Creating a Profound Sense of Comfort to Stimulate Workers' Innovation and Productivity: Exploring Research and Case Study Applications

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Abstract—Purpose: The aim of this research is to explore and discuss innovation-workspaces, and how the design of the workspace has the potential to boost the work process and encourage employees' satisfaction, leading to inventive and creative results. Background: The relationship between the workers and the work environment has a strong potential to enhance work outcomes when optimized for work goals. Innovation-work environment can benefit employees' satisfaction, health, and performance. To understand this complex relationship, this research explores innovation-work environments. Methods: A review of 26 peer-reviewed articles, seven books, and 23 companies' websites was conducted; in addition, five case studies were analyzed to deduce appropriate examples for the study. Results: The research found all successful five innovation environments focused on two aspects: first, workers' satisfaction and comfort, which includes a focus on physical, functional, and psychological comfort; second aspect, all five centers were diverse work environments that addressed workers' needs, design for individuals and teamwork, design for workers' freedom, and design for increasing interaction. Conclusion: understanding individuals' needs and creating work environments that enhance interaction between workers and with the space are key aspects of successful innovation-work environments.

Keywords—Innovation-workspace, productivity, work environment, workers' satisfaction.

I. INTRODUCTION

THE goal of innovation-workplaces is to encourage workers to break the boundaries of what is expected of them to find unconventional and new solutions. Innovation-environments help reduce habits of absenteeism and the number of workers leaving early or taking long lunch breaks. As a result, employees become more active and perform more effectively [1].

Innovation-workspaces concentrate on optimizing the physical work environment to satisfy workers, increase productivity outcomes, and bring new products to the market. Physical work environments affect workers' health and performance. As such, workspaces should support workers'

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The author would like to acknowledge the Saudi Ministry of Higher Education and express her sincere appreciation that funding her stay there.

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mental and physical health [2]. To create a successful work environment, designers must understand the nature of workers' interactions with their environment, workers' needs, and effective methods of encouraging better work results. Understanding the various personal needs of each worker (as affected by interests, personality, motivation observation, and knowledge) is necessary to customizing ideal workspaces.

II. BACKGROUND

"Innovation spaces offer important insights for a large […] body of thinkers and leaders aimed to strengthen local competitiveness" [3, p.6]. A competitive spirit between organizations encourages businesses to design innovation-work environments. When innovation is the primary goal at work, workers can demonstrate to potential customers and colleagues how to come up with new and creative ideas. Moreover, innovation-workspaces are essential for promoting healthy competition, consumer diversity, and the use of new technologies.

Innovation and creativity are key to any business's success. Designing innovation spaces is thus an important tool to strategically plan for product development and enhance productivity [1].

Research has shown that the physical work environment has a substantial effect on employees' health, behavior, perception, and productivity. To stand out in the competitive business atmosphere, companies need to design a healthy workplace to satisfy their employees and increase their productivity and health, mainly when 90% of the business economy relies on workers. Office layout, ventilation, lighting, furnishing, color, interior plants, and views are vital factors that influence employees' wellbeing and performance. In addition to creating a healthy workplace, these aspects also affect innovation.

The physical workplace environment is developed based on the needs of an employee's personal productivity to come up with great ideas. Workers who are content with their physical workstations tend to experience higher productivity [4]. They build social lives at work for connections, work overtime, and eat or sleep at work if they are needed. The physical workplace should enhance workers' satisfaction and feelings and help workers experience a sense of ownership where they feel belonging, which also increases workers' productivity [5]. Globalization and merging cultures diversify the workers, which also creates a sense of comfort and desire for innovation. In addition, workers need more freedom of accessibility and choice of either working in group spaces or

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individual spaces to encourage independence.

Creating a higher-performance work environment requires an understanding of how the workplace impacts users' morale, behavior, and integration into community - which are vital in improving the users' outcomes. Reference [6] indicated that Gensler stated "improving the workplace environment would increase 19% of employees' productivity and their productivity by 17%". This improvement will have a direct effect on the economy of the industries. Gensler followed up on this study and surveyed 2,000 workers at an office in the United States and found that for 90% of the surveyed users, having a better workplace design and layout resulted in healthier and stronger work performance.

