Industrial Design Proposal for WPI

An Interactive Qualifying Project Report
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by
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Abstract

This proposal lays the framework for an Industrial Design (ID) program at WPI. This was achieved by gauging student interest in ID at WPI, researching several universities in the U.S, Japan, Taiwan, Italy, and UK at the graduate and undergraduate level, interviewing current Industrial Design professors at those universities, and tabulating their infrastructure, courses, and extracurriculars for ID. Based on our findings, our group put together a series of recommendations for successful integration of ID at WPI. Firstly, we have listed the courses that would be great additions for the ID curriculum. We suggest introducing new infrastructure resources and centralizing makerspaces integral to Industrial Design.

Executive Summary

Industrial Design (ID) is a rapidly growing field, both in size and importance. Design has grown to play a considerable role in general corporate strategy planning, particularly in innovation and the creation of new goods. Additionally, designers now frequently hold senior-level management roles in major organizations, as their insights and experience are invaluable when attempting to go to market. ID is not limited to the processes and technology engaged in the creation and use of objects, however. It aims to create lasting impressions and memorable experiences by focusing on human-centered design.

An Industrial Design program at WPI will **elevate WPI's standing as a university**, training a new wave of designers able to tackle challenging problems of the future. The curriculum will take a thorough, multidisciplinary approach to investigate the conceptual and theoretical underpinnings of Industrial Design processes and methodologies.

Through our research we **benchmarked courses** offered by 13 universities across the globe (Georgia Tech, Pratt, IIT, MassArt, Academy of Art University, Wentworth, RISD, Nagoya University of Arts and Sciences, Seika University, Kyushu University, Osaka University, National Taiwan University of Arts, Politecnico Milano, and London Royal College of Arts) to find common course themes. From this we have proposed courses that need to be introduced and adapted for the Industrial Design program. The courses suggested are meant to enhance a student's intellectual and scientific understanding of both theory and practice of design, as well as integrate themes of business and customer-product relations. The curriculum will train students in the technical and aesthetic elements of the field and help them appreciate the wider cultural concerns surrounding design's current significance in our world. It will concentrate on the implementation and use of a wide range of cutting-edge enabling technologies. Furthermore, it will enable WPI to take advantage of a once-in-a-lifetime opportunity given by the tremendous expansion of design throughout the world, as well as a significant shift in its social, economic, and technical roles.

From our data, we compiled a list of **proposed undergraduate ID courses** to introduce to WPI's new program, those courses being: Design Basics, Visual Communication, Material Studios, ID Studios, Sketching, History of Design, Movement, Materials, Design Factors, Design Methods, and Marketing/Business in Design. Other courses that would be implemented into the ID program are already taught at WPI, such as: Graphic Design (AR 2301), 3D Modeling 1 (IMGD 2101), Intro to CAD (ES 1310), Advanced CAD (ES 3323), Digital Painting (AR/IMGD 2700), Manufacturing (ME 1800), and Computer-Aided Manufacturing (ME 3820).

Due to its inherent functional model, Industrial Design education is largely taught using a project-based educational model. From our interview with professors at IIT, and faculty at WPI we understand that the success of an Industrial Design program partly comes from the facilities and resources students have access to for their coursework as well as ID related projects. We examined what was accessible to students at other universities as well as what WPI already has to offer to compile a complete **inventory of relevant resources** that are essential for the Industrial Design program. The inventory entails all the resources necessary for a successful ID program at WPI, such as a **carpentry/wood-working shop, plastic shop, textile shop**. Other

than acquiring resources we also suggest centralizing the makerspace and labs for larger integrated projects, as well as reducing the cost and training for using these resources.

WPI has a unique opportunity to **differentiate** its ID program from those of other universities given its current infrastructure and distinguishable characteristics.

- Being a **STEM school**, WPI could bring a technological approach to Industrial Design. This brings many opportunities for interdisciplinary projects and overlap of disciplines.
- Increase in importance of design comes with increased responsibilities for industrial designers. Many designers are expected to create new goods, manage the processes by which these goods are created, as well as learn more about the customers that they are designing for. Through our interviews with current ID professors, we have observed that the management aspect of ID is often forgotten, which WPI will hope to address with **integrated business classes** in the ID curriculum.
- WPI's **Global Project Program** would provide unique opportunities for design students, especially as designers are expected to have an increasing global perspective on their work. The Global Project Program would give design students a platform to do design projects in the industry in places such as Italy or Japan, top areas of design.
- We recommend WPI apply for **accreditation** from the National Association of Schools of Arts and Design (NASAD) to further differentiate the program from others in the area. We also recommend that this be done as a comprehensive unit in conjunction with Interactive Media and Game Design and Communication Design (Professional Writing).

Our team conducted a **voluntary survey** with currently enrolled WPI students who already had a declared major, primarily in computer science. We recognize that this may cause a bias, as only students who are particularly interested in the subject may have responded. Our results show that students feel a need for increased design education at WPI. Additionally, our results indicate that students with a declared major would be interested in a secondary ID education, with interest getting larger if they are offered the option to get minors, certificate and to participate in design related extracurriculars. We also gauged interest for several suggested ID courses to better understand the interest for Industrial Design in other disciplines.

We suggest utilizing and introducing several e**xtracurricular activities** to enhance ID student life and create an enhanced learning environment. These extracurriculars include:

- The **Innovation and Entrepreneurship Center** hosts various workshops on design thinking that provide timeless-transferable skills to the students with an emphasis on interdisciplinary perspectives.
- **Student Clubs** like Art and Design Club and We art Good Club assisting and supporting art and design in the WPI community,
- **Masterclasses** like those offered by the IMGD department provide the opportunity to receive tutelage and one-on-one critique with experts in the field.
- We recommend the **Student Design Exhibition**, which is an opportunity for upper-class students to display their work to provide exposure to potential employers and the community.
- Extending the **career fair** to include companies that hire Industrial design students. Also providing help at the career development center for students' design portfolios.

The Industrial Design program proposed for WPI is unprecedented in its combination of attributes including:

- At all levels, from first-year courses through the Graduate program, there is an emphasis on a research-based, **multidisciplinary approach** to design. Large lectures and small seminars will be used as instructional approaches, along with considerable studio work and an emphasis on cooperation in design projects.
- The program will emphasize core intellectual concepts of design and design processes, as well as aesthetic, cultural, historical, and philosophical concerns linked with design. It will also provide students with a solid foundation in the tools, technical abilities, and material and media understanding as well as the soft adaptation skills to learn the requirements for the rapidly changing field.
- A comprehensive array of **degree programs** at the bachelor's and master's, including BA, BFA, and BS for undergrad and MA, MFA, MS, MDes, MID, MDes + MBA for grad.
    - We recommend that either the undergraduate or the graduate ID program be implemented, but not both as this will not only cost more, but also increase the demand for studio spaces which are already limited in availability.
- For Industrial Design students with more defined and traditional professional aspirations, the option will be provided to have concentrations in design with courses from different majors like Mechanical Engineering, Aerospace Engineering, etc. to create an **interdisciplinary focus** on a particular application and/or to provide the basis for graduate study.
- The administrative independence of a department with formal mechanisms to facilitate the sharing of faculty and students with other units at WPI.

The Industrial design sector is rapidly undergoing profound transformations that are altering what designers do and how they think about their job. However, such change lacks the conceptual clarity and intellectual vision that can only be achieved by scientific investigation and academic inquiry at this stage. There is no doubt that a science of design and a new academic discipline will develop from the varied professional practices and programs that exist now, during the upcoming decades. What remains to be seen is whether this will take place at WPI or elsewhere.

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Introduction

As technology becomes more advanced and complex, so too do the needs of consumers. Consumers demand for innovative products and fresh product style sustains the demand for Industrial Design. The design industry requires people with design skills to solve problems in a society that is constantly changing. Industrial Design impacts every product that exists today: tables, cars, phones, lamps, even fruit stands at grocery stores. We have been asked to develop a plan for an Industrial Design program at WPI spurred by faculty interest. The addition of this program at WPI will educate students to become fully fledged designers, able to create material concepts with ease, clarity, and rigor. Conceptualizing and developing concepts in three dimensions imaginatively and precisely, and successfully conveying their design objective to diverse audiences (including clients, users, and fabricators).

Importance of Industrial Design

Industrial designers have many responsibilities when it comes to the creation of a product. These responsibilities range from determining the physical appearance of the product, such as color, texture, and shape, to more ephemeral properties such as novelty or innovation. An industrial designer must consider competition and create products that will outperform other companies (Cornish 1987). Cornish (1987) also explains that one important task of a designer is to research past accidents to prevent them in the future.

From examining companies that use designers versus those which do not, a thorough design process yields better results. Sometimes companies will decide not to invest in a designer for their product either because it is too costly and seen as unnecessary, or simply due to lack of availability (Cornish 1987). At a later stage in development, companies have realized many requirements were not properly identified at the planning stage of their product and must massively adapt their project.

For example, several design and design management problems that have been discovered investigating space shuttle accidents in the 80s (Fuqua, 1986). The first of these problems was created through a short-term cost efficiency which favored an inexpensive technical solution over a more reliable one. The aim of earning money led to overlooking technical problems and construction changes. Finally, erosion of the O-rings (a part on the space shuttle) caused a leak that was recognized but ignored since technical managers were not properly briefed on the problem. The NASA and Thiokol technical managers “failed to understand or fully accept the seriousness of the problem [with the O-rings]” says Fuqua (1986, p.5). In this report regarding the O-ring failure, Fuqua (1986) also states that in the past there were a dozen instances where O-ring erosion had occurred on space shuttles. Had there been a design engineer or design-oriented manager briefing the technical managers, perhaps they could have foreseen this accident occurring. Due to a lack of proper design process, NASA lost billions of dollars on the Challenger space shuttle alone (Fuqua 1986). The added expense of forgoing a design engineer can be identified when investigating other large disasters, exposing the larger dilemma; Prioritizing short-term goals over proper management practice, training, and organizational aspects of the design process will lead to high risks and inevitable problems in the future (Cornish 1987).

