VRC High School - Career Readiness Online Challenge

It's estimated that by 2025 nearly 3.5 million STEM jobs will go unfilled. The engineering design process is a practical approach to problem-solving that is utilised by VEX Robotics teams and in a wide range of potential careers. Entries for this challenge will explore the way professionals in a specific career or company use and document the steps of the engineering design process.

VEX Robotics competitors are uniquely positioned to become future innovators and pursue STEM-related careers. Many of the skills developed, including application of the engineering design process, will directly transfer to future professions. We want you to explore a possible future career, and discover the similarities and differences in how that prospective career and VEX Robotics teams use and learn from the process of engineering design. There are many paths that you can take to becoming a STEM leader. Which will you choose?

Rules of the Challenge

How does a professional's use of the design process match yours? As the world continues to become more technical, an increasing number of professions rely on some version of the engineering design process to identify and solve problems. Your submission will use a combination of text and images to identify a specific career or company and explore how its professionals apply and document the steps of a design process in the tasks of their job.

Things to keep in mind for a successful submission:

- Which STEM career or company did you select, and why?
- What resources did you find to learn about professionals in this career or company and how they use the engineering design process?
- How do professionals in this career or company apply steps of the engineering design process?
- How does the professional approach to engineering design match or differ from the approach used by your team?
- How has participation in VEX Robotics prepared you for a future career?

Which STEM career or company did you select, and why?

Industrial Technology Research Institute	MediaTek Inc.
工業技術研究院 Industrial Technology Research Institute	MEDIATEK
According to wikipedia, the Industrial Technology Research Institute is a technology research and development institution in Taiwan. Founded in 1973, ITRI has played a vital role in transforming Taiwan's industries from labour-intensive into innovation-driven. Its open lab and incubator have fostered emerging industries and startups including well-known names such as UMC and TSMC. In addition to its headquarters in Hsinchu City, Taiwan, ITRI has branch offices in the U.S., Europe, and Japan in an effort to extend its R&D scope and promote opportunities for international cooperation around the world. In 1982, the new Materials Research Laboratories (MRL) was established under the Industrial Technology Research Institute and Otto C.C. Lin was appointed as its founding Director.	MediaTek Inc. is a Taiwanese fabless semiconductor company that provides chips for wireless communications, high-definition television, handheld mobile devices like smartphones and tablet computers, navigation systems, consumer multimedia products and digital subscriber line services as well as optical disc drives. The company also provides its customers with reference designs. MediaTek became the biggest smartphone chipset vendor with 31% market share in Q3 2020. MediaTek's strong performance in regions like China and India helped it become the biggest smartphone chipset vendor.

As science and technology are constantly advancing, more companies are now looking for talents not by their academic achievement, but to pay more attention to professional technology and clear process analysis. Therefore, in order to be able to become global citizens, we decided to start from the National Institute of Industrial Technology and MediaTek.

The reason why ITRI was chosen is due to it is an international-level applied research institution with the mission of scientific research and development which drives industrial development, creates economic value, and enhances social benefits. On the other hand, It has the most advanced development of technology by having the top research environment, talents from different fields, and has a relatively complete development process. Therefore, we would like to discover how institutions have allowed Taiwan to nurture so many world-class companies and talents.

Furthermore, MediaTek was chosen due to it being a world-leading IC design company that provides SoC integration solutions in various fields such as smart handheld devices, smart home applications, wireless connectivity technology and IoT products. MediaTek's chip footprint can be found all over the world to be more specific; there are 1.5 billion chips installed in hundreds of millions of products each year.

What resources did you find to learn about professionals in this career or company and how they use the engineering design process?

Internet - Employment Centre Website

Find the industry that you are interested in first. Find out what job titles are available in the industry. In order to gain a deeper understanding of this profession, we decided to take a deeper look in the form of interviews.