III. METHOD

Using a qualitative approach to analyze multiple case studies, the paper relies on the methodological paradigm of personality and motivation theories. This method was used to investigate workers' needs and how different existing innovation work environments have achieved these needs. The study examines five critical research and development campuses that are successful in their field: the Novartis Basel Campus in Switzerland; Googleplex (Google's Corporate Headquarters) in Mountain View, CA, U.S.; Bosch (Research and Advanced Engineering Building) in Stuttgart, Germany; 3Mers (Research & Development Building) in Minnesota, U.S.; and the Ri.MED Biomedical Research and Biotechnology Center (BRBC) in Palermo, Italy.

A. The Research Questions

- How are workers affected by their work environments?
- How can businesses design their work environments for innovation?

B. Personality Theory

To serve workers' needs, it is important to understand the science behind human behavior and mental processes such as perception, cognition, emotion, motivation, and personality. In 1967, Eysenck classified people as either "introverts or extroverts" as a core personality theory [5]. Introverts usually need time to recharge socially, and sometimes prefer focusing on a single task alone, whereas extroverts do not get as much work done alone, and instead prefer social gatherings. This theory shows that people with different personalities can suit different work activities, as some prefer to work alone while others prefer to work as a team with their coworkers. Most people are a mix of introvert and extrovert characteristics; their individual preferences for certain work environment depend on other aspects such as their mood and types of activities (Fig. 1).

As shown in Fig. 1, workers differ in their needs, and as such, work environments need to be varied to achieve most needs for better indoor interaction and increase innovation and productivity.

C. Motivation Theory

The essential theory of human motivation is the "fundamental theory" developed by Yerkes and Dodson in 1908. It proposes that there is an "inverted U-shape relationship between a person's performance and their level of arousal i.e. excitement or interest" [5] , meaning that people perform better when they are motivated, but too much stimulation can reduce performance and cause stress. Thus, to maximize workers' satisfaction and increase performance, work environments should have limited and deliberate stimulation.
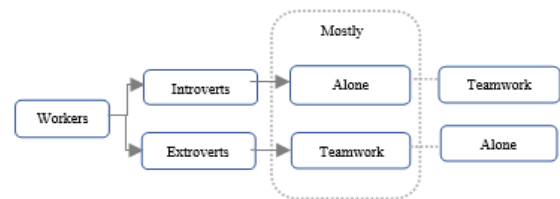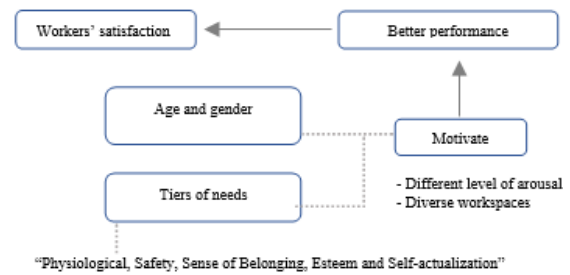

Fig. 1 Personality Theory

Fig. 2 Motivation Theory

Evidence indicates that complex tasks or working under pressure increase the level of arousal; workers need subdued environments to maximize performance. However, repetitive work and menial tasks necessitate more motivating environments to increase arousal [5]. Stimulating workplaces include visuals such as bright colors or sounds such as music or white noise which enhance extroverted workers or workers with simple tasks. On the other hand, calming workplaces are useful for introverts and workers with complex tasks. Thus, it is easier to design for workers who have similar demeanors or tasks, but it becomes more difficult when a space must be designed for both introverts and extroverts working together (Fig. 2).

As shown in Fig. 2, individual workers have different motivators that affect their work achievements and satisfactions. Workplaces need diversity to promote all users' motivations to ensure better satisfaction and performance.

IV. RESULT

The design of work environments has a substantial effect on workers' feelings of belonging, productivity, and satisfaction. All five research and development centers aim to increase innovation, productivity, and competition among their employees. They all give their workers a variety of options and the freedom to choose how they work best. Overall, all

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five of the centers presented are good examples of physical workplaces that increase innovation and creativity. All companies studied provide an environment for wellbeing with human-centered amenities such as flexible workspaces, meeting rooms, break areas, kitchenettes, coffee areas, restaurants, relaxation areas, quiet zones, medical offices, and outside seating areas. These strategies keep workers on campus during their workday. However, each center has a different approach to make them stand out in their field.

The analysis of the five case studies shows the similarity-characteristics of innovation-work environments among those five fields as well as the unique aspects that make them stand out in their industries. The research found that all five innovation environments focused on two aspects: first, workers' satisfaction and comfort which includes physical, functional, and psychological comfort; and second, design for workers' needs, design for individuals and team, design for freedom, and design for increasing interaction.

