

University during COVID-19

In Winter 2020, I began my fifth semester at McGill University. I was taking five classes, four of which were core engineering classes. Two of the four core classes required major in-person lab components. All four core classes required multiple weekly meetings with my peers to complete group projects, and review assessment material. In mid-March, when McGill announced that they were suspending all in-person classes indefinitely, there was a shared, great deal of uncertainty amongst my peers and I as to how classes and assessments would be conducted going forward. Most universities decided to shift classes online. Zoom, not email, Hangouts or Messenger, became the tool used by students to attend lectures and communicate with teaching assistants and professors. Many universities became flexible in their assessment criteria, providing options to take examinations online, over the course of 24 to 72 hour time periods. Some professors, against university policy to make examinations the same difficulty as would be in-person, took the chance to make these equally time-consuming. Hackathons, conferences, competitions were all cancelled, and students left feeling unfulfilled and uncertain about future semesters.

It is difficult to predict how the ongoing pandemic will affect university life going forward. McGill has announced that the Fall 2020 semester will also be delivered remotely. Some universities such as Cambridge in the United Kingdom, have announced that the entirety of the 2020-21 academic year would be online. These decisions will be made by the university administration depending on governmental advice and consultation, and the logistical feasibility of offering the same quality education and university environment remotely. Even if we assume that video conferencing is nearly as good as in-person lectures or tutorials, that students will be able to find appropriate study spaces, and that online assessments will be developed to deal with the higher levels of plagiarism, there are still a number of unanswered questions. Group projects and laboratory work form a key component of the curriculum, especially for students in the Faculty of Science and Engineering. Although programming can be done over Zoom conferences, computer engineers need to be able to work, hands-on, with hardware devices such as microprocessors to learn about computer architecture and do experiments on circuit boards to learn about electronics. Moreover, an integral part of the university experience is networking

and attending competitions and university events. These offer students a chance to form valuable connections with peers and industry to leverage into job opportunities and internships. It is up to universities to convince students that there shall be appropriate solutions to these issues and that attendance during the era of COVID-19 and thereafter is worth the high cost.

Industrial Overview Pre-COVID-19

Computer engineers design and develop computer systems and components and are responsible for their integration into scalable and efficient networks ¹. So, after four years of university generally involving a curriculum consisting of multivariable calculus, differential equations, electromagnetism, data structures and algorithms, software development and computer architecture, what does the daily life of a computer engineer look like?

To answer this question, one has to look at the evolution of the computer software and information technology industry over the past decade. Previously, engineering teams in the industry were chunky and inefficient because they followed the ‘*waterfall*’ approach ² (see **Figure 1**). Regardless of whether an engineering team is following a B2B or B2C ³ model, this approach presents a set of challenges, especially with the way product design and development interact with consumers or clients in the current market. As shown below, when following the waterfall approach, teams are confined to the phase in which they are currently at. If a team has completed requirements elicitation and moved onto designing the product, then they don’t have the flexibility to redefine their requirements based on new evidence found during the design (or later) phase, as the predefined requirements are set in stone. Furthermore, engineering teams need to spend a disproportionate amount of time documenting code and

¹ Lucas, Jim. “What Is Computer Engineering?” *LiveScience*, Purch, 17 Oct. 2014, www.livescience.com/48326-computer-engineering.html.

² In project management, the waterfall approach consists of breaking down a task into a sequence of activities, where each phase is dependent on the completion of the previous phase.

³ B2B is a model where a business entity makes a commercial transaction with another business. For example, Intel manufacturing Apple’s A5 chips. B2C is when a business entity makes a commercial transaction directly with a consumer. For example, Apple selling iPhones to regular consumers. It is important to note that one company can offer products or services which follow both business models.

working on design documents, rather than on the product itself. This is a bureaucratic process and combined with the lack of flexibility (incrementality) in the design, development and validation-verification stages, it makes for a poor project management approach, especially for the modern consumer/client.

