Inclusive Collaboration in Innovation Spaces: A Study of Design's Social Impact in the IDEA Factory

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On my honor as a University of Virginia student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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1. Introduction

Modern academic institutions are increasingly investing in innovation spaces to close the gap between academia and industry, fostering collaborations that could advance technology, entrepreneurship, and interdisciplinary research. These spaces are designed to improve engagement between students, faculty, and industry professionals, enabling them to work collectively on collaborative projects. However, the physical presence of cutting-edge facilities does not guarantee successful collaboration but instead, the effectiveness of these spaces depends on their potential to create an inclusive and friendly environment that supports diverse backgrounds and interdisciplinary cooperation.

How can innovation spaces foster inclusive, interdisciplinary collaboration between academia and industry? This research focuses on how design elements of academic innovation spaces influence inclusivity and interdisciplinary collaboration. Specifically, the study will compare and contrast the IDEA Factory at the University of Maryland with similar innovation hubs, including Cornell Tech's Tata Innovation Center and MIT's Media Lab. By examining key design elements such as spatial openness, accessibility, and adaptability, this paper aims to identify factors that contribute to successful collaboration across disciplines. Understanding these elements is crucial, as it will help inform the development of future innovation spaces, ensuring they provide not only technical resources but also foster engagement across diverse academic and professional sectors.

2. Background and Context

2.1. Sociotechnical Situation

Innovation spaces are often designed to foster knowledge exchange, yet their success depends on more than just their physical aspect. The IDEA Factory at the University of Maryland serves as a case study for examining the relationship between spatial design and collaboration. This 61,000-square-foot facility includes advanced laboratories for quantum technology and robotics, along with dedicated entrepreneurship hubs. While its mission is to foster industry-academic partnerships, the true measure of its success depends on whether it effectively brings together individuals from diverse backgrounds to collaborate effectively. Designing for inclusivity requires different intentional planning aspects that account for accessibility, social interaction, and adaptability. For instance, Universal Design principles play a

key role in shaping such environments by ensuring that facilities accommodate users with diverse abilities. Features such as adaptable workspaces, clear signage, and communal gathering areas help create an accessible and welcoming atmosphere. Beyond physical accessibility, inclusive design should also consider factors such as gender-sensitive spaces, safety, and cultural representation to ensure broad participation across various social groups.

2.2. Literature

A major scholarly attention has been the design of inclusive and collaborative environments, especially in academic and innovation settings. The use of Universal Design, a concept aimed to build environments accessible to all users, regardless of their physical or mental capacities, is at the foundation of this discussion. By incorporating features such as ramps, adaptable furniture, and clear signage, Universal Design helps ensure that all individuals, regardless of ability, can navigate and fully utilize the space. In the context of the design of the IDEA Factory, these principles of accessibility can support an inclusive environment where people of various needs can participate equally in academic and professional activities, contributing to a collaborative and dynamic atmosphere.

While physical accessibility is crucial, inclusivity includes more social aspects such as safety, comfort, and gender sensitivity and equality. Umaña-Barrios and Gil (2017), in their research of Costa Rica's urban mobility system, emphasize the importance of designing environments that prioritize safety and visibility, ensuring that users from all backgrounds, especially marginalized groups, feel secure and valued. By ensuring that all individuals, regardless of gender or cultural background, feel supported and comfortable in innovation buildings such as the IDEA Factory, these principles encourage more participation and engagement within interdisciplinary teams.

In addition to creating accessible and socially inclusive environments, academic innovation spaces must also be adaptable to future needs.The concept of Infrastructure Time (Karasti, Baker, & Millerand, 2010) is critical in this context. It emphasizes the importance of designing spaces for short-term functionality as well as long-term adaptation. This is especially critical for innovation hubs that promote research and interdisciplinary collaboration in a world that is constantly changing. By including flexible features, the IDEA Factory can stay relevant

over time and continue to fulfill the changing demands of students, professors, and industry professionals, thereby promoting long-term multidisciplinary collaboration.

