designers would prefer having control over their personal workstation in order to customize a comfort zone, both for individual contemplative work and occasionally collaborations, which are normally short and unintended, but happen frequently within personal workstations.

9. **How do you use your team workspace?**

- **What furniture/room do you use?**

All subject design organizations have certain kind of team workspaces; even the individual small design firms designed a specific place for collaboration. All of them obtain white boards and tackables as the most frequently used tools for communication and visual display. Chairs and tables in team workspaces are different from workstations, and most of them are mobile. Technology is widely adapted, including projectors, monitor screens, conference phone adapters, video conference facilities, etc. Many team workspaces are surrounded by different kinds of stimuli—books, magazines, office decorations, images created by designer themselves. Designers spend half their working hours in team workspaces as a more formal teamwork place (compared to personal workstations) to discuss projects. They meet frequently, tape sketches on the tackable or white board, share information, and discuss ideas. Sometimes team workspaces are also used as meeting room with clients.

10. What aspects of the firm environments do you like best/least?

The majority of the designers (88%) think the best of the firm environments is the people in it. The team and their energy is what excite designers most. It's a bunch of creative people working individually and collaboratively, with good interactions among each other—that energy flow becomes designers' favorite aspect of the work environment.

However, for the least favorite aspect of work environment, some designers (40%) think there are too much distractions from others.

11. What holds you back from being more creative in your firm?

There are some designers (28%) perfectly satisfied with their current work environment in that they think the workplaces support them very well and they are most creative in the office. Other than that, Chart 4 shows some reasons for designers to experience depressed creativity in the workplace..

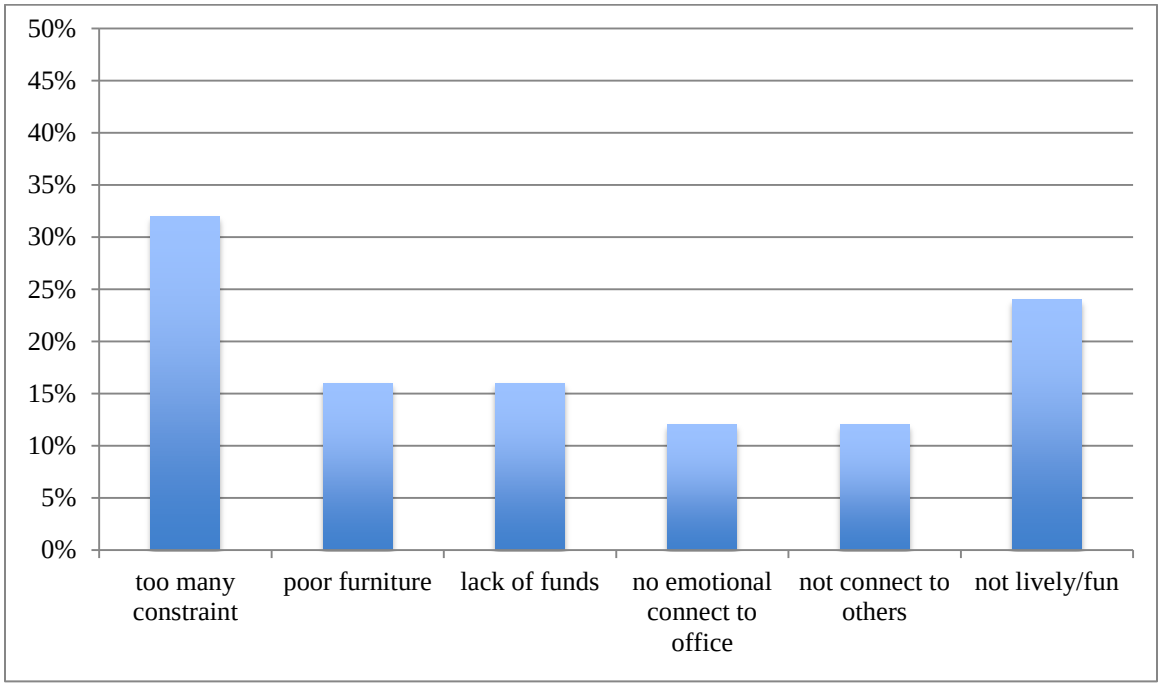

Chart 4 Reasons for Depressing Creativity in Workplace

12. What else do you think that might help you to be more creative?

For this question, designers have various answers. Those who think they are supported well in current settings do not require changes. Other answers could be categorized as requiring bigger customized visual stimuli, easier access to collaboration, more open spaces, and a more natural environment.

13. Can you describe/draw an ideal workspace for your firm?

Many designers (64%) draw in their personal workstation instead of the whole team area. Most of the workstations include a big and long table for sketches and tools, comfortable chair, one to two monitors, storage and customized visual stimuli, which does not differ a lot from their current settings.

The rest of them draw in a team area, which normally includes a mobile table with people around, visual/acoustic stimuli, and easy pop in-out access to the conversation.

14. If you want to design something that can stimulate creativity, what would you do?

Chart 5 shows the different general directions of ideas that designers think of while answering this question.

Nearly half of the designers (48%) think of different ways of reinforcing personal control including acoustic barriers, hand held air conditionesr, etc. Almost another half of them (44%) suggest something that can help to foster collaborations.

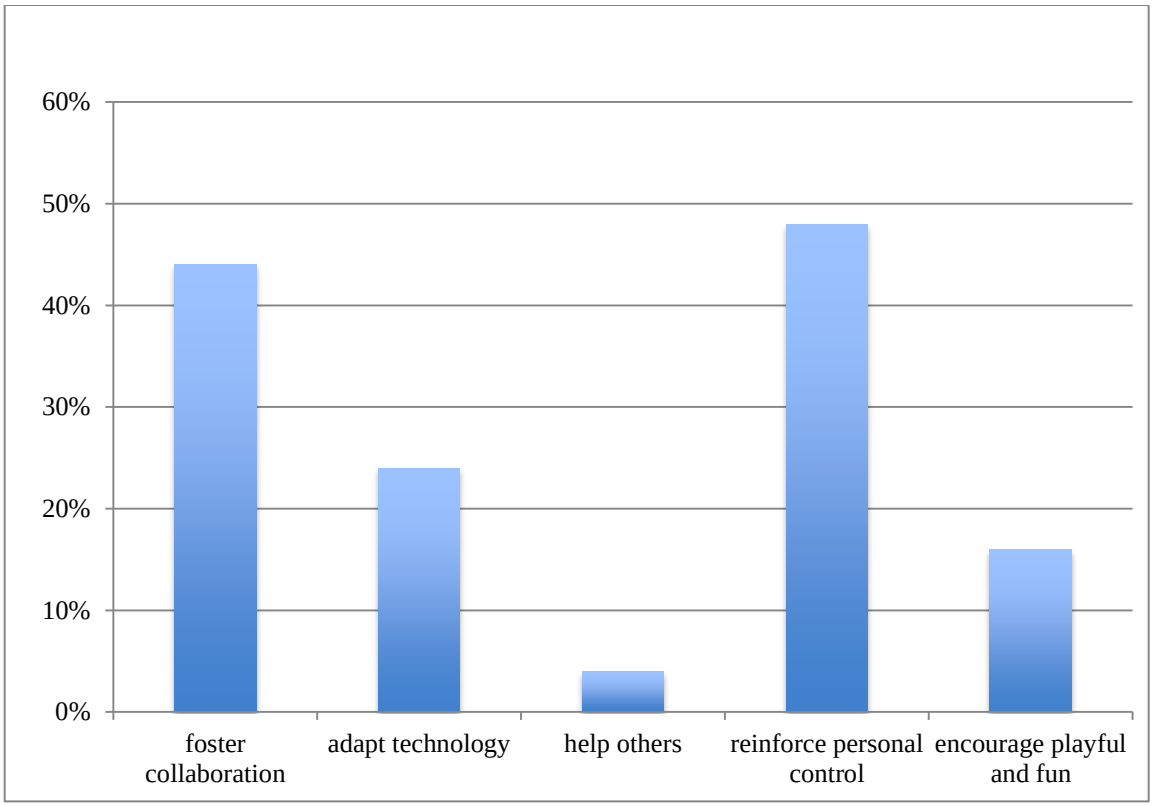

Chart 5 New Design Ideas for Stimulate Creativity by Subjects

3.2.2 Observation shadowing results

The observation shadowing results will be described in two parts: phenomenon and interpretation. Phenomenon would be the literal observation results; interpretation would be the understanding of the researcher. See the following:

Phenomenon: Designers work in groups frequently. Half of their work hours are occupied by collaborative activities. Only 50% of the designers could be seen in their personal workstations. Normally, informal collaborations happen in workstations, only taking a couple minutes involving quick information and opinion sharing, accompanied by physical copies of sketches or images, sometimes physical models. More formal collaborations happen in team areas, usually surrounded by white boards or other

physical displays so designers could walk around, stick their drawings on display, and discuss details.

Interpretation: Collaboration has indeed been the most important part to execute creative work. Designers developed a lot of methods to work in small teams in different sessions of a project, including different kinds of brainstorming and heated discussions. The input and output are equally important. In discussions, the air is very open and equal; everyone is open to offering ideas and helping each other to accomplish the goal.

Phenomenon: All design organizations obtain big white boards and many customize their own. White boards are more used as displays to magnetically attach or tape sketches rather than really scribble on it. Tackables are more preferable than white boards.

Interpretation: Designers require a way to quickly show their ideas to others in order to receive feedback. It is similar to a physical Wikipedia when everyone can view the results and contribute to the results instantly and simultaneously. Normal settings of the white boards are not big enough for such frequent sharing of large amounts of information so designers have to create their own. Designers also prefer drawing on plain paper and sticking it to the white board, so they can easily change the theme by peeling it off and sticking it on. White boards also have an obvious disadvantage compared to tackables in that the boards can not preserve information. It is more suitable for demonstration rather than communication. The white boards or tackables also served as visual stimuli, as after collaborations designers tend to leave it as it is, so then whoever passes by can have a hint of the mental image, and whenever they would like to pick up an idea or continue diving they can easily catch up with thoughts.

Phenomenon: Many designers prefer working facing the hallway.

Interpretation: One reason for that is once employees are sitting facing outside the workstation, their backs feel secured in their workstation, especially in a cubic system. People tend to avoid showing backs to others when they are engaged in work. The second reason is that designers have a tendency of multi-tasking during work, many of them admitting that they like to observe the surrounding activities and are willing to cut into a conversation that intrigues them at any time. The subtle openness to people keeps them energized, feeling connected, yet not too exposed.

Phenomenon: Designers keep physical models in different forms within sight. Tactile items were touched a lot when people pass by.

Interpretation: Industrial designers think in three dimensions. Physical models help them better understand the forms. It could be something very simple like foam cords stuck together, a handful of clay or something functional, or disassembled piece of existing products. Even though not all designers build their models themselves any more, there are still plenty of them who enjoy engaging in hand crafting, admitting that they think better with hands-on physical items. Several designers mentioned they are most creative during the model-making process. It is a hand-brain interaction aid to concentration and to stimulate creativity. Even if it is not model, other tactile items like screens, flip boards or textured tiles could be a good distraction from routine, because people keep touching them when walking by, which in some way becomes an interval in constant daily work, and also becomes something that intrigues creativity by offering visual and tactile stimuli.

Phenomenon: There are not many differentiations between different scales of design organizations. In fact, most designers share more similarities than differences in the preference of workplace.

Interpretation: Designers share a similar work pattern: exploration ←→ research ←→ brainstorming ←→ collaborative discussion ←→ funnel down ideas ←→ model making ←→ engineering. After these the idea may turn out to be feasible enough to manufacture, or it would go circle again. The design part from brainstorming to engineering would repeat many times for modification depending on the projects, but basically the whole process is the same strategy. Therefore the work pattern for an individual designer and a corporate designer is not much different; they may be involved in different phase of the circle, but generally their work consists of a lot of individual contemplative work and different levels of collaborative work. It is the nature of creative design work that identifies their work pattern, as well as the workplace design, which includes big table for drawings, big visual stimuli, openness to energy flow, convenient collaboration area, etc.

