An Integrated Design and Management Program for Taiwan

By

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Abstract

With the continuous exploration of technology, the problems that various companies will encounter in product development are becoming more and more complex. The issues we face cannot be solved by technology or knowledge in one field. Due to the need for cross-domain problem-solver, many top universities in Europe and the United States have created a design, engineering, and business program. This research names this kind of program an 'integrated design' program. It aims to train a leader with cross-disciplinary talents.

As the 21st largest economy globally, Taiwan has been widely known for its excellent OEM and IC manufacturing in the past few decades. In recent years, both the government and private enterprises have invested a lot of money in creating brands. They hope to make these brands go international for more significant economic benefits. This is a substantial increase in the demand for talents with integrated design in the product design or production process. This research analyzes whether Taiwan needs this type of program from many perspectives: The individual needs of students. This research explores personal and professional needs. Taiwanese Brand Potential. There is a significant demand for talents with integrated design in Taiwan's business community. After confirming that Taiwan is suitable for developing this program, review similar programs in several well-known universities globally, formulate a set of program structures exclusive to Taiwan and write an implementation plan. Finally, a case study is conducted on the NTU D-school, which is most similar to the integrated design program in Taiwan.

Thesis Supervisor: Warren Seering
Title: Professor of Mechanical Engineering; Weber-Shaughness Professor

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Chapter 1 Introduction

1.1 Motivation

Integrated design programs with Human-centered design as the core value are the current trend in international education. It can not only cultivate cross-field talents but also directly solve the more and more complex problems in today's product development. As the 21st largest economy globally [1], Taiwan has many world-renowned brands and technologies. Currently, there is no integrated design program in higher education. Taiwan has an excellent industrial foundation and talents in design, engineering, and management, which are very suitable for developing this program.

The following three are the most important reasons for the initiation of this study:

(1) Solve cross-domain problems in product development in Taiwan

With the global flow of information and the rapid development of products, companies are faced with different challenges every day. Challenges may come from competition in the industry, feedback from consumers, or internal coordination with vendors. Issues faced by decision-makers are no longer limited to a single-field knowledge. The problem to be solved or the decision usually requires connecting two to several fields. Most companies have developed mature management systems and a solid engineering knowledge base, with the ability to solve problems and have the corresponding answer database.

However, if we want to comprehensively apply the knowledge of these two aspects and make planning, very few people have cross-domain decision-making ability, and most of them rely on the accumulation of their own work experience. Although it is possible to cultivate cross-disciplinary talents through the accumulation of workplace experience, the overall process is too long. If Taiwanese universities can cultivate cross-disciplinary talents through education and cooperate with enterprises to solve problems together, the industry will be accelerated.

(2) Enhancement of Taiwan's brand value

Taiwan started as an OEM(Original Equipment Manufacturer) , but as early as 30 years ago, the government and private enterprises realized that the OEM industry has disadvantages in future development or profit. So they began to develop Taiwan's brands and sell them worldwide. According to the Taiwan government, the most valuable Taiwanese brands with more than 10% market share in personal computers, gaming laptops, and bicycles. The Industrial Bureau of Taiwan's Ministry of Economic Affairs pointed out that to reduce the risk of chain disconnection in the global supply chain in 2020, it will shift from cost considerations to short-chain and multi-chain methods for stability. Taiwanese companies have excellent technologies, products, and services and play an important role in supply chain restructuring. The total value of the top 20 brands is 10.066 billion US dollars, which is a 5% increase compared to last year against the trend. After 2013, Taiwan's brand value stood at 10 billion US dollars.[1][2]

(3) Let Taiwan's young generation get their way

Return to the essence of education. The integrated design program can make young students no longer be hesitant—for instance, a student with a high interest in product design. However, there was no particular program focused on human-centered design in Taiwan. A successful product must have an excellent internal engineering structure and external appearance. It brings an extraordinary experience to users in terms of appearance and functionality. However, there is no department focusing on product design and management among university departments in Taiwan. Taiwan can establish a program with human-centered design as the core and learn across fields soon if there is an opportunity. Let people who have had the working experience have one more choice to enhance their understanding of other disciplines or organizational structures. Let them return to the workplace as coordinators or decision-makers of cross-disciplinary teams. Facilitate the progress of the overall project.

Chapter 2 Background of Integrated Design Program

2.1 Concept of the Program

2.1.1 Program's Vision

The program aims to cultivate decision-makers with cross-disciplinary knowledge, bringing a higher level of creativity to society and business while maintaining vision and integrity. The program imparts knowledge in design, engineering, and management and enables program students to Integrate knowledge in these three areas and learn from each other.

2.1.2 Teaching Team and Student

Students and teachers are made up of design, engineering, business and other fields. Students and teachers can approach problems with different perspectives and generate innovative ideas. Give new definitions to problems and find solutions.

2.1.3 Program's Structure

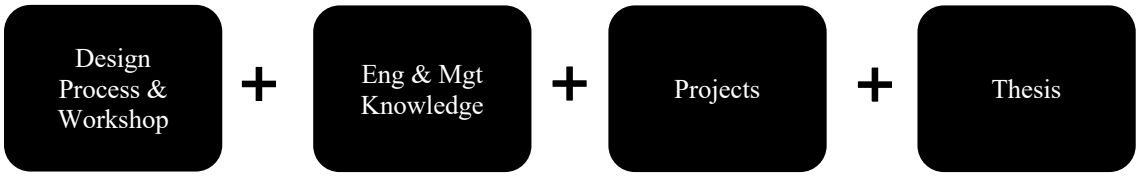

Figure 1. Integrated design program's structure

(1) Design Process:

The program needs to let the students know the product design process in detail because the subsequent team projects will follow this process. Then let students understand the cause and effect of each process and cultivate students' ability to execute the process. From the user research to the user testing, every step cannot be left behind so that students can understand that the entire product design process is not A linear activity but a cycle. There are many knowledge or skills to learn in every design process.

The purpose of the workshop is to learn the tools or skills used to develop various products. From software to hardware tools, all of them will be covered. For example, online brainstorming needs to be familiar with the application of miro or the manufacturing tool machine that needs to be used for physical product prototypes.

(2) Engineering & Management Knowledge

The students of the program may come from different industries. The key issues and core technologies of each industry are different. Schools must ensure that students have access to courses that learn these key technologies they need.

Most of the schools with such interdisciplinary programs are used. There are well-developed engineering colleges and management colleges on campus. In terms of knowledge transfer, students can directly choose to study engineering and management college courses. The colleges plan and deliver courses together.

(3) Project-based

Cooperation through projects allows students from different backgrounds to learn from each other. In this program, the students recruited have work experience and are very diverse. Combining these people to complete the project, they can learn from each other the current problems faced by different industries. Try to think of other perspectives to solve problems. There may be more efficient or creative answers. The project creates a working model in the workplace because the operation of a project initially requires people in various positions to cooperate.

More importantly, many projects will invite companies to cooperate with schools so that students can directly contact the problems facing the industry today. Try to apply what they have learned in the program to the project to verify.

(4) Thesis

Integrated Design program in some schools will require students to write a thesis. However, the specification of the thesis topic is broader than that of classic academic papers. Because the program focuses on product design, the thesis may not be a discussion of academic theory if students want to do a project. It is also acceptable.

The program encourages students to use the thesis to explore topics of interest to them. Alternatively, they can take advantage of the opportunity to write an academic dissertation to collaborate with the industry in research to help solve technical issues. The program encourages students to have empathy, social service, and education. It is also an area where students are encouraged to invest.

2.1.4 Social Impact & Connection

School education must be in line with the industry in order to be able to transfer what they have learned into the industry to achieve substantial help. Students in this program have work experience and may also return to school with some problems to learn related skills to solve. The program should use its own or school relationships and resources to attract industry companies to conduct industry-university cooperation. Students can get in touch with the most real-time industry information in classrooms or projects to maintain their relationship with the industry. The connections established during the cooperation period can also positively impact the employment of students after graduation.