Moreover, effective collaboration in these spaces also depends on the design of the environment itself. Oldenburg's Third Place Theory (1989) emphasizes how informal, communal places create connections that can develop community interaction and enable interdisciplinary collaboration. Spaces like the IDEA Factory show this with open design that allows for informal exchanges between students, instructors, and industry professionals, thereby lowering the traditional academic and professional barriers. Additionally, Goffman's *The Presentation of Self in Everyday Life* (1959) builds on this by emphasizing the significance of physical settings in affecting social interactions and individual behaviors. Transparent, open designs, such as those found in the IDEA Factory, will encourage participation by breaking down social barriers and creating inclusive interactions, however, further studies are needed to confirm this relationship.

2.3. Theoretical Framework

This research applies the concept of mutual shaping, which emphasizes the dynamic interaction of social and technical factors in shaping sociotechnical systems. Mutual shaping indicates that social interactions and physical environments do not independently determine outcomes, but they continuously influence and shape each other. For the IDEA Factory, mutual shaping appears as spatial designs that affect how interdisciplinary teams collaborate, communicate, and interact socially. Concurrently, these social practices will also affect ongoing design decisions, creating an environment that shapes the inclusivity of collaborative spaces.

Moreover, this study also uses the Collaboration Process Pattern (CPP) approach developed by Fan, Li, and Zhao (2017). The CPP approach, according to Fan, Li, & Zhao (2017), systematically analyzes collaboration patterns by mining process logs to identify recurring interactions among individuals, tasks, and the spatial configurations supporting teamwork, “In this research, we conceptualize recurrent structures of a subset of actor interactions and activities in collaboration processes as collaboration process patterns (CPP) and use them as an instrument to study collaboration processes." (p.439) By revealing patterns that either enhance or hinder collaboration, the CPP approach brings insight for assessing the connection between spatial arrangements and social dynamics. Through this framework, the research will identify which specific design elements will foster inclusive, interdisciplinary

collaboration, providing a valuable understanding of how the physical environment and social behaviors mutually shape collaborative behavior in innovation spaces.

3. Methods

3.1. Information needed

To effectively address the research question of how innovation spaces foster inclusive, interdisciplinary collaboration between academia and industry, it was important to gather information on specific physical design features, social interaction patterns, and practical examples that have academic innovation spaces. The focus was particularly on features influencing accessibility, inclusivity, informal social interactions, adaptability over time, and effective teamwork behaviors. Additionally, it was crucial to identify recurring collaborative interactions shaped by these spatial and social factors through concrete examples from established innovation spaces.

3.2. Evidence Collection

Evidence was collected from a combination of academic sources and articles relevant to the argument, as well as images of the IDEA factory and its design features. To guarantee rigor and thoroughness, every source that covered relevant spatial or social design was examined, regardless of whether it directly supported preliminary ideas or current assumptions. Sources specifically outlining design principles, theoretical concepts, and frameworks were prioritized, including Universal Design, Infrastructure Time and Costa Rica's urban mobility system. Additionally, case studies of MIT's Media Lab and Cornell Tech's Tata Innovation Center were analyzed to gather detailed and practical views into successful innovation space design. For empirical rigor, the Collaboration Process Pattern (CPP) approach, as developed by Fan, Li, and Zhao (2017), was utilized. This approach involved analyzing detailed records of collaboration processes from these case studies to identify recurring patterns of interactions and effective teamwork. processes from these case studies to identify recurring patterns of interactions and

effective teamwork.

Figure 1: Example of a Communal Area of The IDEA Factory

3.3. Approach

A spatial analysis was conducted by examining photographic documentation and visual representations of the IDEA Factory's interior spaces, focusing on open layouts, accessibility adaptations, collaborative areas, and social interaction spaces. Utilizing visual analysis, these images were assessed according to the Collaboration Process Pattern (CPP) approach to evaluate how specific spatial arrangements influence teamwork and informal interactions. This approach allowed for a practical comparison with established innovation hubs, identifying design features that effectively encourage inclusive collaboration.

Moreover, collected evidence was categorized into themes reflecting the physical and social design elements of innovation spaces. Information and concepts taken from literature, visual spatial analyses, and case studies were organized to show key design characteristics and their observed impacts on collaboration. Patterns identified through CPP analysis provided an understanding of how specific design elements encourage inclusive interdisciplinary collaboration, aligning closely with the mutual shaping theoretical framework employed by this study.