Phenomenon: Many designers seem satisfied with their personal workstation; they are looking more into the collaborative area.

Interpretation: As interviews have proved, designers seem to have more concern with people they work with. The current workstation settings fulfill their basic needs for working: comfortable chairs, big tables, good computer, multiple monitors, place to display visual stimuli, organized storage, tools within hand reach. So when they think about improvement of their work environment, they are inclined to think more about connections to people.

Phenomenon: Most designers customize their personal workstation, at least the visual stimuli.

Interpretation: Almost all designers keep something personal in the personal workstation, both for fun and visual stimuli. Many designers print out their own visual stimuli (mostly young designers) and tape them on the wall. They do not typically change the furniture of their workstation; instead they install many personal items. Some designers designed certain tools to help with their work, for instance, an ergonomic mouse pad or computer stand, but not a lot of them did that.

Phenomenon: The outside view of their workstation is important to designers.

Interpretation: An outside view of the workplace could be nature scenes or street views. Some designers mention they are fond of street views with people walking and vehicles passing by, which keeps them feel connected to people, as well as the pace of the city. It is another kind of energy flow that is different from the one inside the office. Whenever they are stuck in their thoughts, an interval sight of the outside view will be refreshing.

Phenomenon: Designers naturally prefer changes and diversity both in work style and workplace design.

Interpretation: Most designers do not sit in one position for a whole day. They switch from stool (sketching) to working chair (working on computer) several times a day. Also, when they feel short of ideas, they often try to alter the current method and switch to a different one to figure out ideas. Diversity is very important in creativity, as literature review has proved. For designers, they apparently welcome different perspectives during collaboration for feedback. Again, it is the nature of design work that it requires diversity, both for the outcome of innovative work and the innovative work process that results in

the outcome. As for the workplace, most organizations install their team area with mobile furniture. Designers move their furniture in team workplaces almost every time, which includes chairs, training tables, white boards and sometimes certain shelves. They adjust their workplace settings frequently due to different usages for different projects and different constitution of the teams.

Phenomenon: Design firms usually avoid designing their system layout in a straightforward way.

Interpretation: Straightforward layout means easy to orient and locate. Normally it is a good thing because of convenience. However, most design firms prefer designing a labyrinth layout that is nothing straightforward. Designers seem to more enjoy the fun of walking different ways even to their own personal workstation. That, too, somewhat becomes an interval from daily routine.

Phenomenon: Some firms keep some toy boxes or balls in their team area, so when at break designers can play with it. They also tend to obtain some playful items for display as part of their interior design—some graffiti, baseballs, wind sticks, etc.

Interpretation: Playful and fun is an important part of the culture in design organizations. Research has shown that keeping a child's mind contributes to creativity. Designers tend to keep curious and enjoy creating something fun and playful for themselves. Curiosity is one of the key characteristics to be a creative person; hence designers are generally curious. They are easy to communicate with, always showing their enthusiasm in learning new knowledge.

Phenomenon: When the work needs contemplation the most, designers need to work alone, and undisturbed.

Interpretation: Even though collaboration is emphasized a lot in design organizations, when designers get down to work that requires the most focus and concentration, they prefer to stay in undisturbed environments. Other researchers have also mentioned that real work is more productive and creative when done privately rather than collaboratively. Several designers mentioned they would stay in office before or after work hours to have private quiet time for difficult work. Also generally when they have control over all the environments, it seems to be easier for them to contemplate, which means comfortable environmentsfor designers are familiar with and by themselves, hence with no distraction from others.

Phenomenon: There are higher tables and stools in every design organizations.

Interpretation: Higher tables are normally used for discussion and sketching. While sitting higher, people get closer, which not only saves space, but also becomes more intimate. Designers prefer sitting on stools or standing positions for consuming creative work like sketching. Moreover, it has been observed that many designers prefer switching from stool to chair during work hours from time to time, which provides a different perspective because of the change of height.

Phenomenon: Most designers have headsets on while doing contemplative work, and have headsets off to collaborate in personal workstation.

Interpretation: Headsets produce a sound barrier from others, while at the same time create a personal sound environment that the designer can control. It also becomes a metaphor of availability to collaboration.

3.2.3 Interview conclusions

The following are bullet points extracted from the interview results; they conclude the interview results as:

- The creative process of design activity fascinates designers.
- Personal experience and personality help to become a successful designer.
- Design process starts from exploration, and then solitude and collaboration work alters frequently.
- Most small teams consist of two to three designers of a mentor and apprentices. The constitution of team is fluid.
- Information is transparently shared in teams as well as in the whole organizations.
- Designers think creativity is obtaining a different vision, effective yet attractive problem solving, inventing something new and improving the present.
- Creative inspiration comes from outside of the projects, mostly includes surrounding environments, different senses of stimuli, art trends, and energy flow.
- Collaboration contributes to facilitate creativity; especially the diverse backgrounds of participants help most.
- Exposure to different things helps to maintain creativity.
- Collaboration area is essential in every office. The features of it include white board and tackables as communication tool, mobile furniture, technology for information sharing, and the space is usually surrounded by different stimuli.
- Designers spend half of their work hours in collaboration.
- The majority of the designers think the best of the office environments is the people in it.
- Many think they are most creative when in transportation.

- Designers prefer to have control over personal workstation to customize a comfort zone both for solitude and team work.
- Some designers are satisfied with their current settings.
- Many designers would like to reinforce more control over personal workstation in the future.

3.2.4 Observation conclusion

Followings are bullet points that are extracted from the observation results; they conclude the observations as:

- Seats facing the hallway enable designers to keep a subtle openness and privacy of being able to pursue solitude and collaboration as they like.
- Tactile items in surroundings help to concentrate and stimulate creativity.
- Designers work in a similar pattern using similar tools in different scale of organizations, which means the work activity is defined by the work requirements.
- Many designers are concerned about connections to people once their personal zone requirements have been fulfilled.
- Most designers customize their personal workstation, at least the visual stimuli.
- The most focused work needs to be done alone in environment of which designers have full control.
- Outside views provide a break from routine. The energy flow of street view is refreshing.
- Designers change their positions and physical work environments to accommodate needs. They change their sitting positions and personal equipment for different types of work, and also change team area facilities for different projects.

- Higher tables and stools are available in every organization.
- Design organizations create labyrinth layout for different ways to workstations.
- Designers obtain playful items to remind themselves of keeping curiosity.
- Headphones are used as metaphor for availability, and also create a personal acoustic zone for contemplation.

Chapter Four: Develop Guidelines

4.1 Analysis

When comparing the hypothesis in Chapter Two and the research results in Chapter Three, there are some overlaps while also some loopholes. This chapter is going to build the guidelines based on synthesizing knowledge from the former two chapters. A comparison of the the two chapters is shown in Figure 2.

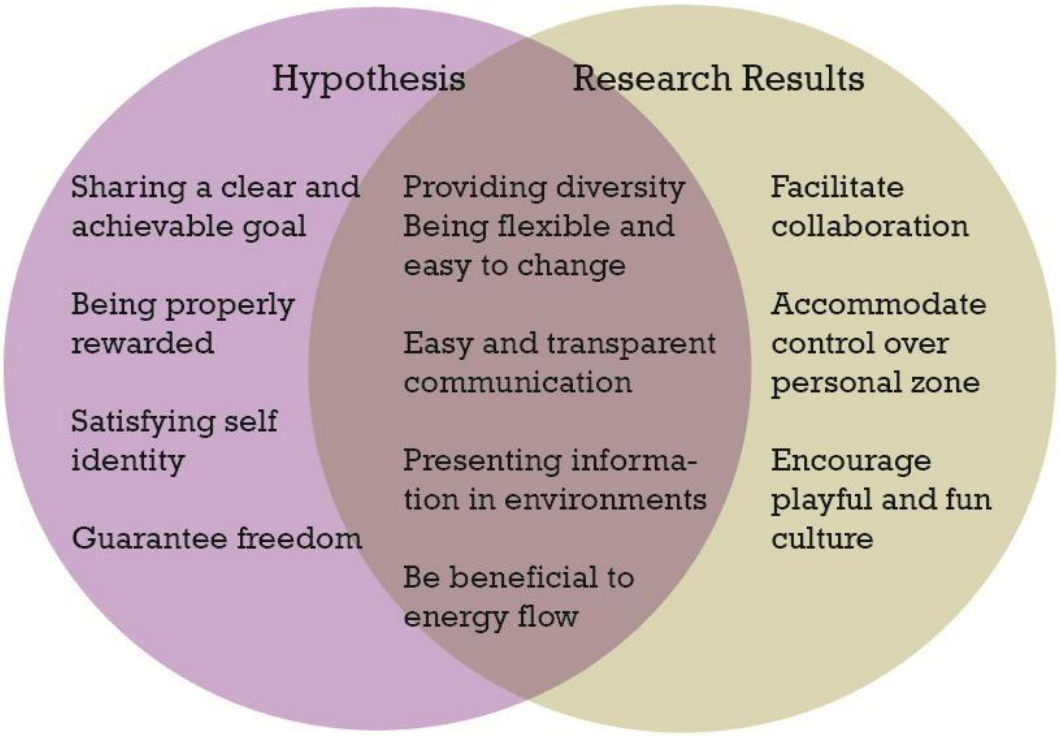

Figure 2 Comparisons of Hypothesis and Research Results

The hypothesis in Chapter Two provides a set of general values that would contribute to facilitate creativity in designers' workplace based on cognitive and sociology science research.

Among all these nine values, there are some abstract ideas that have been proved in earlier researchers' work but could not be directly verified in Chapter Three's research. Those are:

1) Sharing a clear and achievable goal

2) Being properly rewarded

3) Satisfying self-identity

4) Guaranteed freedom

These four not-verified values do not mean they are not important. They actually fall in a more theoretic and abstract category involving management skills that could not be tested in the research executed in Chapter Three. These still need to be taken into consideration while trying to build up a workplace facilitating designers' creativity, but in a more cognitive management level rather than a real physical environment level.

The other five values more or less have been verified coherently in the research. They are:

1) Provide diversity

2) Be flexible and easy to change

3) Easy and transparent communication

4) Present information in environments

5) Benefit energy flow

The verification of these five hypothesizes can be viewed in Chart 6.

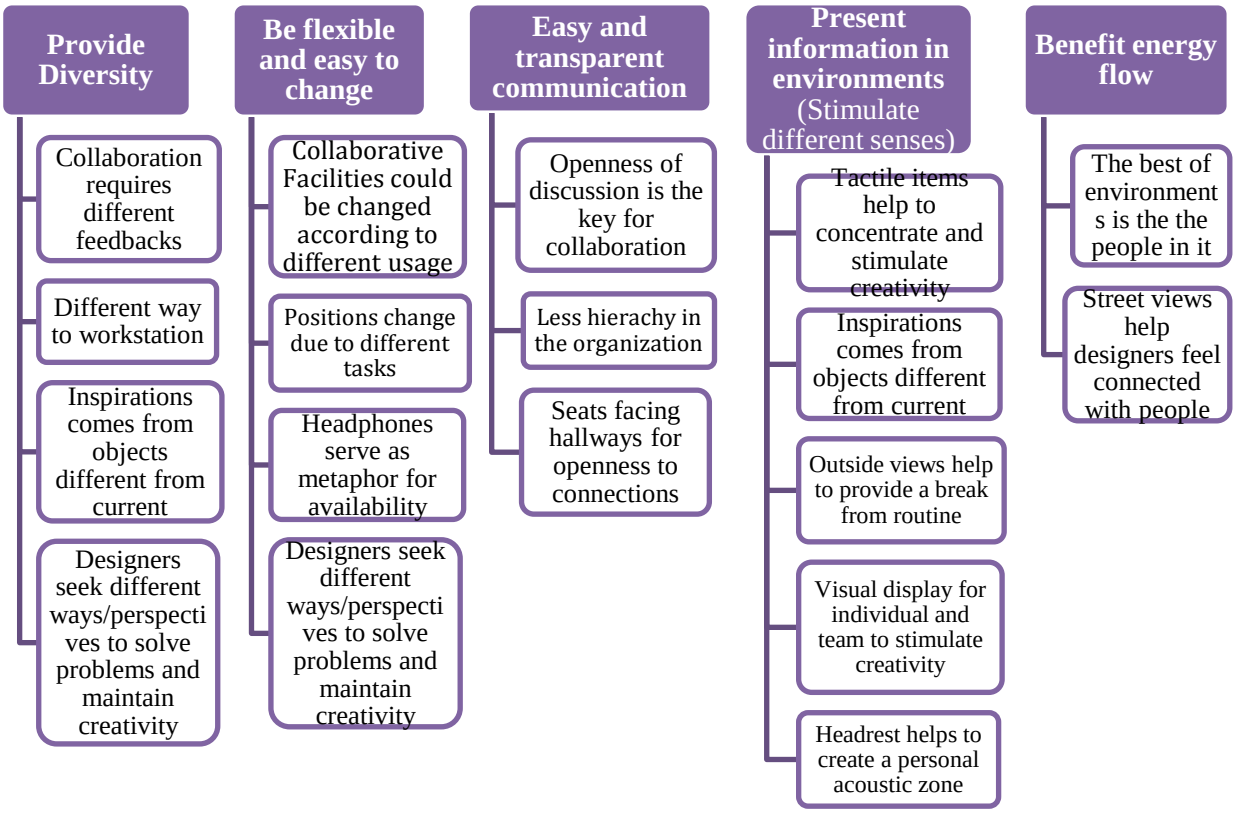

Chart 6 Verification of Five Hypotheses

Providing diversity has been emphasized in the research results in Chapter Three several times. Many designers believe creativity indicates jumping out of box, thinking differently, and resolving problems in a different way. It is the nature of design work that requires diversity.

