Autodesk: The Horse for the Infrastructure Decade

Disclosure: Autodesk is the third largest position in my portfolio

In 1982, John Walker, along with 12 other programmers, gathered $59,000 to found Autodesk. Today, Autodesk is ~$60 Bn market cap company.

More people probably heard about AutoCAD than the company behind the Computer-Aided Design (CAD) software application. Just three years after founding Autodesk, it came to the public market. Mr. Walker perhaps does not miss the IPO process:

"I did not enjoy writing the prospectus for our Initial Public Offering in 1985. Translating a clear statement of the company's goals and strategy into weasel words under a pressing deadline, in endless meetings filled with lawyers and accountants who argued with each other, billing the time to us pales, in my mind, with other avocations such as lying on the beach or juggling chainsaws."

Walker resigned from Autodesk in 1994 and is perhaps now enjoying "lying on the beach or juggling chainsaws" somewhere in Switzerland observing closely a colony of ants. I am not kidding; Walker is deeply fascinated by ants, and when you know how resilient ants are, you would probably wonder whether Autodesk would be even more successful if Walker were still at the helm. Today, Autodesk is led by Andrew Anagnost who has been with the company since 1997 and became CEO in 2017.

The title (and disclosure) of this month's deep dive clearly indicates my opinion (or biases) on the company. Given my money is on the line, I will highly appreciate if you disagree with my bullish tones and share your concerns/divergent views with me. I also want to acknowledge one of my acquaintances at Autodesk as well as @SouthernValue95, a very sharp buy-side analyst who was kind enough to help me understand some of the aspects of Autodesk's business.

Here is the outline for this month's deep dive:

Section 1 Autodesk business model: I briefly discussed Autodesk's products, revenue lines, and overall business model.

Section 2 Autodesk TAM: I elaborated on the Autodesk's TAM in AEC, Design & Manufacturing, and Media & Entertainment.

Section3 A compelling opportunity to convert noncompliant/legacy users: I have addressed three specific questions on this section: a) How big is this opportunity? b) Why is Autodesk likely to be successful in converting noncompliant users? c) Why does it make sense for users?

Section 4 Moats and Competitive dynamics: I explored ADSK's moats in AEC and why it may give its competitors run for their money in design and manufacturing segment as well.

Section 5 Valuation and model assumptions: I explored the embedded expectations in the current stock price.

Section 6 Capital allocation and management incentives: Capital allocation and management incentives are discussed here.

Section 7 Final Words: Concluding remarks on Autodesk, why it has sizable weight in my portfolio, and brief comments on overall portfolio.

Section 1: Autodesk business model

Autodesk is one of the leading global companies in CAx, which is the collective abbreviation for Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM), and Computer-Aided Engineering (CAE). During its IPO roadshow in 1985, Autodesk mentioned its charter is to "provide a low-cost, easy-to-use CAD package for mass market distribution".

Today, Autodesk is not only widely known for its original product AutoCAD, it also has cemented its leadership through the acquisition of Revit in 2002 which itself became synonymous with Building Information Modeling (BIM) which I will discuss later. Autodesk's various software products allow its customers to design, fabricate, manufacture, and build anything by visualizing, simulating, and analyzing the real-world performance early in the design process.

Autodesk reports its revenues primarily in four categories:

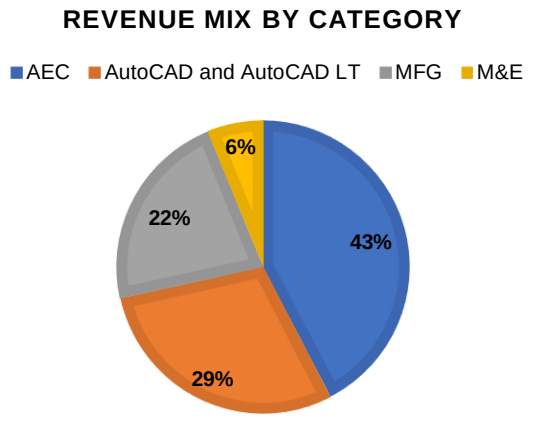
a) Architecture, Engineering, and Construction (AEC),

b) AutoCAD and AutoCAD LT (LT is basically "light" version of AutoCAD which costs less and provides fewer functionality),

c) Design and Manufacturing (MFG), and

d) Media & Entertainment (M&E).

While AutoCAD and AutoCAD LT are reported as a separate category, it is mostly AEC, but AutoCAD is also used, albeit not as extensively as it is in AEC, in other categories. On the last Investor Day in June 2020, Autodesk also provided a more granular snapshot of revenue breakdown within these broader categories. (FY ends on January 31st)



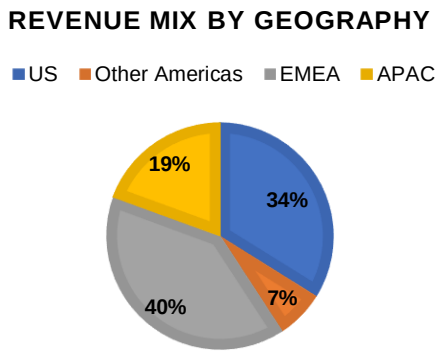
FY20 REVENUE BY INDUSTRY VERTICAL

AEC	Engineering Service Providers	16%
	Construction Services	11%
	Architecture Services	10%
	Civil Infrastructure	7%
	Buildings	6%
	Utilities	4%
MFG	Industrial Machinery	10%
	Process & Other Manufacturing	7%
	Building and Consumer Products	5%
	Auto & Transportation	5%
M&E	Media & Entertainment	5%
Other	Other	14%

Autodesk is truly a global company since almost two-third of its revenues comes from outside the US. While Autodesk is a market leader in the broader AEC space with some distance from the nearest competitor, it is behind Dassault and PTC in terms of market share in MFG. Although some say Autodesk has quasi-monopoly in AEC, it is perhaps only true in certain segments of the broader market, and in some segments within AEC, they are far from being a monopoly. For example, Bentley System is the leader in government infrastructure projects and Autodesk is

mostly trying to catch up with them. I will elaborate more on the competitive dynamics in section 4.

Autodesk is more dominant and has larger market share in Small & Medium Businesses (SMB) segment and faces more competition in the enterprise segment. In fact, 57% of its total revenue in FY2020 came from SMB.



While Autodesk has 78 products listed on its e-store, just 6 products essentially generate super majority of the revenue: Revit, AutoCAD, Inventor, Fusion360, 3DS Max, and Maya. Autodesk also sells an industry collection to enterprise customers which is basically a bundle of different products that allow enterprise customers to save 60-70% by buying the bundle instead of buying all the products separately. I have provided a table below which outlines a very brief description of these products, associated product family, and what it costs to subscribe to the product.

While I have watched a few YouTube videos on some of these products, I am not an Engineer, have never used AutoCAD (or any other Autodesk software), and won't pretend to understand the granular details of how these software works. I encourage you to click the link of the product and get a 20,000-foot overview of what the product does, and if you want to know wonky details, just watch YouTube videos to familiarize yourself with the products.