By integrating thematic literature synthesis, visual spatial analysis, practical insights from case studies, and empirical pattern analysis, the methods ensured a comprehensive and rigorous exploration of how innovation spaces' physical and social designs mutually shape collaborative interactions.

4. Results and Analysis

The analysis of the IDEA Factory at the University of Maryland, alongside the MIT Media Lab and Cornell Tech, reveals how specific architectural elements influence interdisciplinary collaboration and inclusivity. By looking at visual resources and applying the mentioned theoretical frameworks, this analysis identifies design characteristics that have a significant impact on the effectiveness of innovation spaces.

4.1 The IDEA Factory (University of Maryland)

The E.A. Fernandez IDEA Factory emphasizes openness and flexibility in order to foster interdisciplinary connections. A drone footage (A. James Clark School of Engineering, 2023) showed the building's specific architectural elements, proving why its design is essential for improving collaboration. The video highlights the large, open meeting areas, the transparent walls separating different sections, and the flexible workspaces that can be adapted for different collaborative needs. These visual materials especially show how the architectural design actively encourages spontaneous cooperation, allowing different groups to communicate across open spaces with no physical or social barriers. The transparency of the design reflects Goffman's (1959) ideas of how space impacts social interaction by ensuring that all individuals in the space are visible to each other, thus encouraging engagement and minimizing exclusion.

Going into more detail, the large, flexible meeting rooms can be rearranged depending on the size and reason of the collaborative activity. This flexibility aligns with Universal Design principles, which emphasize the creation of places that can be easily adapted to meet the needs of a wide range of users, including those with varying physical and cognitive abilities (Karasti, Baker, & Millerand, 2010). The openness of these spaces encourages informal interactions, allowing students, faculty, and industry professionals to engage with one another outside of structured work or formal meeting environments. This informal space design also brings effective accessibility and breaks down social barriers, making the space conducive to

collaborative as well as efficient knowledge exchange. These design components reflect Oldenburg's (1989) concept of third places, where informal interaction appears in environments that promote social connection and natural conversations. The IDEA Factory's large, open communal areas provide opportunities for people with different backgrounds to meet, interact, and exchange their ideas, serving its role as a third place. According to Goffman, he believes in the concept of self-presentation, which refers to physical environment having a significant impact on how people show themselves and interact with others, "The setting in which the individual performs... provides the backdrop for a number of significant types of interaction and contributes to the definition of the situation. The presence or absence of others... and the general physical environment in which the interaction occurs can affect the way individuals perform and present themselves" (Goffman, 1959, p. 22). The IDEA Factory aligns with this as its transparent walls and interconnected areas provide motivation for individuals to actively present themselves in collaborative settings, reducing barriers to interaction, and making the environment feel inclusive and easily accessible.

The IDEA Factory's design also emphasizes more on its accessibility, making sure that everyone with different abilities can use and navigate the place effectively. The building includes adaptable furniture, clear signage, and a ramp with stairs access, which are all core elements of Universal Design. These features are particularly important for promoting social inclusivity, as they ensure that people with different physical and cognitive abilities can fully participate in the collaborative environment. As Umaña-Barrios and Gil (2017) argue, "spatial design elements such as visibility, lighting, and accessibility significantly influence users' comfort and engagement." The IDEA Factory incorporates these elements, ensuring that everyone, regardless of their background or abilities, feels welcomed and valued in the space.