First: Satisfaction and Comfort

In the study of user satisfaction in occupied indoor environments, many studies go beyond 'if-then' logic of how satisfaction is affected by physical features. Satisfaction is defined as "the processes whereby users know and judge their physical environment" [7]. To ensure physical comfort, the basic needs of the workers is necessary including safety, hygiene, and accessibility. Functional comfort, on the other hand, refers to the degree of support for their individual tasks that the users experience. Finally, psychological comfort deals with users' feelings of control, belonging, and ownership at work.

Physical Comfort

Physical comfort is a foundational aspect of worker satisfaction. Research conducted a study using a questionnaire on 779 workers from nine different government and private sectors workplaces in Canada and the United States [2]. Workers were asked to rate their workplace and how they felt it affected their productivity. The analysis found 18 factors for environmental satisfaction such as privacy/acoustics, lighting, and ventilation/temperature. Structural equation modeling indicated that open-plan office occupants are more satisfied with their workplaces and their jobs [2]. The research showed how the design of physical workplaces has potential effects on users' wellbeing and efficiency. This shows how people's overall satisfaction affects their productivity.

Functional Comfort

Functional comfort is defined as the degree to which workers can perform their tasks in the workplace. It is related to building systems such as lighting ventilation, and temperature as the basis for comfort and wellbeing indoors. It is also dependent on the worker's tasks and their requirements. Thus, a diagnostic estimation of functional comfort measures whether workers can perform their tasks easily, with difficulty, or not at all in the workspace, and how the indoor environment and changing office technologies affect performance.

The level of support in the workplace is determined by the degree to which workers can focus on their work, compared to time spent focusing on distracting or negative environmental conditions. Daylight, ergonomic furniture, diversity of workspaces, and enclosed meeting rooms, are ways to ensure employees experience functional comfort at work. Variables such as lighting, ventilation, or noise for instance, under certain conditions, can produce stress which will affect workers' performance. Positive stress and environment competence are both necessary in functional comfort. Additionally, the work environment should be adaptive and "negotiable" to support workers with tasks changing over time [7].

Psychological Comfort (Territoriality and Belonging)

Satisfaction depends on a sense of belonging, which produces a commitment to stay with an organization. Psychological comfort is determined by factors such as territoriality, privacy, and control that connects workers' psychological needs to the environment. Territoriality at workplaces concerns individuals' sense of belonging. This affects how shared spaces as well as components in an individual's workspace are experienced. This sense of belonging is affected by design decisions and if workers feel included in the decision-making process.

Environmental empowerment and psychological comfort are strongly connected. Evidence shows that workers who participate in decisions about their office environment experience more feelings of belonging [7]. This allows users to feel that they belong in the work environment because they can take ownership of the environment's design. Finally, there are studies on how physiological traits affect how people react to the built environment through cognitive processes. Lewin's field theory (1951) addresses how differences among users affect how they evaluate their work environment. Cognitive processes determine how they perceive not only their environment but also themselves as workers. Another study shows how an open office caters more to extroverts, while introverts may feel less supported [7].

Control can be achieved in simple ways, as in making furniture movable – such as tables that can be raised or lowered or furniture on wheels. Allowing users to have input, as well as teaching them how these items can be controlled, leads to more satisfaction. Another way to control the environment is by making users feel that their needs are acknowledged. This gives a feeling of empowerment, and that one's voice was heard in design decisions. This will encourage workers to cope with environmental demands and explore new ways to solve problems. As a result, workers will increase their learning potential and knowledge to come up with innovative solutions.

Second: Diversity Workplaces for Innovation and Better Interaction

In the book *Innovation in Office Design*, [9] argues that the workplace needs to have a variety of settings to produce more innovative results. Giving individuals or groups the freedom

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of choice for extra space to work and alternative spaces is key to productivity. For instance, when the employees work in private offices, the company could provide them small huddle spaces in the open work areas as a change of setting. On the other hand, when workers use open work environments, they can have an opportunity to choose a quiet area to work as needed, to find some privacy. Moreover, a free-flowing workplace design assists workers to access everything they need to achieve a better work outcome.