			Subscription Pricing*		
Product	Description	Product Family	1-month	1-year	3-year
AutoCAD	CAD software that AEC professionals use to create 2D and 3D drawings	AutoCAD and AutoCAD LT	$ 210	$ 1,521	$ 3,652
AutoCAD LT	CAD software that AEC professionals use to create 2D drawings and documentation. All LT products are basically the cheaper version (with fewer functionality) of the original software	AutoCAD and AutoCAD LT	$ 55	$ 336	$ 908
Revit	Multidisciplinary BIM (to be discussed later) software for efficiency and accuracy across the project lifecycle, from	AEC	$ 305	$ 2,425	$ 6,550

	conceptual design, visualization, and analysis to fabrication and construction				
Inventor	CAD software providing professional-grade 3D mechanical design, documentation, and product simulation tools	MFG	$ 260	$ 2,085	$ 5,630
Fusion 360	Integrated CAD, CAM, CAE, and PCB software	MFG	$ 340	$ 495	$ 1,335
3DS Max	offers a rich and flexible toolset to visualize high-quality architectural renderings, model finely detailed interiors and objects, and bring characters and features to life with animation and VFX	M&E	$ 205	$ 1,620	$ 4,375
Maya	3D computer animation, modeling, simulation, and rendering software	M&E	$ 205	$ 1,620	$ 4,375
AEC Collection	Save ~70% by buying the collection instead of buying Revit, AutoCAD, InfraWorks, NavisWorks etc. separately	AEC	$ 370	$ 2,965	$ 8,005
MFG Collection	Save ~60% by buying the collection instead of buying Inventor, AutoCAD, Fusion 360, NavisWorks etc. separately	MFG	$ 340	$ 2,720	$ 7,345
M&E Collection	Save ~60% by buying the collection instead of buying Maya, 3ds Max, Arnold, MotionBuilder, Mudbox etc. separately	M&E	$ 280	$ 2,250	$ 6,075

**Source: Autodesk e-store (prices as of February 24, 2021 and some of these prices include discounts)*

Like many other technology companies, Autodesk also decided to transition from legacy perpetual licensing model (one-time licensing sales + recurring maintenance plan sales) to subscription model (fully recurring revenue model) in 2016. It stopped selling perpetual licensing in 2016, started incentivizing the existing maintenance subscribers to move to subscription by providing discounts, and simultaneously kept increasing maintenance plan prices to push users to the subscription model. The business model transition is nearly complete as revenue from subscription model was more than 90% in FY2021. Although not as big a transition as moving from perpetual licensing to subscription, Autodesk recently migrated single user subscription and multi-user subscription from serial number to named users in FY2020 and FY2021 respectively. I will discuss the rationale in more details in section 3.

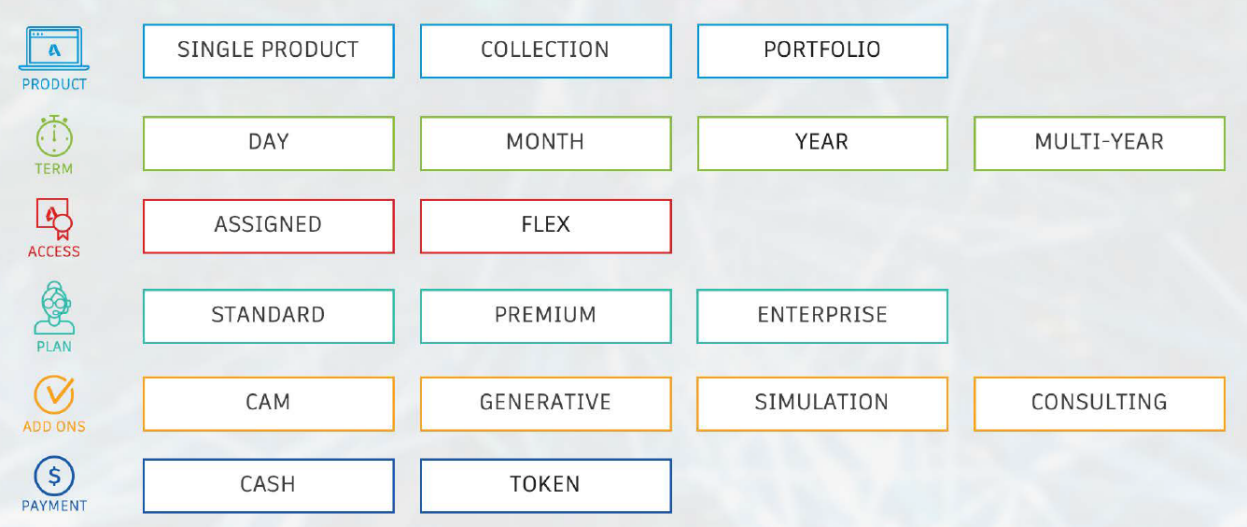
While it may be obvious to many, I still want to mention why the move to subscription makes sense. I came across some estimates that mention the earlier maintenance model had mid-teen churn rate i.e. the average customer would pay for the maintenance plan for ~7 years. Moreover,

historically ~30% customers did not even buy the maintenance plan, or many just canceled after the obligatory initial maintenance plan period. Under the subscription model, given that continued subscription is required to be able to use the product, LTV of a customer is, in some estimates, at least ~20-40% higher under subscription model because the churn rate is usually lower and pricing for maintenance plans are inherently embedded in the subscription model. Moreover, since large upfront costs are not required to buy the software, many SMBs (57% of FY2020 revenue) can now think about subscription as well which can potentially increase TAM penetration. Since many of the products are cloud based, all the subscribers always have the latest model and can enjoy the latest available functionalities which were not possible under the old model. Currently, Autodesk has 5 million paying subscribers.

From customer's perspective, Autodesk has a very flexible approach. Customers can choose to use the product in a way that fits their bill. But let me mention what most customers choose, and what the typical Enterprise Business Agreement (EBA) generally prefers.

Most customers: Single Product. Year. Assigned. Standard. Cash.

Enterprise Business Agreement: Portfolio. Multi-year. Flex. Enterprise. Consulting. Token.



Autodesk products are primarily sold via distributors and resellers. It has a two-tiered distribution structure where distributors sell to resellers, and a one-tiered structure, where Autodesk sells directly to resellers. Autodesk has 1,500 resellers worldwide. In recent years, Autodesk has increasingly shifted to selling directly to its customers and enhanced its sales team to focus on direct sales which is likely to have positive impact on margins as resellers typically buy products from Autodesk at ~30% discount and then sell at full price to end customers. In FY2015, Autodesk used to derive 83% of its sales from indirect channel whereas in FY2020, it came down to 70%.

Section 2: Autodesk TAM

Autodesk cited Cambashi to estimate the size of its Total Addressable Market (TAM) at $52 Bn in FY2021 and expects the TAM to increase to $69 Billion in FY2025. Broadly speaking, this TAM has been segmented to Design TAM ($40 Bn) and Make TAM ($29 Bn). I will elaborate more on the TAM below by business categories.

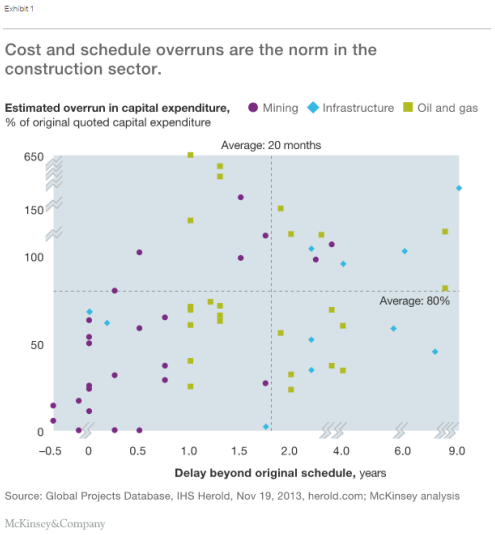
Architecture, Engineering, and Construction (AEC): Autodesk estimates 31 Mn AEC professionals in this segment. With an average ~$1,000 revenue potential per professional, the TAM for AEC is estimated to be $31 Bn in 2025.