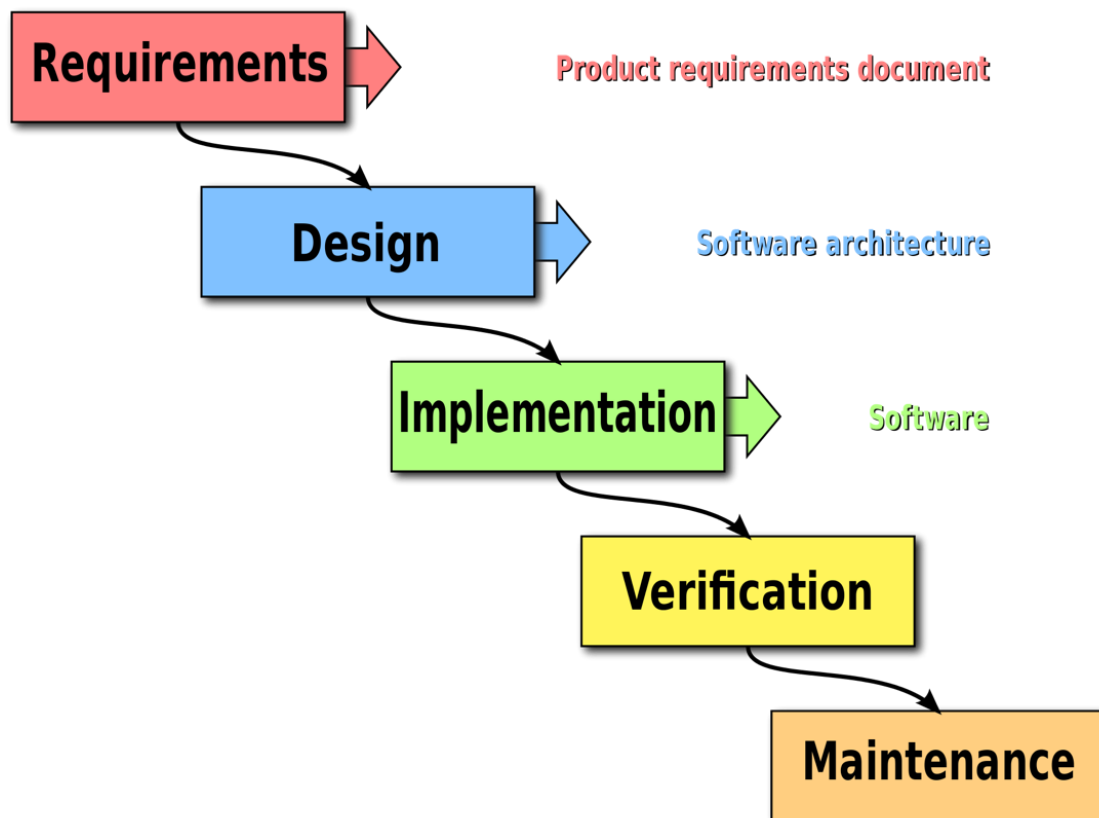


Fig 1: Waterfall approach applied to the software engineering context ⁴

Modern engineering teams use a far more iterative approach, commonly known as the *agile development process*. The agile process allows teams to create *MVPs* (minimum viable products) in the fastest, most responsive and design-friendly way possible. This process encourages communication between team members who are concurrently working on different phases of product development and allows for far more adaptability in response to changing client requirements, consumer tastes/preferences and design improvements and challenges.

⁴ Kemp, Peter, and Paul Smith. "Waterfall Model." *Wikipedia*, Wikimedia Foundation, 29 May 2020, en.wikipedia.org/wiki/Waterfall_model#/media/File:Waterfall_model.svg.

Modern engineering teams are also very multidisciplinary, consisting of software engineers, data scientists, data engineers, UI/UX designers and product managers/owners. To facilitate communication, and apply the iterative and flexible elements of the agile process, *scrums* are used.