The work environment can be enhanced in areas of comfort, socialization, and cooperativity. Innovative workplaces are diverse work environments where everyone has the right to share their thoughts and can choose different jobs in different locations [8]. Culture in the workplace should be a welcome stream of open and collaborative thinking which is initiated when employees can come out of their comfort zone and take advantage of their potential to improve business processes, ideas, and products [8].

Reference [8] investigated an important aspect of connecting workers to the outside landscape as a setting that allows the work to continue beyond the borders of walls. External spaces have been used in innovative companies such as Office Daiwa in Japan, where the employees have skillfully intertwined the external atmosphere to become a part of the office. Nature in the break areas offers a diversity of unorthodox workplaces which can enhance creativity and innovation. These strategies can create new avenues for fulfilling workers' comfort and promoting innovative solutions.

Design for Workers Needs

It is essential to serve the needs of workers to ensure their productivity. The concept of "bringing the comfort of home to the office" helps workers stay focused on their work for a longer time without stress or panic [9, p.189]. This also helps workers to balance between their work and their personal life. Diversity of work environments promote teams and individuals; teams are more productive, especially when they have a team space to build energy. Employees' feelings of motivation and happiness are very important factors in a company's success.

As a successful example of a diverse and accessible workplace, Google's campus gives its employees everything they need, encouraging them to stay as much as they want on the campus, with places to take a break and take a moment to enjoy the day so later they can come up with more ideas. Google provides whiteboards in the central part of campus where the major break areas are located to encourage employees to think and discuss ideas together. The campus uses unique furniture to help create different atmospheres which can boost employee's creativity.

The innovative office layout in the Bosch research center allows privacy if employees need to focus while providing places for collaboration with others. Löckle contends: "The days when the design of workplaces decided from above are over. Our associates spend much time at their workplaces. It is only right that they should also have a say in their design"

[10]. Denner said that "Here, we want our researchers to do more than think about what the future could bring. We want them to be successful entrepreneurs as well. Renninger is Bosch's own Stanford. Moreover, at the same time, the center is an expression of our faith in Germany as a technology location" [11].

In the Novartis Basel Campus in Switzerland, the design of the campus reflects the changes in the modern work environment which places value on communication, creativity, and collaboration [12]. The campus environment enhances the wellbeing of their employees through nature with a park located in the middle of campus. Also, many buildings aim to bring as much sunlight indoors as possible through the façade and the atrium which helps enhancing workers' alertness and reducing mistakes. Some buildings have a unique façade to create a new experience. The buildings on campus have a flexible structure that uses transparency to connect the indoor and outdoor environment. It makes the campus more dynamic, by giving users multiple views in both open and closed workstations, as well as quiet meeting zones. Remarkably, the campus is decorated with artwork. Forum façade, for instance, is designed by the Swiss artist, Helmut Federle, to give a sense of liveliness to the building. The campus is a positive environment due to the variety of spaces and furniture provided to workers to support individual needs.

Design for Individuals and Teams

Innovation-workspaces aim to support both individuals and teams. The concept is the same among the five examples of innovation-environments; however, each company bases its design on both cultural and functional elements. A "working environment" focuses on the workers in the organization and the ways in which the work guides people's behavior and affects the culture of the spaces [13]. Central design is based on a flexible open innovation concept that maximizes teamwork and brings diverse disciplines by creating extra space for individuals. "Open innovation" is a process where organizations generate new ideas and introduce them to the market to participate in the increasing competition in the industry.

The physical work environment should create formal and informal collaboration areas to improve communication among workers. The goal is to use these spaces in ways that will impact innovation and productivity. Especially in a research space, campus layout should aim to encourage the sharing of ideas and overcome the intellectual, rather than physical, partitions that develop in such workspaces. The Burch company offers such collaborative workspaces to boost their workers' morale and productivity [14]. Also, a team of 12 researchers at the Massachusetts Institute of Technology (MIT) found that merging different sectors is a great source of innovation and improves how researchers conduct their work, as they can exploit the range of knowledge "from microbiology to computer science to engineering design" [3, p.19].

The central vision in the Google work environment is to merge the workplace with the experiences found in

educational environments to create a new way of working and allow workers to conceive, investigate, and execute even the most impossible ideas. Google looked at Stanford University as an example of giving employees many opportunities for selecting the spaces where and how they conduct their work, whether preferring to work self-directed or with a group. The educational environment offers a self-sufficient concept, where the campus provides all users with the essential needs in work and in life which helps encourage employees to collaborate any time, with the focus being the students' best interest for better performance.