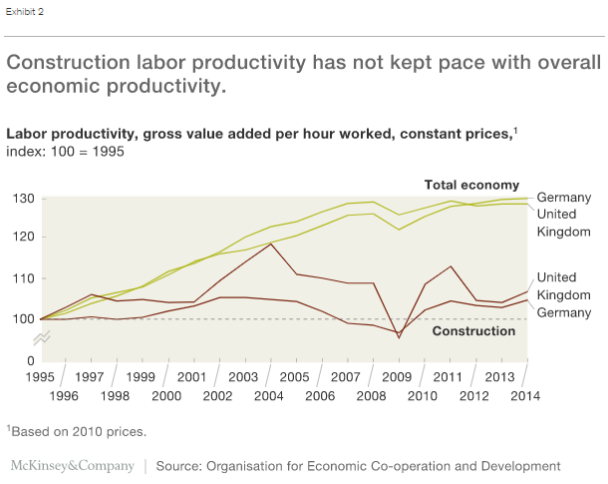
Perhaps nothing encapsulates the current state of infrastructure than this quote from the most recent earnings call of Autodesk:

"You probably have heard that the American Society of Civil Engineers in the U.S. rated U.S. infrastructure a D+. Other countries aren't doing particularly well either."

Given the scope of the deep dive, we cannot delve into how we ended up here, but the broader infrastructure sector has been a big laggard in the 21st century in adopting technology. The impact of such lethargic adoption of technology peeks through many data points. McKinsey cited a report that showed 98% of large Infrastructure projects overrun by 20 months on average in terms of time, and by 80% in terms of cost. The overall construction industry remains a labor-intensive industry and the productivity in this industry lagged the overall economy significantly for decades. To address the productivity challenge, Building Information Modeling (BIM) came to the scene. BIM is a model-based technology linked with a database of project information and is the process of generating and managing information throughout the life cycle of a building. BIM is used as a digital representation of the building process to facilitate exchange and interoperability of information in digital formats. BIM provides "a single collaboration environment/document management system and real-time feedback loop between design and construction teams, save time through reduction of paper-based processes". It also provides faster payment, simulate construction, and allow you to audit trail to settle disputes years later.

The idea of BIM existed as early as 1970s, but Autodesk first published a white paper highlighting their focus on BIM in early 2000s. In April 2002, Autodesk acquired Revit, a multidisciplinary BIM software and current market leader, for just $133 mn cash.



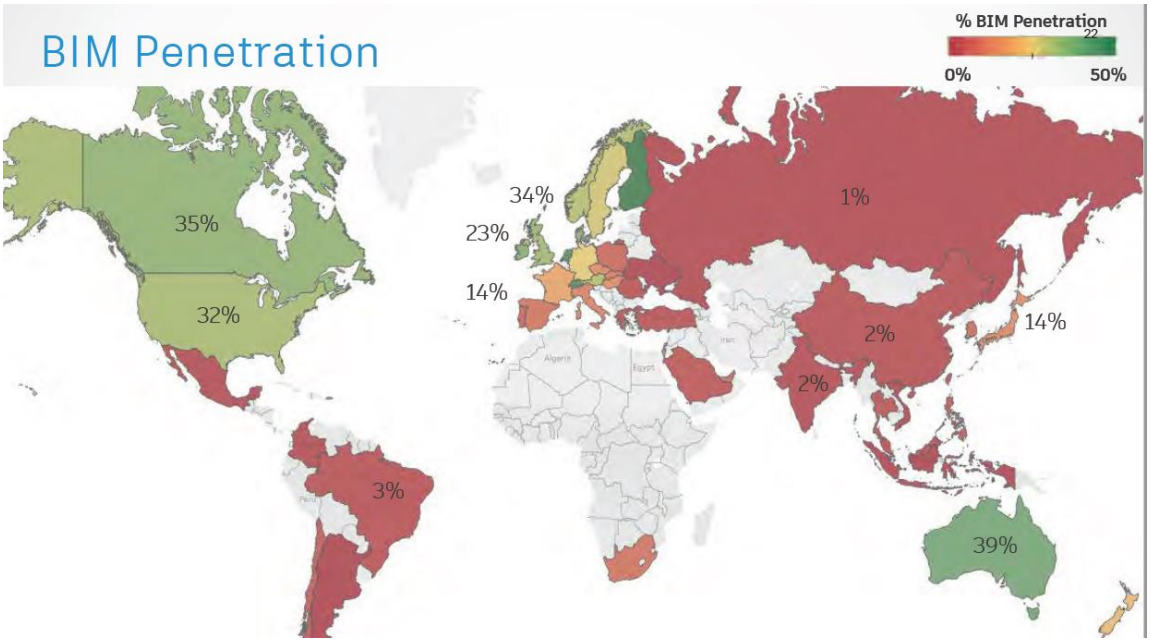


So 50 years since the idea existed and almost 20 years since Revit was acquired, one might think everyone uses BIM for construction projects by now, but that is far from the reality.

Just look at the below global penetration graph Autodesk shared in their Investor Day presentation last year. Not a single geography in the world had >40% penetration yet and countries such as

China and India have ~2% penetration. Therefore, although we are not in Day 1 here, the runway seems still quite long that may allow lucrative reinvestment opportunities for the next decade.

Looking at the terrible tendency of cost and schedule overruns, slow adoption of BIM, and the value BIM brings, many governments have mandated the use of BIM in construction projects. Such legal mandate will obviously quicken the process of adoption at a much faster rate. Till date, US, UK, Japan, Australia, Finland, Denmark, Singapore, South Korea, Germany, Italy, Chile, and Vietnam imposed BIM as a requirement in their construction projects. Germany and Japan, respectively #5 and #6 largest construction markets in the world, introduced BIM requirements in less than a year ago. Autodesk mentioned there are several countries in the pipeline that are likely to enact similar mandates. Some of these countries include China, Brazil, France, Spain, Norway, Czech Republic, Colombia, Indonesia, and Peru.



On the Investor Day, Autodesk highlighted three key trends in AEC: asset performance, BIM mandates, and suburbanization:

"…we have more and more people moving to cities or suburban centers. So this means, again, more buildings and more infrastructure. So we have to build enough road, rail and highway to circle the earth 30 times per year. We'd have to build 20,000 more bridges each year than we are currently building, and it's currently estimated that there are $4 trillion worth of assets that are currently at risk."

While it is not easy to assess the validity of the TAM estimates, considering global BIM penetration and the size of the scope and challenges construction/infrastructure sector will be dealing with in the next 10-20 years, it is unlikely that the TAM estimate is too aggressive. Global construction output is estimated to be $12.9 Tn in 2022, and based on Autodesk's estimates, their TAM implies ~25 bps of the global construction output. Of course, it is difficult to consider the whole global construction market as their "end customer TAM". Interestingly, Autodesk CEO in a letter indicated that the cost for Autodesk's products averaged 0.63% of revenues of their customers. So, if we assume half of the global construction output as Autodesk's relevant "end customer

TAM", we get close to ~60 bps. I think it is possible that eventual relevant TAM for Autodesk is higher than 50%; therefore, I think the TAM Autodesk cites for AEC is very reasonable.

Design and Manufacturing: Autodesk estimates 29 Mn Design and Manufacturing professionals in this segment. With an average ~$1,150 revenue potential per professional, the TAM for this segment is estimated to be $33 Bn in 2025.

Autodesk dissects the TAM into two categories: Design TAM ($19 Bn) and Make TAM ($14 Bn). There are 9 mn professionals estimated in the design TAM which include professionals such as mechanical engineers (4 mn), electrical engineers (1 mn) and drafters (4 mn). There are 20 mn professionals estimated in the Make TAM which include professionals such as tool makers, setters, & operators (10 mn), manufacturing managers (6 mn), manufacturing supervisors (3 mn), and production & plant operators (1 mn).