In addition, as future leaders, the students need to consider whether they can bring a positive impact on society. For example, whether the product design that students input can solve infectious diseases or food problems.

2.2 Existing Integrated Design Program Analysis

2.2.1 Integrated Design and Management – MIT [3]

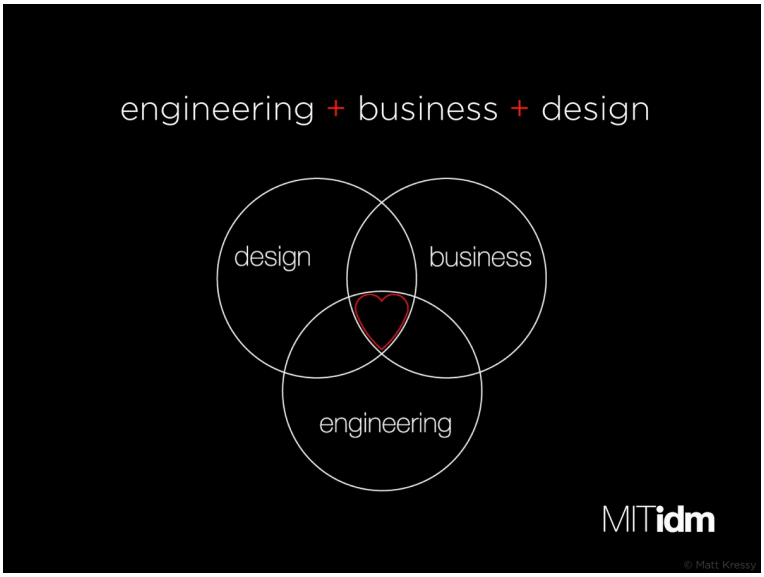

Figure 2. MIT IDM's venn diagram

Integrated Design and Management (IDM) program has its own laboratory. It can be used by students in different stages of group projects. Students from design, engineering, and business backgrounds collaborate on projects. Want to use state-of-the-art manufacturing tools. Lay the foundation for success.

IDM's faculty and students consist of three fields: Engineering, Business, and Design. Through the interaction of their different perspectives, students learn to appreciate and incorporate the values of other disciplines into their work. A successful product project needs to combine engineers, designers, good managers, and market planning to achieve the final success. There will be many complex and challenging to define problems in product development. IDM is

committed to Cultivating leaders with cross-disciplinary talents and letting these leaders bring higher creativity and vision to the enterprise and society.

2.2.2 The Master of Design (MDes) – UC Berkeley [4]

The Master of Design (MDes) uses three-semester courses to develop students to emphasize critical design and social practice to address the new realities of emerging technologies in the 21st century. The teaching focuses on three broad areas: Design Theory, Technical Rigor, and Social Practice. This program focuses on emerging technologies such as AI augmented reality or the Internet of Things to plan new types of human environments and communities and discuss ethical issues and solutions that may arise. To respond to these dynamic issues more comprehensively, industry leaders (maybe designers, engineers, business professionals) need to reach out and learn more methods and have updated toolkits.

2.2.3 Integrated Product Design (IPD) – UPenn [5]

With Human-centered design as the core, the three fields of design, engineering, and business are applied to product development. Integrated Product Design offers two degrees, the Master of Integrated Product Design (M: IPD) & the Master of Science in Engineering in Integrated Product Design (MSE: IPD). Students who are pursuing other degrees can apply Certificate in Integrated Product Design.

The above three different degrees and certification methods focus on slightly different directions. M: IPD is aimed at students from the three backgrounds of design, business, and engineering and in-depth study of the original major. You can also broaden your skillset. MSE: IPD wants to

enhance the knowledge of technology and manufacturing, such as CAD, CAM, and electromechanical integration courses in the disciplines studied initially in engineering at the university. As for the Certificate in Integrated Product Design, which does not provide a master's degree, it can make the product design Interested students can gain a deeper understanding.

2.2.4 Master in Design Engineering (MDE) – Harvard [6]

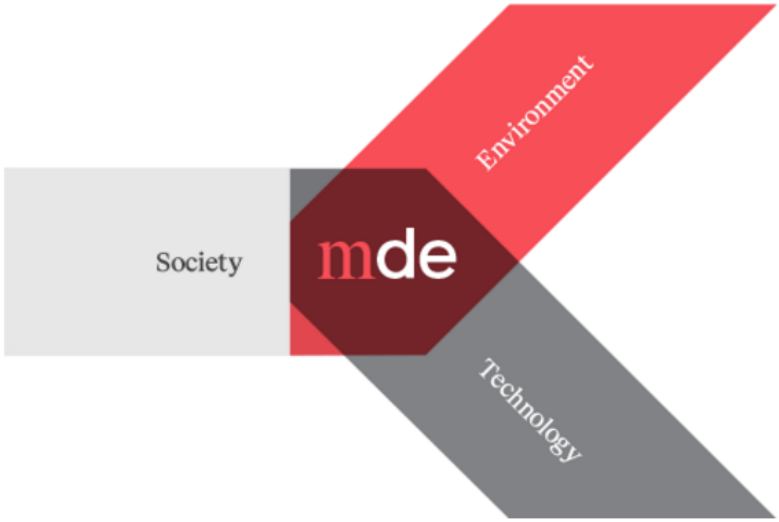

Figure 3. Harvard MDE

The MDE program is co-founded by two schools, the Harvard University Graduate School of Design (GSD) and the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS). Identify critical issues in industry and society and train a new generation of innovators. The four-semester (two-year) program covers design, engineering and business, government regulation and policy, and sociology. Courses in the four areas are spread evenly over four semesters. The instruction further emphasizes collaborative problem-solving. MDE aims to

develop thought leaders in various fields. Be it industry, government, or academia. They study and engage a variety of situations with the technical and critical skills needed to design new forms of intervention and mitigation. It teaches and expects students to develop practical, comprehensive prototypes to address real-world questions.

2.2.5 Master of Integrated Innovation for Product & Serves (MIIPS) – CMU [7]

MIIPS is a two-semester (nine-month total) program offered by the CMU Integrated Innovation Institute. The program emphasizes that People, not products drive innovation. Engage engineers, designers, and business professionals with empathy to address industry and societal challenges. Learn from collaboration to solve cross-cutting problems. And students from different backgrounds should be able to learn from each other about their fields. Engineers need to know how to pitch their inventions. Business people are familiar with manufacturing techniques. And designers need to learn the ability of project communication.

At the same time, the college also provides a master's degree program as well as online degrees and certificates. You can choose the field you want to improve to get certificates, and you can get the corresponding master's degree after getting all the certifications.

2.2.6 Innovation Design Engineering (IDE) – RCA/Imperial College London [8]

The Royal College of Art and Imperial College London have co-founded a unique dual master's program. IDE hoped students could learn the different strengths and cultures of the two schools at the same time.

IDE hopes to achieve creative integration and development in science, technology, and engineering. In addition, the rigor and precision of engineering must be considered. Students will be able to observe critically and not cut into problems with previous design thinking. Through experimentation, research, and development of new technologies, the evolution of engineering capabilities, and close communication with enterprises to develop innovative and influential Power technology.

IDE's feature is to hope that students look at the world with critical psychology. And imagine how to create new experiences for human beings based on the system's dynamics. In this way, economic, cultural, and social values are generated.

2.3 Degree and Certification

The programs mentioned above use in-person teaching as a mainstay. In order to cope with the transformation of the educational mode, many schools have also begun to plan and implement learning methods of different lengths and credit requirements. Offering different kinds of degrees or certification options for students with different needs is the future education trend.