The primary strategy of the Bosch and 3Mers is to use the university as a co-producer of innovative ideas. This method of collaboration leads their team to generate new perspectives. The 3Mers company built a new Research & Development Building in 2016, focused on developing products that were designed to encourage the worker to be more creative [15]. The more creative [15]. The corporate Research and Development center encourages innovation through flexible office spaces, research, and interaction to improve collaboration through division and commerce partners. The floorplan is designed with flexible adjacencies for long-term functionality and ease of use of the space. The design uses an open plan concept to increase productivity, competitiveness, operation, and efficiency. These open workplaces are divided with white acoustic noise-suppressant panels, so workers can focus on their tasks. Furthermore, the building's design has large windows throughout the facility allowing access to natural light, even from inside most labs [16]. The research center provides a variety of places for employees to meet and engage in conversation. The buildings' design is in a V-shape, where the conference room and break areas are located in the middle, allowing workers to meet and brainstorm, which workers describe as an ideal work environment [17].

The Ri.MED center creates a dynamic and flexible work environment for its scientists to promote innovation and discovery. The design of the center "integrates cutting edge technology with flexible functional spaces to create an extraordinarily functional, yet iconic facility that will advance modern medicine" [18]. An open office layout improves collaboration between researchers and clinicians, which boosts critical networking and communication and leads to fast-tracking the development of solutions to medical challenges. The building was designed "as a small compact village" that integrates into the landscape [19]. In the middle, all buildings are connected through the pedestrian street crossing and have views to the Tyrrhenian Sea to the north and the mountains to the south [19]. The collaborative spaces are divided into four wings across three floors. It is designed in a way which allows each laboratory zone to be easily divided into custom workstations. By using floor to ceiling glass between the laboratory and documentation area, the space allows for visibility between teams and provides natural light. Also, it creates formal and informal workplaces to encourage collaboration.

The Novartis Basel Campus has a flexible work environment that enhances the collaboration of multiple physical and virtual teams. The structure consists of an open workspace for seventy people that allows them to work in various environments supporting a multitude of tasks which may require a high amount of concentration, working independently, or working in different-sized groups. The idea is implemented through partitions which allow customized separation of spaces or helps the manager work with his team in the same work environment. In this building, the open workplaces replace the traditional grid-style office to collaborate in an indoor setting that emphasizes communication and teamwork among coworkers. This strategy helps the company overcome mistakes and miscommunication [20]. The team has a wide variety of social spaces such as mailboxes, coffee areas, conference rooms, and lounge spaces with seating and televisions. With the workstations, there are shared benches that allow users to break away and chat in different places as well as creating a variety of informal meeting places.

Design for Freedom

Giving individual freedom in the work environment encourages workers to be creative. The Novartis Basel Campus offers a wide range of areas where workers can choose their work environment. There are views of the park and nature which enhance employees' productivity. This multi-space office environment allows employees to choose the work area which best fits their needs. This work environment also allows workers to succeed through open communication and the freedom to work in different ways throughout the day. Designing the office in zones available for the employees' choosing is one example of enhancing workers' freedom in the workspace.

The Bosch Innovation center is a leading universal contractor of technology and aims to improve the quality of life with innovative products and services [15]. The campus provides many amenities like a university, [15] which gives the researchers the freedom to choose where they want to work. Depending on if they are using laptops, tablet computers, or conference calls, it is an environment where the campus can serve everyone's needs. The campus focuses on innovation to inspire their performance and work environment.

Operation elements in the work environment give employees the freedom to make changes to their environment. The "Google Experience Center" was the beginning of Google forming a campus that supports the learning, collaboration, and wellbeing of its staff through diverse experiences in the workplace. The design of the campus follows a simple distribution of work environments into 'neighborhoods,' which are comprised of four buildings. These allow workers to engage and often communicate in the middle of the campus in the outside landscape and seating areas. It functions like a main street where all ideas can come together. This allows employees to enjoy being in nature and with others, with amenities such as meeting rooms to concentrate in, the use of technology for speakers, micro-kitchens, and library lounges [21]. The design firm also hangs whiteboards on perimeter

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walls where employees can capture their ideas anywhere and anytime [9, p.186].