Media and Entertainment: Autodesk estimates 2 Mn professionals in this segment. These professionals are from film & TV (1 mn), Advertising publications and graphics designers (800k), and Gaming (200K) industries. With an average ~$2,500 revenue potential per professional, the TAM for this segment is estimated to be $5 Bn in 2025. Autodesk highlighted trends such as streaming & subscription content, and new online platforms as avenues for growth opportunity going forward. Given that it's just ~6% of Autodesk's revenues, I will not spend too much time on this.

I am slightly out of my depth in terms of how to assess the reasonableness of the TAM estimates for Design and Manufacturing. One and half year ago, I, along with my former colleagues, was on an expert network call with an ex-Adobe guy who was once part of a team for estimating Adobe's TAM (I wasn't the analyst covering Adobe, so don't remember much details now). He indicated he felt the assumptions his team used to estimate Adobe's TAM were quite aggressive, and yet the TAM estimates appeared reasonable in hindsight because of topnotch execution by the company that helped significantly beat the internal long-term revenue growth trajectory. The point of this story is management is inherently likely to be a bit more optimistic or aggressive in their TAM estimates, especially in a market when there are set of investors who probably don't find multiples such as EV/TAM as ridiculous as they should. But the flipside of the point is we may not need to fret too much over the size of the TAM; perhaps +/- 10-20% error is very likely with the caveat that overestimation is more likely than the opposite. As long as the execution remains strong and the growth/reinvestment runway appears long (but hard to pinpoint how long), it is unlikely to be a major concern.

Section 3: A compelling opportunity to convert non-compliant/legacy users

I have addressed three specific questions on this section: a) How big is this opportunity? b) Why is Autodesk likely to be successful in converting noncompliant/legacy users? c) Why does it make sense for users?

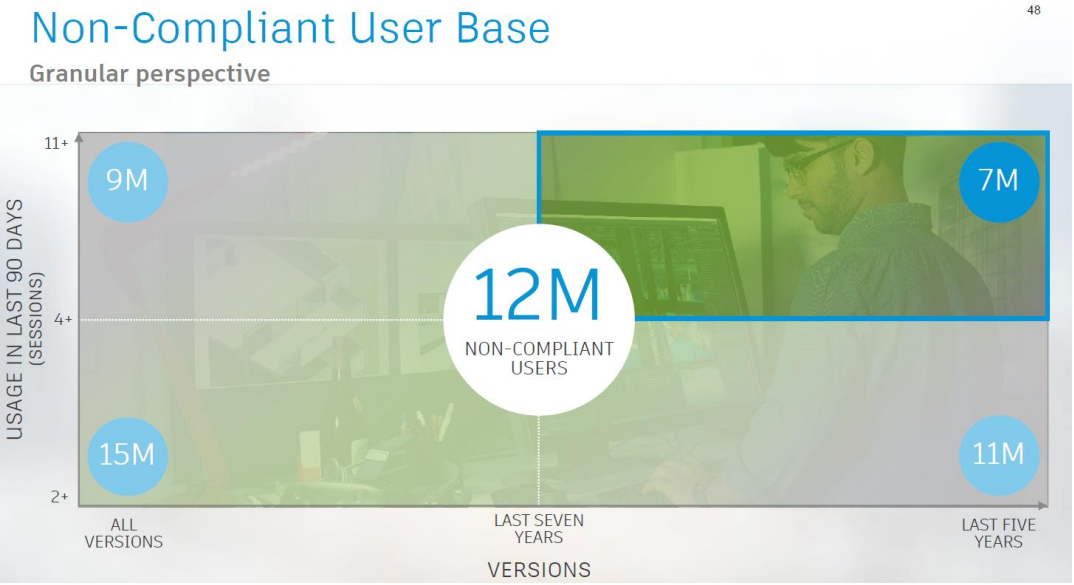
How big is this opportunity?

Autodesk currently has 5 mn paying subscribers, 2 mn compliant legacy users, and a whopping ~12 mn non-compliant, non-paying users. The number of noncompliant users is the highest in China, followed by the US. However, I do not know (and could not find out) whether the number

is heavily skewed to China (e.g. is it 60% China, 20% US, and the rest is rest of the world or is it 30% China, 25% US, and the rest is rest of the world?)

While it is quite evident how big this potential opportunity is if Autodesk can convert a sizable portion of non-compliant users, the real question is quantifying the probable conversion from noncompliant to paying subscribers.

The below image may appear a bit confusing at first glance, so allow me to explain a little.



The y-axis denotes the number of times noncompliant users have activated a session with the product in the last 90 days and the x-axis represents what version of the product they're using. Please note the y-axis starts from 2+ sessions i.e. if a noncompliant user has logged in just once in the last 90 days, that user is excluded from this calculation. The higher you are on the y-axis (range 2-11 sessions), the more you used Autodesk products in the last 90 days. In the x-axis, the further right you are, the latest version of Autodesk products you are using. Therefore, the holy grail of the noncompliant user universe is the top right quadrant i.e. you are actively using Autodesk products AND you are using the latest version.

Autodesk estimates 7 mn noncompliant users in the top right quadrant. These 7 mn users are using the most recent Autodesk software products 11+ times in a three-month period, and yet Autodesk is receiving ZERO dollar from them. Autodesk indicated they consider 12 mn as a potential target for conversion to paying subscribers. Even if ~15-20% of the potential target noncompliant users convert over the next 5–10-year period, that will unlock $1-1.5 Bn revenue assuming current average revenue per subscriber of ~$600 which is also likely to increase in 5-10 years. For context, Autodesk generated $3.7 Bn revenue in FY 2021, so we are talking about ~30-40% of the last year's revenue that are potentially untapped but can possibly be unlocked in the next 5-10 years.

Of course, none of this will happen overnight, and Autodesk indicated they typically add ~500-800k subscribers every year which include both the new subscribers as well as conversion from maintenance and noncompliant users. However, they did not disclose a more granular level details of new subscriber segmentation i.e. how much growth is coming from new business vs

conversion from legacy/noncompliant to paying subscribers. Even though the pace of conversion can predictably slow down after an initial surge in the next few years, considering the size of noncompliant user base I believe this opportunity will persist way beyond the next 2/3 years and possibly the entire decade.

As mentioned earlier, Autodesk also has 2 million compliant, legacy users who probably have much higher probability to switch to subscription plan than a typical noncompliant user. Half of these users are using a version that is more than 5 years old, and the other half is using a version that's one to five-year old. More than 50% of the latter group use Autodesk products for more than 45 days per year. Overall, it seems likely that 50-75% of this latter group will become paying subscribers over the next few years.

Why is Autodesk likely to be successful in converting noncompliant/legacy users?

If Autodesk wants, it can stop all the charade of noncompliant software users tomorrow. They can make noncompliant software stop working any moment and yet they do not want to use this nuclear option. Autodesk prefers that noncompliant users rather pirate its software than using a competitor's product so that its products remain the industry standard. Therefore, Autodesk usually leans onto using the carrot rather than the stick.

Autodesk's recent move to named users is one such carrot. It is easier to pirate serial number, but it is harder to be noncompliant when everyone is a named user. Off-line activations are stopped and even trial users are closely observed. Autodesk also made some changes for student licenses (free for students) which has been a potential loophole for noncompliant usage. They have changed student license from 3 years to 1 year and students need to verify their status every year in order to keep using the software. Student verification has been extended not just in universities, but also in trade schools and secondary schools across the US, Canada, and the UK, and it has just recently been extended to the rest of the world. Moreover, as Autodesk is shifting more and more from resellers to direct sales, that will also lower noncompliance. To meet target and get commission, some resellers allegedly would sell a few seats to the end customer and look the other way if the customers use more seats.

Although there are no serial numbers to pirate, Autodesk has preemptively thought about new form of abuses that may prop up after moving from serial number to named users. One such abuse could be sharing login credentials. Autodesk has imposed a maximum number of active sessions allowed per named user and if it exceeds the maximum allowed number, users receive a message that prompts the user to logged out of other sessions running concurrently in other machines.