2.3.1 In-person Degree

The three- to four-semester teaching method is currently the most used in programs, and it is also the most fundamental teaching method. In-person teaching allows students to have more connections with the school. Students have a long time to plan their learning process. In addition to the courses, they can also use the semester to do internships in companies. The advantages of the in-person method are as follows:

(1) Better integration into the academic environment: Students can directly interact with teachers and classmates, and participate in other related academic activities held on campus.

(2) Get more on-campus resources: If the student needs a physical product prototype in the product development stage, the in-person method can directly use the on-campus workshop operation, which is convenient for students to familiarize themselves with various manufacturing tools.

(3) Get more community resources: Students can cooperate with local enterprises and get more community help through their studies in school, which is also conducive to entering the workplace in the future.

2.3.2 On-line Degree

Many famous schools such as USC, Purdue, and the University of Illinois[9][10][11] have launched completely online learning and degree-granting teaching methods. Especially after the outbreak of covid-19, the trend of online learning has begun to flourish. It has also made many universities think about how to allow students to study regardless of location. When online degrees become more mature, more people with work experience may be willing to leave the workplace and return to study because they do not need to spend too much time and money studying abroad.

In addition, many programs now take the form of hybrid, and students can choose the length of time to study in person on campus. They can use the time of in-person courses on campus to complete projects with the industry and students. The online class mode can be used to listen to lecture classes. Therefore, students can use the early stage to make up all the knowledge and then go to the school to experience the physical course.

2.3.3 Certification

Professional certificates or course certifications are also a trend in education. Although the division of professional knowledge has become more and more detailed with the evolution of the times, it has also led to the division of knowledge becoming clearer. The companies can clearly express what kinds of people with specific knowledge they want. Students can choose the academic certifications they need based on these requirements. Example: A senior engineer wants to transform his career into a technology PM. He may not need to re-enter the school obtains a master's degree in management. To achieve his goals, he only needs to obtain PM certification through a credible educational unit or school. Of course, professional certification can also be in the form of in-person or online.

Chapter 3 Program User Research

The approach studied here takes the form of Abductive reasoning.[12] Abduction starts with a collection of facts and derives a process of reasoning that best explains it. The term abduction is sometimes used to mean generating assumptions to explain observations or conclusions. Applied to this research, the core idea of this research is that Taiwan needs this Integrated Design program. We have to find different assumptions and application cases (What & How) to confirm this set of facts. I know now that programs like MIT IDM are the current trend in global design education. The trend is 'value.' This type of department is produced in many top universities. According to this trend, the need for such cross-disciplinary talents. However, it is still a question mark how much this value adds to the current situation of Taiwan's industry. Therefore, I must gradually use different frame aspects to collect data based on this concept. There are too many variations in the combination of What and How. We need to develop many different varieties to get there.

3.1 Research Goals

To establish a cross-disciplinary program in Taiwan, we must first know whether Taiwan has this demand. When evaluating whether Taiwan is necessary for the establishment, there are two aspects: industry needs and student needs. These two have a very close relationship. Program users are students. However, when most Taiwanese students choose a program, their future career planning will be considered the most significant factor. However, students do not know which courses or programs are suitable for their needs. So we need to know their talent needs

through industry orientation and by interviewing company executives. The cross-disciplinary talents cultivated by this type of program are suitable for solving complex and multi-faceted problems, especially suitable for product development projects or start-up companies. The goal of this study is to confirm that the Integrated Design Program can meet the following three needs:

(1) Student Personal Needs

(2) Student Professional Needs

(3) Industry's Needs

3.2 Methods

3.2.1 Interviews

The interview can get the most direct information from users. There are two main objects of interviews. First, what conditions will they consider when choosing a program, and how should the current programs in Taiwan meet their needs? Are they willing or have any doubts about the integrated design program.

The second is to conduct interviews with people in the industry. From their perspective, to know whether there is a lack of integrated design-related talents in the industry. And ask them what basic knowledge for the people they want.

3.2.2 Literature

To find out whether Taiwan is suitable for developing the Integrated Design program. The leading information that I want to explore in Literature is from the perspective of the industry:

(1) Find out whether the Taiwan industry has the potential to develop brands.

(2) Find out whether these users have their own brands and their demand for cross-disciplinary talents.

(3) Analyzes what role cross-disciplinary skills can play in Taiwan's more promising industries.

3.3 Finding

3.3.1 Students Needs

The program users are students, so we should know how to meet users' needs. The needs of students can be divided into two aspects, personal needs, and professional needs. The following findings will be based on these two perspectives.

(1) Personal Needs

I introduced Maslow's Hierarchy of Needs [14]. This theory proposes that people's motivations are based on physiology, safety, love, esteem, and self-actualization. The order in which they need to be satisfied is not discussed here. We can discuss using several categories of requirements proposed by Maslow. Discuss how the program addresses needs from different aspects.

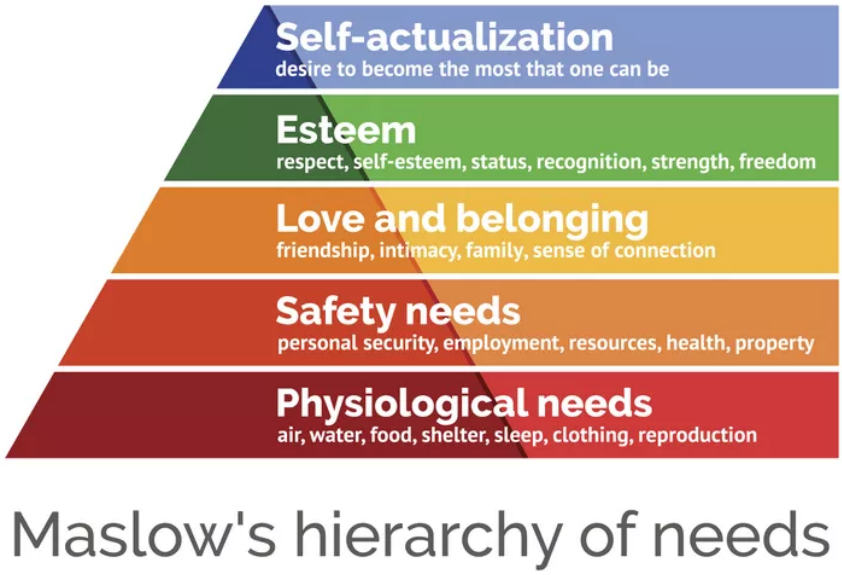

Figure 4. Maslow's hierarchy of Needs

We decided to first divide the term "design" into "design program" and "design courses" to set the foundation for our following ideas. We think design courses and design programs can meet people's needs from different perspectives and in different levels. The following is a classification discussion using Maslow's theory of human needs how a design program can be met.

i. Self-actualization

For the students who like design originally.Students who already know what they are interested in design in high school, want to choose a design-related program. The Design program directly satisfies their desire to pursue advanced design knowledge. For example, a student only want to do in this world is to go to design program and

develop their talents. So this program can meet the needs of their self-realization.

ii. Love and Belonging

Here we must first emphasize a concept. Personal needs do not necessarily conform to wishes. Many decisions we often make in the process of growing up are due to the influence of the environment. We subconsciously know which choices are most beneficial to us; often it drives us in that direction even if it goes against our own will. For example, some students who choose the design department may meet the expectations of the society/parents: the parents want to study design, or the parents have made some achievements in the field of design, and the child may have no preference. The student who chooses the design department will meet the need for harmonious family relationships. Or use the design department as a bridge to connect with parents' resources in the industry.

iii. Esteem

Human self-esteem needs to relate to feeling valued by others. Humans want to be recognized for their achievements or contributions. When the students have talents in design and enter the industry after training through an integrated design program, they will feel that other people need their design talents or project concepts. For example, Students who want to develop their talents as chief designers of international companies win applause for themselves.

iv. Physiological Needs

Design programs can enable students to strengthen their professional skills so that they can work. For example, I only have a talent for design and want to make a living in this profession.

If we are discussing design courses, then we first need to know what kind of design courses we have and what people could learn from these courses.

