Thesis Project Portfolio

IDEA Factory Design-Build Response to a Request for Proposal

(Technical Report)

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

(STS Research Paper)

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Executive Summary

Modern universities are increasingly investing in innovation spaces that are designed to foster collaboration between academia and industry, recognizing that interdisciplinary and inclusive spaces would significantly advance research, entrepreneurship, and technological innovation. However, successfully achieving these objectives involves more than solely providing advanced laboratories and technologies. An important challenge is effectively balancing specialized, technical research requirements with inclusive and adaptable environments that encourage meaningful collaboration across diverse disciplines. At the University of Maryland, the IDEA Factory—a 61,000-square-foot research facility—aims to address this challenge by having advanced laboratories for quantum technology, robotics, and rotorcraft alongside flexible spaces like the Startup Shell and ALEx Garage for entrepreneurship and industry partnerships. However, the true effectiveness of such spaces depends not only on technical aspects but also on their design's ability to foster inclusive interactions among students, faculty, and industry professionals. As a result, it is crucial to fully understand how flexibility, accessibility, and architectural features support effective interdisciplinary collaboration. My technical project focuses on finding solutions for these practical engineering challenges, while my STS research analyzes how inclusive, flexible spatial designs can enhance collaboration, drawing insights from comparable innovation hubs. Together, my two projects aim to identify key physical and social factors that contribute to successful collaboration.

The technical project focused on designing the IDEA Factory at the University of Maryland, responding comprehensively to the university's Request for Proposal (RFP). My team's primary objectives were to provide thoughtful designs, estimates, schedules, and plans for the purposes of accuracy and quality in our final product. The 61,000-square-foot facility contains modern research laboratories, including the Robotics Realization Laboratory, Quantum

Technology Labs, and the Rotorcraft Laboratory, as well as collaborative environments such as the Startup Shell and ALEx Garage, designed explicitly to foster entrepreneurship and strengthen industry-academia partnerships. One of our key design challenges was the high groundwater table, which required the development of an integrated groundwater management system involving deep well point dewatering and sheet pile excavation supports. Structural system material selection was also critical; after a detailed comparative analysis, concrete was selected over steel due to its better performance in vibration control, fire resistance, long-term durability, cost-effectiveness, and sustainability. Furthermore, our project also implemented the mat slab foundation, carefully selected for stability and efficiency in managing the challenging below-grade conditions. A phased logistics plan, developed using a three-dimensional site model, addressed constraints of limited storage on campus and ensured minimal disruption to university activities through strategic material deliveries, pedestrian safety measures, and optimized site circulation. Our proposed design also included comprehensive scheduling strategies to ensure completion on time and a cost analysis, effectively estimated below the anticipated Guaranteed Maximum Price (GMP). Moreover, the proposal actively prioritized Minority Business Enterprise (MBE) participation, promoting diversity and inclusivity within the project team and aligning with broader university values. Ultimately, the complete design approach intends to make the IDEA Factory a model facility for multidisciplinary research, innovation, and inclusive cooperation at the University of Maryland.

My STS research project investigated how innovation spaces can foster inclusive, interdisciplinary collaboration between academia and industry, with a particular focus on the IDEA Factory at the University of Maryland. The study mainly focused on analyzing architectural and spatial design features that can influence collaborative interactions,

accessibility, and inclusivity. By using theoretical frameworks such as Mutual Shaping and the Collaboration Process Pattern (CPP) approach, the research demonstrated how specific design elements—including open layouts, transparent spaces, adaptable furniture, and accessible entryways—actively shape social behaviors and encourage informal interactions for effective collaboration. Moreover, comparative case studies of established innovation hubs like MIT's Media Lab and Cornell Tech's Tata Innovation Center further supported these findings, highlighting how intentional design directly impacts users' engagement and collaboration efficiency. These findings were obtained through visual spatial analysis, literature reviews, and structured comparison of layout and use patterns in different spaces. The IDEA Factory was found to effectively incorporate many of these principles, including Universal Design elements that accommodate diverse user needs and flexible spatial features that can adapt to evolving research demands. The research concluded that spaces designed for adaptability, transparency, and inclusivity significantly improve interdisciplinary interaction by breaking down traditional barriers, promoting sustained engagement, and supporting effective teamwork. Overall, the study emphasizes that spatial design is not only for providing a place for collaboration, but also a place for equality, innovation and inclusivity.

Together, my technical and STS research projects contribute to a deeper understanding of how innovation spaces can be designed to support both technical excellence and inclusive collaboration. Through the technical project, my team developed a comprehensive and practical design for the IDEA Factory that responds to complex engineering constraints while creating flexible spaces. Simultaneously, my STS research examined the sociotechnical aspects of space design, showing how thoughtful architectural features can improve collaboration by fostering accessibility, comfort, and social interaction. While each project approached the IDEA Factory

from different perspectives—one practical and one analytical and theory-based—they both led to the same idea: that innovation improves most when environments are both technically sound and socially inclusive. Although time constraints limited further evaluation of post-occupancy experiences from users, both my work have offered suggestions for future researchers and designers. Moving forward, similar projects can benefit from integrating more empirical data on user engagement to ensure spaces meet the evolving needs of their communities. Overall, this portfolio demonstrates the value of combining technical design and STS analysis to build environments that not only provide technical needs, but also create equitable and collaborative settings.