90% of the noncompliant usage is basically detected in just 6 key products and Autodesk can now message these noncompliant users to nudge them to be paying subscribers. Autodesk has plans to provide more targeted value message based on usage and other behavioral characteristics of the user to make these nudges more effective.

It is important to note that the transition to named users is not just conversion of noncompliant users to paying subscribers story. It is much more than that which can be understood from the following quote:

"Named users are good for Autodesk and our partners, too, and critical to knowing our customers. When we understand usage down to an individual level, we and our partners can have richer

conversations with customers about their needs, both now and in the future. Sometimes these conversations lead to customers needing fewer licenses. But usually, it's the other way around, and they end up growing their footprint, and we see net revenue retention rate grow. We would rather have satisfied customers whose value is aligned with usage."

Therefore, even for currently paying subscribers, I sense an opportunity to increase average revenue per subscriber by upselling products with higher functionality and price.

Why does it make sense for users?

It is quite intuitive why transitioning to named users or converting currently noncompliant users to paying subscribers makes enormous sense for Autodesk, but what about the customer?

I am an Amazon shareholder, and I understand the value of customer obsession. But what customer obsession means varies from business to business. Allowing noncompliant users continue to use the software certainly doesn't fall under any definition of customer obsession from Autodesk's perspective. One concern I heard is whether Autodesk's tough stance on noncompliance will just incentivize users to switch to competing software. It is difficult to do so because of the network effects which I will discuss more in section 4. I asked about this concern to my acquaintance at Autodesk, and he told me all the mid to big players are getting serious about noncompliant usage. However, there are apparently some Chinese and Japanese alternatives which are Autodesk clones that can be a potential destination for some of these noncompliant users. He did mention Autodesk sued some of these Chinese/Japanese alternatives, but he could not remember any successful outcome yet out of these litigations. This can be a concern, but given the base of noncompliant usage, even 15-25% conversion from noncompliant to paying subscribers is a pretty sizable opportunity.

Autodesk outlined why it makes sense even for the user to be paying customer and access the latest version of their products:

"Having named users also benefits business owners, offering them visibility into who's using software, when and for how long. They can then optimize their licensing for the growing needs of their businesses. They can better align value with usage. Employees or contractors can also easily be added to teams or projects. And just as importantly, they can be removed when they leave a team, thus giving tighter control over data and security.

If we look at the last 5 years, there's an ever-widening gap of new capability that customers using older products are missing out on. I'll highlight just a few of these: shared views, introduced for Inventor subscribers first and now available across the portfolio, it quickly became the most widely adopted cloud-enabled collaboration capability in our design and manufacturing product line; broad performance enhancements across the portfolio, like a 5x speed improvements in Maya by enabling multi-threading; and the inclusion of a specialized tool sets within AutoCAD, so AutoCAD subscribers have access to industry-specific features and libraries for architecture, mechanical design, electrical design and more, which allows for the completion of design tasks in a fraction of the time."

It does not seem quite prudent from the users perspective not to use the latest version of the product when they earn their livelihood using Autodesk software that only costs a fraction (<1%) of their revenue. I think it is mostly a question of when, not if, the most customers will eventually end up being paying subscribers.

Section 4: Moats and Competitive dynamics

Peter Thiel in his seminal op-ed "Competition Is for Losers" wrote the following:

"Monopolists lie to protect themselves. They know that bragging about their great monopoly invites being audited, scrutinized and attacked. Since they very much want their monopoly profits to continue unmolested, they tend to do whatever they can to conceal their monopoly usually by exaggerating the power of their (nonexistent) competition."

While I do not fully agree with the statement in a literal sense and perhaps 9 out of 10 times when a business is labeled as monopoly is just a narrow definition of the market to fit the regulator's overzealous narrative, it is certainly music to investors' (and my) ears whenever a business is trying to prove to the world that they are not a monopoly. It is the most potent signal out there to indicate that a business enjoys powerful moats. When 25 UK architect firms complained about Revit's rising cost and complexity of Revit, Architect Magazine did an interesting feature on the feud. When asked about competition, Autodesk spokesperson said the following:

"With the move to subscription, it's easier than ever for customers to vote with their feet."

And yet, the article mentioned that *"But in my reporting for this piece, I couldn't find a single large American firm that had ever transitioned off Revit."*

So why are customers not voting with their feet instead of creating pressure through press release?

Pat Dorsey in his book "The Five Rules for Successful Stock Investing" cited Autodesk as an example to make his point about high switching cost: *"Autodesk has a lock on the architecture and construction design software market because architects and engineers are trained to use the software early in their careers. Switching to a competing program isn't very attractive to folks who have been working with Autodesk for years. For the most part, software companies that benefit from this moat have products that are either too expensive or too time-consuming for customers to stop using."*

Autodesk's market power is also exhibited by the number of people who list AutoCAD and Revit as their skills on LinkedIn. While 7 million people listed AutoCAD and 1 million people listed Revit as their 'Skills" on LinkedIn, the next best AutoCAD competitor had fewer than 250k people listing it as skill. As Dorsey explained, Autodesk strategically makes the student licensing free and partner with all the universities across the world to make sure students learn how to use the software. Once you learn a particular software, human inertia takes over, and it becomes excruciatingly difficult to switch to a competing product.

Product	Skill listed by # of people on LinkedIn
AutoCAD	7,000,000
MicroStation	233,316
ARES	11,824
DraftSight	10,496
ZWCAD	2,891
BricsCAD	2,613

Source: LinkedIn Talent Insights as of 15 May 2020

However, customer complaints are perhaps not baseless. While speaking with my acquaintance at Autodesk, I sensed that there is an element of dissatisfaction even among Autodesk AEC employees. The development velocity is not ideal and reflective of the market power Autodesk holds within AEC segment with its Revit/AutoCAD products. AEC is essentially considered a cash cow with considerable higher margins than MGF and M&E, thanks to the market power Autodesk enjoys. Of course, too much of a good thing can be abused, and it is never a good idea to test the limit.

My sense is Autodesk thinks AEC is already in the bag, so the next frontier of large growth opportunity will come from by making inroads into the manufacturing segment in which they are playing the catchup game against the likes of SolidWorks (Dassault). Manufacturing is at the center of attention within Autodesk these days, and AEC employees obviously aren't quite fan of not being center of attention in long-term strategy when they are still driving the bottom line. It may sound a bit counter-intuitive, but I think the tension resulted from the customer letter may end up being a win-win situation for both Autodesk and its customers. AEC employees now have a stronger voice within the organization and can push for resources to ramp up the velocity of development. CEO and senior management now understand it is not the best look to invite media attention about their monopolistic power in a market segment and shareholders themselves can get nervous (even if in the short-term) if they continue to hear customer complaints.

What calms me is despite Autodesk's lack of attention on AEC, Autodesk mentioned they are gaining market share against Procore, one of the major alternatives to Autodesk in AEC. While Procore's revenue expansion rate has been around ~120%, Autodesk's products in AEC had ~125-135% revenue expansion rate. I wonder whether this is what Buffett had in mind when he mentioned buy a business that even a ham sandwich could run.

Let's focus on the manufacturing now, and Autodesk's moat in AEC will be clearer by the time I finish discussing manufacturing.

As mentioned earlier, Autodesk is the challenger in the manufacturing segment which is led by Dassault's SolidWorks.