Design Thinking

Design thinking is an innovation and problem-solving method based on iterative usage of creative design methods. Across industries, design thinking has shown its value as a methodology for generating innovative ideas (Combelles 2020). Early examples of design thinking, which tend to be science based, contrast with modern design thinking. This association of design with science, which evolved through military design thinking methods used in the Second World War, started to lose popularity in the 1970s. There was a lack of success in the application of scientific methods to areas of design (Cross 2001; Jackson 2020). Design problems required better solutions than the fundamentals of science and engineering could offer. This was an important step towards the development of modern design thinking. Design had moved away from a focus on technical rationalism and instead emphasized different ways to trigger innovation, build and test prototypes and then redesign as needed until there was a final product. Design thinking explores possibilities of what could create outcomes that benefit the user (Combelles 2020; Jackson 2020).

Teaching Design Thinking

Design thinking had been introduced at higher education institutions such as MIT since the 1960s, but really took off towards the end of the 20th century. From the late 1980s and on, design thinking had become a much more widely researched idea. Different schools had slightly different definitions of design and different methods of teaching. One of the most prominent developments in the design field during the late 1980s was participatory design, which emphasizes user needs during product development (Jackson 2020). From this evolved user-centered design which develops a deeper understanding of the user experience.

Design thinking was approaching what we consider today to be modern design. With a focus on the user experience, designers could create products that consumers did not even know they needed. But as technology became more complex at the turn of the century, so too did the needs of consumers, which were changing faster than ever before. It had become apparent that the user-centric design approach could not properly address the complexity of the problems that designers were facing. According to Meyer, without attention to details, ensuring that the requirements of multiple stakeholders are addressed, the design will fail (Meyer 2020). Design was becoming less about solely designing a product for a user, and more about designing a product for the future experiences of people. Design now has focus placed on the quality of the user experience and culturally relevant solutions, not driven by a single design discipline. This shift towards human-centric design was further developed and popularized by the Stanford University design school. They use a human-centric design methodology with five modes, empathizing, defining, ideating, prototyping, and testing (Jackson 2020). Many other universities follow a similar approach to teaching the design process. He and Ortiz (2021) examined multiple of these universities' design programs and defined design thinking as “a human centered approach, following a gradual and iterative process, presenting a solution of complex problems by collaborating in multidisciplinary teams” (p. 3). The emergence of this new methodology shifted the focus of design from designing products to designing social systems.

Wicked Problems

Design thinking is a way to create solutions that could not otherwise be achieved through science and engineering alone. In Rossman's book, *Designing Experiences*, he explains that design is about imagining something that does not yet exist, using only creativity to create something new and unique, and drawing inspiration from past experiences. He also goes on to say that this design process is not always linear, it requires learning from past mistakes and building upon your attempts at a solution (Rossman 2019, p.77). For example, in the case of Thomas Edison, he and his apprentices had thousands of unsuccessful attempts before the invention of the incandescent light bulb. These types of problems have come to be known in the design world as "wicked problems". This term, popularized by Horst Rittel and Melvin Webber, describes complex problems that lack a clear singular solution. The subject matter of a design problem could potentially be universal, as design thinking can be applied to every area of the human experience (Rossman 2019; Jackson 2020).

Phases of the Design Process

There are three main phases of the design process that enable designers to effectively identify critical issues before the manufacturing phase of a system or product (Ranta 1988):

- Requirement specifications
- Functional specifications
- Implementation

Requirement specifications include going over the end goals of the product, and resource allocation which includes budget, time, and human design organization and management. The functional specifications include task allocation, vendor selection, creation of detailed functional descriptions (controls, sequences, displays, etc.) and training principles. Finally, the implementation phase includes the operational system or final product, software and hardware design, training sessions, and quality assurance (Ranta 1988). Poorly defined goals are normally the root cause of problems in creating a new product, thus following these phases will ensure greater success than ignoring the initial investment in design and ensure that companies do not face avoidable risks or setbacks.

Reiterating the above, unexpected redesigns due to poorly analyzed project requirements can lead to "economic disaster" (Ranta 1988, p.43). To combat this, designers should be briefed from relevant departments of their company such as marketing and engineering, where topics such as materials, components, production technology, and manufacturing techniques are discussed (Cornish 1987). Using this combined information, the designer should be able to synthesize a plan which encompasses all the company's requirements for a project.

Many international case studies have demonstrated the positive effects of adopting a design process. One study examined flexible manufacturing system (FM-systems) in the USA and Japan. The US design team was composed of outside specialists, whereas the Japanese team was a homogeneous in-house group (Ranta 1988). In this scenario, the US-based company invested few resources into design, whereas the Japanese company ensured design played a crucial role in their project planning. Unsurprisingly, the product that the US created had much lower scores than that of the Japanese product, which scored higher for flexibility and availability than the US

product. Additionally, the Japanese finished their product in about a third of the time that it took the US (Ranta 1988).
It is obvious that design plays an important role in the cost of creating new systems or products, shown through numerous examples above. The first systems created by a company tend to be more expensive and time-consuming than those which succeed them because after a company produces a product once, the design of the product can be reused and improved to create a new product more quickly (Ranta 1988). This means that investing more resources into the design process of a product is directly correlated with improving the overall costs, benefits, and impacts of the product (Cornish 1987). Neglecting the design process has proven that more resources could be wasted than what would have been used in the first place to implement a thorough design process as in the case of the Challenger space shuttle accident (Fuqua 1986). This demonstrates the necessity for designers in the engineering industry and that without a design process, companies could face major setbacks and risks which could have been avoided.

Modern View of Industrial Design

Modern industrial design has become a critical component in personalizing new technologies for public needs as well as cultural and economic developments. There have been significant changes in the design processes to consider new customer definitions, value propositions, goods, and services. There is a clear movement away from creating objects and towards designing interactions, experiences, and systems, away from designing for people and toward designing with and by people (Sanders and Jan Stappers 2014). The modern industrial designer mainly embodies innovation, the need for personalized plans according to the market changes and consumer needs, as well as integrating the aspects of brand design, service, and interactive design (Zhang Q., Cheng, C., Ye, J., & Ding, W., 2015).

Modern industrial design also plays a range of functions in businesses today which are important to other functional areas such as marketing, engineering, sales, and manufacturing (Kotler and Rath, 1984, Persson, 2005, Trueman and Jobber, 1998). As a profession in constant development, the roles of the industrial designer are not static, but it is well known through research that companies with industrial designers do have an edge on profits over their competitors (Gemser and Leenders, 2001). Companies have sought new ways to profit from the skill set of designers. Of the many skills, the two often used are the ability of designers to follow trends and their ability to visualize ideas. Modern designers know to follow societal and technological trends, assess what is important for the customer, and to translate those into a concrete product idea (Blaich and Blaich, 1992). Research describes that when Industrial designers coordinate with other departments within product development, they have better production efficiency (Hertenstein et al. 2005). Interpreting ideas into visual representation for other members of the project team also has a substantial impact on the team dynamic, helping achieve a shared understanding of ideas so that relevant aspects of a product are considered and can be agreed upon (Valencia, A., Person, O., & Snelders, D., 2013).

Design has become much more than a simple embellishment of our lives that is enjoyed occasionally, it has rather become an integral part of everything we do for both physical and spiritual enrichment. A modern look at industrial design shows it is more than the concept generation for manufacturing. Industrial design is about maximizing the value that the

stakeholder places by managing customer preference, social problems, and the joy of ownership. One such example is using Vision in Product design (ViP), a human-centric strategy used to develop sports cars (Giacobone & Mincolelli, 2020). ViP produces strategic design decisions for a project based on the analysis of the stakeholders. This model tries to find new design opportunities not only for the current problems that people have but also analyzes the evolution of socio-cultural models to foresee new coming auto-motive trends. This is a significant opportunity for the anticipation of potential social demands. (Verganti, R., 2008)
Compared to the initial history of industrial design, modern industrial designer plays a significant role in production design as well as other disciplines of businesses. The focus of industrial design has shifted mostly from the objects themselves to looking at organizational structures and social problems.

Importance of Culture and Interdisciplinarity in Industrial Design

There are many subtle yet important factors that influence industrial design. The importance of interdisciplinary teams cannot be understated in the design process. "This is visible particularly in contemporary product development processes where a holistic understanding of the word design forms the base of successful communication and collaboration between designers and engineers," says Frye et. al., (2017, p.1) from Aalen University. These two groups, however, "remain separate in design education itself. Whereas engineering is dedicated to the institutional contexts of technical universities, industrial design is rather associated with art and thus taught at schools of art and design," continued Frye et. al., (2017, p.1)

From a case study of engineers at West Point and industrial designers at the Rhode Island School of Design (RISD), students who worked together in multi-disciplinary groups "described the experience as 'eye-opening'," while "[it exposed them] to various design perspectives, [and] a fresh perspective [to] their design challenge" (Novoselich, Weis & Jones, 2018, p.2). This same sentiment holds true for multi-disciplinary groups in the work environment. Working together allows for groups to better "solve problems, [and] come up with innovative designs" (Silva, 2018, p.26). Another important benefit to working in interdisciplinary groups is the open-mindedness it can bring. Sometimes, working in a homogenous group can lead to an echo chamber, where no other perspectives are considered since in the small scale, it seems like every perspective has already been considered. This can lead to a lack of deeper thinking, without exploring new or innovative ideas. This sentiment carries over into the design process and incorporating people of many different backgrounds into the design process can help alleviate this oversight.

