The Inhuman Skills of Surgical Robots and the Very Human People Who Created Them

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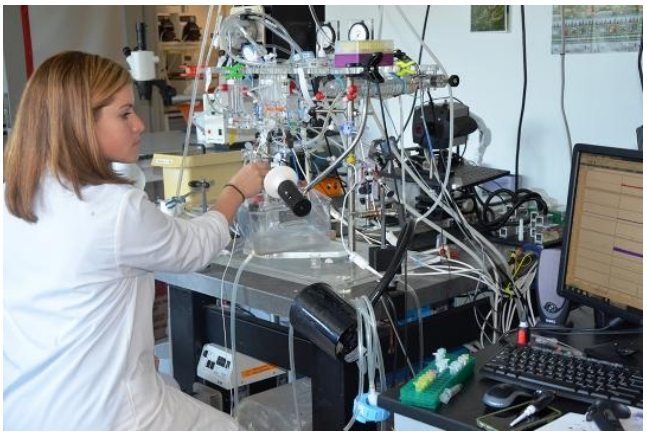
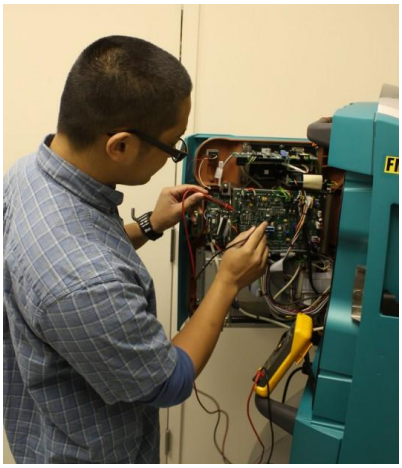
Imagine this: a large and clunky robot filled with various parts and mechanisms successfully doing a minimally invasive surgery. Although this may sound impossible, this is the current future of surgery: large robots being manned by extremely well trained surgeons to perform surgeries with less risks and less of a fallout. Well who are the masterminds behind this unique robot? The people who create these efficient and risk-reducing robots are biomedical engineers. As a team, we are fascinated by the beauty and vastness of the Biomedical field, especially with all of the new innovations produced that help with human health.

The Life of a Biomedical Engineer. A Biomedical Engineer is a type of engineer that specializes in designing, constructing, testing, and revising prototypes specifically designed to assist in the medical field. Biomedical Engineers have created various inventions, such as 3-D printing organs, creating prosthetic limbs that react to the patient's brain signals, and most notably: a robot that is able to perform surgery.



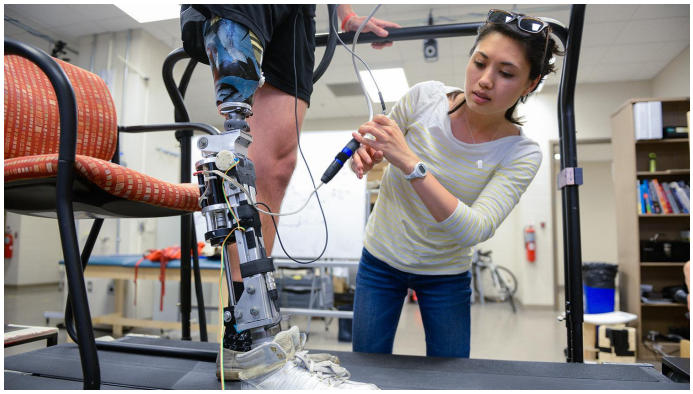
The Design Process. When creating a robot that can help the medical field, biomedical engineers have to go through the engineering design process for a suitable outcome, similar to how many VEX Robotics students do, such as my team. I will be using the example of the design process of the DaVinci Robot. The first step is to define the problem. The problem that the robot

is trying to solve is the lack of mapping and visualizations that surgeons have due to the limited vision and perspectives. Also, humans are mobile creatures, therefore, don't always have a stable hand when operating. This issue can lead to various botched surgeries, as well as long term consequences for the patient and the doctor.



After listing problems, biomedical engineers would triage these questions, see which ones are realistic, and which ones have feasible solutions. Through this, biomedical engineers would generate concepts to solve these problems. A group of engineers would research the rate of these problems and see what solutions can be produced. These engineers would collaborate with surgeons, board members and hospital administrators to discuss the finer details of the solution. Even though they would add in factors such as usage of materials, size, and complexity of build, the engineers come up with every single idea that is feasible and able to solve the problems given.