While manufacturing segment generated ~22% revenue last year, it has become the primary focus. Within manufacturing, Fusion360 gets a lot of attention within Autodesk. While Autodesk does not report revenue by product line item, I have been told that Fusion360 is an insignificant source of revenue today, but Autodesk senses this can be much bigger in the next 5-10 years. But the dynamics within this segment is not entirely different compared to what I described in AEC. SolidWorks customers also have high switching cost and Fusion360 will find it extremely hard to encroach into SolidWorks market as much as competitors find it difficult to challenge Autodesk in AEC. Autodesk understands this and their playbook to challenge SolidWorks is perhaps similar to what they did with Revit to unseat Dassault's dominance in that space.

Autodesk didn't always have the lead it enjoys today in BIM/Revit. In early 2000s, it was led by Graphisoft, Bentley, and Dassault's CATIA. Revit was just a small startup which was acquired by Autodesk in 2002. Despite the head start, Dassault eventually lost in this market. It did not want to lower prices and its products used to cost tens of thousands of dollars. Revit took a different approach which would seem familiar if you read Clayton Christensen's "The Innovator's Dilemma".

Matt Jezyk, an early Revit product manager, wrote that during the early days “a small set of customers who believed in the vision and were not afraid to stick their necks out and try out software, and were vocal in telling us what did and did not work”. When Autodesk acquired Revit, they allowed Revit to continue their collaborative approach with the architects and even took profits from AutoCAD to reinvest into Revit. Eventually Revit became almost synonymous with BIM and became the giant it is today.

Some may be wondering if history is any guide, why someone else cannot do the same against Revit today. It is certainly not impossible and my reference to Buffett’s ham sandwich comment was made in tongue in cheek. I do, however, think it will be order of magnitude more difficult to do the same against Revit today as the scale is much bigger and adoption of BIM is far from “Day 1”. This is also why Autodesk’s investments into students becomes much more important which help them enjoy a higher switching cost and resultant competitive advantage than earlier incumbents.

The other question I myself wondered whether the dynamics within manufacturing is any different than it is in AEC. If it is so hard to challenge Autodesk in AEC, what will make it possible for Autodesk to encroach into manufacturing?

The answer somewhat lies to network effects. AEC requires a lot of collaboration among smaller firms, and sometimes multiple workgroups and subcontractors. It’s like excel; you can certainly use more advanced programming tools, but if you are working on M&A deal that requires collaboration with all sorts of workgroups both internal and external (e.g. law firms, client etc.), you better use excel to make it more accessible to everyone. While Revit is a ~20-year-old product and it does have many valid criticisms, thinking about switching from Revit is mostly a non-starter.

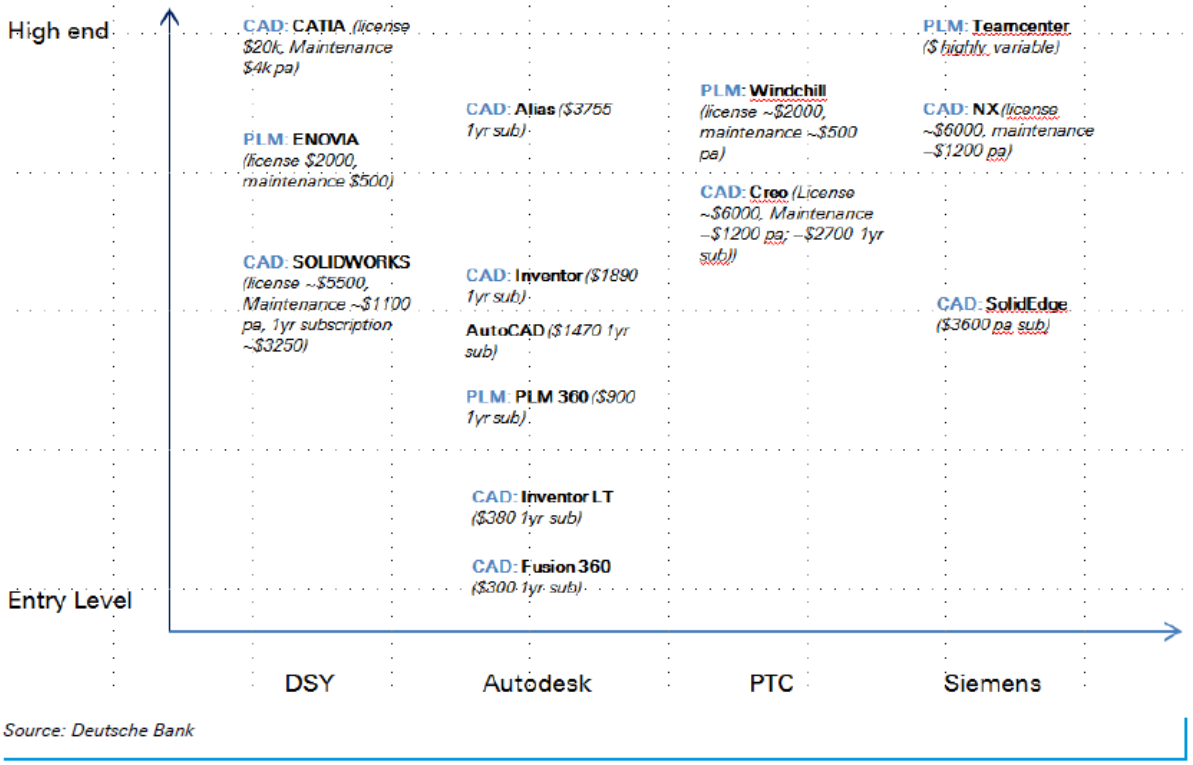
When I spoke with “SouthernValue”, he told me their firm spoke with the architecture firms who wrote the letter to Autodesk. Those firms indicated moving from Autodesk is not the most viable option and even when some of them tried, they could only switch for some projects since shifting all the projects (both historical, ongoing, and future) is just impossible. But even that created a lot of confusion and integration issues within the firm, and some firms just came back to Autodesk despite the complaints they have on Revit. Given the heavy dependence and lack of any real alternative, those firms resorted to publicly complain about Revit rather than voting with their feet.

Dassault’s SolidWorks does enjoy high switching cost, but it probably doesn’t have as much networking effects as Autodesk enjoys on Revit. Design and manufacturing related projects are done by large firms, and there is less collaboration required internally as well as with external smaller firms/subcontractors which make it less cumbersome to switch to a different alternative. It is also possible to have multiple subscription to use different software from different companies without creating too much headache in terms of integration issues as some design projects can be separate and disparate from other projects.

Autodesk is giving design and manufacturing a proper shot. Fusion360’s primary focus seems to be not only to gain market share from incumbents but also to expand the TAM. The price point is just ridiculous compared to the incumbents. While from revenue perspective Autodesk is #3 player in this segment followed by Dassault and PTC, it has the highest market share from number of users perspective implying the impact it had because of the price point. While Autodesk will find it hard to convince Dassault’s existing customers to switch to Autodesk, they are more focused on getting incremental market share in the industry. I came across the following chart which

compares the price point of different companies within the manufacturing segment. Although the chart is a bit dated, directionally it remains largely relevant.