The notion of culture also ties into interdisciplinarity. As Godfrey (2014) notes, different disciplines may create their own cultures or ways of thinking. These separate cultures may at first not lend themselves well to collaboration, as noted in the West Point and RISD case study. Students displayed "initial ambivalence or assumptions of unhelpfulness regarding the potential benefits of the multidisciplinary collaboration," but later said they "gained some unique insights." (Novoselich, Weis & Jones, 2018, p.3). This exemplifies the benefit of working in teams with different cultural backgrounds.

Degree Programs

At the undergraduate level, there is the option of awarding either a Bachelor of Science or a Bachelor of Fine Arts degree. At the graduate level, there is an option of awarding a Master of Industrial Design or a Master of Fine Arts.

The increasingly prominent roles that design and design management are playing in business argue strongly for a special concentration with the industrial design program. The design management track focuses on understanding, analyzing, and establishing design processes and an organizational design culture, as well as the business of design, brand design, and design law and intellectual property challenges. A fully realized successful innovation, for example, still needs tremendous work to manage the transition to a successful product. This program will provide a unique experience and opportunity with management in transforming innovative design into a successful commercial enterprise.

This will be offered in cooperation with the Business School, where students pursuing Industrial Design at the graduate level could also enroll in the M.B.A program. The strategic organization of this program is similar to that used at IIT's Institute of Design, which is one of the more popular options in graduate design programs available.

WPI Student Feedback on Industrial Design Programs

To gauge interest for Industrial Design among current WPI students, we conducted a survey including questions of whether students felt that design is an important part of STEM, whether there is a lack of design education at WPI, and how Industrial Design should be implemented at WPI. At the end of the survey, we asked participants to express interest levels in a few core classes for an Industrial Design program.

While we would have hoped to gather responses from students of all majors and demographics, we received 43 responses from friends of different majors and students from the Computer Science alias. Our sampling method was a voluntary sample since the survey was sent out and participation was optional, so **we recognize that there may be a bias towards students who feel strongly about this topic**. Our survey questions are listed in Appendix D

After analyzing the responses, it is apparent that the selection of WPI students who filled out our survey thought that Design was indeed an important aspect of STEM, and that there is a lack of Design education in WPI programs. The overwhelming majority of these students believe this should change, and that WPI should include design as a part of its STEM courses, as seen below in figure 1.

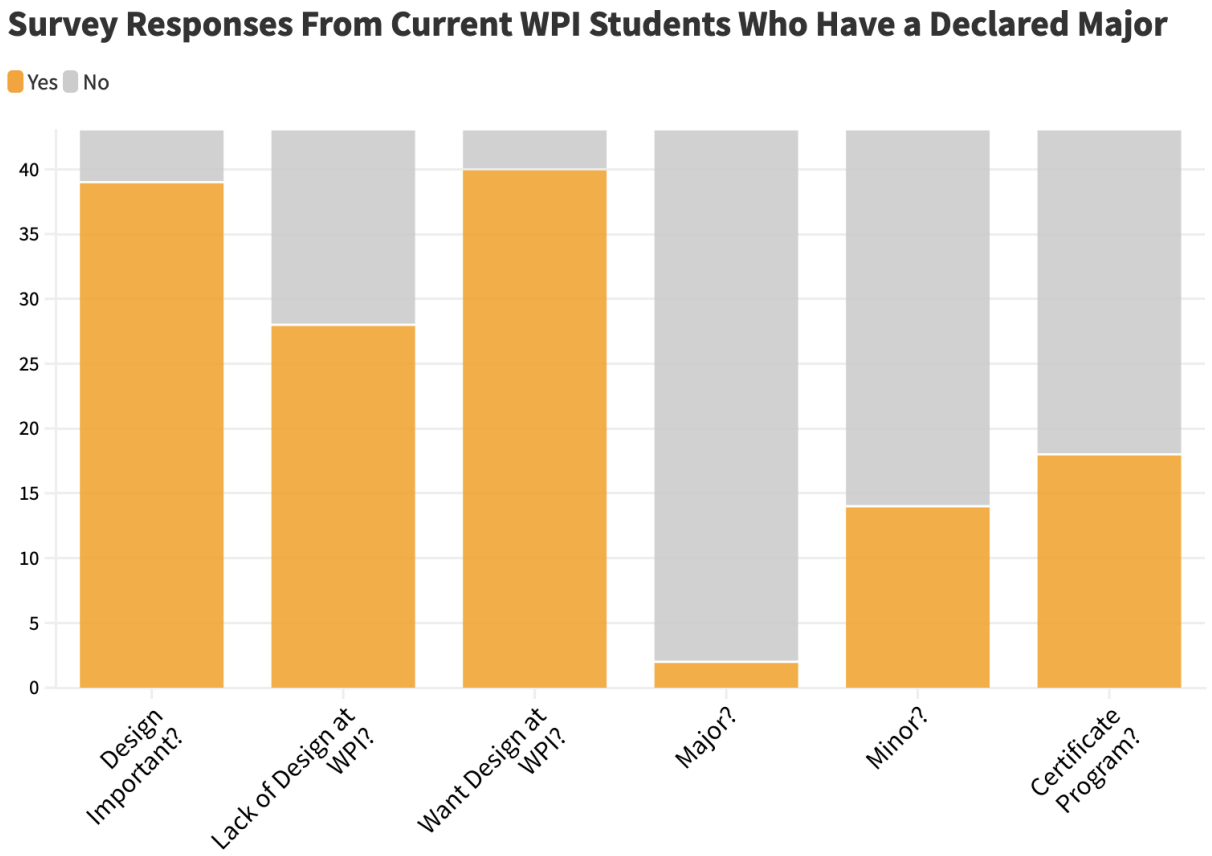

Figure 1: WPI Student feedback on the importance of design education in STEM, and at WPI, and how to implement an Industrial Design program.

We asked participants to justify their responses to gain an understanding of trends in our data, or overwhelming majorities. The anonymous responses that the participants gave are in the Appendix D
From these results we concluded that — should our survey results be representative of the student population of WPI — the majority of current students would like to see Design implemented into WPI STEM programs due to its importance and prevalence in the industry.

Next, we asked students how they would like to see an Industrial Design program implemented at WPI (figure 1, last three questions). On an individual level, it seems that students are more inclined to take an extra-curricular or minor program for Industrial Design rather than an undergraduate major program. With nearly half of the participants showing interest in an extra-curricular based program, and a third of the participants showing interest in a minor program, we concluded that a smaller Industrial Design program may show more success amongst current WPI students than an undergraduate major program. We recognize, however, that the students we have surveyed may not necessarily be the type of student sought after for a coming Industrial Design major at WPI, which may skew the results away from interest in a major.

Courses

Undergraduate Education

Course List Comparison

For our course and resources comparison we looked into the following universities with either an undergraduate or a graduate Industrial Design program:

- United States of America
  - Georgia Tech
  - Pratt Institute
  - Wentworth Institute of Technology
  - Massachusetts College of Art and Design
  - Academy of Art University
  - Illinois Institute of Technology
  - Rhode Island School of Design
- Japan
  - Osaka University
  - Kyushu University
  - Kyoto Seika University
  - Nagoya University
- Taiwan
  - National Taiwan University of Arts
- England
  - Royal College of Art, London
- Italy
  - Polytecnico Milano

The courses we decided to catalog came from just over a dozen U.S. and international schools that are leading the academic area of Industrial Design. By listing the entire curriculum for these schools' respective ID programs, we compiled a list of common course themes across all schools. We then created a matrix — seen below in figure 1, as well as in appendix B — which compares these schools across all course themes. This allowed us to identify which course themes were the most prevalent, meaning these themes were more likely to be core areas of Industrial Design. Some of the courses which appeared most frequently were design basics, materials, and ID Studios, emphasizing how crucial it is for our program to include hands on studio work

Course Theme	Politecnico Milano	Wentworth	Nagoya	Georgia Tech	MassArt	IIT (Grad Program)	Pratt	Academy of Art	Kyoto Seika	Osaka U (Sample)	Kyushu U	National Taiwan U
Design Basics	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Art History				✓			✓	✓		✓		✓
Color Studies	✓	✓				✓	✓	✓	✓	✓		✓
Space Studies	✓		✓						✓			
Visualization	✓	✓			✓		✓					
ID Studio	✓	✓		✓		✓	✓				✓	✓
Modeling	✓	✓	✓	✓	✓		✓	✓	✓			✓
Graphic Communiation	✓		✓	✓		✓	✓	✓	✓			
Sketching/Drawing		✓	✓	✓	✓		✓	✓	✓			✓
History of Design	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Movement								✓	✓			
Materials	✓	✓	✓	✓	✓		✓		✓	✓		✓
Project	✓	✓	✓		✓		✓	✓		✓	✓	✓
Design Factors	✓	✓		✓	✓			✓			✓	✓
Methods	✓					✓						✓
Mathematics	✓	✓		✓							✓	
Physics		✓		✓				✓			✓	
Light	✓							✓				
Marketing/Business	✓	✓				✓	✓	✓	✓			✓
Environmental Design	✓		✓								✓	
Strategy/Economics	✓					✓						
Interdisciplinary	✓											
Interactivity	✓								✓			
Ethics	✓											
Photography	✓								✓			✓
Restoration	✓											
Interior Design	✓		✓									✓
Capstone	✓	✓				✓		✓	✓			
Media Computation				✓		✓		✓	✓			✓
Manufacturing		✓			✓		✓					
Art Writing					✓						✓	✓
Creative Writing					✓							

Figure 2: Matrix comparing universities with course themes that can be found in their Industrial Design programs. A green check indicates that the respective school has a course in that area in their ID program.

Existing WPI Courses

While a new Industrial Design program would require adding many new courses, WPI already offers several courses that would be necessary for such a major. These courses can primarily be found from the art and IMGD departments, however many general education classes such as physics, math, and gym credit will also be taken from existing programs. The table below details proposed classes for the ID curriculum and their corresponding existing classes at WPI. The team's cataloging of these classes can be found in Appendix B.