According to the needs theory of psychology, human needs may have many different levels. So we need to figure out what knowledge or courses can be taught by design and then apply this knowledge to different needs. They can find out what they really like through the knowledge of user research imparted by Design Thinking. For example, the students can interview some seniors and ask for their advice or observe what they work on daily. Also, in the design world, there is never an optimal solution or absolute right or wrong. Learning and applying this critical thinking mode can also provide guidance for people's general life.

(2) Professional Needs

The most important thing in the minds of most students is whether the content of the program can make it easier for students to connect with future jobs or make it easier for them to find their favorite positions.

The interesting is that although the users are students, as college students, they do not actually know what skills they need to have or which program to choose to have a good connection with the workplace after graduation. Students often do not know whether the job they aspire to meets their imagination. They are not even sure whether the skills they have learned in college at this stage can be applied at work.

In order to find the professional needs of students, we must find out the necessary conditions for students to study in school from university teachers or industry leaders. In addition, there is also a common phenomenon in Taiwan, choosing schools instead of departments. Taiwanese students pay great attention to the halo of a famous school and its reputation, also believe that a renowned school can provide better teachers, equipment, resources, etc. It can also rely on the blood of famous schools to increase employment opportunities in the future · In The Aims of Education Address [13], Andrew Abbott said that when you enter a good university, even if the job after that is different from your major in school, you can get a good income. Because it is decided the moment you enter the school, your future job income will be of a higher-income group.

3.3.2 Analysis of Taiwan's Export lndustry

The talents cultivated by integrated design will be widely used in the leadership of leading companies or brand decision-making. Therefore, when we evaluate whether Taiwan is suitable for establishing this program, we need to confirm whether Taiwan has its own brand potential. This study starts from the perspective of Taiwan's export products and analyzes whether the product category has branding potential. For example, if the research finds that Taiwan's primary export goods are raw materials, the potential for brand development is negligible. Enterprises have a relatively high demand for integrated design talents. In other words, if Taiwan's export products are mainly human-computer interaction devices or even toys, no matter whether it is primarily OEM or their brand, there is a great potential for brand development.

According to the Taiwan government's announcement of the proportion of export products in 2021, the following table shows:

Category	% of total export value of 2020
Mechanical and electrical equipment	61.88
Basic metals and their products	8.25
Plastics, rubbers and their products	6.69
Chemicals	5.24
Optical and precision instruments; clocks and watches; musical instruments	4.50
Transportation	3.27
Mineral products	2.72
Other	2.21
Textiles	2.02
Prepared food; beverages, tobacco and alcohol	0.68
Non-metallic mineral products	0.60
Jewelry and precious metal products	0.59
Pulp; paper and its products; printed matter	0.48
Live animals; animal products	0.41
Plant Products	0.19
Fur and its products	0.11
Shoes, hats and other accessories	0.10
Wood and wood products	0.04
Animal and vegetable oils	0.03

Table 1 Taiwan export products in 2021

From the analysis of Taiwan's export products in 2020 in Table 1, it can be seen that Mechanical and electrical equipment accounted for the most significant part of the export value. Still, since

this category contains many product categories, I checked the Taiwan Ministry of Economic Affairs website again for more detailed categories.

Product	category	% of total export value of 2020
(1) Electronic components	Mechanical and electrical equipment	38.53
(2) Machinery		6.23
(3) Motor products		3.22
(4) Information communication and audio-visual products		13.74
(5) Household appliances		0.16
(1) Plastic raw materials	Plastics, rubbers and their products	4.11
(2) Plastic products		1.80
(3) Rubber and its products		0.78
(1)Furniture	other	0.53
(2) Toys and sporting goods		0.94

Table 2 Details of Taiwan Export Products

Table 2 is a subdivision for export products. The part marked with red font in the table is the items I think have brand development potential after excluding raw materials, such as: Electronic components, Machinery, Motor products, Information communication, audio-visual products, Household Appliances, plastic products, Furniture, and toys. These export products together account for 65% of the total export value. This data can preliminarily show that the product

structure of Taiwan's exports can go in the direction of brands. Whether it is an OEM industry or a brand for development, companies in Taiwan need some decision-makers who can use knowledge, technology, and internal and external communication skills. Therefore, from the analysis of export industries, it can be concluded that Taiwan has brand potential.

3.3.3 Taiwan Brand Value Analysis

After analyzing the composition of Taiwan's export products, it is confirmed that Taiwan has brand potential. This is only a very general analysis, so I want to corroborate more information to confirm this fact. Every year, the Taiwan government selects the most valuable 20 brands. This selection process is based on a comprehensive evaluation of brand reputation, brand value, and growth rate. With the help of this information, I can better understand the industrial distribution of Taiwan's renowned brands. Table 3 is the most popular brand in Taiwan in 2021. 20 valuable brands.

#	Brand	product	2021 Brand Value(100 million USD)	growth rate
1	ASUS	Computers, Laptops, Other 3C Supplies	18.71	+23%
2	TREND Micro	Antivirus and Internet Security Services	18.43	+13%
3	Want Want	food	10.96	+9%
4	GIANT	Bicycle	6.70	+19%
5	Advantech	industrial computer	6.32	+1%
6	MEDIATEK	semiconductor	5.94	+42%
7	Cathay Financial Holdings Co., Ltd.	financial holding	5.63	+10%
8	acer	Computers, Laptops,	5.36	+27%
9	CTBC HOLDING	financial holding	5.22	-5%
10	MERIDA	Bicycle	4.48	+12%
11	DELTA	Power and Transformer Systems	3.95	+19%
12	Chailease Finance Co., Ltd.	financial holding	3.87	+10%
13	SYNNEX	Computers, Laptops,	3.55	+13%
14	85°C	Food	3.14	-12%
15	Uni-President	Food	2.73	+9%
16	MAXXIS	rubber	2.64	-8%
17	JOHNSON	Sports Equipment	2.14	+21%
18	msi	gaming laptop	1.72	+31%
19	CHLITINA	Beauty Care/SPA	0.95	-16%
20	ADATA	Memory / Solid State Drive / Pen Drive	0.86	+41%

Table 3 Taiwan Most Valuable Brands Rankings

Among the top 20 valuable brands in Taiwan, the two products with the largest market share in Taiwan are notebook computers and bicycles. In terms of notebook computers, the brand value ranks. First, ASUS and Acer's gaming pens are the third. The electronic market share ranks second and third in the world, respectively. These companies that mainly focus on gaming laptops have also launched personal computers, and devices such as Virtual Reality Devices are trying to establish a good brand image and enhance competitiveness. GIANT and MERIDA It is the top three bicycle manufacturer in market share, and in addition to its bicycle brand, it also accepts OEM business from other bicycle companies. For example, MERIDA company OBM and ODM account for 35:65 respectively, in addition to its brand " MERIDA," the joint venture between American brand "SPECIALIZED" and European "CENTURION" mainly focuses on the mid-to-high-end vehicle market.

From this survey, Taiwan already has many brands with the top market share. Especially in technology products and sports products. The related industry chain is also developing quite vigorously, which can drive the growth of other brands. In addition, Taiwanese start-up companies The ethos of Taiwan is also booming. Whether it is a brand with an international reputation or a new brand, cross-disciplinary management talents need to make decisions. After this research stage, it is more proved that Taiwan needs this kind of interdisciplinary program.

3.3.4 Talents Needs Analysis

Ask about the current situation of the industry and the direction of the demand for talents. Although the students are program users, they do not know their needs. They do not know which subjects they need to learn in the program or what kind of talent the job market will most accept them.

I visited Victor Hsu, director of the industrial design department of ASUS, which ranks first in Taiwan's brand value. He mentioned that Asus urgently needs decision-makers cultivated by cross-disciplinary learning. And ASUS is also very willing to provide resources and funds and recommends designers, engineers, and engineers within the company to schools to cultivate cross-disciplinary talents.