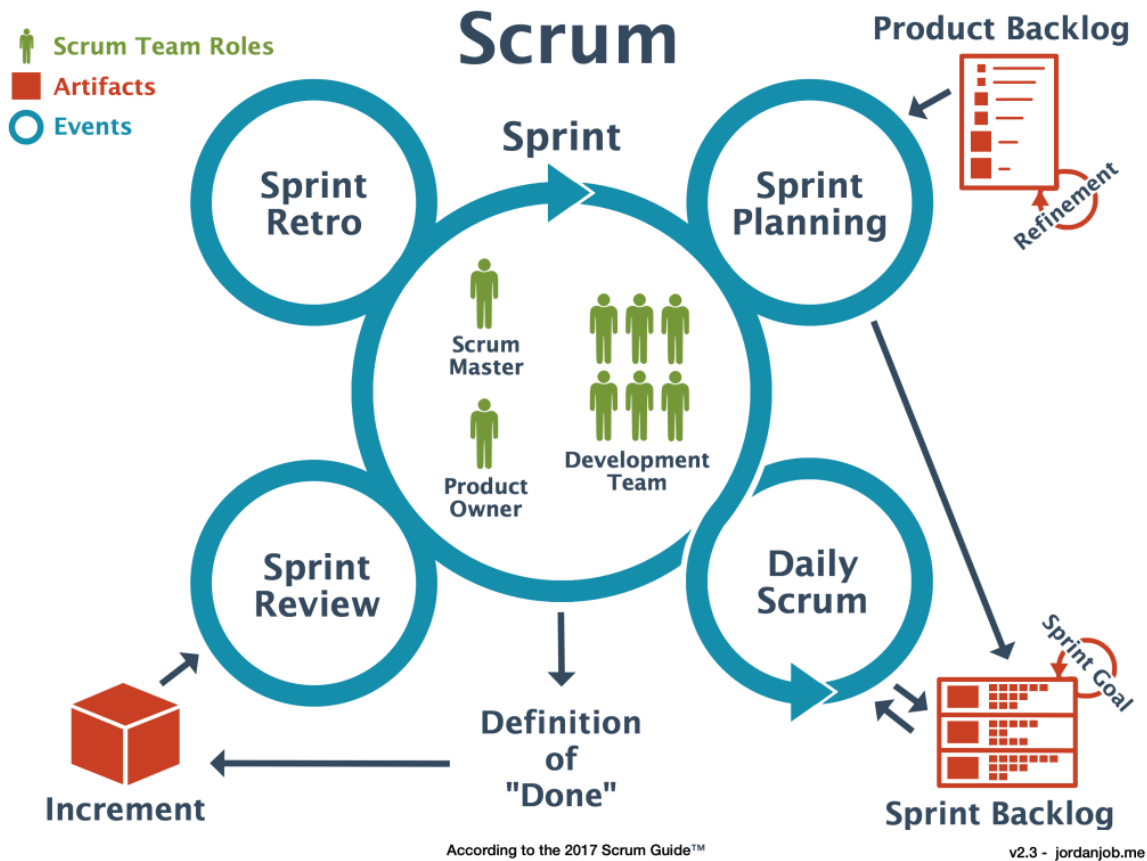


Fig 2: How do Scrums work? 5

The key to succeeding in the computer engineering profession, assuming one has met the prerequisite technical requirements, is one's ability to be an excellent communicator, working efficiently as an individual and as part of a team. The agile process allows engineers the liberty and challenge of personally taking on big tasks and the sense of responsibility to constantly report successes and challenges. This is why group projects have become such a quintessential element

5 Kanyer, Chad, et al. "Free Scrum Diagram - Descriptive Picture." *Jordan Job*, 21 Apr. 2020, jordanjob.me/blog/scrum-diagram/.

of the curriculum in Faculties of Engineering worldwide, especially in ECSE (Electrical, Computer & Software engineering) departments.

COVID-19 Market Analysis

Although COVID-19 has proved devastating for many prominent industries worldwide, the technology sector is substantially less effected (although it remains to be seen whether this is a bubble). The heavily tech-oriented NASDAQ 100 index climbed 700 per cent from 2009 (post-housing debt crisis and financial collapse) till 2020 and even climbed 15 per cent in April 2020 to end up back in positive territory for the year while other stocks were crashing down. One reason is due to the increased demand for technology services and infrastructure during the coronavirus lockdown. Companies such as Amazon, Netflix, Zoom and Microsoft have profited from the increased utilisation of online delivery, streaming and workplace productivity services. Google, Apple and Facebook have been flat, certainly faring better than a majority of other giants in the S&P500. Microsoft, Apple, Amazon, Alphabet and Facebook now account for a fifth of the entire index's market capitalisation ⁶. All this isn't to say that the industry hasn't also suffered from layoffs, technology companies who are heavily reliant on travel and transportation such as Uber, Lyft and Airbnb have suffered greatly, and the industry overall has cut close to 41,000 jobs in America ⁷.

So, how are things going to look for the industry going forward? A Q2 KPMG report says that although the technology sector has seen the steepest drop in business since the 2008 Financial Crisis, as we move into recovery, “ 1) we can expect tech companies to be back in the spotlight as the demand for reliable, fast connectivity increases efforts to accelerate solutions like the Internet of Things and artificial intelligence to customers 2) an increased focus on

⁶ Wigglesworth, Robin. “How Big Tech Got Even Bigger in the COVID-19 Era.” *Financial Times*, Financial Times, 1 May 2020, www.ft.com/content/d2e09235-b28e-438d-9b55-0e6bab7ac8ec.

⁷ McBride, Sarah, and Christopher Cannon. “COVID-19 Brings a Reckoning of Layoffs to Silicon Valley.” *Bloomberg.com*, Bloomberg, 28 May 2020, www.bloomberg.com/graphics/2020-coronavirus-technology-layoffs/.

cybersecurity 3) tech companies to revisit customer segmentation and consumer experience”⁸. A recent PwC report on “COVID-19 and the technology industry” breaks the problem down into several key facets. In terms of operational and supply chain challenges, it is expected that production will slow as a result of global supply chain disruption. Therefore, the hardware and consumer electronics industry is expected to suffer in the future. The smartphone industry is “projected to decline by 12% YoY in 1Q20; server revenue is projected to decline by 16% YoY in 1Q20”. Undercapitalized companies will face cash-flow challenges⁹. This is especially relevant for start-ups who are often strapped for cash as-is. In response to the pandemic, the Canadian government introduced “\$250 million for an Industrial Research Assistance Program (IRAP) COVID-19 Innovation Assistance Program (IAP), which offers a wage subsidy more targeted for the tech and innovation community”¹⁰. Similar programs are likely to be implemented in countries with emerging technology markets.