Proposed Course Addition	WPI Course	WPI Course Description
Color Studies, Graphic Communication	AR 2301 Graphic Design	This course introduces design principles and their application to create effective forms of graphic communication. The students will learn the fundamentals of visual communication and will work on projects to analyze, organize, and solve design problems. Topics may include: the design process; figure/ground; shape; dynamic balance; Gestalt principles; typography; layout and composition; color; production and presentation in digital formats.
	WR 2310 Visual Rhetoric	This course explores how visual design is used for purposes of identification, information, and persuasion. It looks at many modes of visual communication, such as icons, logos, trademarks, signs, product packaging, infographics, posters, billboards, ads, exhibits, graffiti, page layout, films, television, videogames, and web sites. The course provides an overview of the history of graphic design movements, as well as analytical tools to understand how visual design encodes messages and the role visual communication plays in contemporary culture. Students will write about and create a number of visual media in this project centered class. Suggested background: WR 1010
Modeling	IMGD 2101 3D Modeling 1	3D modeling is concerned with how to render created forms in a virtual environment. This course covers 3D modeling applications in video game development, film production, product design and fine art. Topics may include creating and armature, modeling organic and hard surfaces and sculpting using traditional techniques applied

		to a 3D model. Students will create works suitable for presentation in professional quality portfolio. Recommended background: AR 1100 and AR 1101.
	ES 1310 Intro to CAD	This introduction course in engineering graphical communications and design provides a solid background for all engineering disciplines. The ability to visualize, create and apply proper design intent and industry standards for simple parts, assemblies and drawings is a necessity for anyone in a technology environment. Computer Aided Design software is used as a tool to create 2D & 3D sketches, 3D parts, 3D assemblies and 2D drawings per an industry standard. Multiview and pictorial graphics techniques are integrated with ANSI standards for dimensioning and tolerances, sectioning, and generating detailed engineering drawings. Emphasis is placed on relating drawings to the required manufacturing processes. The design process and aids to creativity are combined with graphics procedures to incorporate functional design requirements in the geometric model. No prior engineering graphics or software knowledge is assumed.
	ES 3323 Advanced CAD	This course is intended to strengthen solid modeling and analysis skills with an emphasis on robust modeling strategies that capture design intent. The use of solid models for applications in mechanical design and engineering analysis is emphasized. Topics include advanced feature-based modeling, variational design, physical properties, assembly modeling, mechanisms, and other analytical methods in engineering design. Recommended background: familiarity with drafting standards (ES 1310), mechanical systems (ES 2501 or CE 2000, ES 2503), strength of materials (ES 2502 or CE 2001) and kinematics (ME 3310) is assumed. Additional background in machine design (ME 2300, ME 3320) is helpful
Space, Form, & Lighting	AR/IMGD 2700 Digital Painting	This course covers painting techniques as applied to texturing a 3D asset or illustration/conceptual

		art. Topics include are color theory, study of form, lighting, applying traditional painting ideas to the digital format, character design, generation of ideas and a history of digital painting. Each class features a demonstration on the topic followed by individual critique and study. Students work towards a final project that may be suitable for an Art portfolio. Recommended background: AR 1101, AR 2202
	AR 1100 Essentials of Art	This course provides an introduction to the basic principles of two and three-dimensional visual organization. The course focuses on graphic expression, idea development, and visual literacy. Students will be expected to master basic rendering skills, perspective drawing, concept art, and storyboarding through traditional and/or computer-based tools.
	AR 1101 Digital Imaging and Computer Art	This course focuses on the methods, procedures, and techniques of creating and manipulating images through electronic and digital means. Students will develop an understanding of image alteration. Topics may include color theory, displays, modeling, shading, and visual perception. Recommended background: AR 1100.
	AR 2222 2d Animation I	2D Animation I teach students how to draw, pose, breakdown and in-between characters for 2D animation, focusing on weight, balance, timing, and movement to achieve well-structured and fluid animation. Lectures and projects are conducted to train students in the twelve classical animation principles using digital 2D media. Projects and lectures are designed to practice the fundamentals of traditional frame-by-frame and hand-drawn character animation. Recommended background: Basic knowledge of figure drawing (AR 2202) and digital art software (AR 1101) is recommended.
	AR 3200 Interactive Electronic Arts	This course introduces students to techniques and processes for the creation of real-time, interactive works of art. Students learn to use electronic sensors and other tools for audio, graphics, and video processing, as well as design customized software interfaces to create interactive artworks

		that respond to users and their environment. The course also introduces students to the work of significant contemporary arts practitioners as well as their historical precedents, with a special emphasis on inter-media works that bridge visual art, music composition, and the performing arts. Topics may include electronic musical instruments and performance interfaces, computer vision, VJing, electronically augmented dance, controller hacking, wired clothing, networked collaboration and mobile media, and algorithmic and generative art. Recommended background: Animation (AR/IMGD 2101 or equivalent), and exposure to digital audio or music and introductory programming.
	AR 3700 Concept Art and Creative Illustration	This course covers drawing as it applies to concept art and illustration. The course begins with study of a human model and representational drawing. Following this, students work on drawing from the mind and applying the lessons learned from the figure drawing to creating concept art and illustration. Topics covered are shape recognition and recalling, inventing from the mind, creative starters, study of form and light, visual composition and developing a personal approach, working with individual strengths to create a compelling visual design. Students create a series of concept art exercises and apply these skills towards a personal project of their own. Recommended background: AR 2202, IMGD/AR 2700
Art History	AR 1111 Introduction to Art History	How do we understand a work of art? Through readings and the study of objects at the Worcester Art Museum, the student will survey the major developments inworld art and be introduced to various critical perspectives in art history. Students will learn how art historians work with primary materials and formulate arguments. No previous knowledge of art is required.
Manufacturing	ME 1800 Manufacturing Science, Prototyping,	This course introduces students to manufacturing science and engineering and prototype part production. It emphasizes CNC (computer-

	And Computer-Controlled Machining	controlled) machining. Students will learn how to go from a solid (CAD, computer-aided design) model to a machined part, using CAM software (computer-aided manufacturing) and CNC machining. They will also be exposed to associated issues in manufacturing process analysis, engineering design, material science, and in dimensional and surface metrology. Using machining as an example, the science of manufacturing processes is developed in a combination of class work and laboratory experience. The laboratory experience includes an experimental component that relates process variables in machining with performance and machined part quality. Students whose project work will necessitate fabrication of parts and those who want a background in manufacturing process science and engineering should take this course.
	ME 3820 Computer-Aided Manufacturing	This introductory course in modern control systems will give students an understanding of the basic techniques, and the range of equipment used in most computer controlled manufacturing operations. The class work is reinforced by hands-on laboratories in the Robotics/CAM lab. Modeling and analysis of machining processes, and applications of PLC (programmable logic control) are included. Class topics include Manufacturing Automation, Microcomputers for Process Monitoring and Control, Computer Numerical Control, Switching Theory and Ladder Logic, Transducers and Signal Conditioning, and Closed Loop Digital Control. The laboratories allow students to program and implement several types of the controllers, and will introduce the topic of industrial robotics. Recommended background: manufacturing (ME 1800), materials processing (ME 2820), elementary computer/logic device programming.

Business	MIS 4084 Business Intelligence	This course provides an introduction to the technologies and techniques for organizing, analyzing, visualizing, and presenting data about business operations in a way that creates business value, and prepares students to be knowledgeable producers and consumers of business intelligence. During the course, students will study a variety of business decisions that can be improved by analyzing large volumes of data about customers, sales, operations, and business performance. Students will employ commercially available business intelligence software to organize, summarize, visualize, and analyze data sets and make recommendations to decision makers based on the results. The course explores the technical challenges of conducting analytics on various forms of data including social media data and the managerial challenges of creating value from business intelligence expertise deployed in organizations. The course includes business cases, in-class discussion, hands-on analyses of business data, and methods for presenting results to decision makers. It is designed for any student interested in analyzing data to support business decision-making, including students whose primary focus is Management Information Systems, Marketing, Operations and Industrial Engineering, Business, Management Engineering, Data Science, or Computer Science. Recommended background: Previous knowledge in data management, such as that provided by MIS 3720 Business Data Management or CS 3431 Database Systems I.
Senior Capstone	MQP	

Recommended Additional Courses

The table below is a comparison of courses we recommend WPI includes in an Industrial Design program, and courses that were found in Industrial Design programs from some of the top universities in the world for ID. The courses we recommend WPI bring to an ID program come from comparing over a dozen universities and their four-year programs. We then compiled a chart of common course themes across all universities, which revealed the most frequently taught courses. We determined that these courses which appeared frequently were core areas of Industrial Design and should be included in WPI's program. While the table below does not

include all the universities we compared, it includes a diverse selection that best represents the other universities.

Here is a list of course themes we would recommend adding to an Industrial Design program at WPI, also found in Appendix B. These courses were found to be the minimum required core classes for an Industrial Design program at other universities:

Design Basics Course/Catalog Description: This course will develop a sensitivity and understanding of design principles through a series of three-dimensional projects. It will cover the fundamental topics of Industrial Design.
ID Studio Course/Catalog Description: This course will cover topics related to Industrial Design with a focus on designing products in a studio-based environment.
Sketching/Drawing Course/Catalog Description: This course will cover sketching to improve the medium in which a designer communicates ideas with other people quickly.
History of Design Course/Catalog Description: This course will cover the history of modern Industrial Design.
Movement Course/Catalog Description: This course will cover movement, including dynamic systems and moving parts.
Materials Course/Catalog Description: This course will cover different materials that are used in design, and their impacts.
Design Factors Course/Catalog Description: This course will cover different factors in design, ranging from targeting a specific type of client, to an entire demographic.
Design Methods Course/Catalog Description: This course will cover several different methods used in the design process.