He mentioned that he had experienced various projects of various sizes in the company. There are often many problems when the team of engineers and designers cooperate. Often under the pressure of schedule, an issue engineer and designer will push each other. In addition to the design process, because the designer team he led and the engineer lacked a person who knew the knowledge of the two fields in the early stage of the product, it resulted in extra costs to make design modifications and delays in delivery. The delivery date. Therefore, ASUS or other Taiwanese brand companies are in great demand for such talents who can connect various departments in the project.

Chapter 4 Design of Integrated Design Program in Taiwan

4.1 Structure

This part will be designed and planned for the Integrated design program. Since this interdisciplinary program is relatively new in academia, there is still a lot of room for adjustment in the planning and development of the program. Based on my experience and the experience of visiting students studying in the same program, I will design the curriculum.

I look forward to improving the user experience to develop this interdisciplinary program.

Figure 5 is my class schedule for a total of two years and a total of four semesters. Each semester has a main learning focus. I want to use a step-by-step approach to allow students to have the most effective learning process.

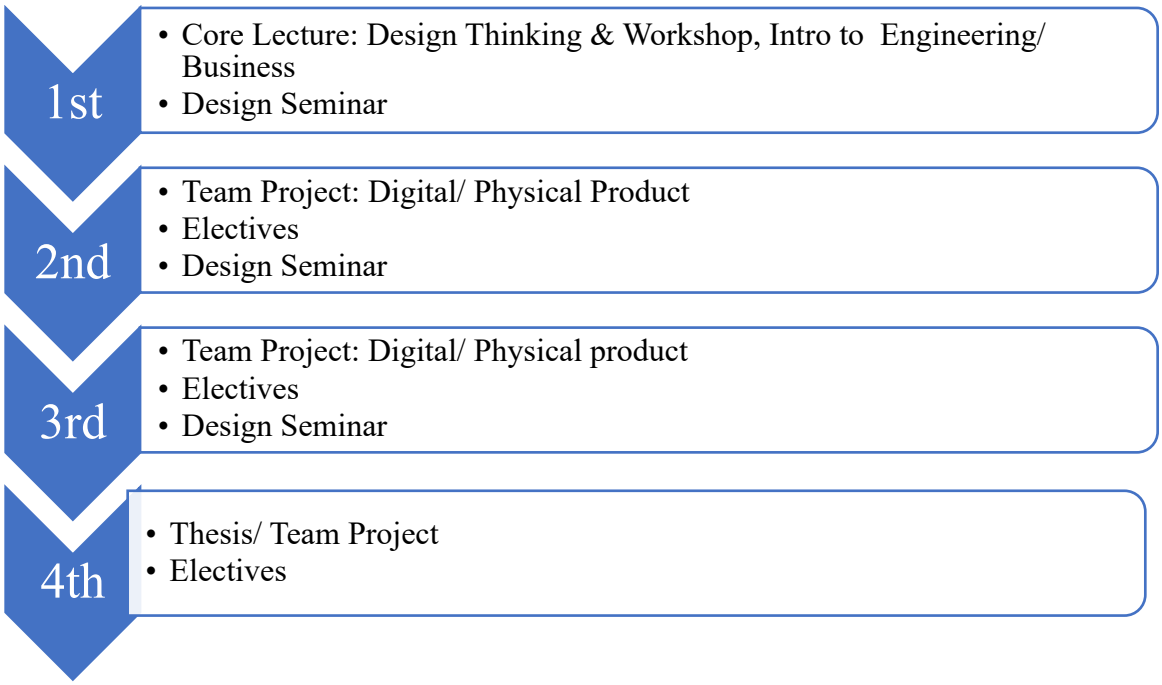

Figure 5. Program Curriculum Structure Planning

1st Semester: Forming Basics Knowledge

The program tries to use the first semester to teach all students the basic knowledge needed for subsequent team projects. Be prepared for subsequent projects. Because each student comes from different background, they hope that students can try to stand on the same foundation. In addition, the basic knowledge can be learned by allowing students to use some pre-recorded course videos for students to preview during the pre-enrollment period, such as summer vacation. Planning problem discussions and sharing informal classrooms are based on the videos students have already seen. Therefore, the overall learning efficiency can be improved.

Second semester: Digital Project/Physical Project

From the second semester, the team project is the central theme. Students in different fields work together to learn from each other and solve problems. In addition, some students in the course can start to choose elective courses according to the team project or personal preference of the semester. Students should continue attending design seminars to keep themselves connected to the industry.

Semester 3: Digital Project/Physical Project,

The digital and physical in the second and third semesters can be reversed, as long as students can have experience in both product projects. This semester can also plan part of the time to take elective courses.

Semester 4: Thesis/Team Project

Students are free to choose to write a thesis or a team project. Since the development of students after graduation is different, students can choose to write a practical project or an academic thesis. The detailed course content planning will be described in detail in the following chapters.

4.1.1 Student Qualification

Students have more than five years of work experience. Integrated Design Program is to train decision-makers, and the average time for promotion to a supervisor in Taiwan's technology industry is four years. We want to ensure that students who return to the workplace can have

actual decision-making power to apply what he has learned. Therefore, the requirements for working hours will be longer than the average working hours of a general MBA.

4.1.2 Core class

It is necessary to clearly understand what type of courses can be helpful for a student's career regardless of what background they have. For these courses, it is best to be offered by the integrated design program itself so that feedback from students can be received at any time. According to the results of the interview, the following three core courses are summarized.

(1) Design Thinking and Workshop

Design Thinking and Processes is the core of the whole course. There are three goals that the program hopes to achieve: First, to be familiar with the product design process. Second, to understand the perspectives of different fields to view problems. Third, to learn essential software and hardware skills for process operation from the workshop.

Each interdisciplinary program can define a product design process with characteristics similar to the industry process. The purpose is to ensure that students can be in line with the industry after graduation and emphasize the uniqueness of this program. Ths students should have a design process lecture class first. Furthermore, after the lecture course, the workshop time is arranged so that students can learn the tools that the process needs to be familiar with. The operation tools of digital products or physical products should enable students to operate proficiently.

In addition, a significant focus of this program is to be able to understand what people in other fields pay attention to or think about when the product project is being carried out. Therefore, lecturers from different fields can join the discussion in the Design process course. Invite guest tutors to teach students how to communicate with others or how people from different backgrounds will frame problems with their industry experience or perspectives.

(2) Introduction to Engineering/ Business

Because students come from different backgrounds, everyone's basic knowledge is different. We must use a short period to complete the basic knowledge that everyone should have. For example, for students from non-engineering backgrounds, if this basic knowledge is lacking at the beginning of the course training. It is relatively tricky to take engineering courses at the graduate level directly. Students will also not know which techniques can help them.

So we need to spend some time equipping students with basic knowledge. However, the scope of engineering and business is extensive, and it is impossible to complete all the knowledge in one class. Therefore, the design of the course should be based on product design. It is more likely that the knowledge will be used to design courses based on the knowledge. In addition, a complete set of online teaching materials and videos are provided. Students who have time to study in-depth can make the most efficient learning of their time. The knowledge learned can be applied to product design.

(3) Design Seminar

The primary purpose of the seminar is to enable students to make connections with the industry. Whether it is to enable students to better understand the current situation faced by the industry or the methods and processes of solving problems in different industries, students use the seminar to discover industries or jobs in which they are interested.

Moreover, they can get job opportunities or more connections through the speakers. Design seminars can also invite students who have graduated from this program to share their careers, from finding a job and promoting themselves to how the industry views the graduates of this program. The seminar can chain all the resources together.

Speakers invited to the seminar can do a little planning on the topics of their speeches if the topics covered by the speakers can correspond to the course content of the Design Thinking and Workshop that week. It will make students' learning more profound and understand more Many applications in the industry. For example: If the theme of the workshop is about 3D printing. Seminars can invite 3D printer manufacturers to share; if students have practical problems in learning, they can directly ask and discuss with the speaker.