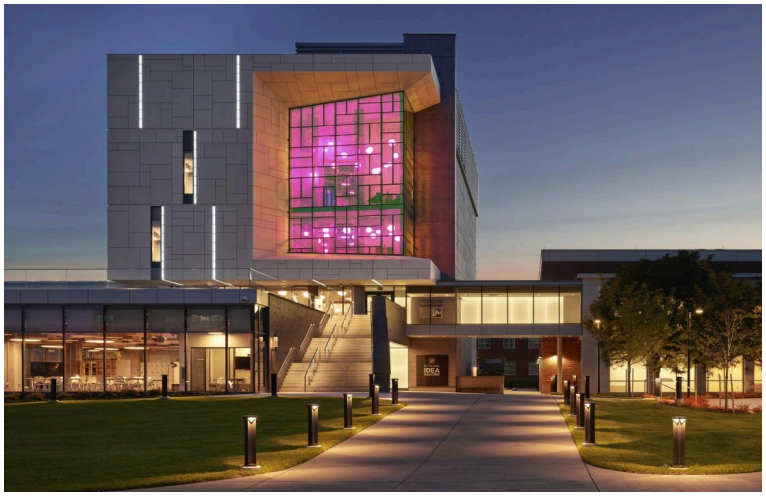

Figure 2: Access to the IDEA Factory

Another critical feature of the IDEA Factory is its ability to adapt to changing needs over time. As Karasti, Baker, and Millerand (2010) note, "infrastructure should be designed to accommodate not only immediate needs but also future changes in technology and collaboration patterns." The IDEA Factory embodies this principle through its flexible layouts and the use of movable walls and furniture as well as different types of labs. These features allow the space to be easily reconfigured as the needs of the users evolve, whether for research projects, technical competitions, or industry collaborations. The facility houses labs like the Angel P. Bezos ’69 Rapid Prototyping Lab, Robotics and Autonomy Lab, or Lockheed Martin Rotorcraft Labs. These labs are equipped with cutting-edge tools and technologies, enabling research across a broad spectrum of fields, from advanced robotics to aerospace engineering. By providing access to this modern equipment, the IDEA Factory supports a diverse range of research projects, fostering collaboration between academic disciplines and industry sectors, and encouraging innovation in both theoretical and applied contexts. The adaptability of the space is crucial for supporting interdisciplinary innovation. As academic disciplines evolve, the space must accommodate new technologies, methodologies, and collaborative practices, making sure that the IDEA Factory can continue to serve as a cutting-edge hub for interdisciplinary innovation.

Figure 3: Lockheed Martin Rotorcraft Lab on Fourth Floor of IDEA Factory

The IDEA Factory's design, examined through the lens of mutual shaping, shows the mutually beneficial relationship between social practices and physical environments. The space not only promotes innovation and collaboration, but also continuously evolves through the behaviors it fosters. These social practices, in turn, influence the future development of the space, ensuring that it remains inclusive and adaptable. The Collaboration Process Pattern (CPP) Approach (Fan, Li, & Zhao, 2017) plays a crucial role in understanding this evolution. The CPP framework identifies and analyzes recurring collaboration patterns that emerge from the spatial and social configurations within the environment. These patterns reflect how physical layouts, such as open meeting areas and flexible workspaces, enable spontaneous interactions and enhance teamwork efficiency.

For example, the transparent and open design of the IDEA Factory encourages visibility and communication across different groups, reducing social barriers and promoting equity in collaboration. According to the CPP approach,“collaboration processes are shaped by the spatial configuration and the flow of interactions within the environment,” which is shown in the IDEA Factory. In the IDEA Factory, the layout facilitates a continuous flow of communication by providing adaptable meeting spaces that support both formal and informal interactions. This

openness encourages active participation, making it easier for individuals to engage in collaborative efforts, whether through structured meetings or casual discussions. These elements of the CPP approach align with Goffman's theory of self-presentation (1959), where the physical environment actively shapes how individuals present themselves and engage with others. Thus, the IDEA Factory's design, by encouraging both formal and informal collaboration, creates an environment conducive to interdisciplinary and innovative teamwork.

4.2.Case studies

4.2.1. MIT Media Lab

A video of MIT Media Lab shows it as a design that fosters interdisciplinary collaboration, much like the E.A. Fernandez IDEA Factory. The MIT Media Lab features extensive use of glass walls, an open atrium, and interconnected spaces that create visual and physical transparency. This design supports effective collaboration and improves the interaction between individuals from diverse disciplines, fostering a dynamic environment where ideas can be exchanged freely.