Diversity covers a variety of aspects, including:

1) Collaborations anticipate different ideas bouncing from different backgrounds and perspectives.

2) Labyrinth system layout helps designers have different paths to walk around.

3) Inspirations come from looking into different objects other than current projects: visual/tactile stimuli, different art forms, outside views, etc.

4) Designers seek different ways to solve problems and maintain creativity.

Being flexible and keeping changing are also discussed a lot in the previous chapter. In general, keep changing means always looking for different things, which is the key for designers to inspire and maintain creativity. Here are some features that are mentioned in the research:

1) Facilities in team area are flexible to different layouts according to projects.
2) Designers change positions for different work (stool for drawing and discussion, chair for computer work).
3) Designers switch methods/perspective in order to solve problems/overcome obstacles.
4) Designers changes views frequently in intervals of daily routines as a means of refreshing minds.
5) Headset serves as a metaphor to change availability status.

Easy and transparent communication could be often seen in collaboration. Design firms have meetings when every team shares their progress on a regular base. Also, design firms seem to place less emphasis on hierarchy, which means vertically the whole organization is more flat (design director→ senior designer→ junior designer); thus, the same information needs fewer levels to pass through. Horizontally within the team, information is shared openly, usually shown on the white board or tackables in the team area. Also, designers tend to view ease of communication both verbally and visually as one of the most important characteristics; plus most of them are curious, and keen to learn new knowledge. All these factors contribute to the rich and openness of communication. Designers place their seats facing the hallway, which means they can jump in the conversation as they like.

Presenting information in the environment is mentioned frequently in last chapter. Different kinds of stimuli could be viewed as information presented in different environments. Based on the research, it could be also be viewed as:

1) Tactile items help designers to think.
2) Designers seek inspirations from other objects than current projects, such as art trends.
3) Outside views (both street view and nature scene) create an interval from routine.
4) Visual display for individual and team to stimulate creativity.
5) Designers create personal acoustic zones for contemplation.

Generally these features could be concluded as *stimulating different senses*, which is more accurate than just *presenting information in the environment*.

Benefiting energy flow means residents could have access to energy flow as their purpose. Designers think the best of their firm environments is the people in it. The energy flow is what excites designers most, which become their favorite part of the whole environment. Moreover, good collaboration work allows energy to flow fluidly. The openness to energy flow is one of the most important features to keep the whole organization in positive, productive working conditions. Some designers enjoy watching the street view could be viewed as enjoying the outside energy flow, in which they feel connected with the people in the street.

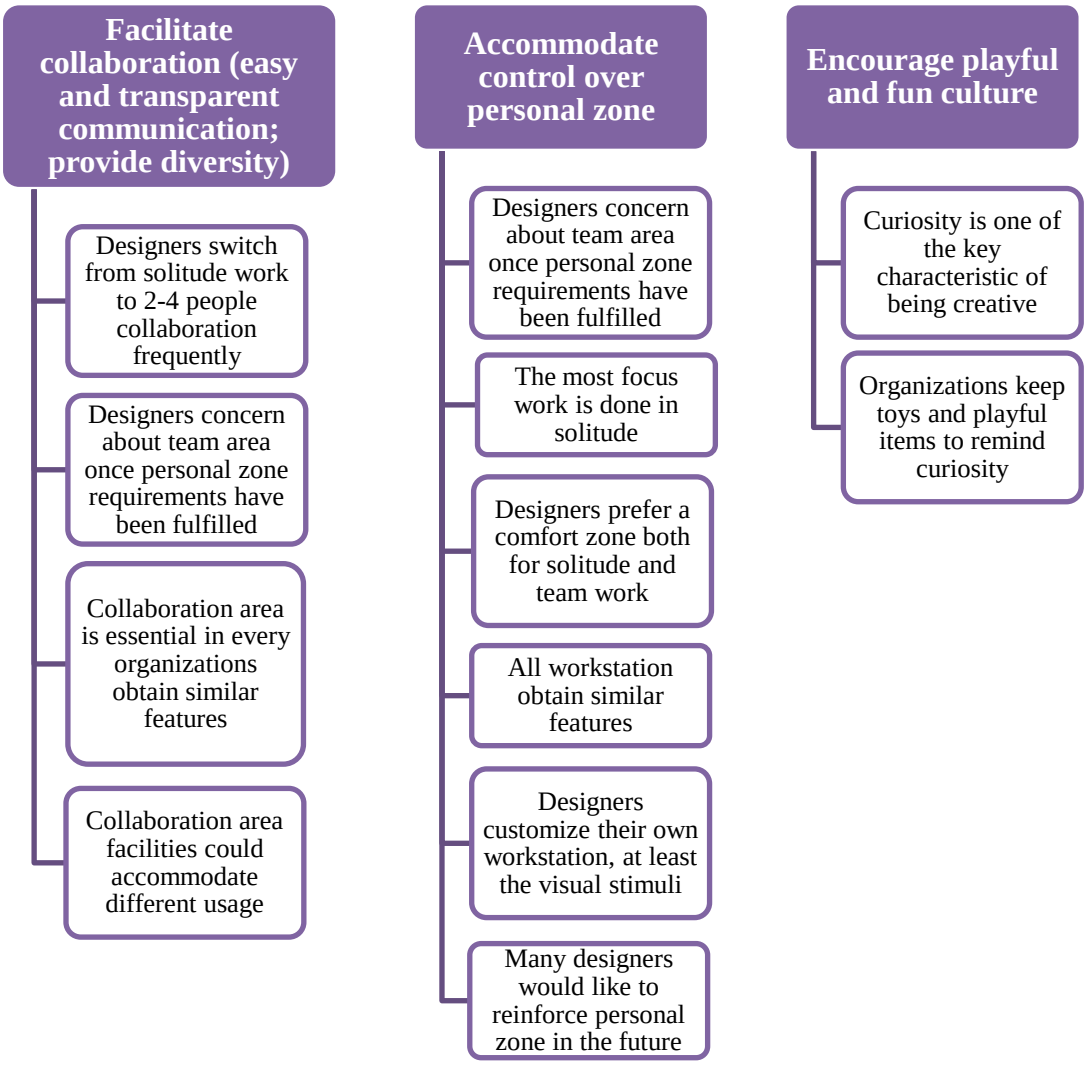

Chart 7 Verification of the New Findings

However, besides these five main values that help to facilitate creativity in designers' work place, there are also several values worth listing based on the research results in Chapter Three (see Chart 7).

First of all, the importance of collaboration assures *facilitating collaboration* needs to be the top choice. It is different from *providing diversity* or *easy and transparent communication*. Collaboration is a broader term, which could possibly cover part of meaning of *provide diversity* as well as other categories. As the literature review has pointed out, collaboration could

effectively stimulate and develop individual creativity, which can significantly enhance the cost effectiveness and quality of the project (Watson, 2007). Design work requires collaboration as its essential. Therefore *facilitating collaboration* need to be considered the foremost in the guidelines. As far as proving *facilitate collaboration*, research has shown the following:

1) Normally designers switch from working in solitude to working in two to four people teams on a daily basis for projects.
2) Many designers are inclined to consider methods of reinforcing the team area when their own personal workstation requirements have been fulfilled.
3) Every design organizations provide team areas for collaboration and design them deliberately with mobile furniture, visual display and good surroundings.

Secondly, apart from the apparent need of collaboration, designers also feel the requirement of *accommodating enough control over personal zone*. This mostly happens within personal workstations, where designers do most of their individual work.

Here are some proofs in Chapter Three that could indicate this value:

1) Many designers are inclined to consider reinforcing the team area as far as their own personal workstation requirements have been fulfilled.
2) Mostly contemplative work is done undisturbed within personal workstations.
3) Designers prefer personal workstations that could let them do both their solitary work and collaborate comfortably.
4) All workstations obtain big tables (for sketches), tools within hand reach, computers (many have two to three monitors), and customized visual stimuli.
5) Most designers customize their personal workstation, at least the visual stimuli.

6) Headsets help to create personal acoustic zone while also being used as metaphor for availability of collaboration.

Thirdly, *encouraging playful and fun culture* is also a new finding in Chapter Three. Curiosity has been proven to be one of the main characteristics that creative people have. Moreover, design organizations always try to install some elements that can encourage playfulness and fun in their work environments. Possessing a culture that is playful and fun would reduce the fear of constraints and help people feel more positive and more energized, therefore helping to set the creativity free.

4.2 Guidelines

In general, designers ask for diversity, and enjoy having fluid vigorous energy around. They want close connections to people, great stimuli for different senses, and a fun and playful environment. They embrace changes to keep their minds moving.

Below are the guidelines extracted from the above analysis. They can be categorized into two groups: organization guidelines and design guidelines. The former one incorporates general organizational environments; the latter one deals with specific physical environments. Design guidelines are built upon organizational guidelines, and can be viewed as an *execution* of organizational guidelines in the workplace.

As for organizational guidelines, to facilitate creativity in the office, the organization should be able to:

1) Facilitate collaboration

2) Stimulate different senses

3) Accommodate enough control over personal zone

4) Embrace changes

5) Encourage a playful and fun culture

6) Be beneficial to energy flows

7) Share a clear and achievable goal*[1]

8) Be properly rewarded*

9) Satisfy self-identity*

10) Guaranteed freedom*

As for design guidelines, based on the organization guidelines, the following features should help to facilitate creativity in the workplace:

For *facilitating collaboration*:

- Most collaboration happens between small groups of two to four people
- Large white board or tackable used for swarm information sharing
- Higher tables reduce the distance between people
- Decorate surroundings with stimuli
- Flexible furniture that is mobile and changable due to usage

For *stimulating different senses*:

- Highly customizable visual stimuli
- Tactile items on display
- Good outside view (nature scene/street view)

For *accommodating personal control*:

- Seats facing the hallway helps to keep privacy when required
- Big table for drawings

[1] * indicates hypothesis that has not been verified in the research but still requires concern.