Marketing/Business in Design Course/Catalog Description: This course will cover the marketing and business aspect of Design, focusing on customer-product relations.
Aesthetic CAD Course/Catalog Description: This course will cover how to effectively use CAD to appeal to the aesthetic side of a product.

WPI Student Interest for Industrial Design Courses

In our Survey [Appendix D] we asked the participants about specific Industrial Design classes and how interested they would be in taking each of them:

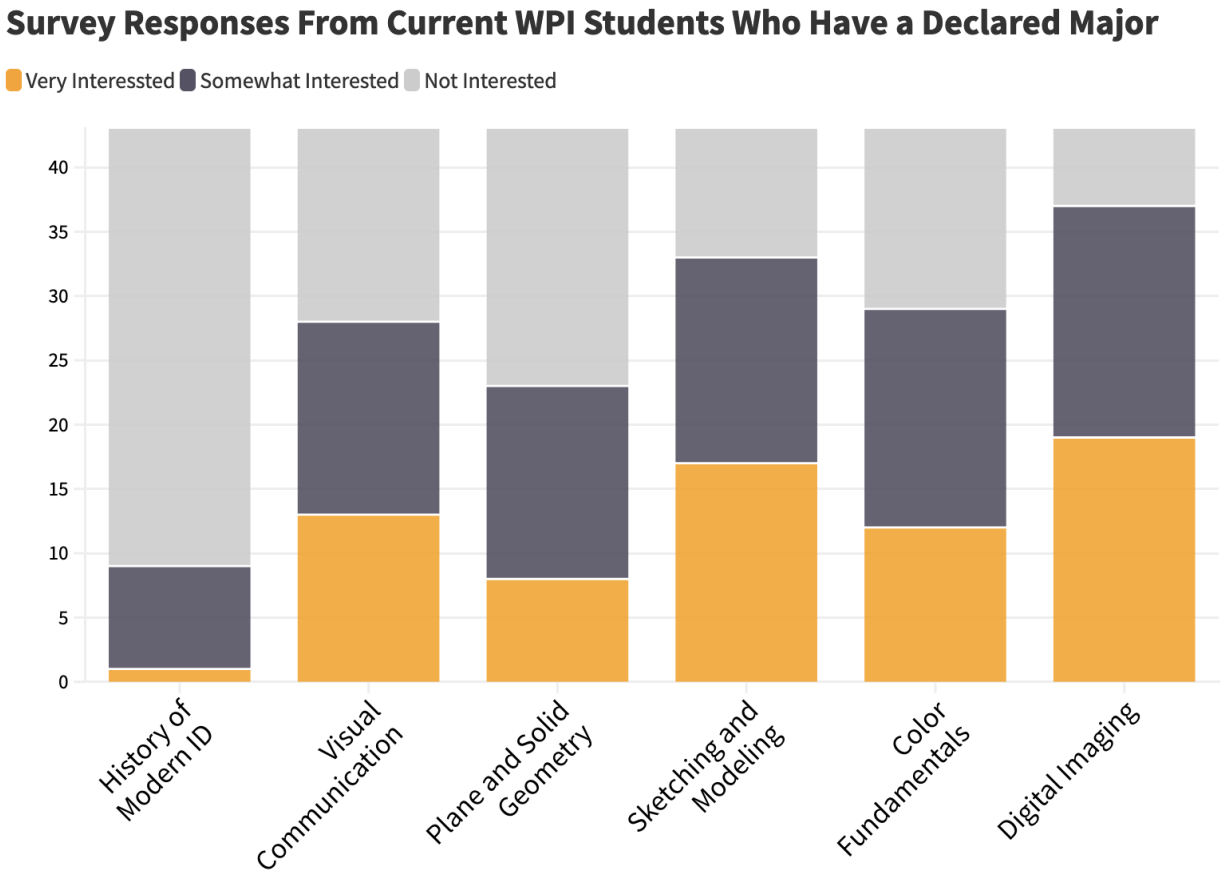

Figure 3: WPI Student feedback on interest levels in proposed Industrial Design courses at WPI.

These results from figure 4 were more for our information regarding what classes students were interested in, however this gives us an indication that there are many students who are strongly interested in taking these Industrial Design courses with over 50% of participants expressing interest in all courses except for History of Modern ID.

Sample Undergraduate Schedule

From our proposed courses, we constructed a sample undergraduate schedule to demonstrate how an incoming student could create a four-year plan at WPI.[Appendix E]

Year	A Term	B Term	C Term	D Term
First Year	Design Basics Mathematics HUA	Sketching (HUA double count) Intro to CAD Social Science	ID Elective Aesthetic CAD HUA	1000 lvl Mat Studio Movement Modeling
Second Year	Graphic Design 2000 lvl Mat. Studio HUA	Visual Communication 2000 lvl Mat. Studio Color Theory	Design Factors Sketcing for Design Free Elective	Design Methods HUA Capstone 2000 lvl Mat. Studio
Third Year	Manufacturing Digital Painting 3000 lvl ID Studio	Marketing/Business in Design Advanced CAD 3000 lvl ID Studio	ID2050 Free Elective Social Imps. of ID	IQP IQP IQP
Fourth Year	MQP Communication Design 3000 lvl ID Studio	MQP 4000 lvl ID Studio Free Elective	MQP 4000 lvl ID Studio ID Elective	UX ID Elective Customer Product Relations

Figure 4: Table showing a sample undergraduate ID program schedule.

In this schedule, we have broken up studios into Materials studios (1000 and 2000 level), and ID studios (3000 and 4000 level). In materials studios students are working with a specific material, and in ID studios multiple materials are used, and work is more individual. At the 1000 level, students will be working with small projects involving paper and 3D printing. At the 2000 level, students are introduced to laser cutting and computer-aided prototyping. At the 3000 level, specializations are introduced through integrated work, and finally at the 4000 level, work is totally integrated and at the industrial scale.

Tracking Sheet

Below is a tracking sheet we have created that would help guide students through the requirements of the undergraduate ID program proposed above, also seen in Appendix E. We have included the core areas of all majors at WPI, being Humanities, IQP, MQP, PE, and free electives, and have also included areas specific to the ID program such as: ID Studios, Sketching/Drawing, Design Theory, Business/Marketing, etc.

	Course	Term	Grade	Units	
	Sketching/Drawing			2/3	
1	Sketching for Design			1/3	
2				1/3	
	Design Theory			3/3	
3	Design Basics			1/3	
4	Design Methods			1/3	
5	Design Factors			1/3	
	Visual Communication			1/3	
6				1/3	IMGD 2000 or 2001
	Visual Arts			1/3	
8				1/3	AR 1100, 1101 or 2301
	Business/Marketing			2/3	
9				1/3	
10				1/3	Any two design-based business classes
	General Science			1/3	Any MA, CS [3], DS or
11				1/3	Nat/Eng Sciences [2]
	Math			1/3	
12				1/3	Any MA, DS
	CAD/CAM			3/3	
13				1/3	
14				1/3	ES 1310, ES 3323, ME 3820, or Aesthetic CAD
15				1/3	
	ID Studios			8/3	
16				1/3	Any Studio
17				1/3	Any Studio 2000+
18				1/3	Any Studio 2000+
19				1/3	Any Studio 2000+
20				1/3	Any Studio 3000
21				1/3	Any Studio 3000
22				1/3	Any Studio 4000
23				1/3	Any Studio 4000
	ID Electives			4/3	
24				1/3	
25				1/3	Any ID Courses not listed above
26				1/3	
27				1/3	

Figure 5: ID Tracking sheet, 1/2

	Course	Term	Grade	Units		
	HU&A Requirement			6/3	(Maximum 1/3 AP credit)	
28				1/3	Any HU&A	
29				1/3	Breadth (group not incl. focus)	
30				1/3	Focus	
31				1/3	Focus	
32				1/3	Focus 2000+	
33				1/3	Focus (Inquiry/Practicum)	

Focus areas: AR, MU, EN/WR, EN/TH, HI/HU/INTL, PY/RE

ID classes can be double counted as HUA requirements. EX: AR1101

Breadth groups: AR, EN/WR, EN/TH, MU, SP/GN/AB/CN, HI/HU/INTL, PY/RE

Alternative HUA Requirement: 6 courses in a single foreign language.

	Social Sciences			2/3		Any 2/3 from:
34	ID 2050			1/3	}	ECON, GOV, PSY,
35	Social Imps of ID			1/3		ENV, SD, SOC, SS,
						STS or ID
	IQP			3/3		
36				1/3		
37				1/3		
38				1/3		
	MQP			3/3		
39				1/3		
40				1/3		
41				1/3		
	PE			1/3		
				1/12		
				1/12		
				1/12		
42				1/12		
	Free Electives			3/3		
43				1/3		
44				1/3		
45				1/3		

NOTE: WPI requires 45/3 unique units to graduate. Shaded HU&A courses above may be double-counted, provided additional courses are taken to meet 45/3 minimum and all degree requirements.

Use the spaces below to record courses taken to compensate for double-counting, unassigned AP credit, courses taken towards minors and/or double majors, and other credit earned beyond the 45/3 minimum.

Additional Classes

Figure 6: ID Tracking sheet, 2/2

Graduate Education

For our interviews with professor at IIT and our research of the top master's programs we have seen that unlike the undergraduate program where students are given a lot more freedom with their courses and specialization, for the graduate program the students are expected to already have a solid foundation, so classes are more open-ended and individually focused, with a mixture of studio and theory classes. We have also seen universities like the Royal College of Arts, London with a more unit-based approach, leaving the structure of courses primarily to the students. Sample curriculum for the graduate schools can be food in appendix B

Foundational Courses (Recommendation)

For students in the graduate program that do not have any formal education in design, we recommend introducing foundational and fundamental courses to fill in the gaps. These courses should be pre-set. Based on the selection process and design portfolios of the students the courses should be made mandatory for the students to gain knowledge and experience that they may have missed.