The Innovation space in Bosch (Platform 12) is located on the 12th floor in the research center. This space is used exclusively for the exchange of ideas. It is a break area where employees have the freedom to explore thoughts and ideas by writing on the walls or windows without limiting themselves with an expected result or goal. The space includes furniture that reflects the 1920s to 1950s with a library, and two talk terminals that function as workshop spaces. It has inspired workers to ignore routine and think creatively. Thoben claims that workers go to this area when they are struggling with creating new ideas, to find what they are looking for. It is rich with natural views and has become a place where new ideas have formed before workers know what they are creating [22].

Design for Better Interaction

Innovation-workspaces need to enable fast connections for users to transfer knowledge and communicate. The utilities and amenities are aligned along with the circulation patterns in the space to create opportunities for worker interaction. Wagner & Watch interviewed architects for their study on how they perceive the influence of changing the office design on workers. Many architects indicated the power of Millennials in driving and bringing new ideas. Designing high-quality space is a way to attract and retain talent [3, p.12]. Design can provide an informal network that features transparent dividers in the workspaces in a way that invites workers to communicate due to physical proximity within the space and to create important face-to-face interactions. Face-to-face interaction helps with quick and efficient problem-solving.

Interaction with others helps individuals generate ideas, deal with mistakes, learn from other coworkers, take risks to identify new ideas and products, be competitive, and adapt to change [13]. Openness is an important factor in the work environment that has an important influence on innovation. Open spaces at work make users feel refreshed and enthusiastic to walk, meet, and talk with other coworkers. It makes interaction among workers easier, especially in brainstorm sessions. Studies show how the increase of interaction can improve brainstorming and ideas in workplaces by using an open layout [9, p.189].

The workplace atmosphere should reduce barriers and increase collaboration. This ensures individuals, as well as groups, form new ideas and exchange knowledge. It also helps to mix the wisdom of different generations, as the young can bring new insight to the company while older employees can bring their knowledge and experience. This combination will ensure organizations the best results of innovation.

The Novartis Basel Campus has had a specific physical work environment that aims to build a sense of community to increase productivity [12, p.41]. The campus design enhances interactions between users through ergonomic workspaces and relaxation zones. Communication for complex innovation: Rich interaction and communication among individuals such as face-to-face communication help tacit information to

transfer and develop. Combining innovation-oriented sectors will benefit the sharing of complex information [3, p.27].

Finally, workplace environments should enhance social life among workers to increase their communication and innovation. It helps workers get to know each other better and discuss issues quickly. The laboratory on the Novartis Basel Campus creates an interdisciplinary sharing of ideas and encourages researchers to improve on critical thinking, the depth of their research, and helping coworkers with their workloads, which makes their work more efficient. Furthermore, this work environment helps researchers pinpoint problems and generate solutions.

V. Conclusion

Understanding individuals' needs and creating work environments that enhance interaction among workers and with the work environments help create innovation-work environments. The challenge of designing innovation-workspaces lies in understanding the holistic aspects of experiencing the workspaces, including creating work environments that enhance interaction and minimize distraction. The design should provide high partitions or offices for everyone with extra multi spaces for informal meeting, breakout, and quiet areas as well as supplemental workplaces that can be used as needed. These spaces will not reduce team interaction and line-of-sight administration; rather, they will increase communication and productivity. The resolution is as much to do with the organization of the space as it is the strategy and acoustic properties as well as the optimization of different areas. Workers are more comfortable doing their work, placing new ideas, thinking out of the box, and gathering involvement to share ideas through such innovation-workspaces.

VI. Design Implications

- Creating a space for the exchange of ideas helps workers process early ideas by changing their way of thinking; they can even come to the space to become inspired to create new ideas.
- Providing different types of both formal and informal workplaces encourages collaboration.
- Giving users a variety of choices to work, in addition to their original station, and different work opportunities such as self-directed work, diversity of workplaces, independent study areas, either in private or within a group, is conducive to creative and efficient work.
- Bringing many facilities together like a university gives researchers the freedom to choose where they want to work. Whether it is with laptops, tablet computers, or video calling, the environment allows for the entire campus to be a workplace.
- Giving additional amenity spaces where employees can sit, think, rest, relax, and enjoy their favorite activities encourages workers to stay longer.
- Bringing discussion elements such as whiteboards to break area in case workers have ideas during their break

times can allow for creative and new ideas.

- Designing different comforting layouts and homey atmospheres helps workers break out and feel free in their space.
- Using technology to assist and connect workers is an avenue for further communication.
- Using unique furniture and art helps users experience the space better and enjoy their work. This can include residential furnishings to feel more comfortable and active.