The flexibility of the MIT Media Lab's layout is a key feature that aligns with the CPP Approach (Fan, Li, & Zhao, 2017), which emphasizes how spatial design can directly influence teamwork efficiency. The Lab's atrium provides effective communication between different levels, ensuring that individuals and groups can collaborate across spaces without physical or social barriers. This design fosters a flow of interaction where social and physical barriers are minimized, allowing for spontaneous engagement between various groups, whether they are from different disciplines or industries.

This principle of flexibility is similar to the IDEA Factory's adaptable workspaces, which can be reconfigured based on the specific needs of the users. In both environments, the spatial design is a critical factor in shaping how collaboration is created, reflecting the CPP Approach's emphasis on the interdependence between physical space and social interactions. In these settings, the spatial configurations do not stay the same but are designed to evolve, enabling the spaces to be customized for different activities, such as research projects, workshops, or industry collaborations. Therefore, the design ensures that the spaces continuously support the dynamic and evolving needs of the teams, allowing for a greater flow of communication and more effective teamwork. This aligns with the idea in the CPP Approach that collaboration patterns

emerge from recurring structures of interaction and are shaped by the environment in which they occur.

Both MIT Media Lab and the IDEA Factory align well with the concept of mutual shaping as their physical spaces do not only contain the users but shape the behaviors and interactions of them as well. The structure at the MIT Media Lab fosters multidisciplinary collaboration by putting people from different departments close together, allowing for spontaneous discussions and idea-sharing conversations. Moreover, similarly to the IDEA Factory, the MIT Media Lab's design incorporates informal spaces that improve social conversation outside of the formal settings. As seen in the video, the central atrium serves as a meeting point for people from different fields, further supporting Oldenburg's (1989) Third Place Theory. In these shared spaces, people take part in informal, natural interactions that often lead to innovative solutions. The flexibility of the Lab's layout supports these interactions by providing areas that can be easily adapted to satisfy diverse needs, whether for casual discussions, team brainstorming sessions, or structured meetings.

Overall, both the MIT Media Lab and the IDEA Factory demonstrate how thoughtful spatial design can foster cooperation, innovation, and inclusivity. By utilizing open layouts, transparent spaces, and flexible furniture, both buildings can create an environment where interdisciplinary collaboration thrives, proving that the design of innovation spaces is crucial in shaping the behaviors and outcomes of their users.