After generating concepts, the biomedical engineers create a tangible solution that can be constructed as a prototype for testing. Here,—like many VEX teams—engineers use what is called the 'Decision Matrix' to pinpoint and find the best solution for the problem. The decision matrix would have various forms of criteria such as cost of build, complexity of build, and type of materials used. Ideally,



engineers look for a cost effective and easy-to-build prototype that can be easily repaired. This makes prices easier for the engineer and the hospitals buying goods. Sometimes, solutions don't fit all of the criteria but still are the most ideal option. For example, the DaVinci robot is an extremely useful robot, but the price is two million dollars to buy, so it is not cost effective.

Now after finding a feasible solution, engineers now construct and test the prototype. This can be done in various ways, but biomedical engineers always test on non-living items first, then do controlled experiments on humans. While testing, they look for any issues relating to dangerous effects that can harm patients. If this happens, they go back to square one and generate concepts. Very rarely do biomedical engineers have a successful prototype, so there is plenty of trial and error when it comes to problems like these. This is why it can take months, even years for a successful prototype to create, because you are not treating a problem, you are treating humans. An iconic example of this is biomedical engineers testing the DaVinci robot by doing a surgery on a grape.

After finally testing and having a final solution, the biomedical scientists evaluate the robot a few more times, and present it to the medical community. In the case of the DaVinci robot, it is presented through advertising and directed towards hospital administrators, who are the ones that will buy it. Usually in presenting the solution, biomedical engineers think about their targeted audience (medical professionals) and work with advertising professionals to reach that audience.

Our 'Mini Engineering' Team. In my team, we use similar tactics to the biomedical engineers. We utilize the decision matrix quite often when finding a robot for the challenge, as well as trial and error being a big component to our building and coding process. However, in our design process our main goal is to succeed as a team and succeed with other teams. The main idea of a biomedical engineer's design process is to create the best possible solution for the problem in the shortest possible time, especially since the biomedical field is competitive. Even though we had varying experiences in VEX Robotics (all successful), we agreed as a team that VEX Robotics has taught us valuable skills that we can use in our respective future careers.

We learned about collaboration with people from different backgrounds, perseverance, independence, and overall having fun and keeping a competitive spirit. Sometimes, competitive feelings blind us from what is truly gained from a competition, and VEX Robotics really taught us to enjoy the long process and not the end result. Who knew that a biomedical engineer and some determined high school robotics girls have extremely similar design processes in becoming successful in the STEM field?

Works Cited

Detail Occupational Guide, www.labormarketinfo.edd.ca.gov/OccGuides/Detail.aspx?Soccode=172031&geography=0604000059.

"Bioengineers and Biomedical Engineers : Occupational Outlook Handbook." *U.S. Bureau of Labor Statistics*, U.S. Bureau of Labor Statistics, 4 Jan. 2022, www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm.

Boehm, Andy. "Da Vinci Surgical System Fast Facts." *St. Clair Health*, 18 Jan. 2019, www.stclair.org/services/az-listing/surgical-services/da-vinci-surgical-program/da-vinci-surgical-system-fast-facts/.

Crew, Bec. "Worth the Cost? A Closer Look at the Da Vinci Robot's Impact on Prostate Cancer Surgery." *Nature News*, Nature Publishing Group, 22 Apr. 2020, www.nature.com/articles/d41586-020-01037-w.

Lizard, Visual. *CMBES*, www.cmbes.ca/about/what-is-a-biomedical-engineer.

"Master of Engineering in Regulatory Biomedical Engineering." *SEAS Graduate Admissions & Student Services*, www.graduate.seas.gwu.edu/masters-regulatory-biomedical-engineering.

Nagesh, Ashitha. "New Meme Alert: Did You Know They Did Surgery on a Grape?" *BBC Three*, BBC, 26 Nov. 2018, www.bbc.co.uk/bbcthree/article/4a466b39-8b03-4717-bde8-822760b430fa.

"Robotic Surgery." *Mayo Clinic*, Mayo Foundation for Medical Education and Research, 26 Mar. 2021, www.mayoclinic.org/tests-procedures/robotic-surgery/about/pac-20394974.

"VRC High School - Career Readiness Online Challenge." *Online Challenges*, www.challenges.robotevents.com/challenge/174/vrc-high-school-career-readiness-online-challenge.

"Biomedical Engineering." *The Graduate School*, www.grad.ncsu.edu/news/tag/biomedical-engineering/.