REFERENCES

[1] P. Roelofsen, "The impact of office environments on employee performance: The design of the workplace as a strategy for productivity enhancement". *Journal of facilities Management*, 2002.

[2] J. Veitch, K. Charles, K. Farley, and G. Newsham, "A model of satisfaction with open-plan office conditions: COPE field findings". *Journal of Environmental Psychology*, vol. 27, no.3, pp.177–189, 2007

[3] J. Wagner, and D. Watch, "Innovation spaces: The new design of work." *brookings institution,* April 2017. https://doi.org/10.1109/CEIDP.1996.564589

[4] N. Kamarulzaman, A. Saleh, S. Hashim, H. Hashim, and A. Abdul-Ghani, "An overview of the influence of physical office environments towards employee". *Procedia Engineering*, vol. 20, 262–268, 2011.

[5] N. Oseland, "The impact of psychological needs on office design." *Journal of Corporate Real Estate*, vol. 11 no. 4, 244–254. Nov 20, 2009.

[6] K. Chandrasekar, "Workplace environment and its impact on organizational performance in public sector organizations." *International journal of enterprise computing and business systems*, vol. 1, no. 1, 1–19, 2011.

[7] J. C. Vischer, "Towards an environmental psychology of workspace: How people are affected by environments for work." *Architectural Science Review*, vol. 51, no. 2, 97–108, 2008.

[8] G. Llopis, "Job titles disrupt productivity and innovation." (2015, September 15). Retrieved from https://www.forbes.com/sites/glennllopis/2015/09/15/job-titles-disrupt-productivity-and-innovation/#7cf73c227486

[9] D. Stegmeier, "Innovations in office design: The critical influence approach to effective work environments." *John Wiley & Sons.* 2008.

[10] N.D. "Bosch officially opens new research campus in Renningen." *Torque*. 2015. Retrieved from http://news.cision.com/torque/r/bosch-officially-opens-new-research-campus-in-renningen,c9848937

[11] A. Wade, "Stuttgart via Stanford: Inside Bosch's new R&D campus." May 06, 2016. Retrieved from https://www.theengineer.co.uk/stuttgart-via-stanford-inside-boschs-new-rd-campus/

[12] V. Magnago Lampugnani, J. and Burckhardt, "Novartis campus: A contemporary work environment premises, elements, perspectives." *Hatje Cantz,* 2008.

[13] E. Martins, and N. Martins, "An organisational culture model to promote creativity and innovation." *SA Journal of Industrial Psychology*, vol. 28, no. 4, 58–65, 2012. https://doi.org/10.4102/sajip.v28i4.71

[14] D. Kreuscher, "Global coworking survey: coworking as a corporate trend." October 27, 2017. Retrieved from https://www.smartworkers.net/2017/10/coworking-als-unternehmenstrend/

[15] "Bosch starts construction of new center for research and advance engineering in Renningen," Germany. *BOSCH*. 2012. Retrieved from https://www.bosch-presse.de/pressportal/de/en/bosch-starts-construction-of-new-center-for-research-and-advance-engineering-in-renningen-germany-41793.html

[16] M. Saint Paul, "Research & Development Building." *BWBR*. 2017. Retrieved from https://www.bwbr.com/portfolio/research-development-building/

[17] F. Jossi, "Progress MN: 3M Co. Finance-Commerce." April 11, 2014,). Retrieved from https://finance-commerce.com/2014/04/progress-mn-3m-co/

[18] "Ri.MED biomedical research and biotechnology center." HOK. 2010. Retrieved from https://www.arthitectural.com/hok-ri-med-biomedical-research-and-biotechnology-center/

[19] "HOK's design of ri.med's new biomedical research hub in Italy." *HOK Network*. December 12,2012. Retrieved from https://www.youtube.com/watch?v=ONrRFL33Ew0

[20] "Novartis Campus Pilot Project." *Sevil Peach*. 2019. Retrieved from http://www.sevilpeach.co.uk/project/novartis-pilot

[21] J. Meachem, "Googleplex: A New campus community." 2019. Retrieved from https://clivewilkinson.com/case-studies-googleplex-a-new-campus-community/

[22] "The Art of Wimmel Research." *Schloss-Post*. April 30, 2018. Retrieved from https://schloss-post.com/the-art-of-wimmelresearch