- Tools within hand reach
- At least one monitor per person
- Personal sound barrier
- Highly customizable visual stimuli

For *embracing changes*:

- Easy change from stool to chair
- Flexible furniture that is mobile and changable due to usage

For *encouraging playful and fun culture*:

- Labyrinth layout of the systems
- Installing playful objects in the environments

For *fostering energy flow*:

- System furniture face the hallway
- Open view for the street

Also here are some miscellaneous features that could be beneficial:

- Headsets (mostly personal belongings) provide a personal acoustic zone while also serve as a metaphor for availability
- Storage for past projects/disassembled products

It may be noticed that there are several bullet points that are repeated more than one time; for instance, highly customizable visual stimuli showed up both in *accommodate control over personal zone* as well as *stimulate different senses*. This makes sense because for one phenomenon there may be more than one interpretation, which also means one guideline of the physical workplace could be effective in more than one organizational guideline feature.

The connection between facilities and design guidelines is shown more directly in Table 2, Matrix of Applied Facilities of Guidelines.

Table 2 Matrix of Applied Facilities and Design Guidelines

Facilities	Interpretation	Guidelines					
		Facilitate Collaboration	Stimulate Different Senses	Accommodate Control Over Personal Zone	Embrace Changes	Encourage Playful and Fun Culture	Be Beneficial to Energy Flow
Large white board or tackable in team area	Visual display for swarm information sharing	X	X				
Communication technology in team area	Facilitate communication	X					
Seat facing hallways	Provide subtle openness and privacy for solitude and collaborative work	X		X			X
Customizable personal workstation, at least visual stimuli	Reinforce control over personal zone, create own comfort area, and also stimulate visual senses		X	X	X		
Labyrinth layout	Different way to workstation create an interval from routine				X	X	
Higher table	Used for sketching and intimate conversation	X			X		
Outside view- street view	Help feeling connected to people, also be refreshing from routine		X		X		X

Facilities	Interpretation	Guidelines					
		Facilitate Collaboration	Stimulate Different Senses	Accommodate Control Over Personal Zone	Embrace Changes	Encourage Playful and Fun Culture	Be Beneficial to Energy Flow
Outside view- nature scene	Be refreshing from routine		X		X		
Tactile item around	Tactile stimuli helps to focus, also becomes an interval from routine		X		X	X	
Mobile and adjustable furniture in team area	Be able to accommodate different usage and arrange differently on needs	X			X		X
Personal comfort zone for solitude and collaborative work	Focus work need to be done undisturbed alone, while informal collaboration mostly happens within personal workstations	X		X			X
Toys and playful item around	Curiosity is important for creativity, playful item helps to remind curiosity and create a fun and relaxing air					X	
Headsets in personal workstation	As a metaphor for availability, also create a personal acoustic environment	X	X	X	X		
Switch from stool to chair	Different works ask for different positions, results in different perspectives				X		

Facilities	Interpretation	Guidelines					
		Facilitate Collaboration	Stimulate Different Senses	Accommodate Control Over Personal Zone	Embrace Changes	Encourage Playful and Fun Culture	Be Beneficial to Energy Flow
Big table, tools within hand, 1-2 monitors, storage, visual stimuli, comfortable chair for personal workstation	The design work pattern is defined by work requirement, so does the workplace design			X			
Table for 2-4 people conversation	Most collaborations happen among 2-4 people accompanied by physical items like papers or models	X					

Chapter Five: Design Application

This chapter applies the guidelines in previous chapters into a design process to design a set of office furniture that could facilitate creativity in designers' workplaces.

5.1 Furniture Design Development

5.1.1 Training table design

This idea begins with considering the importance of *facilitating collaboration* and *stimulating different senses*.

White boards are widely used as visual displays for sharing information during collaboration. They are also used as visual stimuli from time to time. Research showed that tackables are more welcomed than white boards. Designers use white boards as tackables to paste drawings. Moreover, it is noticed that almost all design organizations build their own white board or tackables because the ordinary white board settings are not large enough for swarm collaboration information sharing.

Therefore the basic idea forms as trying to build a bigger white board/tackable screen as shown in Figure 3. Then after some development, there is a thought: a white board as a flip training table. Training tables have been widely installed in offices. Their mobility and ease for storage have been their most recognized advantages. While flipped up, it becomes a typical vertical writing surface, the same as a white board. Thus, the white board/tackable design has been combined with the flip training table idea. The main surface is painted with white board paint, while in between the front surface and back surface there is a sandwiched tackable. The tackable can be pulled out and retreated using a detent mechanics (see Figure 4). The flip

mechanics are the same as most training tables on the market. The table leg could be a stationary T leg or C leg, and it also could change with casters for customization.

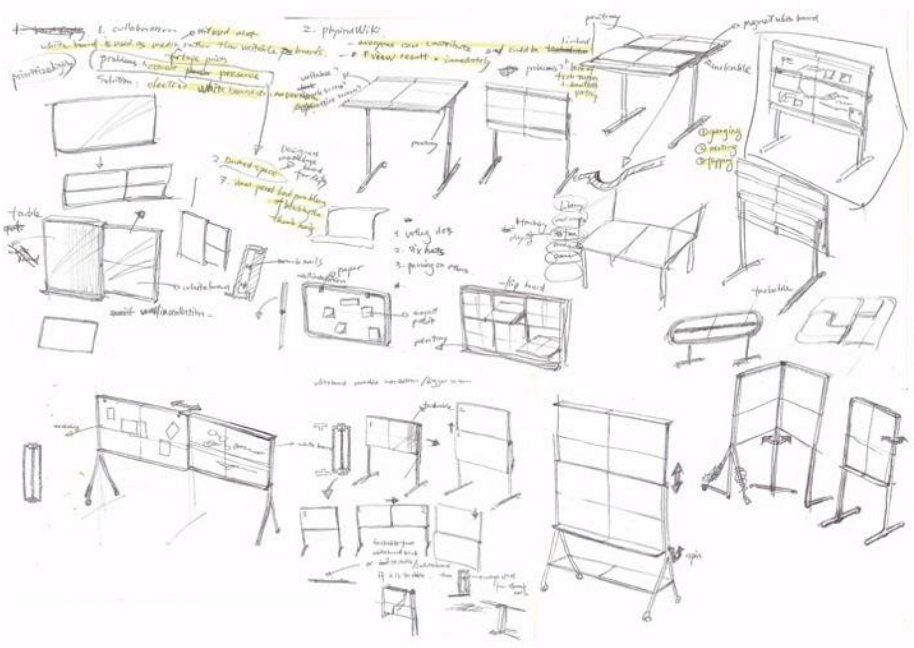

Figure 3 Sketch Development of White Board/Tackable

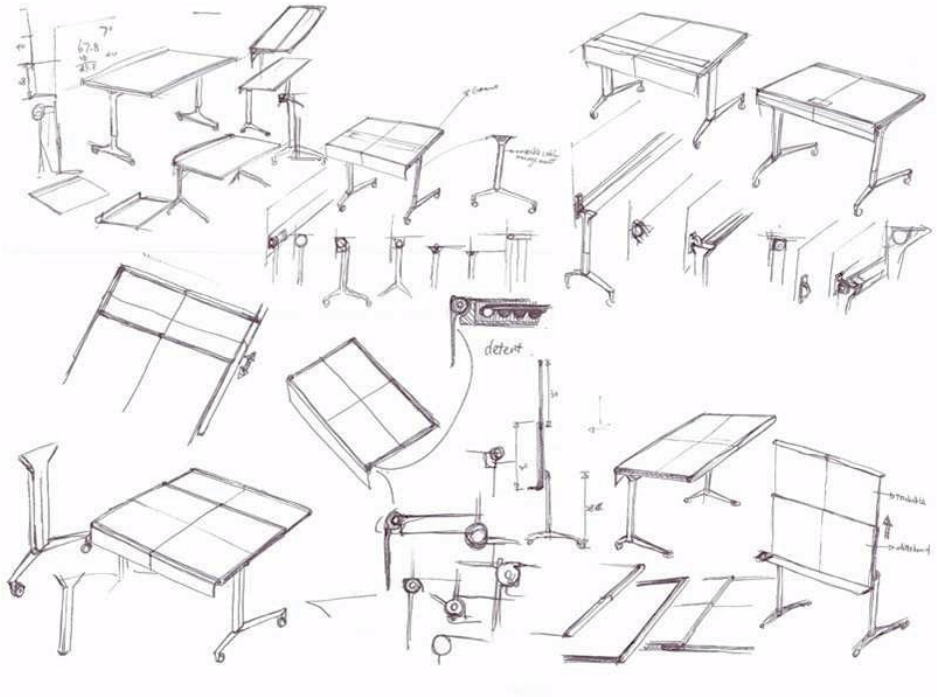

Figure 4 Sketch Development of Training Table

Figure 5 Rendering of Training Table

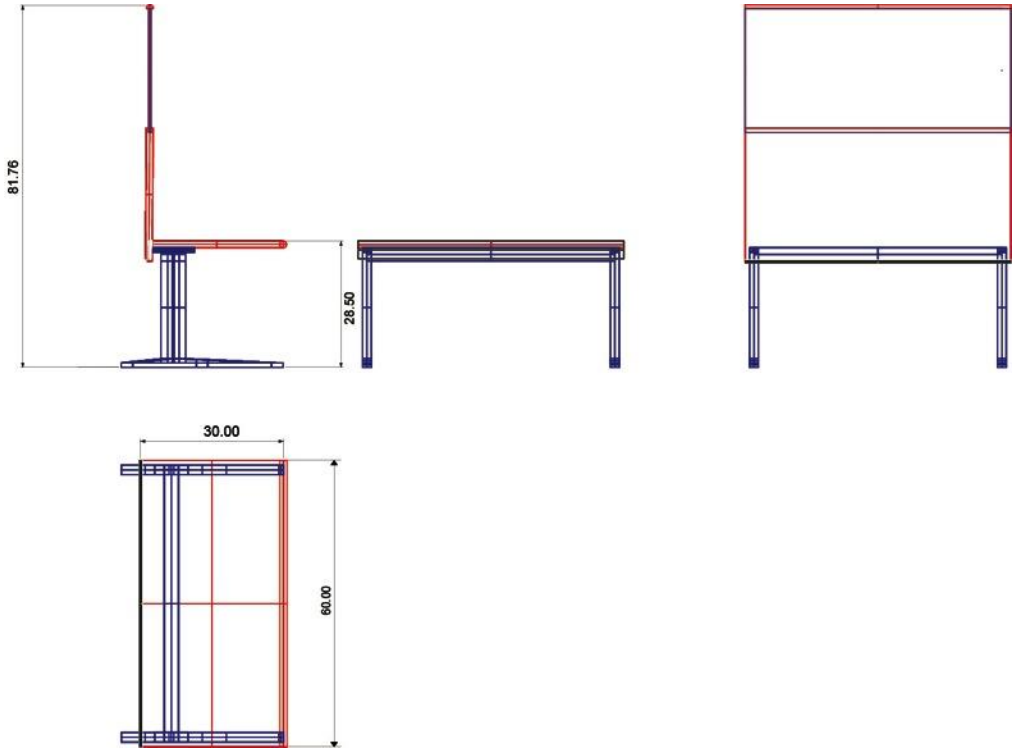

Figure 6 Dimensions of the Training Table

Figure 5 shows the rendering of the training table design. The modesty panel could be flipped horizontally while the table is flipped vertically to serve as a pen tray. When the table is kept horizontal, it will fall due to gravity. There would be power management hidden inside the legs as well as a pole if customer requires them.

Figure 6 displays the dimensions of this training table. Basically, the training table surface size varies from 20X40 inches to 48X96 inches on the market. The most common standard size is a rectangular 30X60 inches, which is the one shown in the figures. The height of surface is 28.5 inches, which is the standard table height. As part of the customization, the leg could be switched to height-adjustable leg if required. When the tackable is fully pulled out, the total height will be 81¾ inches, which is within the full arm length of the standing position of 95 percent of people.

5.1.2 Chair-stool design

This idea starts from the feature of *embracing change.* Changing seat height could easily change perception of environments. Also, designers switch their seats from stool to chair several times during work. Thus, the design begins with an idea that combines stool and chair together (see Figure 7).