Dual Degree (MDes + MS/MFA) (Recommendation)

Like RISD and Brown's Dual Degree Program, this program provides students to develop and integrate diverse spheres of academic and artistic interests. In such programs students interested in combining fields such as design with sciences, product design with mechanical engineering, etc. are offered intensive, specialized education in the category of arts and industrial design with comprehensive concentrations in social science, physical, and life sciences.

Dual Degree (MDes + MBA) (Recommendation)

Like IIT's Institute of Design, we recommend a dual degree program, where students would acquire a Master of Design alongside a Master of Business Administration. This program combines a user-centered, method-based approach with basic management coursework. As a result, this curriculum is suitable for individuals who want to lead collaborative, multidisciplinary innovation projects in global enterprises. For WPI, the MBA would be acquired through the School of Business. The curriculum should provide students with real-world skills needed to integrate, interconnect, and innovate beyond the current practices of design, with sample credit system of 42 design credit (without the foundation courses) and 36 Business credits to graduate in 2 years with a dual degree.

Infrastructure

The success of an Industrial Design program partly comes from the facilities and resources available to students. We analyzed what was available to industrial design students at other universities as well as what exists already at WPI to create a comprehensive list of important resources that can be used for an Industrial Design program.

Studio and Workshop Spaces

Due to its inherent functional model, Industrial Design education is largely taught using a project-based educational model. This model intertwines theory of design with practical design, ensuring a rounded design education. The studio is the conventional style of instruction in design curricula. It acts as a shared environment in which students are given issues and tasks to solve through a process known as "reflective practice", described as "a dialogue of thinking and doing through which [students] grow more skillful" (Schön, 1983). Because it seeks to combine numerous curricular areas within a project-based approach, the design studio is usually regarded as the core of the curriculum (Pektas, 2012). From our interview with professor at IIT we have learned that Industrial design students that use shop space as part of the overall studio space will benefit from working through ID problems. This is because the making environment, which emphasizes hands-on manual skills, provides information and a form of learning that no technology can duplicate. The team has benchmarked various studio spaces and workshops offered by universities with Industrial design programs, as well as investigated which of these resources exist at WPI to determine which resources could be used by or acquired for the ID department. We would recommend creating a **new woodworking location** since the existing one is geographically separated from other maker spaces and studios, and already used by theatre to create sets. Additional we recommend adding **Plastic and Textile Shops** to further enrich the ID curriculum

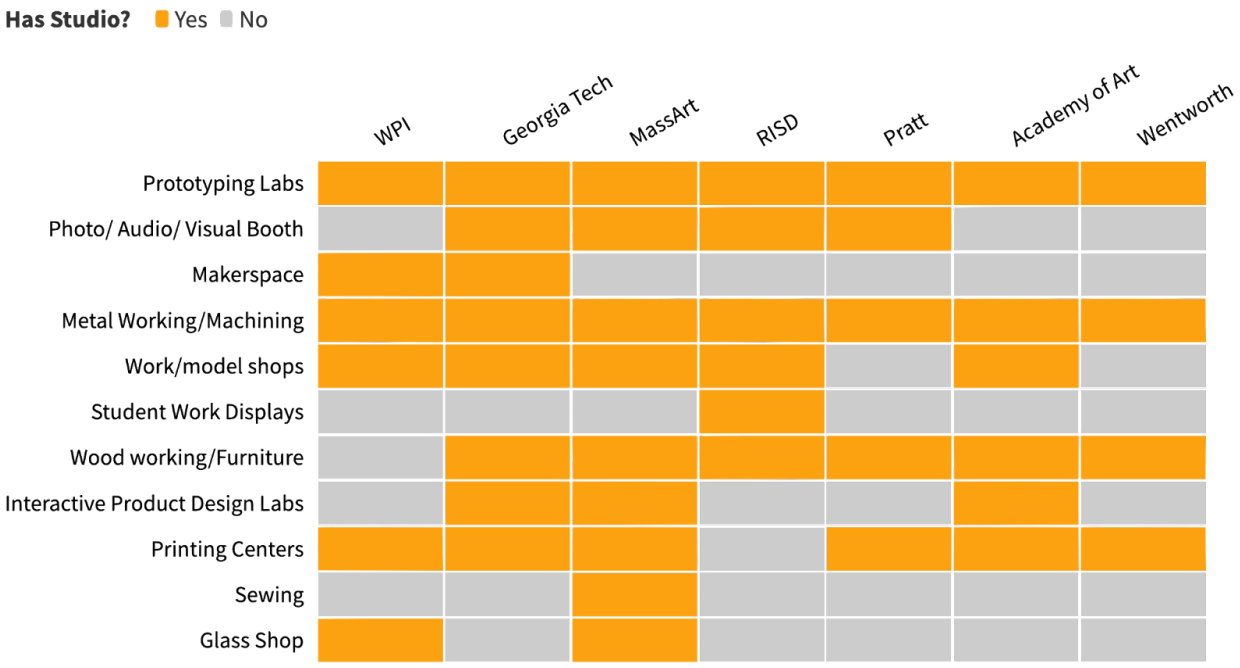

Figure 7: Table showing which studios and workshops different schools have.

Centralizing Makerspaces and Storage (Recommendation)

WPI currently has prototyping labs at innovation studio, Higgins's Labs, and machining labs in Washburn labs. We also have the various computer lab location at Stratton Hall, AK hall,

Salisbury Labs, and the library where students can work on their design. We also have the Worcester for crafts (outside map) for ceramics, glass/hot shop. Our recommendation, in addition to introducing new resources for the ID program, would be to **centralize these resources for larger integrated** projects that utilize them. Additionally we suggest introducing centralized storage spaces for design projects so that students have a space to store their work.

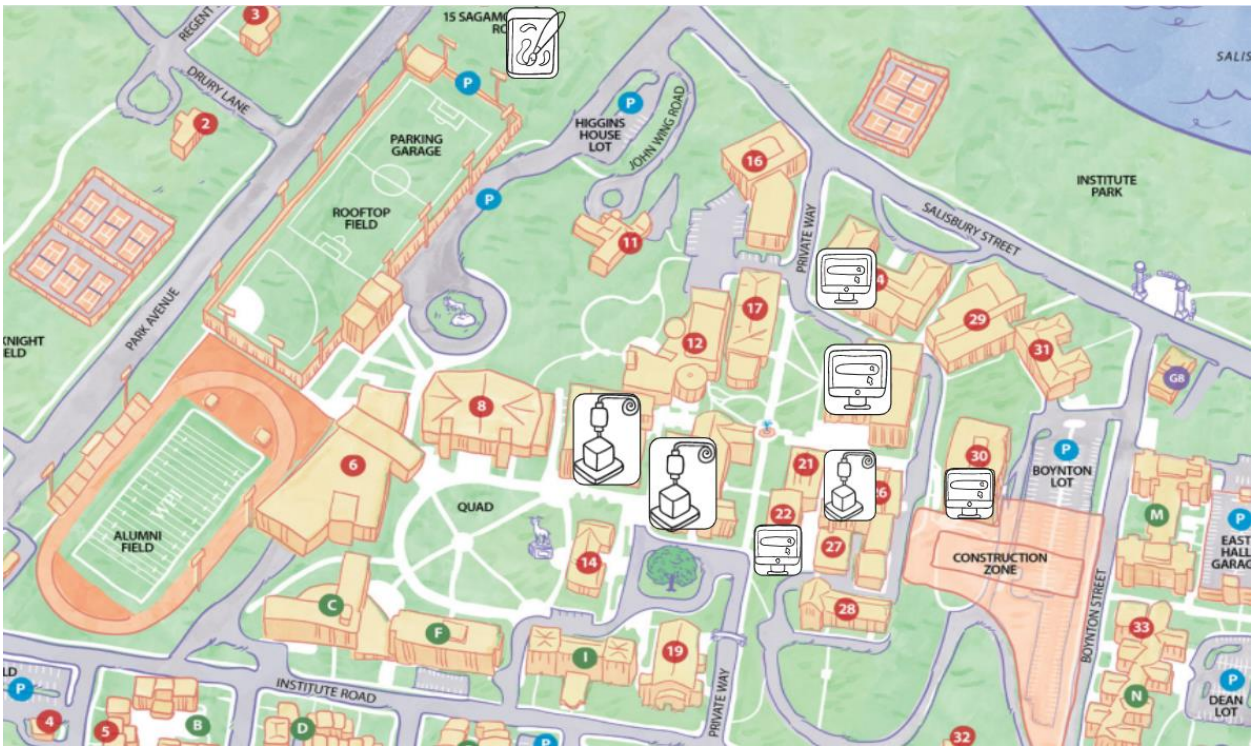

Figure 8: Map showing current WPI resources that can be used for the ID program.

Software

The advancement of computer technology has resulted in the creation of a computer assisted industrial design (CAID) idea and software to support it. These programs assist designers in gathering information, sketching, 2D design, 3D design, prototyping, and visualizing the design process. Using CAID software is not a matter of personal preference for industrial designers; rather, it is a professional obligation, as it can accelerate the design process, help share the design with others while efficiently managing the design process. Other than having benefits in the design process, knowledge of CAID software has a good influence on the recruiting process as well. (Dönmez, 2013). Shown below is a detailed list of software currently used. What's important to note here is that WPI already owns the vast majority of currently used ID software, so no additions would be necessary.