4.2.2. Cornell Tech:Tata Innovation Center

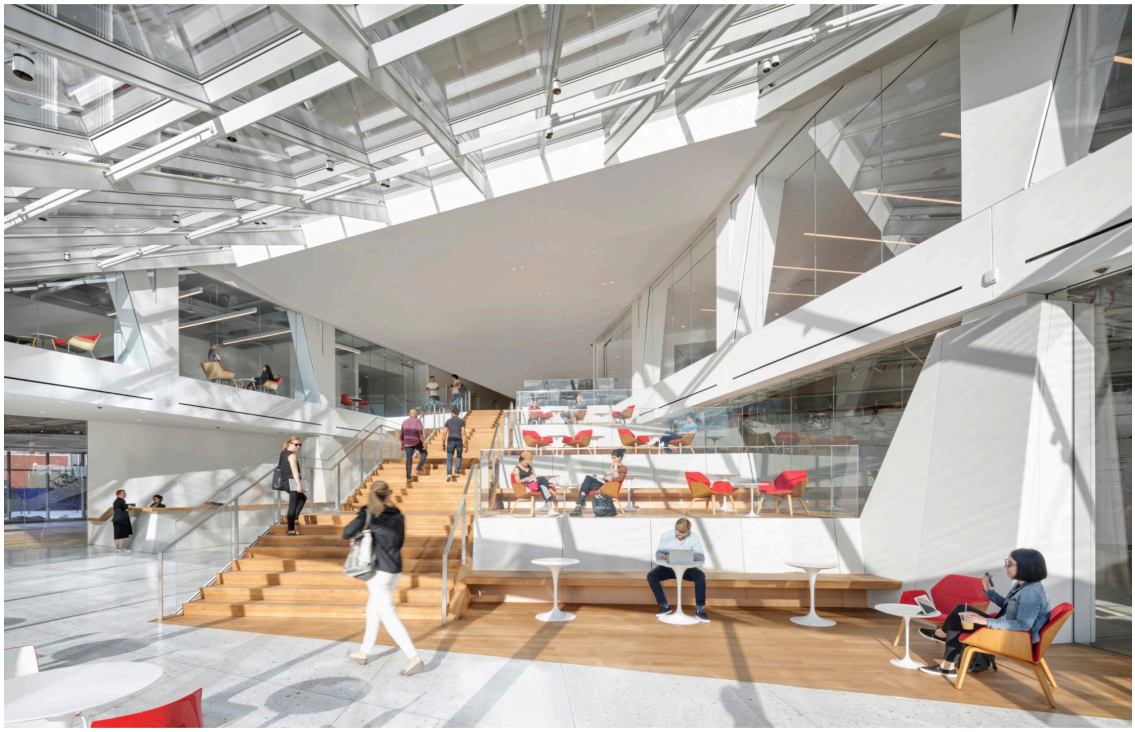

Figure 4: Tata's Innovation Center

Cornell Tech, located on Roosevelt Island in New York City, is another great example of an innovation space that shares similar design principles with the E.A. Fernandez IDEA Factory. Similar to the IDEA Factory, its innovation center with multi-level lounges and collaboration spaces creates a distinctive environment that promotes innovation and inclusivity. A special aspect of the building is its flexible spatial configuration, which allows the space to evolve with changing educational models and technological advancements. This adaptability goes well with the CPP Approach (Fan, Li, & Zhao, 2017), which suggests that spatial layouts significantly influence the efficiency and effectiveness of team collaboration. The CPP Approach emphasizes the interdependence between physical environments and social behaviors, and in this context, the design of the space supports this dynamic by providing areas that can evolve to accommodate new collaboration needs over time. The building's design includes equitably scaled circulation sections equipped with lounges and stairways that support meeting rooms, enhancing the efficiency of work.

The Tata Innovation Center also emphasizes the concept of mutual shaping, where the physical environment and social practices connect with each other. By integrating academic researchers and professional start-ups within the same space, the building creates smooth

connections between industry and academia. This intentional design encourages spontaneous interactions and knowledge exchange, much like the IDEA Factory's emphasis on creating spaces that promote interdisciplinary collaboration.

In comparison, the E.A. Fernandez IDEA Factory similarly implemented flexible layouts and collaborative spaces to support interdisciplinary innovation. Both buildings prioritize adaptability, transparency, and sustainability, creating environments that not only respond to current needs but are also prepared for future developments. The open communal areas in both structures encourage informal interactions, fostering a culture of collaboration and continuous learning.

5. Conclusion

This research emphasizes the important role of architectural and spatial design in fostering inclusive, interdisciplinary collaboration within academic innovation spaces. By examining the E.A. Fernandez IDEA Factory at the University of Maryland alongside case studies of MIT's Media Lab and Cornell Tech's Tata Innovation Center, it becomes clear that intentional design significantly influences collaboration and inclusivity. Features such as open layouts, transparency, adaptable furniture, and communal spaces not only encourage effective collaboration but also actively shape social behaviors, interactions, and innovation processes—validating the theoretical frameworks of mutual shaping and the Collaboration Process Pattern (CPP) Approach.

The findings from this study highlight broader implications for the future design of educational and professional innovation spaces. Architectural decisions must prioritize adaptability, inclusivity, and informal interaction, as these elements will heavily contribute to interdisciplinary collaboration and innovation. Moreover, with continuously fast advancements in technology and evolving collaboration practices, flexibility and adaptability in spatial design are becoming more crucial for long-term sustainability.

Future research could expand upon these findings by exploring quantitative measures of collaboration efficiency or by evaluating user experiences within these spaces through surveys or further studies. Additionally, in-depth comparative analyses involving various geographic and cultural contexts could improve understanding of how spatial design universally or variably influences interdisciplinary collaboration. Ultimately, recognizing the mutual relationship

between physical space and social behaviors can guide the design of innovation spaces, ensuring they remain responsive and effective in supporting interdisciplinary work for years to come.

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