Interviews -professionals

- The father of team member Lu Siyuan, he used to work in the Electro-Optics Institute of the Industrial Technology Research Institute. He was an engineer at the time. He worked in the development team and was responsible for the process development of equipment and components. He was also the maintainer and manager of the equipment. And process developers, through interviews, we learned about the steps taken by this company to make a solution.
- He also interviewed the father of team member Li Ziping, who works for Lianfa Technology and is the manager of Lianfa Technology.

Photo of Lu Siyuan's interview with former ITRI engineer

Photo of Li Ziping's interview with MediaTek's manager

How do professionals in this career or company apply steps of the engineering design process?

Step1：**Set goals and Do Research.**

When setting goals, consider the maturity of the market, choose more advanced technology research and development, and also imagine whether the required equipment needs to be purchased or modified to keep up with the idea and think about the production method, and consider the output value and production capacity of this solution. , and then consider which country or company in the world is doing the same, then look for some relevant papers or international journals, and make a graph of their development and technology trends. The horizontal axis is time, and the vertical axis is technology trends. , to evaluate whether there is a chance to break through, and think about

STEP1, **selected topic**

Play space, income, cost, ROI (must be an ideal ideal.

STEP2,**selected target**

S specific
M measurable
A achievable
R relevate
T time-bound
Think about how much
The most critical factors for the problem
Then schedule, break down the goals into items, and list the timetable

whether it is worth investing in. For example: Siyuan's father initially made a DVD head with a wavelength of 650, but later DVD began to mature, so he thought about developing long-wavelength optical communication, but the problem was that the hardware could not keep up with the idea, and there was no way to achieve transmission. When the distance reaches 20 kilometres, make an evaluation and think about whether it is worth investing in.

Setp2：**Executing**

Once you decide to invest, you must decide what kind of technology to use to keep up with others, or even make breakthroughs from others' patents, so as not to touch others' patents. Use imitation from the start. At least the results presented in referenced patents or papers published in international journals should be imitated. Once you have a close result, you know you're following in the footsteps of others, and you'll find a breaking point to create new results.

Setp3：**Testing**

Step by step, do a small amount of tests to a medium amount to a large amount to check whether there is a problem with the design. Calculate the completed mass production and consider whether the production capacity has reached the expected result. Use failure mode analysis to estimate and analyse the causes of failure, and list the frequency and risk of occurrence. to increase experimental design success.

Setp4：**Readjust the design plan**

Confirm whether the design plan is missing items, such as calculation parameters, ideas or equipment that were not thought of at the beginning, and then repeat the plan => execute => test => plan, and cycle, and slowly modify the design process in each cycle, Confirm whether there are any missing items in the process, and make the plan more and more refined to achieve the expected goals.

S	Specific 具體明確的	明確不含糊，包含做哪些事情？對工作任務的要求是什麼？
M	Measurable 可衡量的	做到什麼樣叫好？衡量的基準是什麼？什麼樣叫做100分？
A	Attainable 可達成的	去年成長20%，在沒有大幅度的策略調整或資源投入的狀況下，今年要成長200%，這一般是無法被達成，但若是20%→30%，這或許就是一個有機會被達成的目標。
R	Relevant 相關聯的	子目標必須與主要目標相關，子目標的全部達成應該等同於主要目標達成
T	Time-bound 具時效性的	必須要有一個明確的完成期限或里程碑，這是設定計畫的基本要素，可能以天、週、月或季為單位。

STEP3, **Time Arrangement**

Allocate manpower and time for the breakdown of the goals. From the very beginning, a long-term plan (weekly or monthly plan) is drawn out, weekly booking items are roughly listed, and assessment points (product announcements) are listed. competitions, exams), and set aside a unit (week or month) of time for buffering. Then list out the detailed plan (daily plan), and make detailed and clear arrangements for the long-term plan of the next unit. And before the end of each day or the beginning of tomorrow, the next self-assessment percentage of the previous completion degree.