Figure 35: Manufacturing CAE Competitive landscape



Autodesk's comments on Fusion360 during Investor Day (June 2020) confirms their strategy and the early success appears encouraging:

"The entry point for Fusion is very disruptive, and it's intended to be that way. ***The terminal state in terms of what a user will pay for a Fusion subscription is going to be different.*** *I'll let Scott comment on how that stacks. Remember, we moved our entire business to subscription, our Inventor-based business is on subscription, the Fusion-based business is on subscription, and we see nobody else building out the kind of robust, integrated, cloud-based, multi-tenant platform that we've built and especially in the SolidWorks space, where there really isn't a strong alternative. So what we see, regardless of what happens to the TAM, what we see is shift -- share shift coming our way, and we're already seeing it. We're seeing some of these older on-network solutions without the cloud infrastructure, without the end-to-end, start to come our way."*

"And so we see the big opportunity as one is share shift, for example. ***So a lot of our competitors have stopped sharing unit numbers for obvious reasons, but for the data that we have, we show that across Inventor and Fusion, we've outsold SolidWorks from a unit perspective for 3 quarters running****. So that's where we see the big opportunity coming from is from share shift. We definitely want to take care of our existing base, and we see Autodesk as the safe bet for them. Again, relentless on becoming the leader across design and make and manufacturing, and share shift is where we believe a lot of that's going to come from."*

Section 5: Valuation/model assumptions

If you are reading my deep dive for the first time, I encourage you to read my piece on "approach to valuation". I follow an "expectations investing" or reverse DCF approach and try to figure out what I need to assume to generate a decent IRR from an investment. Then I glance through the model and ask myself how comfortable I am with these assumptions. As always, I encourage you to download the model and build your own narrative and forecast as you see fit to come to your own conclusion.

While writing this piece, I am seeing the market, mostly the tech stocks are experiencing correction. I have noticed that many investors are tempted to lower their hurdle rates during bull market and increase the hurdle rate during downturns. Yes, sentiment/factors do play a role in markets and stock prices, but a process is process and unless we stick to it across the market cycle, we are susceptible to be dart throwing chimpanzee. I can evolve, of course, but the evolution is a gradual process, not a fast changing lane that changes direction at every turn. Despite the rising bond yields, the fact remains the 10-year is still yielding 1.5-1.6% and if you add 5-5.5% equity risk premium, 7% IRR still seems quite reasonable to assume while trying to do a reverse DCF model. Of course, my guess is most investors have a higher hurdle rate than 7%, and I, therefore, strongly encourage you to download the model and insert your assumptions and hurdle rates to figure out your comfort. My model/assumptions below are not necessarily my forecasts/opinions on the company; it is just a way to figure out what exactly I am underwriting at the current stock price. In my humble opinion, the process is generally very revealing and it has worked reasonably well for me so far.

Before delving into the details of the model, let me show you the reverse DCF model output. After modeling FCF for the next 10 years, I assumed 23x FCF terminal multiple to generate ~7% IRR. My initial plan was to use 25x terminal FCF multiple, and then build the model to generate ~7% IRR. *But the stock price kept falling as I was writing this piece and I continued to lower my fundamental estimates.* At some point, lowering estimates just stopped making sense, so I decided to keep the fundamental estimates (after lowering it a few times, so what you see is the version after repeatedly revising it downward) and started decreasing the terminal FCF multiple. Why was I keen to use 25x FCF multiple? Autodesk operates in an oligopolistic industry with quasi monopoly in the largest revenue segment, has ~90% gross margin, requires little capital to grow, will be minting FCF year in year out, and has net cash balance sheet. It's not hard to think investors would be happy with ~4% FCF yield to own a piece of such an asset, especially in this low interest rate world. Can I be wrong on that? Absolutely. My sense is that Astrology can perhaps appear more scientific than our ability to predict the correct multiple or come up with target price for a stock, but we still have to pick our poison in a way that will hopefully not kill us.

Items		**2021A**	**2022E**	**2023E**	**2024E**	**2025E**	**2026E**	**2027E**	**2028E**	**2029E**	**2030E**	**2031E**
OCF		1,437	1,706	2,485	2,611	2,776	3,139	3,547	3,880	4,209	4,477	4,603
Capex		(91)	(108)	(102)	(117)	(128)	(141)	(155)	(168)	(182)	(195)	(205)
FCF		**1,346**	**1,598**	**2,382**	**2,494**	**2,648**	**2,998**	**3,392**	**3,711**	**4,027**	**4,283**	**4,399**
FCF/share		6.1	7.2	10.9	11.6	12.5	14.4	16.5	18.5	20.5	22.3	23.4
Terminal FCF multiple												**23.0x**
Terminal Stock price												538
Current price*	**265.4**											
Dividend/share		-	-	-	-	-	-	-	-	-	-	-
Cash flow		(265)	-	-	-	-	-	-	-	-	-	538
IRR	**7.3%**											
#shares outstanding	220	220	222	218	216	212	209	205	201	197	192	188
**Closing price of March 04, 2021*												

Revenue: While transitioing the business from perpetual licensing to subscription model, Autodesk used to emphasize on metrics such as Annualized Recurring Revenue (ARR), number of subscribers, Avg revenue per subscriber (ARPS), number of maintenance to subscripton transition (M2S) etc. Since the transition is nearly complete as evidenced by subscription's contribution to overall revenue exceeding 90% last year, Autodesk mentioned they are now more focused on metrics such as overall revenue, net recurring revenue retention (NR3), Revenue Performance Obligations (RPO) etc. As a result, they stopped disclosing the subscriber numbers and started focusing more on TAM and strategies to grow their presence in each of their product family categories: AEC, MFG, and M&E.

Since Autodesk won't be disclosing subscriber numbers or ARPS metrics, I haven't used these metrics as drivers in my model. Revenue has been segmented in five categories (AEC, AutoCAD and AucoCAD LT, MFG, M&E, and other). While AutoCAD/AutoCAD LT are separated, they are mostly part of AEC as well, but since AutoCAD products are also used by industries beyond AEC, they are reported separately.

Although there is no real driver used to drive these growth forecasts in my model, I will show some back-of-the-envelope type calculation to traingualte these numbers to get a better sense of the reasonableness of the forecasts. Please note that on the last investor day in June 2020, management guided to 16-18% revenue CAGR from FY21-FY23. My forecasts imply the low end i.e. 16% CAGR in the next two years.

Amount in USD Mn, except %	2016A	2017A	2018A	2019A	2020A	2021A	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Revenue	2,504	2,031	2,057	2,570	3,274	3,790	4,318	5,116	5,838	6,418	7,054	7,749	8,412	9,088	9,728	10,228
Growth		-18.9%	1.3%	25.0%	27.4%	15.8%	13.9%	18.5%	14.1%	9.9%	9.9%	9.9%	8.6%	8.0%	7.0%	5.1%
Product family																
AEC	949	810	788	1,022	1,377	1,649	1,896	2,275	2,616	2,878	3,166	3,482	3,796	4,137	4,468	4,692
Growth		-14.6%	-2.8%	29.7%	34.8%	19.7%	15.0%	20.0%	15.0%	10.0%	10.0%	10.0%	9.0%	9.0%	8.0%	5.0%
AutoCAD and AutoCAD LT	725	473	561	732	948	1,099	1,264	1,517	1,745	1,919	2,111	2,322	2,508	2,684	2,845	2,987
Growth		-34.8%	18.8%	30.4%	29.6%	15.9%	15.0%	20.0%	15.0%	10.0%	10.0%	10.0%	8.0%	7.0%	6.0%	5.0%
TAM						23,500				31,000						
Penetration						11.7%				15.5%						
MFG	595	575	529	616	726	799	894	1,029	1,152	1,267	1,394	1,533	1,671	1,805	1,931	2,047
Growth		-3.3%	-8.1%	16.5%	17.8%	10.0%	12.0%	15.0%	12.0%	10.0%	10.0%	10.0%	9.0%	8.0%	7.0%	6.0%
TAM						25,000				33,000						
Penetration						3.2%				3.8%						
M&E	160	139	152	182	199	219	237	265	292	318	344	368	390	409	426	438
Growth		-13.3%	9.6%	19.7%	9.5%	10.1%	8.0%	12.0%	10.0%	9.0%	8.0%	7.0%	6.0%	5.0%	4.0%	3.0%
TAM						3,500				5,000						
Penetration						6.3%				6.4%						
Other	76	34	27	18	24	24	27	30	32	36	39	43	48	52	58	63
Growth		-55.2%	-20.9%	-32.1%	30.2%	3.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Revenue mix																
AEC	37.9%	39.9%	38.3%	39.8%	42.1%	43.5%	43.9%	44.5%	44.8%	44.8%	44.9%	44.9%	45.1%	45.5%	45.9%	45.9%
AutoCAD and AutoCAD LT	28.9%	23.3%	27.3%	28.5%	29.0%	29.0%	29.3%	29.7%	29.9%	29.9%	29.9%	30.0%	29.8%	29.5%	29.2%	29.2%
MFG	23.8%	28.3%	25.7%	24.0%	22.2%	21.1%	20.7%	20.1%	19.7%	19.7%	19.8%	19.8%	19.9%	19.9%	19.9%	20.0%
M&E	6.4%	6.8%	7.4%	7.1%	6.1%	5.8%	5.5%	5.2%	5.0%	5.0%	4.9%	4.7%	4.6%	4.5%	4.4%	4.3%