One of the biggest changes in the technology industry is the emergence of “work-from home” policies. The industry already had protocols in place for employees to work-from home far greater than other sectors. In a Wall Street Journal & SurveyMonkey poll conducted in early March, before the announcement of any work-from home policies, 62% of workers in the technology industry called it “very possible” for them to work-from home, the highest of any industry¹¹. From the previously cited PwC study, “as companies seek business solutions to address remote work, social distancing and the need for in-store alternatives, the demand for developer and engineering talent is likely to increase”. This is also likely due to the reduction in

⁸ Brown, Bernard. “COVID-19: A Perspective on the Technology Sector.” *KPMG*, KPMG, 5 May 2020, home.kpmg/uk/en/home/insights/2020/05/COVID-19-a-perspective-on-the-technology-sector.html.

⁹ McCaffrey, Mark, et al. “COVID-19 and the Technology Industry.” *PwC*, 2020, www.pwc.com/us/en/library/COVID-19/coronavirus-technology-impact.html.

¹⁰ Simpson, Meagan. “Nearly Half of Canadian Tech Companies Report Decrease in Value Due to COVID-19, Survey Finds.” *BetaKit*, 18 May 2020, betakit.com/nearly-half-of-canadian-tech-companies-report-decrease-in-value-due-to-COVID-19-survey-finds/.

¹¹ Wronski, Laura. “Op-Ed: The next Silicon Valley Exodus - Over 25% of Tech Sector Wants Permanent Work from Home.” *CNBC*, CNBC, 20 May 2020, www.cnbc.com/2020/05/19/how-silicon-valley-work-from-home-forever-will-hit-every-worker.html.

capital expenditure from office spaces and complementary employee benefits. Historically, technology companies have been industry leaders in offering food, beverages and other leisurely benefits and amenities at the workplace at highly subsidised rates if not, completely free. Now, already, industry giants such as Twitter, Square and Shopify have announced permanent work-from home policies.



Fig 3: Shopify CEO Tobi Lutke announcing a permanent WFH policy

Employees in the Industry

Finally, what effect do these changes have on students entering the industry? The important thing to realise is that there will be opportunities and losses. Consumer electronics and hardware will be hit the hardest as their supply chains will be heavily affected and spur uncertain. Companies which rely on the movement of people (Uber, Lyft, Expedia etc.) will continue to experience losses due to social distancing measures and stay-at-home policies. Companies which are infrastructure-as-a-service will benefit from the tremendous increase in internet traffic (Amazon Web Services, Microsoft Azure, Salesforce etc.). Companies which offer online entertainment services to consumers (such as Netflix, YouTube, Twitch etc.) and especially companies which offer workplace productivity applications (Zoom, Slack, Microsoft Teams etc.) can expect a boom. For students, this signals a change in market demand, to prepare and develop skills which accompany the booming sectors within the industry. The benefit of studying within the ECSE spectrum is the chasm of freely accessible information on the internet. Websites such as EdX, Coursera, Udemy and countless others offer courses in highly marketable skills at a substantial fraction of university cost. The rise of open-source

projects, especially in the software industry, allows students to engage with wide developer communities and make commits ¹² to constantly evolving codebases to showcase to employers.

Work-from home will be a challenge and an opportunity for future computer engineers in industry. Some will thrive in the solace and privacy of working from home. Others will struggle to concentrate in places which have always symbolised comfort and entertainment. The important thing is for students to adjust to the requirements of being a computer engineer in industry post-COVID-19. As explained before, these requirements demand high levels of communication, independence and accountability. These will be tested even more when not seeing co-workers on a day to day basis, being able to approach them with questions and speak face to face. It is important to remember that there isn't going to be any increased leniency on performance reviews. Companies are gearing up and expecting the same productivity out of their employees remotely, just as they did in-person, so whoever can adjust to the demands of the job remotely as fast as possible will undoubtedly fare the best.

Some of today's most valuable companies were forged in the aftermath of the 2008 financial crisis, including Airbnb, Dropbox Inc. and Uber. Not only can computer engineering students study the demands of the market in terms of getting a job, but they can also study it in terms of *creating* jobs. With the increased remote-ness of society, it will be digital services which will dominate our work, transactions and interactions for the foreseeable future. Having a grasp of how to set up scalable infrastructure and develop applications which can aid societies work, interact, be entertained and active is undoubtedly a key asset, and computer engineering students can expect to deal with a lot of these challenges in the upcoming years.

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¹² A developer term meaning "adding code to"