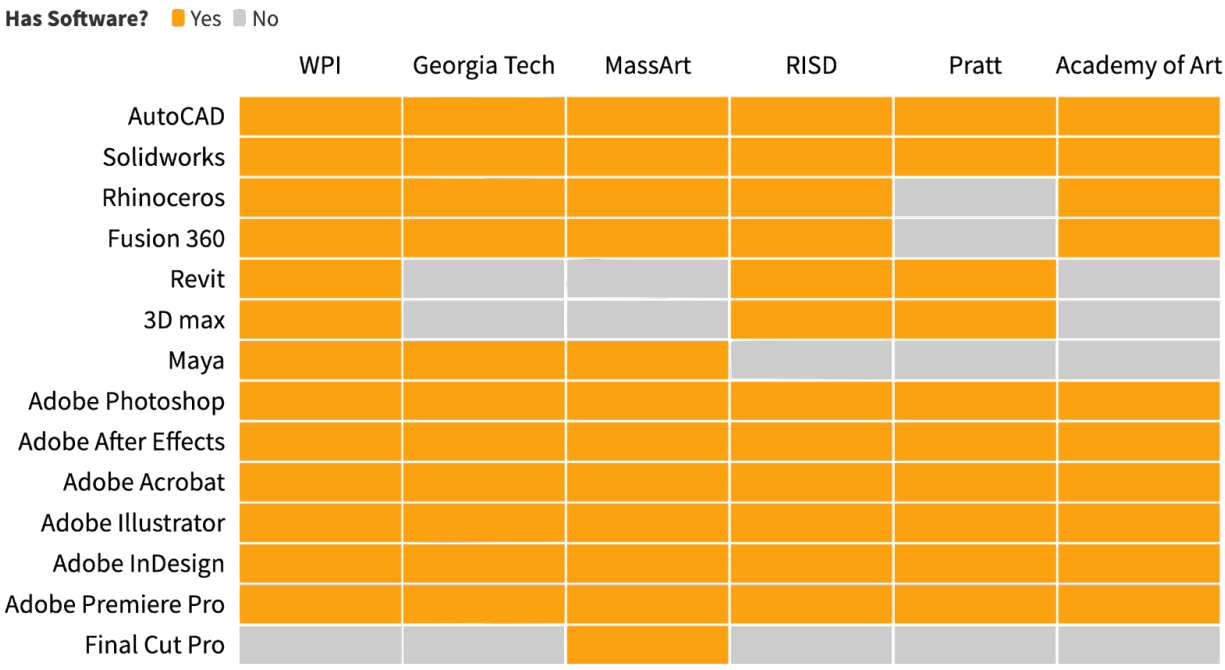

Figure 9: Table representing which software different schools have.

Extracurriculars

Along with the normal course structure of the Industrial Design program, some extracurricular workshops and presentations can be beneficial to students both inside and outside the program. During our research and interviews with professors at various universities, we found that there were not many opportunities for extracurriculars in the Industrial Design program. WPI has many programs already in place that ID students will most likely be interested in.

WPI has an advantage in providing extracurricular activities to ID students through our **Innovation and Entrepreneurship Center.** The I&E Center has many programs available to all students that focus on entrepreneurial and innovative thinking through skill-based workshops, seed funding, mentorship, innovation challenges, networking opportunities, hands-on projects, and more through programs like Tinkerbox, WinterSession, Embark etc. Visiting speakers, conferences, and seminars are of particular importance in an industrial design program. Not only do they provide interesting and innovative intellectual possibilities; listening to and talking with renowned designers can provide immense intellectual and creative stimulation for students in the school. A particular emphasis for all such events will be interdisciplinary perspectives.

WPI has several **student clubs** like Art and Design Club and We Art Good (Mural club), that assist and appreciate art and design in the WPI community that would provide enriching experiences and opportunities to the incoming Industrial Design students.

The IMGD department provides opportunities to upperclassmen as well as graduate students to attend free, not-for-credit classes under the tutelage of industrial professionals to try their hand at some aspects of the industry and receive **one-on-one critique with experts** in their fields.

In addition to the usual campus activities, we would recommend that WPI host Bi-Annual/Annual **Student Design Exhibition** featuring the work of the junior-, senior- and graduate-level design studios that will support the exposure of their work. Through our research we have seen that most of the universities that we looked at promote their students work through such displays. The school's yearly design exhibition will acquaint students with each other's work while also showcasing it to potential employers and the community. We suggest that this event be attended by professionals in the design industry to expose the students to potential employers, with studio sponsorships, internships prizes and sponsored projects.

For the **Career Fair** hosted for the students and alumni, we recommend extending the current career fair, inviting employers and industrial design related firms to provide an opportunity for the students from this program. We also recommend additional help at CDC for design portfolio.

Budget

In this chapter we will go over a table of expected resources and their respective costs, giving a total estimated cost for the implementation of an Industrial Design program at WPI.

Studio Spaces
This entails the necessary studio spaces and their respective machinery necessary for a successful Industrial Design program.

Software
Through research and benchmarking other universities' software requirements for their Industrial design program, an inventory for the needed software was prepared. The WPI Hub software library currently has all the Computer Aided Industrial Design software (installation and license information). There is no additional cost to acquire this software for the curriculum or student needs.

Hardware
This entails the estimation for the additional hardware required or recommended for general coursework as well as ID related student projects such as machinery, tools, high wear resources that need to be replaced in a certain period to avoid inconvenience and damages to the students and the instruments.

Shops
Because we recommended adding new shops, this area was too difficult to estimate the cost for. This would depend on how new shops are implemented, and whether other makerspaces need to be relocated.

Faculty
This section includes the financial estimate for Industrial Design professors teaching the courses as well as TAs and PLAs required for those courses. This also includes the cost for administrative assistant required for the Industrial Design Department.

Conventions
This section details any expenses that would need to be made towards mandatory events. Similar to how the IMGD program is required to show up at PAX East, the ID program will have to make mandatory appearances at conventions.

Student Life
This section highlights the fact that student life will be an additional expense, specifically quality of life events such as social gatherings, as well as educational opportunities such as speakers.

Course Resources
This section refers to any expenses that go towards resources that would be used in Industrial Design Courses. Some of these expenses would be the cost of teaching the course, Raw materials for 1000 level ID courses, and rental fees for any machines or equipment the professor would need to rent to run the course.

Below, we have included tables for budget allocations for both the undergraduate and graduate programs. In the graduate program budget sheet, the differences from the undergraduate program are highlighted. The estimated minimum cost for an ID **undergraduate program** is expected to be around **$850k**, while for a **graduate program** this minimum cost would be around **$660k**.

Category	Name	Estimated Expense	Comments
Studio Spaces	Relocation of Workshops	$20,000	Wood + Metal shops should be together. **Not feasible for woodworking to be so far away. Also wood is being used by theatre already.**
	Capital Funds		Building buildings, rooms, restructuring
	Paid Organization(s)	$100,000	Possibly pay an organization (worcester crafts) to set up studio spaces
Software	None	$0	
Hardware	Computer Hardware		I&E Replaces computer hardware every 3 years
Shops			"Totally Different"
Faculty	6 ID Professors	$510,000	One professor can teach 4 classes and/or sections
	2 TAs	$100,000	$50k/year/TA (tuition, benefits and stipend)
	16 PLAs	$16,800	10h/week 7 weeks per term. IMGD pays 35k for PLAs each year
	Administrative Assistant	$55,000	
Student Life	Pizza days	$1,000	
	Speakers	$2,000	
	Socials	$5,000	
Undergraduate Program	MQP	$12,000	Only have to pay for faculty, since students get $5k. $6k per MQP. 2 MQPs per year?
Course Resources	Adjunct	$5,000	Amount per class to teach
	Literature/Databases	$1,000	
	Raw Materials		WPI Buys recourses for 1000 level courses to reduce barrier to entry
	Rental Fees	$20,000	
	Grand Total	$847,800	

Figure 10: List of undergraduate budget allocations separated by category.

Category	Name	Estimated Expense	Comments
Studio Spaces	Relocation of Workshops	$20,000	Wood + Metal shops should be together. **Not feasible for woodworking to be so far away. Also wood is being used by theatre already.**
	Capital Funds		Building buildings, rooms, restructuring
	Paid Organization(s)	$100,000	Possibly pay an organization (worcester crafts) to set up studio spaces
Software	None	$0	
Hardware	Computer Hardware		I&E Replaces computer hardware every 3 years
Shops			"Totally Different"
Faculty	4 ID Professors	$340,000	One professor can teach 4 classes and/or sections
	2 TAs	$100,000	$50k/year/TA (tuition, benefits and stipend)
	0 PLAs	$0	
	Administrative Assistant	$55,000	
Student Life	Pizza days	$1,000	
	Speakers	$2,000	
	Socials	$5,000	
Graduate Program	GQP	$12,000	
Course Resources	Adjunct	$5,000	Amount per class to teach
	Literature/Databases	$1,000	
	Raw Materials		WPI Buys recourses for 1000 level courses to reduce barrier to entry
	Rental Fees	$20,000	
	Grand Total	$661,000	

Figure 11: List of graduate budget allocations separated by category, with the differences from the undergraduate program highlighted.

The amounts for TAs and PLAs were determined by hand by looking at which courses would require such faculty. The only difference for graduate programs would be that there are no PLAs.

Accreditation

WPI should prepare to apply for accreditation from the National Association of Schools of Art and Design (NASAD), which accredits art and design schools in the United States. Although not all design schools with the industrial design program are NASAD-accredited, a well-rounded and rigorous curriculum may be ensured through accreditation evaluation as well as enhance the reputation and legitimacy of a successful Industrial Design program.

Department Structure

We recommend WPI collaborates with the IMGD department and Professional Writing Program (renaming it Communication and Media Design) to make an integrated design unit, with established coursework with NASAD guidelines in affiliation with UX and Architecture design (Figure 12). We understand that IMGD is already pursuing accreditation, so we recommend that this be put on hold until the actualization of the Industrial Design degree to apply in conjunction. Pursuing the accreditation in the future with other departments will guarantee that the curriculum and program communications have been polished, improving the chances of a successful NASAD evaluation.