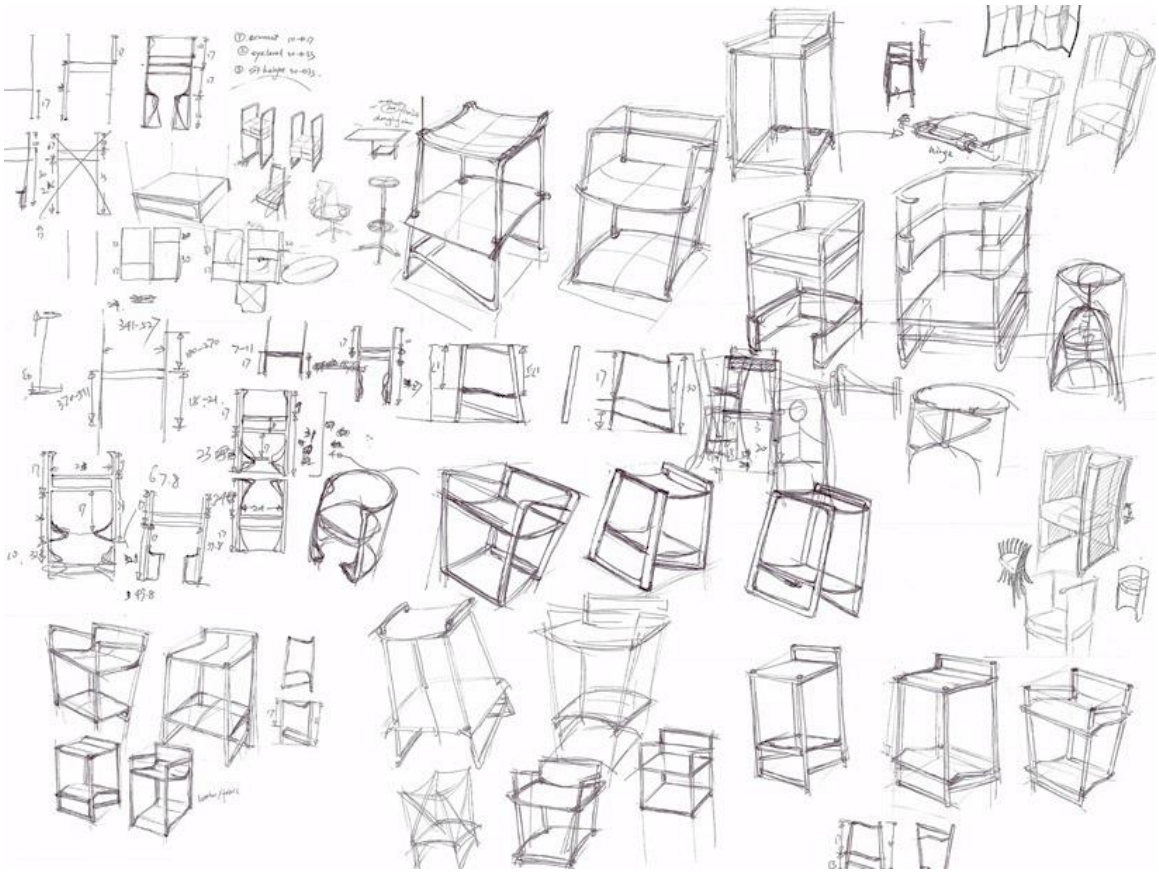

Figure 7 Sketches of Chair-Stool

The main thought is the chair-stool need to be intuitive to use; thus, no mechanics are involved in the design, only the form to indicate its convertibility. The final design can be seen in Figure 8.

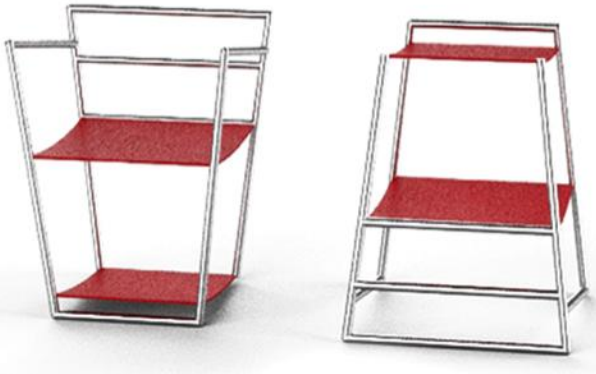

Figure 8 Rendering of Chair-Stool

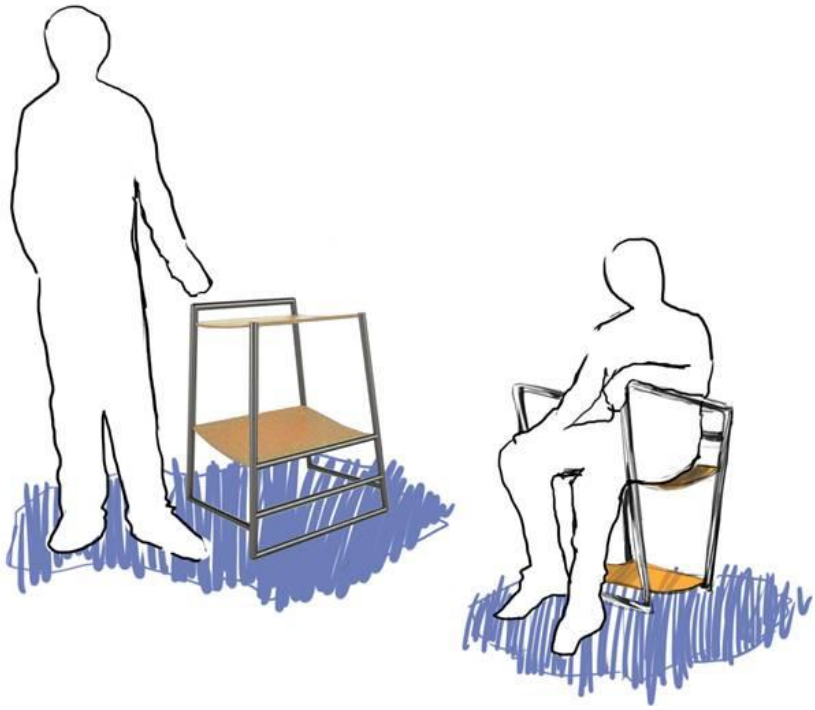

Figure 9 User Scenario of Final Design

The chair-stool is made of an aluminum frame and fabric seat pans. The seat pan could also be made of materials other than fabric, like leather or plywood. As a stool, there is a handle in the back to carry it around, as well as a foot stop on the front. As a chair, there are armrests for arms to lean on and a lumbar support to support the back. Figure 9 showed the user scenario as well as the proportions of the final design.

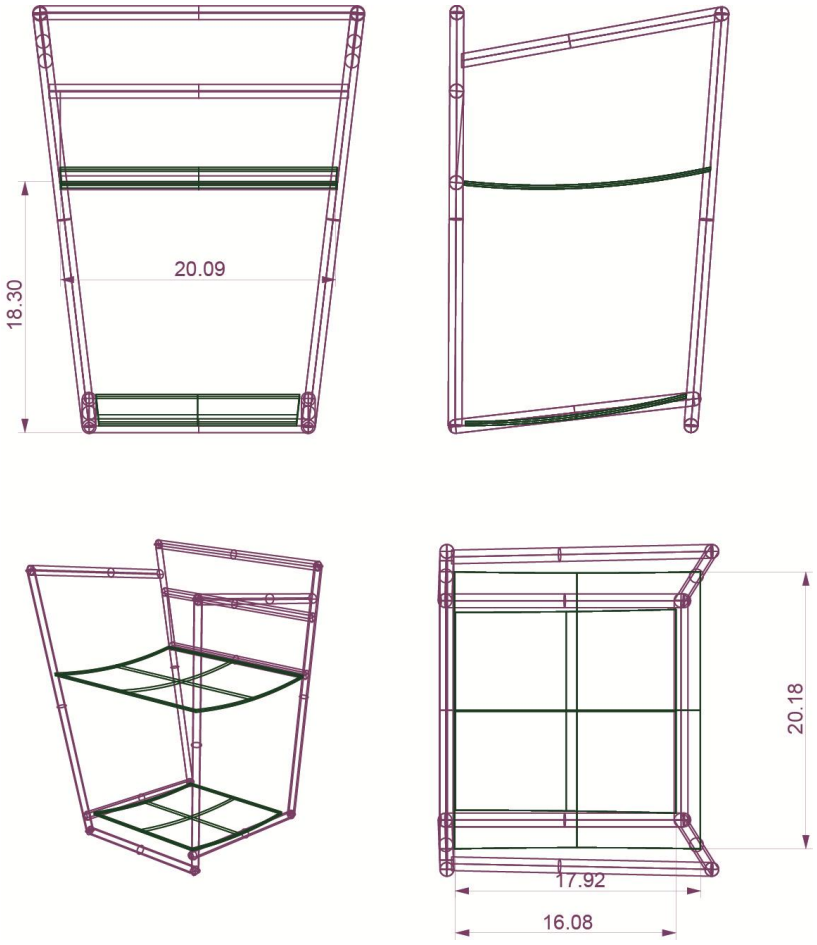

Figure 10 Dimensions of Chair-Stool

Figure 10 shows the dimensions of the chair-stool. The seat pan size of chair condition is 20X20 inches, and the seat pan size of stool condition is 16X18 inches, which are both comply with standards. The stool seat height is 30 inches; the chair seat height is 18 inches.

5.1.3 Swivel table design

This idea started from *encouraging playful and fun culture*. The gist of *encouraging playful and fun* is not designing toys, but helping people engage in interaction with others. Therefore, designing something playful that also could help with *facilitating collaboration* is the main concern of this design. With something that could encourage playfulness and fun, people

will be more willing to participate in collaboration. As the research has found out, most collaboration happens between two to four people. The most frequent tools they use are merely paper and pen; thus, small collaboration does not require a big tabletop like a conference table. The first idea comes out as a table that has three levels: bar-height, table-height and coffee table height. It has been mentioned prior that a higher table brings people closer. The sketch development can be seen in Figure 11.