4.2 Projects

Project is the essential teaching project of the Integrated Design Program. A project is a comprehensive project that can combine knowledge, teamwork, project process, design engineering technology, and community cooperation.

4.2.1 Team formation

Since it is a semester-long team project, I think the best team size is to choose two people from each of the three fields (engineering, design, business) to form a six-person team. The advantage is that in addition to integrating people from three areas. And mutual understanding and learning of each other's viewpoints, two people with the same major in the group can also discuss to make the project deeper in a single field.

4.2.2 Topic & Problem Framing

Students in the Integrated Design Program should complete a group product design project every semester. The project is the best way for students to apply for the certificate. Because the students in this program are experienced, the standard requirements are also relatively high. The project topics are hoped to come from the problems encountered by the current industry. And there can be mentors from the industry to guide and teach. If the subject of the project is for students to imagine, it seems that they do not want to limit the creativity and imagination of students. It may lead to a disconnect between the project and the industry. Being able to cooperate with off-campus companies, students can also get the most up-to-date information in the field. Maintain familiarity with the area, and after graduation, you can also work seamlessly. The program should try its best to cooperate with industry-university companies in the industry and ask the company to provide project topics. Students can choose topics they are interested in from an extensive project list. It is hoped that the project can send several employees from the cooperative companies to be project mentors, can provide students with helpful information if

they encounter any problems and want to ask for advice.

4.2.3 Project Duration

The product project process is not linear but a loop. There may also be many failures during the project. And we must reserve a time margin that may fail and redo at any time. Therefore, this study suggests that the length of each team project should be at least one semester.

As shown in Figure 5, two projects, digital and physical, will be planned, and each will take one semester to complete the entire product design process. In the end, the business model will be calculated according to the sales. If the two product design projects can stimulate students' interest and find business opportunities, the program will also provide resources to help with follow-up development or further industrial cooperation.

4.2.4 Weekly Meeting,Check point & Evaluation

When the project is in progress, it is best to have a meeting with the instructor or industry professionals once a week. In addition to reporting the progress, you can also discuss the future development direction of the product. The weekly meeting format should allow each group to be free to choose to have an interview with the instructor with the background they need. Or form a professional guidance team with all aspects of the program to deal with the problems encountered by students from various fields.

In addition, share with other groups every three weeks checkpoint. The form of sharing can not be limited to slide presentations. The critical point is to express product concepts and ideas to

unfamiliar audiences. Presentation skills are also worthwhile in team projects.

4.2.5 project competition

The program should find a way to enhance the participation of students. Project competitions can be held during the study so that students can have healthy competitive relationships. Usually, most of these design challenges are initiated by companies and provide bonuses for students to participate. But we cannot ensure that there will be companies willing to hold this type of design challenge in the environment of Taiwan as in other countries. So we can take the opportunity of the team project, add a competition evaluation element to the process, and provide incentives so that students can be more motivated to complete the project.

(1) Unified topic

First of all, for fairness, the design topic should be formulated by the program or collect a problem list and let students vote to decide the topic. It is strongly recommended that the program can negotiate and cooperate with companies in the industry for sponsor. The problems faced are brought into this challenge. After the design process is over, the ideas of the students can also be brought back to the company. Under such a cooperation model, the students can get closer to the industry, and the company will also be able to get different suggestions. So both students and the sponsor company can get a win-win situation.

2. Reward Mechanism

In addition to providing students with the knowledge and skills training they need, making students maintain a high degree of enthusiasm for learning is also a question worth thinking about. Different interactive teaching or reward systems can be added to the design of team projects. For example, the top three groups in the final evaluation can get the start-up subsidy for the project, or they can further communicate with partner companies or turn their ideas into commodity sales, etc. Students in this program must have great enthusiasm for solving interdisciplinary problems. But each student might care about different social issues and industries field, so if students do not have 100% enthusiasm for the project topic selected for the semester, perhaps a variety of rewards can increase the student's enthusiasm for the project. Each student can learn different aspects of knowledge from the team project.

4.3 Elective Courses

4.3.1 Courses Source

Since the purpose of the Integrated Design Program is to make students familiar with the knowledge and thinking modes of other professional fields, therefore, when asking students to choose courses, they also hope that students can choose areas that they are not familiar with. The program should study all courses offered by engineering, business, and design schools on campus. And make relevant information tables for students to consult. The purpose is to allow students to find courses that meet their needs. You can have a good learning experience in all aspects. When the program is established, it is best to be in a university that already has

successful engineering, design, and business college. These high-quality courses are directly provided to students who choose this program.

Suppose the college itself is not complete. For example, National Taiwan University does not have a design college. Programs can strive for cross-school cooperation. Cooperate with art colleges of other well-known schools. Students can go to famous courses in other schools to improve their abilities.

4.3.2 Interdisciplinary Electives

Some restrictions will be imposed on students' courses to let the student not focus on only one area. These restrictions will be based on the planning method of the school's course credits to make corresponding rules. For example, MIT IDM stipulates that for students in this program, the difference between the credits of Management and Engineering should not exceed 12 credits. (About 1-3 courses) . Use credits to make students' studies more extensive.

4.4 Implementation Planning

It is not easy to set up a program at a top university in Taiwan. It may also cause uneven distribution of educational resources. Therefore, it should start with more minor activities to make some achievements before setting up. Let the school or the department sees that the industry and students need integrated design. Then integrate resources step by step until the

program is finally established. As shown in Figure 6, I propose to divide the implementation plan into four phases. The results obtained in each stage will be the basis for the next phase.

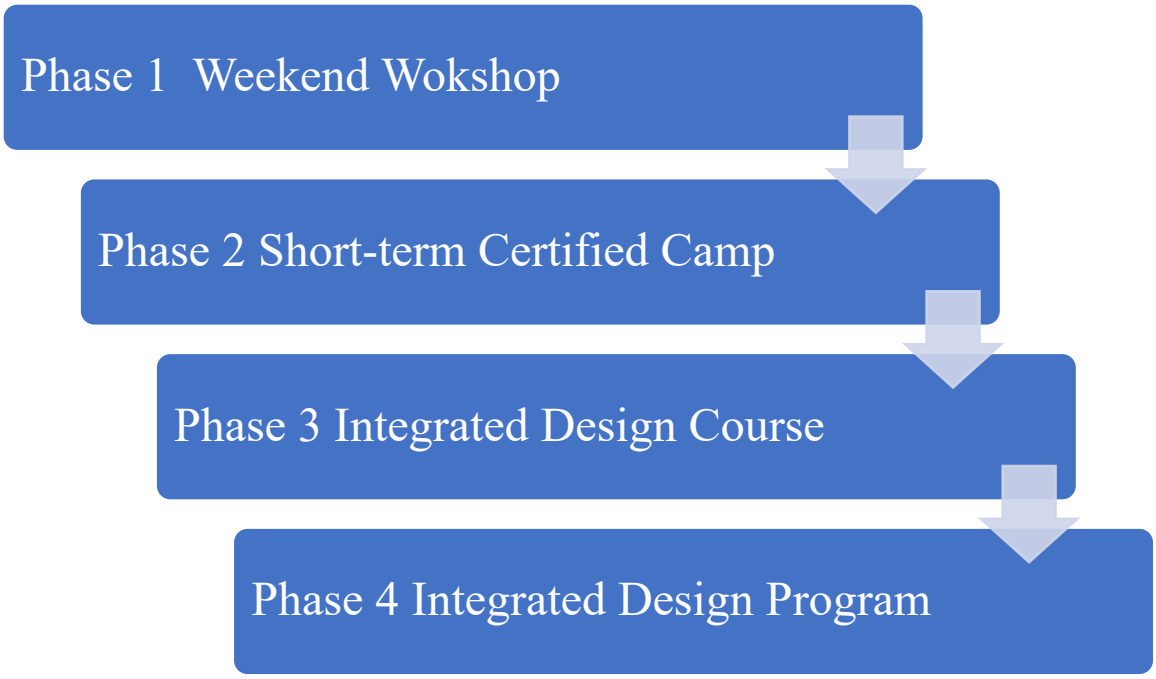

Figure 6 4 Phases of Developing the Integrated Design Program

4.3.1 Phase 1: Weekend Workshop

The first stage aims to introduce the concept of integrated design to the Taiwanese academia and industry. The primary purpose of setting up a weekend workshop is to attract working professionals to take advantage of the weekend to participate in the workshop. In order to imparting knowledge related to the design thinking process, the workshop also can invite well-known companies to join. These companies provide workshop discussion topics or assign experienced leaders to share with the students the current difficulties the industry faces. Let

students from different fields brainstorm. Moreover, through this type of workshop, students can bring the concept of integrated design back to their own companies.