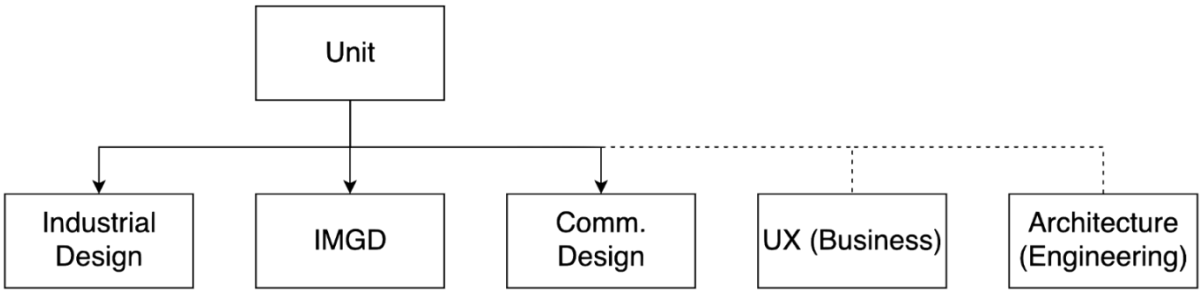

Figure 12: Diagram of proposed Design department structure.

WPI Differentiators

As with most experiences at WPI, an Industrial Design program has potential to stand out among other top programs in the area. There are a few aspects of this program that can make ID at WPI unique. First, WPI is a technical school. This means that students develop **a strong technical skill set** when they come to WPI, which is important to their future careers. This also allows for interdisciplinarity throughout the program. Many universities with an ID major are heavily design focused and lack the technical expertise that WPI students develop over their time at university.

Second, WPI has already established a **global projects program** in the form of IQP. This means that our design students can have the opportunity to complete a design-based project in a different area of the world. This global experience will be an extremely important aspect of this program as students as there are many benefits for a design student to be able to go abroad. They get the opportunity to study art and design in another area of the world which will show them new ideas and how culture can have an impact on design.

Finally, WPI has a strong **business program**. Based on our research and interviews with professors at some universities (See Appendix A & B), a strong business base can make our ID program successful and unique. In the industry, most design is done in a group as part of a larger organization, so it is important to have skills related to business to be successful. Industrial Design also involves bringing new products to the market. Having knowledge and understanding of the market will be important when designing products for a company.

Next Steps

Our campus and current curriculum provide a good base to build a strong Industrial Design program and have the potential to be extremely successful. In this section we outline what the next steps should be in creating this program. These are what we consider to be the most important first steps to take in terms of resources and structure for the program.

First, this program has the potential to be successful at both the undergraduate and graduate level. Each program has different advantages and could work well at WPI. We would recommend the **implementation of one of these degrees** rather than both. Implementation of both would be very costly, and students would have more limited access to resources and facilities such as different labs and studio spaces. Our current infrastructure cannot support that many students resulting in the studio spaces becoming really cramped.

Next, we would recommend the **addition of workshops** like carpentry/woodworking shops as well as plastic and sewing shops. Woodworking is extremely important to ID as we have observed from many universities. WPI has a small carpentry shop, but it is almost exclusively used by the theatre department as well as being far from the main campus. This would be difficult to convert to a usable woodworking space for ID students so the addition of new shops would be the best solution.

Along with this, we recommend **centralizing the makerspaces** and studios that would be available to the Industrial Design department. Currently, many resources that WPI already has are spread throughout campus, with many of the computer labs, prototyping labs, and other makerspaces in various buildings. For an Industrial Design student, this could be an issue when completing a project that requires the use of many different resources. Having to travel all around campus with your project is not only time consuming, but also risks the integrity of the project. Centralized resources would allow students to have easy access to all the machines and lab spaces they might need. This will be especially crucial for a graduate level program, as these students will be working on higher level projects that will require access to more resources.

Another step in this process would be to **hire more professionals**. We will need to hire ID professionals to teach the wide range of courses we recommended be added to the program. Some current WPI faculty are qualified to teach courses within the ID program, but it would be wise to hire new faculty that have experience in teaching Industrial Design.

Finally, the **market study** concerning Industrial Design at WPI would need to be completed. This market study will assess if the program will be profitable and gauge student interest in the program. We will need to know how many students are interested in this type of degree program to ensure our resources can support all the students. This will also give a more definite estimate as to how much this program will cost.

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Appendices

Appendix A: Consultation Process

This proposal was created in collaboration with a diverse group of professional and academic designers. Some of them hold professional appointments in departments of Industrial design at universities like IIT, Pratt, etc.; others are WPI faculty that consulted us regarding the Industrial Design program requirements.

Interview Questions for Matthew Mayfield
[Associate Dean & Senior Lecturer at IIT School of Design]

A. We are so excited to interview you, especially because the IIT Institute of Design is a leading school in design. We are particularly excited to look at IIT because you guys are a tech school. WPI has a number of design degrees such as Interactive Media and Game Design and User Experience Design, and is looking at expanding into ID. We are interested in understanding how to start building our ID program meaningfully. Can you talk about how the Institute of Design fits into IITs broader curriculum? What are some of the challenges & some of the opportunities that come with this?

B. We understand that you lead curriculum development at the Institute of Design. Since we are building an ID program from scratch: what should we be thinking about? Tying into that, if you had the freedom to do anything with your curriculum, what would you add?

C. This is what we're thinking about in terms of curriculum, is there anything that we're missing? We were also thinking of potentially putting a focus on business & customer relations into our degree program. We know that IIT has an MBA. Do you have any insight on this?

D. What are the challenges and possibilities students are faced with in projects you provide, and what do you hope they gain from them?

What kinds of skills and ways of thinking do you want to emphasize to students through course work?

1. Are there any opportunities or workshops for students not enrolled in the Institute of Design to be introduced to the design mindset? If so, are these programs successful?

E. In your opinion, what makes IIT unique and so successful as a school of design?

Minutes Link

Interview Questions for Lawrence Au
[Lecturer at PRATT]

A. We are so excited to interview you, especially because of the success of Pratt's ID program. WPI has a number of design degrees such as Interactive Media and Game Design and User Experience Design, and is looking at expanding into ID. We are interested in understanding how to start building our ID program meaningfully. Can you talk about how Industrial Design fits into Pratt's broader curriculum? What are some of the challenges & some of the opportunities that come with this?

B. Since we are building an ID program from scratch: what should we be thinking about? Tying into that, if you had the freedom to do anything with your curriculum, what would you add?

C. What are the challenges and possibilities students are faced with in projects you provide, and what do you hope they gain from them?
D. Does the ID program at Pratt provide opportunities of collaboration with other fields?
E. Are there any opportunities or workshops for students not enrolled in the ID program to be introduced to the design mindset? If so, are these programs successful?
F. In your opinion, what makes Pratt unique or so successful as a school of design?
G. How do you think the students can get more exposure for their projects?
H. Since the field of ID seems to be changing over the years, how do you suggest we tackle this issue, in terms of courses and skills taught to the students
Minutes Link

Interview with Adam Sears
[**Director, Innovation Studio Technical Operations, Innovation & Entrepreneurship**]

Minutes Link

Interview with Mitra Varun Anand
[Makerspace Advanced Technology & Prototyping Specialist, Innovation & Entrepreneurship]

1. Here are the resources that we looked at, from other universities' ID program [Show him the chart]. What resources does WPI currently have that could be utilized in an Industrial Design curriculum, and what would you suggest is vital for this program to be successful at WPI?
   I. Can you tell us about the design class you are currently teaching or planning on introducing to WPI?
   II. Could these classes be beneficial to the industrial design program?
   III. We intend to introduce a number of studio classes in our program. Would you be willing to join the industrial design department as a professor to teach some of these classes?

Minutes Link

Appendix B: Industrial Design Sample Curriculum

During the process for creating this proposal, many programs at other universities in the U.S, Japan, Taiwan, U.K., and Italy were examined. We looked at the course schedule for Industrial design students throughout their degree program and sorted the common core courses and themes that are essential to the ID program at WPI.
Link

Appendix C: Industrial Design Sample Facilities and Resources

During the process for creating this proposal, many programs at other universities in the U.S, Japan, Taiwan, U.K., and Italy were examined. We looked at the resources and facilities that Industrial Design students had access to for their coursework as well as ID related projects. We sorted the common facilities and resources that are essential to the ID program at WPI. This also includes an inventory of the WPI resources that can be utilized and what WPI needs.
Link

Appendix D: Survey for Student Interest

This appendix presents the questions and results acquired by performing a survey with the students currently enrolled at WPI to gauge interest in the ID program
:

4. Do you think that design education is an important part of STEM?
5. Do you feel there is a lack of Design education in WPI STEM programs?
6. Would you like design education to be integrated into courses currently offered at WPI?
7. Would *you specifically* be interested in an Industrial Design MAJOR at WPI?
8. Would *you specifically* be interested in an Industrial Design MINOR at WPI?
9. Would *you specifically* be interested in an extra-curricular Industrial Design certificate program?
10. Given your current major, would you be interested in taking a certificate program focused on one of these topics to enhance your degree…

Here are some of the anonymous responses that participants gave:

- I design components every day for work and WPI didn't teach me anything about it.
- A lack of design education can lead to students missing out on educational/job opportunities related to design. Additionally, design education may cause a student to take interest in improving end user experience.
- Designing products to be usable and with the user's interests in mind is important to create good and successful products.
- Design is important in tying art with STEM and creating things that are not only functional but appealing in form and style.
- Form has a place alongside function in bringing out the success of a tool.
- Engineers often focus on development but lose sight of how important the design stage is. You can't make anything efficient if you haven't planned it out, otherwise you waste valuable time and resources.
- If it's used in basically everything then it's worth learning about!

Link

Appendix E: Sample Tracking sheet for ID major and scheduling

Tracking Sheet Link

Sample Schedule Link