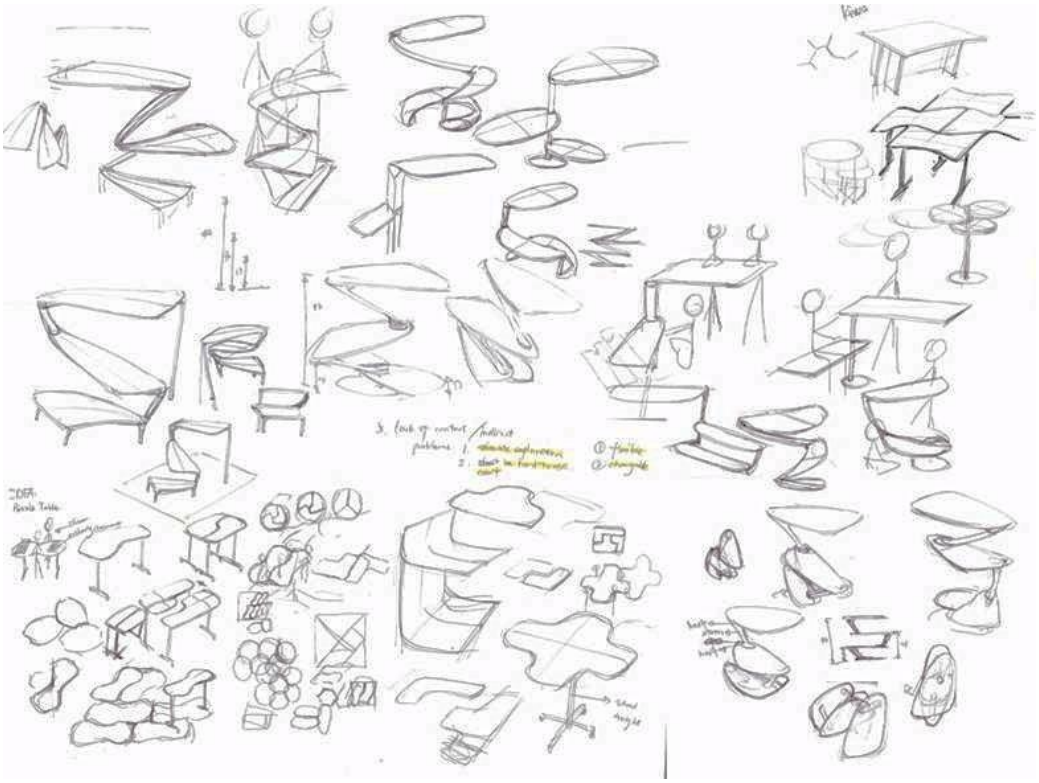

Figure 11 Sketches of Swivel Table

Figure 12 Rendering of Swivel Table

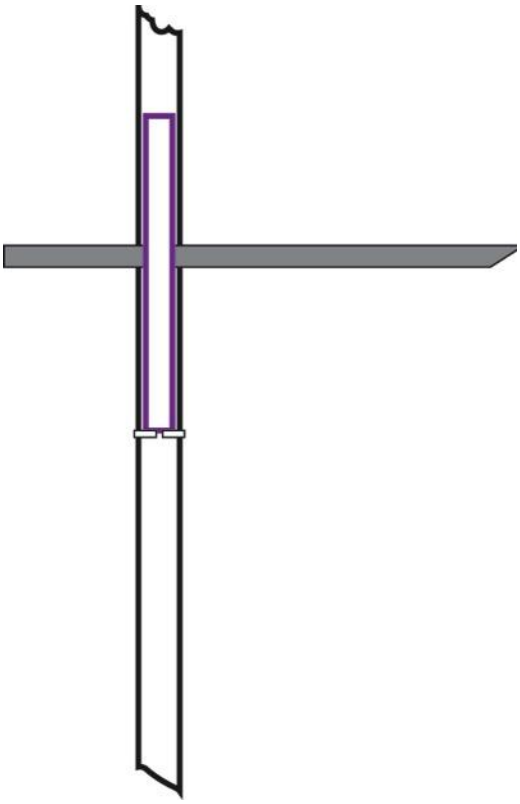

Figure 13 Axle Pole of Swivel Table

Figure 14 User Scenario of Swivel Table

Figure 12 shows the final design of the swivel table. The top two levels have three legs; thus the bottom two levels could be retrieved from under the above levels. Figure 13 shows the axle pole that is rotatable and supportive for both top and bottom level surfaces. Figure 14 shows the user scenario of this design. Because the three surfaces can spin in one direction for 180 degrees, a variety of user scenarios can be produced. The bottom surface could be used for sitting, as well as a coffee table; the middle surface could be used for regular table, as well as a stool; the top surface could be used for a bar-height table. All three surfaces are rotatable and mobile; thus, all three could spin accordingly, in some way creating a zone of playfulness and fun. Moreover, this design is suitable for the demand of high flexibility of a collaboration area.

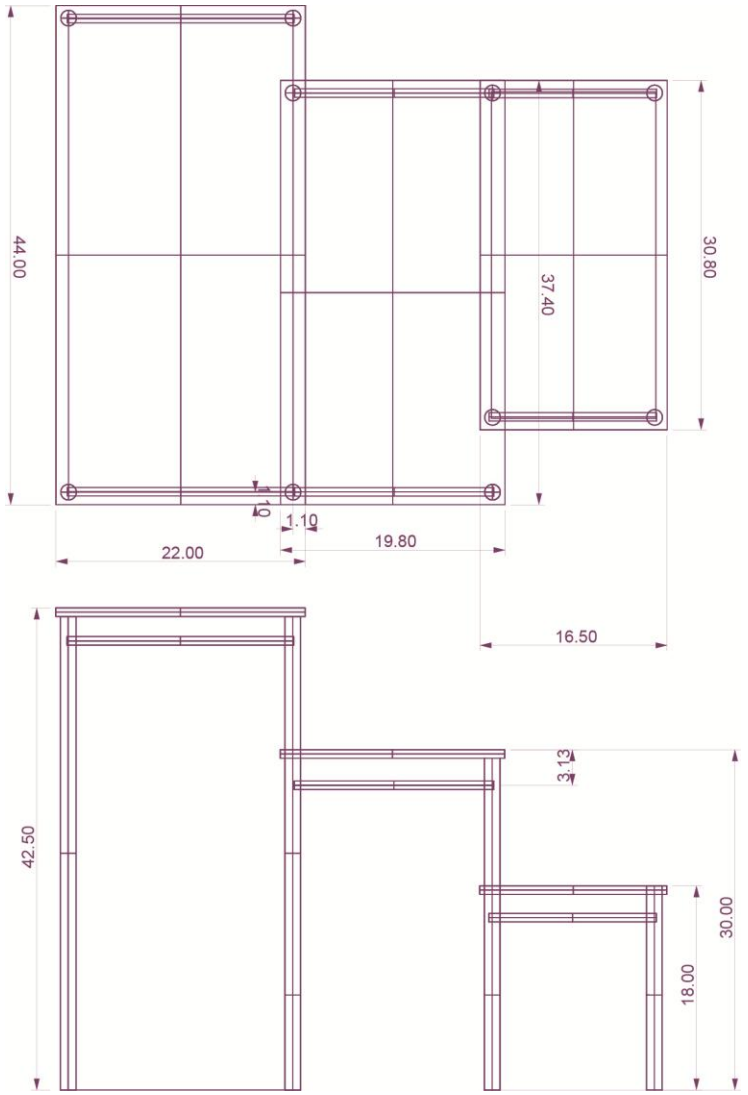

Figure 15 Dimensions of Swivel Table

Figure 15 shows the dimensions of the swivel table. The table top is 20X44 inches, which is smaller than a standard table but enough for collaboration of fewer than four people. The bottom level height is 17 inches, which is the standard seat height as well as the coffee table height. The middle level height is 30 inches, which is the standard table height as well as the stool height. The top level height is 42 inches, which is the standard bar height.

5.1.4 Acoustic screen design

This design idea is generated from the features of *generating control over personal zone* as well as *stimulating senses*.

Screens have become more and more popular in today's office environments. They are very helpful to separate spaces, creating barriers but not blocking the air. They can be used for a separate personal zone while not being too rigid, which would possibly impair energy flow. Screens also have been frequently used for stimulating senses. Imbued with certain textures and colors, the screen likewise could become a fairly conspicuous tactile—visual stimuli. During development of a screen, the author considered adding an acoustic sense into the ordinary visually stimulated screen as well, so that it could have three senses of stimuli. The development can be seen in Figure 16.

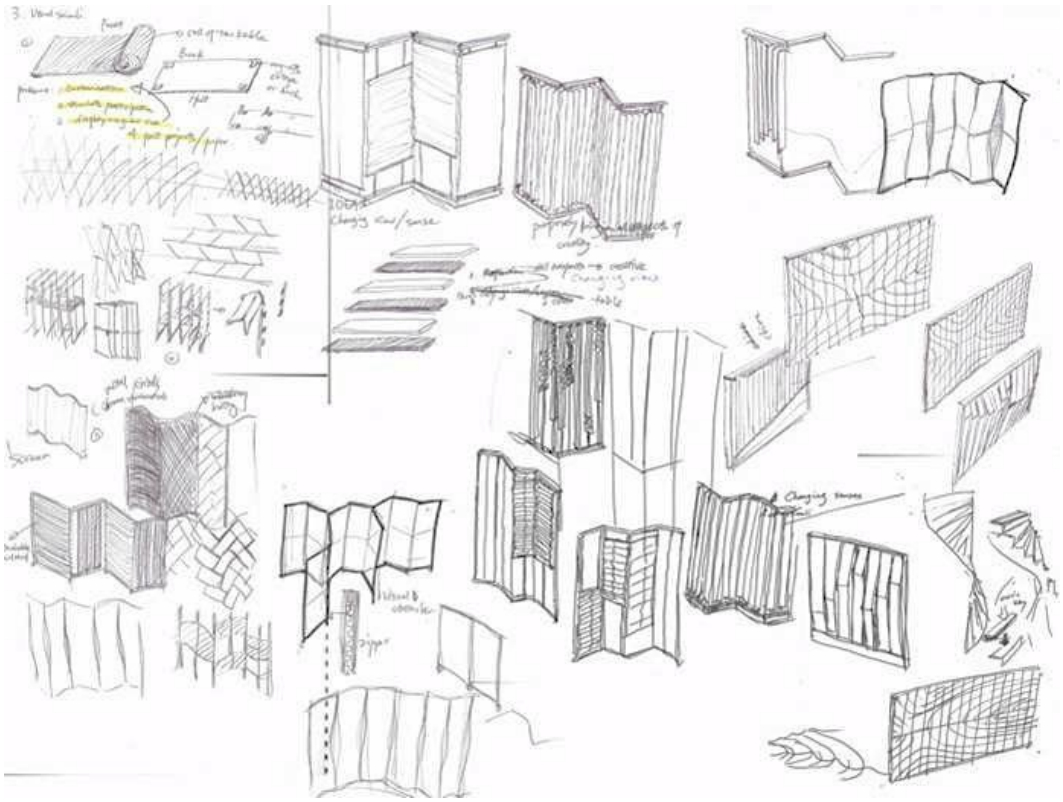

Figure 16 Sketches of Acoustic Screen

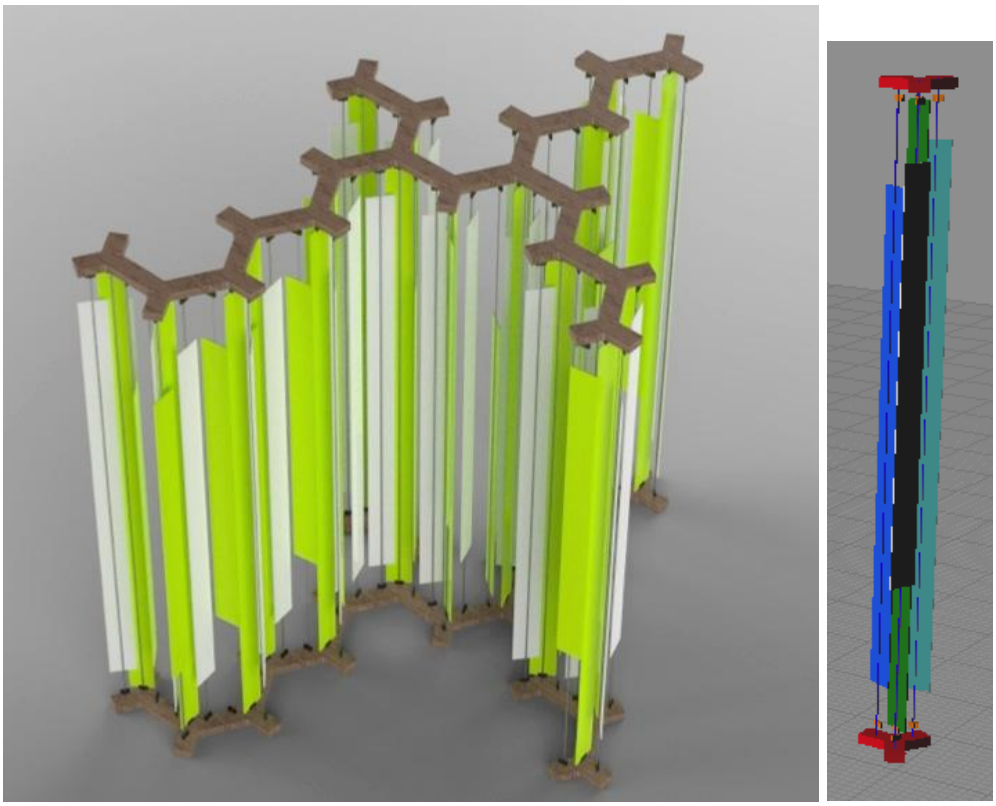

Figure 17 Rendering of Acoustic Screen

Figure 17 shows the final design of the acoustic screen. The right figure indicates the screen is constituted of various amounts of the same module. The module has three extensions from the pole; each extension has a string attached; each extension can be connected to another module, and therefore extended into three directions and be highly customizable to create patterns as required. In the center of the pole, there is another string; all four strings have a resin plastic pad attached. These four resin plastic pads are all different lengths and thicknesses; thus when colliding with each other, they could make different sound keys. In this way, the screen not only provides visual stimuli, but also tactile and acoustic stimuli. When someone passes by, he or she can use fingers to flip the pads, making sounds as he or she likes. It also *encourages playful and fun culture* by the relaxing way of playing sounds from it.