4.3.2 Phase 2: Short-term certified or Design Thinking Camp

Based on the weekend workshop experience, we can start negotiating short-term training with companies interested in integrated design.

Create a three-month project camp. Allow employees to leave the company two afternoons a week early to participate in project discussions. Furthermore, give employees a certification after the project is completed. Prove that they have been trained by the integrated design team and can effectively communicate with talents in different fields.

4.3.3 Stage 3: Integrated design course

It is not easy to directly create a program within the university. The department itself will also consider that if it fails, the resources invested in the early stage will be wasted. Therefore, before the program's creation, we can first open up about design thinking or product design processes. It can quickly bring this concept into education. In addition, it can also be used as a test to see how well students accept the course. The decision that may be faced should be the course enrolled.

4.3.4 Stage 4: establishment of programs

The final stage is to set up a program. It is hoped that the success of the program will attract the support of the engineering school, Design school, and Business school on campus. Discuss with

the three school different cooperation possibilities and resources that can be provided. For example, the engineering college can use its manufacturing lab to provide students with product prototypes. In addition, it is essential to receive support from industry companies. At the beginning of the program's establishment, it was hoped that there would be more industry support.

Chapter 5 Case Study: NTU D-school

5.1 Introduction

5.1.1 History

National Taiwan University (NTU) is the best university in Taiwan, ranking 68th internationally in 2022. NTU has the best educational resources in Taiwan and is the university with the complete types of colleges in Taiwan. In 2015, NTU began to introduce Design Thinking and interdisciplinary concepts from the United States; This led to the birth of NTU Design School (NTU D-school).

The origin of NTU D-school is founded by a group of people who had significant interests in Stanford D-school. They went to Stanford to learn design thinking and bring it back to Taiwan. However, NTU D-school did not cooperate with Stanford University but just used the same college name.

5.1.2 Vision

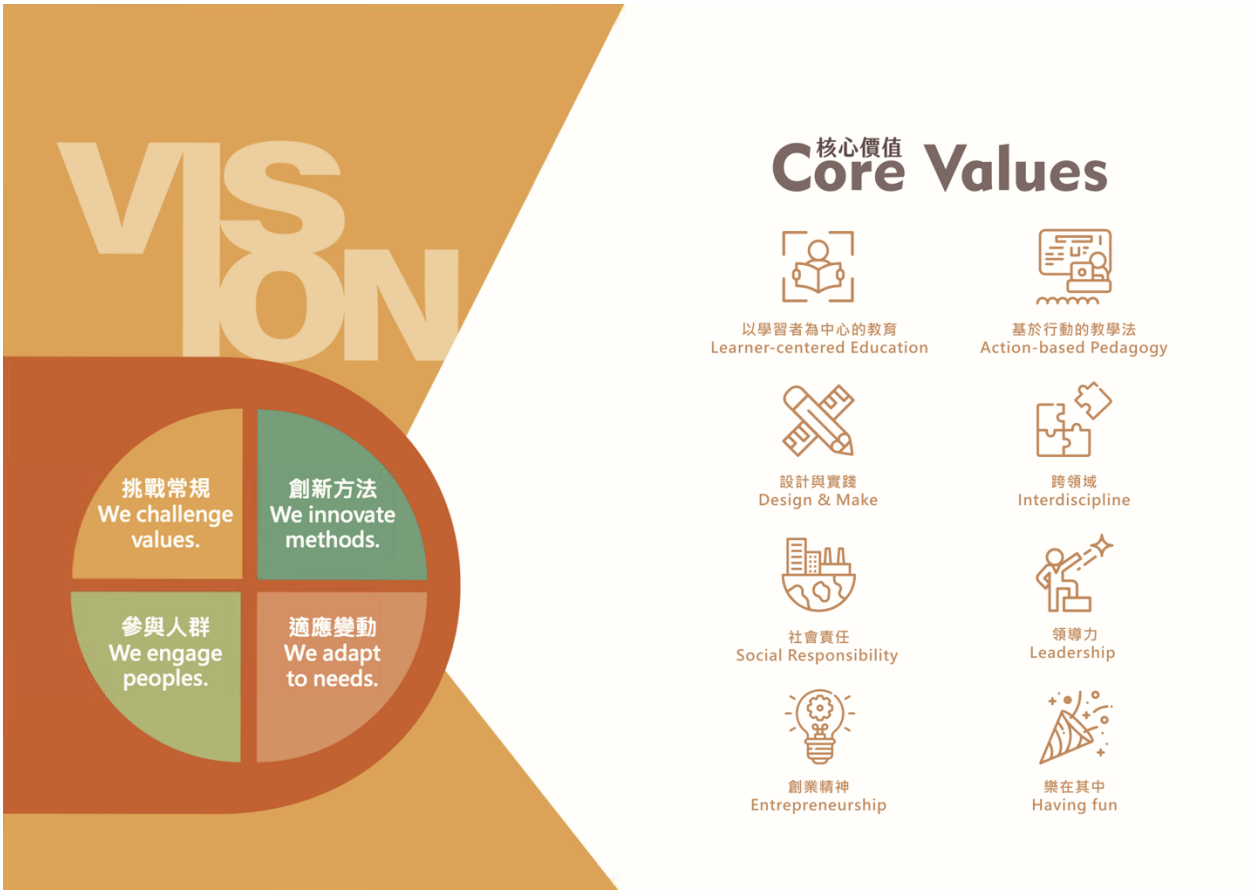

Figure 7 Vision of NTU D-school

The mission of NTU D-school is to challenge conventions and use innovative methods to adapt society to future changes. It also hopes to be student-centered, and teaching will no longer only use lecture courses but use practical actions to teach design skills and functional ability. At the same time, it emphasizes cross-disciplinary learning, cultivating the next generation's leadership skills, entrepreneurship, and the ability to enjoy the process.

The tasks of NTU D-school in terms of future education drive, entrepreneurship cultivation, interdisciplinary leadership, practical ability development, university social responsibility, and innovative teaching and research promotion are as follows:

(1) Future education drive: assist in joint research on strategies and plans, and launch the experimental sandbox of future universities; Research and develop a system of adaptive education, establish a talent training mechanism for fields, and use innovative education to drive the development of Taiwan, the driving force behind the reform of higher education in Taiwan.

(2) Entrepreneurial spirit cultivation: to promote the results of the incubation of entrepreneurial teams through a professional guidance mechanism; Plan industrial experiential learning, validate proposals and improve learning motivation; connect with external industry resources, guiding theoretical knowledge to practical operation.

(3) Cross-disciplinary leadership: develop self-management and leadership skills through team-based cooperative learning; Cultivate innovative talents to serve the society through project design and implementation; participate in social project competition, creating social impact through action.

(4) Cultivation of practical ability: build-essential practical equipment and encourage the realization of ideas into prototypes; Plan and cultivate practical coaches to promote the development of learners' functional ability; organize various teaching workshops to

encourage the practice atmosphere and innovation base.