STEP4, **Engineering process**

Understand how to plan and set up milestones and checkpoints from start to finish, process decomposition, assess whether the level to be achieved for each milestone is in line with the resources and time that can be invested, if not, consider whether to reduce the quality and strengthen later or make other sacrifices. When scheduling, it is necessary to simultaneously review each potential risk and think about countermeasures. Don't make rolling corrections, it means you don't have a grasp of the target.

How does the professional approach to engineering design match or differ from the approach used by your team?

Through the interview I learned about the professional engineering process and found it to be very similar to our team's thinking process. However, the difference lies in the company's search for information and thinking. In search of information, many charts are made to increase the basis for evaluation; the thinking process is a more in-depth consideration of many aspects.	In my opinion, there is no difference between us and big companies in terms of topic selection, but in the part of target selection, we are not perfect in execution. Most of the time we lack clarity and measurement, which leads us to It is often only possible to make a finished product within the time limit, which is caused by the lack of mastery of the two. In addition, in terms of arranging, we often only list rough items, and do not assign detailed items, and only review what has been done, but do not make a grade-like check. And actions are often initiated without considering the overall risk, resulting in frequent post-mortem corrections of avoidable mistakes, which in turn result in reduced time.

Through the interview I learned about the professional engineering process, our large company and our team's thinking process is very similar, but in the part of the selected goal, we are not perfect in execution. Most of it is that we lack clarity and measurable, we The mastery of these two is not enough. In addition, in terms of arrangement, large companies often consider many things in depth, and think more delicately. We often only list rough items, do not do detailed assignments, and rarely do grade-like checks. So we still have a slight gap with the big companies.

How has participation in VEX Robotics prepared you for a future career?

After interviewing professionals and comparing what we have learned at VEX. We believe that participating in VEX events can help us learn the engineering project design process in advance. In addition, when designing robots, you can learn skills such as listing problem points, analysing frequency of occurrence, risk management, time allocation, and self-checking, which can achieve design goals more quickly, and can also learn professional skills in other aspects. Skills such as: coordinating with others, writing programs, building websites, and assembling. Among them, it is necessary to think about how to use the fewest parts to achieve the expected effect during assembly. This is a very important skill for a company to save costs. Furthermore, in this increasingly internationalised global village, with the advancement of technology and transportation systems, it will become easier for us to communicate with different people, so the experience of learning how to work with people with different personalities and orientations will become increasingly impossible. lack. Therefore, participating in VEX can better connect with society.	In this increasingly internationalised global village, with the advancement of technology and transportation systems, it will become easier for us to communicate with different people, so the experience of learning how to work with people with different personalities and orientations will become more and more indispensable. Doing vex as an activity not only allows me to get in touch earlier with how to coordinate, cooperate, and communicate with people I don't know well, creating a new and beautiful experience for both parties. In addition, when designing robots in the group, you can also get early access to the future workplace operation modes, such as the engineering design process, how to carry out practical skills such as risk management, time allocation, self-checking, etc. Used in other areas, such as schoolwork.

Nowadays, people tend to argue that having a great academic achievement sounds anachronistic, it is still vital as it is supposed to work like a ticket. Over the past few decades, people have tried to build connections between industries and academic careers, and as a result, a variety of education systems were created. Whereas the only way to learn from a specific industry is to listen to people who actually work there, and this could potentially create the lack of resources especially to pupils that are not related to their background. As clusion, we really appreciate that we could have such privilege to listen to experts, but we are still wondering if there is any way to make this information more accessible?

References and terminology:

FMEA
Failure mode and effects analysis, FMEA • Accumulate experience, find the cause of failure early and take countermeasures. • Promote design improvements. • Improve operating methods and establish references for maintenance plans.
Reference
1. How to Perform a Failure Mode and Effects Analysis https://www.slideserve.com/robin-noble/fmea 2. FMEA https://slidesplayer.com/slide/14433585/ 3. Failure Mode and Effects Analysis https://pse.is/3spbyu