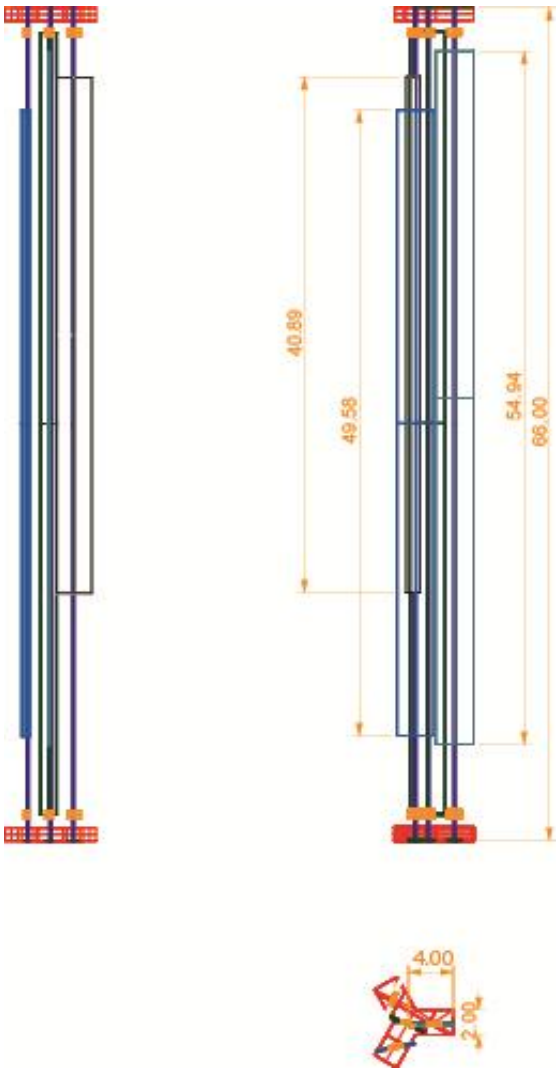

Figure 18 Dimensions of Acoustic Screen

The dimensions of this design can be seen in Figure 18. The dimension from one extension to the pole is 4 inches, and the total height of the screen is 66 inches, which is the common height of screen products on the market.

5.1.5 Storage-display design

Storage is an essential part of office furniture design. Normal storage is just cabinets, drawers and file folders, which generally cannot contribute to facilitating creativity. The nature of storage is to store items that are not being used at the present. However, if we could

reintroduce into storage something new and innovative, playful and fun, it could also be part of the creative office. Thus, this design tries to apply into the traditonal storage form the design guidelines *facilitate collaboration, stimulate senses, embrace changes and encourage playful and fun.* Figure 19 shows some design development of the design process.

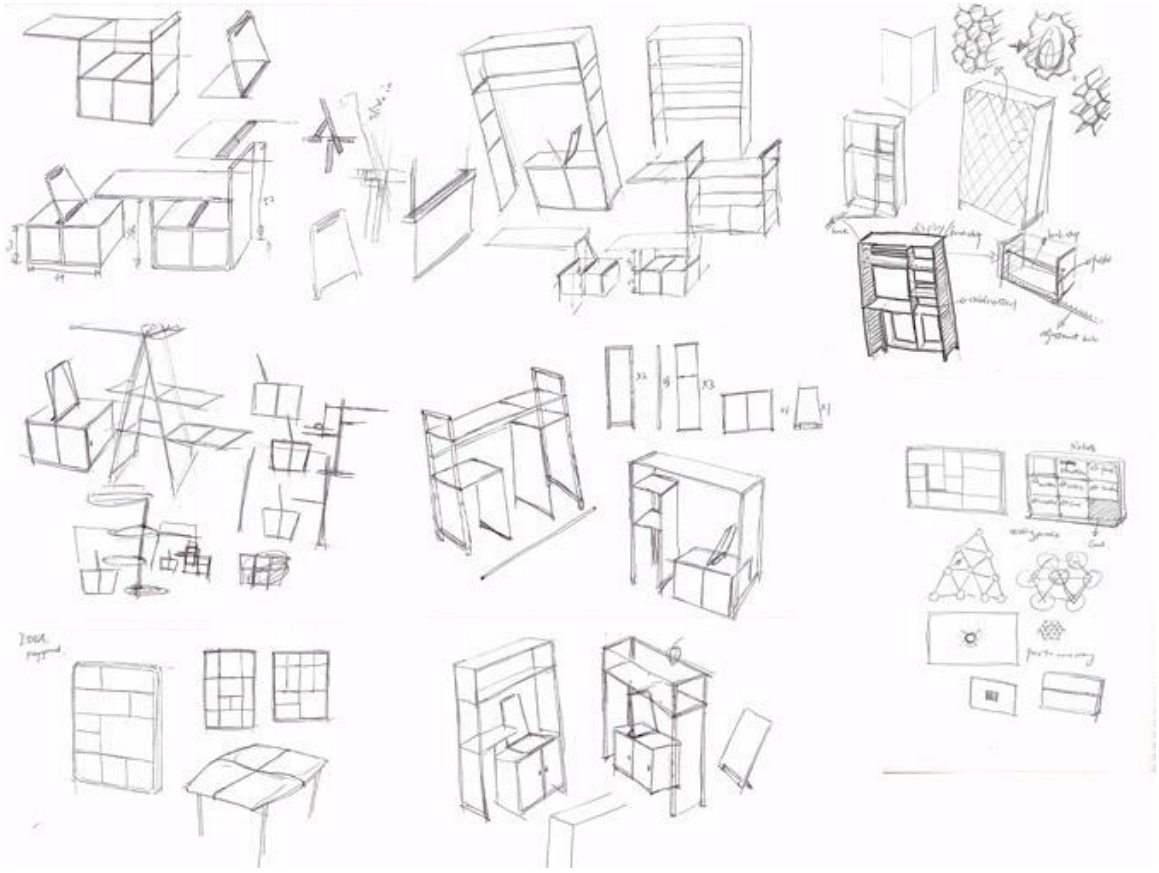

Figure 19 Sketches of Storage-Display

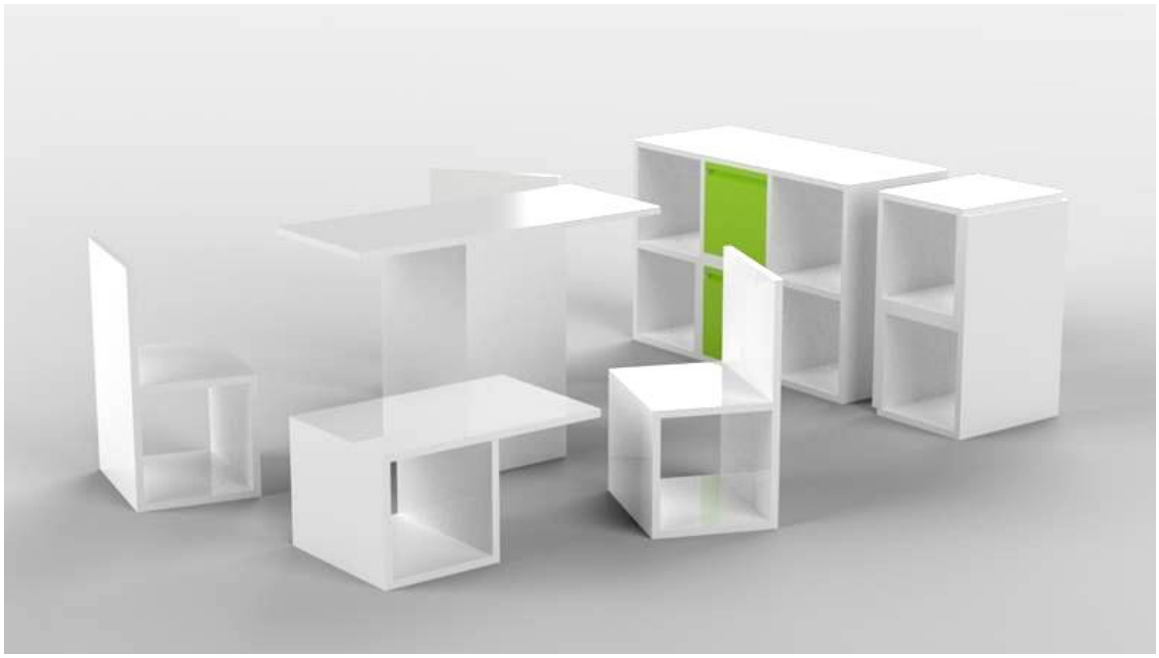

Figure 20 Rendering of Storage –Display

Figure 20 shows the rendering of the final design. The storage has become a convertible storage—collaborative zone. The chairs can slide under the table and change into a display. The table itself contains two drawers that can store files. And when the chairs have been slid in, it will become a display for storing objects like past projects or decorations. When the chairs are slid out, the set could become a collaborative zone, with two chairs and a long table. Also the chairs could be flipped down and serve as a coffee table, or two chairs stacked together into a two grids' display. There are various conditions to play with the sets; thus, it fully embraces the guidelines.

Figure 21 shows the dimensions. The chairs have a seat pan of 20(W)X16(H)X16(L), and a back height of 14 inches. The table has a height of 32 inches, 48 inches length and 20 inches width. The chair seat is slightly lower than standard; other dimensions all fall within standards.

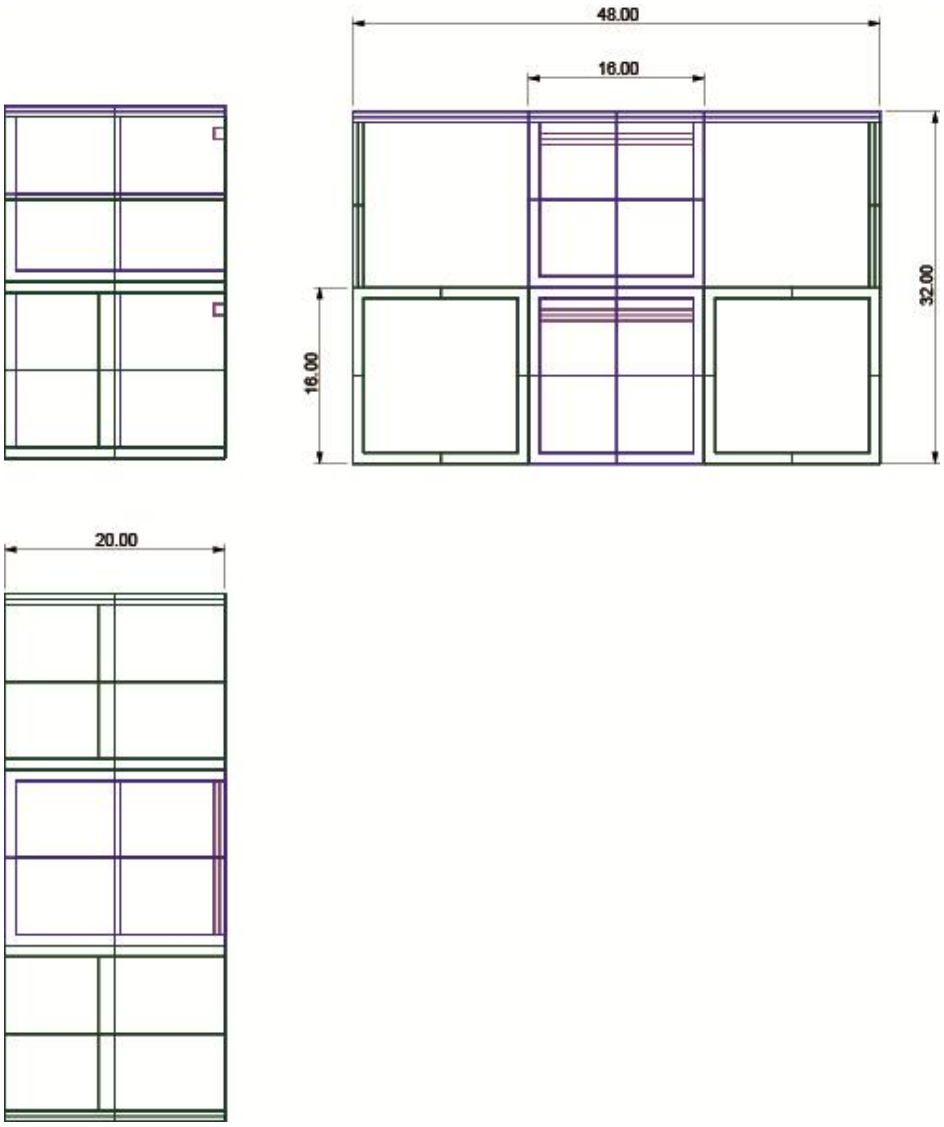

Figure 21 Dimensions of Storage-Display

5.2 Layout Scenario Configuration

To achieve the goal of creating an office suitable for designers as well as facilitating their creativity, only introducing furniture is not enough. For instance, one of the guidelines—*being beneficial to energy flow*—could not be shown in furniture products, but only in office layout configurations.