(5) In terms of university social responsibility: through the operation of action projects, link innovative educational resources inside and outside the university; Develop an ex-situ learning ecosystem, deepen on-site cultural learning and experience; operate the Social Responsibility Action system, and give full play to the social influence of NTU.

(6) Innovative teaching and research promotion: cultivating learners to apply what they have learned and be innovative in active learning attitude; recruit cross-disciplinary teaching teachers, develop topic-based innovative courses; establish open learning environment and become an innovative education platform inside and outside the school.

5.1.3 Degree

NTU D-school offers a bachelor's degree option. Students can apply to enter this program after the first year.

D-school focus on Design Thinking, Human Factors Engineering. However, it does not teach the product design process.

The class schedule has courses from the School of Management, but the students lack work experience. They promote students' ability to respond quickly to rapidly changing social and complex issues through different teaching and learning strategies.

5.2 Teaching Methods

5.2.1 Design Thinking Workshop

All students on campus can sign up for the workshop. It is a two-day workshop course. The primary purpose of completing it in two days is to let students understand how to achieve a human-centered design in product development. Based on this, they brought in the industry leaders to bring the issues that needed to be solved that week. Moreover, the workshop team has already found the user well before the start, so that the whole workshop process can be smoother. The grouping of the project is based on two: the student's professional field and the personality analysis test. Try to make the team have more diversity. Each team has about 5-7 people and is matched with a teaching assistant. The teaching assistant is mainly responsible for guiding students through the process of design thinking and controlling each stage's progress to ensure that prototypes can be presented within time. Through the two-day workshop, students can learn about the difficulties encountered by the industry through mentors from the industry. The students can also learn from each other from a highly diverse team. Learn how to use existing technologies and solutions to reassemble to get new solutions or give users a better user experience. Since the workshop is only a two-day workshop, It is difficult actually to solve the problem for the company. However, the mentors can still get much valuable advice to bring back to the company.

5.2.2 Design Thinking Coach Class

This is a one-semester course designed to train TAs who can lead other students to do projects together in the weekend design thinking workshop. It is a group of students who are very enthusiastic about Design thinking. Moreover, they love to study various product development methods and later form a team. The course preparation team helps Taiwan University with course planning and establishment.

5.3 Difference between Integrated Design Program

We will compare the similarities and differences between NTU D-school and integrated mentioned in this study from various aspects, and whether the integrated design program can be established through the transformation of NTU D-school.

	MIT IDM	NTU D-school
TA	Young Professional	Freshman
Students Working Experience	3-5 years	0
Core course content	Design processes	Design processes
Team Project	3	0
Electives	Engineering / Management	All Fields
Workshop	Yes	Yes

Table 4 Difference between MIT IDM and NTU D-school

5.3.1 Potential Development

NTU D-school is more like an experimental cross-disciplinary course selection model. After applying, students can make their course selection freer. NTU D-school does not have a decision-maker dedicated to operating this department. The college is a team of professors who are enthusiastic about cross-field learning. They plan their own courses originally opened on campus into the course selection list of NTU D-school students.

After studying their elective subject list, I found that there are also business management courses. Although students can also acquire management knowledge through school education, the most significant difference between them and MIT IDM students is their lack of work experience. Without work experience, it is impractical for students to plan their own skills sets because they do not know what skills they need to have to help them in their future careers. It is easier to see what skills they need to face complex cross-disciplinary problems when entering the workplace.

Fortunately, NTU D-school has taken the first step toward cross-disciplinary learning. I believe that if you want to develop the Integrated Design Program in Taiwan, you can start at NTU D-school and discuss cooperation with the MBA of Taiwan University. It has the most significant help for cultivating cross-disciplinary talents in Taiwan and the training of brand decision-makers.

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APPENDIX

Interview Questions List

Interview I – MIT IDM Student

Purpose: The primary purpose of the interview is to ask the current users of the Integrated Design Program's experience and opinions. Since the development of this type of department is not long, there is still room for adjustment and revision of the curriculum structure. After the interview with MIT IDM students and the program's feedback, I will compile and plan the opinions and ideas. Use these valuable opinions to integrate into the program design of Chapter 4 of this research so that the program can be more in line with the needs and expectations of students.

Pre-MIT Experience

1. What kind of industry did you work in before? How many years
2. What made you want to study at MIT IDM?

MIT IDM Experience - Lecture

1. Do you think the program's lecture courses help you expand your cross-field learning?
2. Is there a problem with the arrangement of the class schedule?

3. What troubles your engineering discipline

4. What troubles do design courses bring you?

5. What troubles do business courses bring you?

6. Do you think program planning needs to cooperate with Sloan business school?

MIT IDM Experience – Project

1. How long do you think a group project should take?

2. Which way do you think is better for project grouping?

3. Do you think you should choose between digital and physical projects?

4. What can be improved when the tutors are evaluating? Did you find the helpful opinion?

5. How often should the checkpoint (meeting) be

6. Do you think you should join a personal project?

MIT IDM Experience - Thesis

1. When did you start thinking about your thesis topic?

2. Do you think the dissertation's current research direction and the topic will help you in the future?

3. Do you think the thesis is necessary or optional?

MIT IDM Experience- others

1. Where do you think the program should help you more?

2. If you were allowed to improve the program's user experience, what would you most like to do?

Interview II - Industry executive

Purpose: When evaluating whether Taiwan is suitable for establishing an integrated design program, it must be judged from multiple aspects. In addition to the needs of the students themselves, it is also essential to ask the supervisors in the workplace whether the students trained by this program are the ones they want to hire. Employed. And ask them if they will encourage their employees to learn across fields, or even offer bonuses or sign cooperative programs with schools to train and exchange talents.

Warm-up

1. How are you?
2. How are the recent projects? Will the covid outbreak in Taiwan affect your work?
3. What is your position in the company? How many people are there in total on the team?

interviewer

1. Do you have experience as an interviewer?
2. What traits do you look for when interviewing new people
3. In addition to personality traits, how do you or the company system test the professional ability of candidates?

Project

1. How many people does a project in your company consist of?
2. How do you usually solve interdisciplinary problems if you encounter them?

3. In the project, are there conflicts or delays in progress due to unclear communication between different departments?

4. Are there cross-disciplinary talents in the project? Can you briefly describe this type of talent background based on your perception?

Cross-disciplinary talents

1. Does the project require cross-disciplinary talents?

2. What are the strengths of cross-disciplinary talents?

3. Can cross-disciplinary talents make the project run more smoothly?

Cultivation plan

1. Is your company willing to cultivate cross-disciplinary talents based on your knowledge or authority?

2. If there is a program dedicated to cultivating cross-disciplinary talents, would you encourage your employees, or even yourself, to learn more about it or study it?

3. Do you think you send your employees/or yourself to this program for further study. What kind of study mode is suitable?

4. Do you think your company can sponsor this type of program to be established in Taiwan?

Interview III – Student Needs

Purpose: In order to better understand students' needs for interdisciplinary learning. In Taiwan's No. 1 university - National Taiwan University, I found that since last year, the school has offered an interdisciplinary bachelor's degree program with design thinking as the core. This study The program is somewhat similar to integrated design, so I wanted to interview students enrolled in this program to understand their motivations for applying and what they want to gain here.

Background

1. How are you? What is your name

2. What was your major before applying for this interdisciplinary program?

3. Did you study high school in Taiwan in the past?

Personal Needs

1. Did you already know your interests when high school?

2. Ask your parents whether they will advise on the departments of your university

3. What do you think you consider when evaluating college majors?

4. Do you think you will choose more schools or departments when deciding on your future department?

5. What motivated you to apply for this interdisciplinary program in the first place?

6. Are you worried that this department is very novel and that your job search will be hindered later?

Professional Needs

1. When you select a department, will you consider your job search situation?

2. Have you thought about what professional skills you need for the position you want to apply for?

3. How do you obtain job-related information or the qualifications of candidates