According to the guidelines, for fostering energy flow, one of the main points is the orientation of the personal workstation. It should be open to the hallway, so designers can jump into conversations as they like.

Moreover, while designing the layout of the floor plan, all of the guidelines need to be taken under consideration, since the configuration arrangement is the vital element of determining people's interaction with the furniture: the route they walk, the place they go to collaborate, the area they rest. All those should be considered prior to setting up the floor plan. Also, because of the various physical conditions and different purposes of the workplace and company issues, there is no perfect answer for all. The followings demonstrate some examples of layout configuration using the designed furniture. They assume different objectives; thus, the results vary.

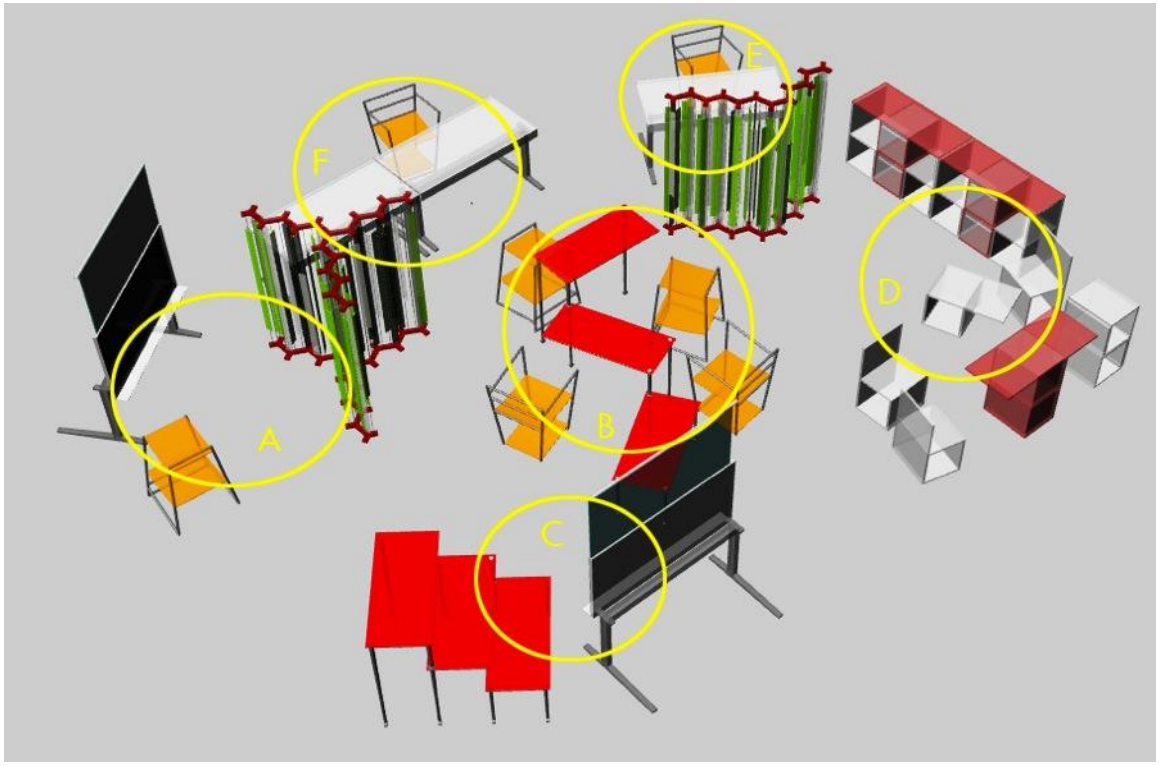

Figure 22 Layout Configuration 1

Figure 22 showed one example of a layout configuration. This layout emphasizes casual collaboration and open planning. Area A, B and D are all designed for collaboration. Area A has been separated from the workstations by ascreen. It also has a white board and tackables for sharing information. Area B is more casual. It has a swivel table for different usages. It could be used for coffee breaks, drawing, casual meetings, etc. Area D is in the back corner, close to the storage. It is also a casual place to meet. While someone is picking up files, he or she can sit on the chairs close by to chat. Also, the storage nearby could be used for displaying physical models. People could walk around to touch and talk about them. Area C is used as visual stimuli as well as an information center; the table nearby could be generally used for all purposes. Area E and F are two personal workstations that have been divided by the screen. The workstations are facing the collaboration area.

Figure 23 Layout Configuration 2

Figure 23 shows another example of a layout configuration. This layout focuses on an organized team workspace. Six personal workstations are in tandem together (Area A) to set up a

team workstation. Those tables could also be used as meeting tables. Around the tables, there are two flipped training tables serving as an information center as well as visual stimuli. Storage containers are lined up in the back both for keeping files and displaying objects. Area C is used as a relaxation area with the multi-usage table. The screen separates the whole workplace from other floor plans in the office.

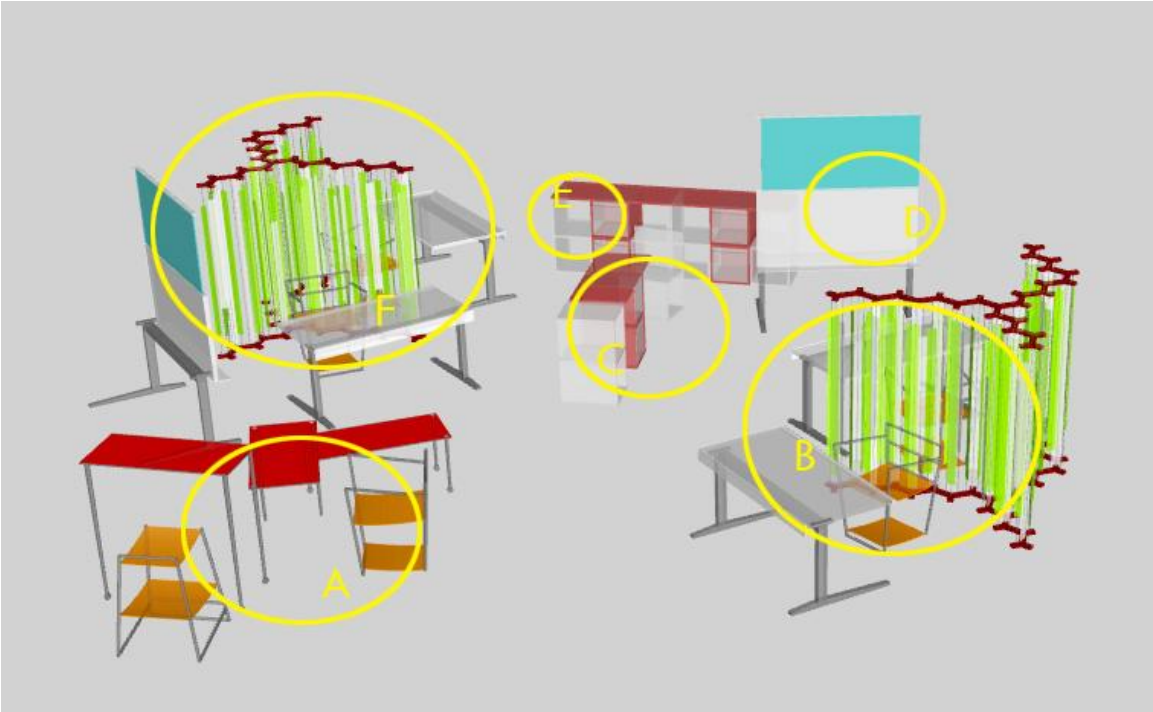

Figure 24 Layout Configuration 3

Figure 24 shows a workplace highlighting the personal workstation. The screens divide four personal workstations as indicated in Area B and Area F. In between those workstations, the storage serves as a casual place for short conversation with chairs that are easy to pull out (Area C). Other storages are installed in the back corner (Area E). The white board/tackable in Area D is used as a personal information center and visual stimulus for employees in Area B. So does the white board in Area F. Area A keeps the multi-purpose table for casual conversation.

These three examples try to apply the design guidelines in layout configurations with different emphases. Figure 22 emphasizes *facilitating collaboration* and *encouraging playful and fun culture*; Figure 23 emphasizes *facilitating collaboration, stimulating visual senses* stressing organized team workplace; Figure 24 emphasizes *accommodating enough control over personal zone* and *stimulating different senses*. While all three hold enough flexibility to *embrace changes*, they are also designed to *be beneficial to energy flow* by placing the furniture in certain orientations.

Chapter Six: Conclusion

6.1 Conclusion of Thesis

The intention of this thesis is to develop a set of guidelines for designers to use when they are designing workplaces for industrial designers. The main purpose of the thesis is to help designers understand better about the creativity in workplace and how they can design a workplace that could facilitate employees' creativity based on the guidelines.

The guidelines were formed by a combination of an analysis on secondary research of cognitive science documents and a synthesis work of research composed of qualitative interviews and observation shadowing. The guidelines can be categorized into two parts: organizational guidelines and design guidelines. The latter is built upon the former and can be viewed as an execution of the former in physical environments. There are total of ten features listed for the guidelines.

Later, the author applies the guidelines by designing a set of office furniture. There are five pieces in the set, serving different usages under different guidelines. Moreover, the layout configurations of the sets vary due to different purposes as shown in the later phase. The layout configurations also followed the developed guidelines to facilitate creativity. Those designs are not the only answer for the guidelines, but a demonstration of application.

6.2 Next Step

The guidelines were intended to help with designing industrial design offices; however, part of them would probably be worth applying to a wider scale, like corporate offices, since the

core idea of this thesis is creativity, which is universally important in all organizations. And some features from the guidelines, like *facilitating collaboration* and *being beneficial to energy flow*, are generally recognized in most organizations as well. It may be worth exploring more on larger scale subjects. Moreover, if the furniture designed in this thesis could be applied in real work environments, it will be good to gather another round of research to verify results.

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Appendices

Figure 25 Flip Training Table Scale Model (1:8)

Figure 26 Flip Training Table Scale Model (1:8)

Figure 27 Convertible Chair-Stool Scale Model (1:8)

Figure 28 Convertible Chair-Stool Scale Model (1:8)

Figure 29 Spin Tri-Table Scale Model (1:8)

Figure 30 Spin Tri-Table Scale Model (1:8)

Figure 31 Acoustic Screen Scale Model (1:8)

Figure 32 Acoustic Screen Scale Model (1:8)

Figure 33 Display Storage Scale Model (1:8)

Figure 34 Display Storage Scale Model (1:8)

Figure 35 Spin Tri-Table and Convertible Chair-Stool Configuration

Figure 36 Training Table, Chair-Stool and Screen Configuration

Figure 37 Training Table and Chair-Stool Configuration

Figure 38 Display Storage, Chair- Stool and Training Table Configuration

Figure 39 The Whole Set Configuration

Figure 40 The Whole Set Configuration

Figure 41 The Whole Set Configuration

Figure 42 The Whole Set Configuration