Now let's look at from a different perspective. As mentioned earlier, Autodesk used to disclose number of users under both subscription and legacy perpetual model. As legacy model is being permanently discontinued, almost the entire revenue base will be under subscription model. If we assume 5% ARPS per annum, we can back calculate the implied net subscriber add every year. While the implied subscriber addition appears largely aligned with management's indication of ~800k subscriber addition for the next two years, it is instructive to see the out years' numbers. While 2025-2027 numbers seem soft, the forecasts imply almost no growth at all in subscribers numbers by the time we reach FY2031. Of course, we cannot forecast what happens 10 years from now, but considering global BIM penetration has a long runway left, the huge base of noncompliant users many of whom will have no option but to pay for subscription sooner or later,

and Autodesk's increased focus on design and manufacturing, the out years' numbers appear very, very low.

Amount in USD Mn, except %	2016A	2017A	2018A	2019A	2020A	2021A	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Revenue	**2,504**	**2,031**	**2,057**	**2,570**	**3,274**	**3,790**	**4,318**	**5,116**	**5,838**	**6,418**	**7,054**	**7,749**	**8,412**	**9,088**	**9,728**	**10,228**
Growth		*-18.9%*	*1.3%*	*25.0%*	*27.4%*	*15.8%*	*13.9%*	*18.5%*	*14.1%*	*9.9%*	*9.9%*	*9.9%*	*8.6%*	*8.0%*	*7.0%*	*5.1%*
Subscription	*228*	*443*	*894*	*1,802*	*2,752*	*3,479*	*4,189*	*5,013*	*5,721*	*6,322*	*6,948*	*7,671*	*8,328*	*8,997*	*9,630*	*10,125*
As % of total revenue	*9.1%*	*21.8%*	*43.5%*	*70.1%*	*84.0%*	*91.8%*	*97.0%*	*98.0%*	*98.0%*	*98.5%*	*98.5%*	*99.0%*	*99.0%*	*99.0%*	*99.0%*	*99.0%*
Growth				*101.5%*	*52.7%*	*26.4%*	*20.4%*	*19.7%*	*14.1%*	*10.5%*	*9.9%*	*10.4%*	*8.6%*	*8.0%*	*7.0%*	*5.1%*
ARR	*255*	*571*	*1,175*	*2,200*												
# of subscription plan (in thousands)	*427*	*1,087*	*2,267*	*3,534*	*4,218*	*5,078*	*5,823*	*6,637*	*7,213*	*7,592*	*7,946*	*8,356*	*8,639*	*8,888*	*9,061*	*9,073*
Net Add		*660*	*1,180*	*1,267*	*684*	*860*	*745*	*814*	*576*	*379*	*354*	*410*	*284*	*249*	*173*	*12*
ARRPS (reported)	*597*	*526*	*518*	*623*												
Revenue per avg subscriber		*585*	*533*	*621*	*652*	*685*	*719*	*755*	*793*	*833*	*874*	*918*	*964*	*1,012*	*1,063*	*1,116*
Growth			*-8.9%*	*16.5%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*	*5.0%*
Maintenance	*1,153*	*1,103*	*990*	*635*	*387*	*183*	-	-	-	-	-	-	-	-	-	-
As % of total revenue	*46.0%*	*54.3%*	*48.1%*	*24.7%*	*11.8%*	*4.8%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*
Growth				*-35.8%*	*-39.1%*	*-52.6%*										
ARR	*1,121*	*1,068*	*879*	*549*												
# of maintenance plan (in thousands)	*2,151*	*2,018*	*1,449*	*796*												
ARRPS	*521*	*529*	*607*	*690*												
Total subscribers	*2,578*	*3,105*	*3,716*	*4,330*												
Net add		*527*	*611*	*614*												
Other	*1,124*	*485*	*173*	*132*	*136*	*128*	*130*	*102*	*117*	*96*	*106*	*77*	*84*	*91*	*97*	*102*
As % of total revenue	*44.9%*	*23.9%*	*8.4%*	*5.2%*	*4.1%*	*3.4%*	*3.0%*	*2.0%*	*2.0%*	*1.5%*	*1.5%*	*1.0%*	*1.0%*	*1.0%*	*1.0%*	*1.0%*
Total	*2,504*	*2,031*	*2,057*	*2,570*	*3,274*	*3,790*	*4,318*	*5,116*	*5,838*	*6,418*	*7,054*	*7,749*	*8,412*	*9,088*	*9,728*	*10,228*

One may wonder the reasonableness of 5% ARPS growth for the next 10 years. Even though it is clearly not difficult to find customers complaining about Autodesk's pricing, the fact is Autodesk's products cost less than 1% of its customers sales and for their customers it is a mission critical product, and therefore, Autodesk does have pricing power. Also note that NR3 in FY2019 and FY2020 was in the range of 110%-120%.

It is instructive how Autodesk outlined their revenue growth forecasts for the next two years. While the FY 2020-2023 column outlines management's guidance on the Investor Day, FY 2024-2031 column is mostly my imagination of what Autodesk may be able to achieve in the out years. The following table clarifies 5% ARPS is not just a pricing power story, but also a mix-shift to higher priced industry collections, and shift from resellers to direct sales mix as well. Almost none of these drivers are one-off, but drivers that will remain relevant perhaps for the next 10 years. As you can see, while it appears ~10-14% topline growth is possible for Autodesk in FY 2024-2031, my reverse DCF model implies lower growth estimates than the low end of the range.

Growth Driver	**Primary type**	**FY 20-23**	**FY 24-31**
Market factors		**4-6%**	**4-6%**
Real GDP Growth	Volume	2-3%	2-3%
Inflation	Price	2-3%	2-3%
Autodesk specific factors		**11-13%**	**6-8%**
Growing renewal base	Price	8-9%	5-6%
Monetization of non-compliant users	Volume		
Conversion of legacy customers	Volume		
Increasing mix-shift to industry collections	Price		
Increasing direct sales mix	Price		
Expansion in construction & manufacturing	Volume	3-4%	1-2%
Total revenue		**16-18%**	**10-14%**
Implied in reverse DCF model		*16.0%*	*9.0%*

Management also indicated they want to target double digit growth way beyond 2023:

"And we also have a lot of confidence in the double-digit growth as we head beyond fiscal '23. Fiscal '23 isn't some event, it's just another milepost like fiscal '20 was. It's another mile post on a journey but there is ongoing growth in the double-digit range out beyond fiscal '23."

SouthernValue also wrote an insightful thread on twitter on Autodesk a few months ago, and his back-of-the-envelope calculation showed that in 10 years, Autodesk may potentially generate revenue of ~$13.4 Bn, a number that is ~30% higher than what my model implies. While we do not have to take anyone's forecast as gospel, I think these triangulated data points give us a sense that there is likely to be a lot that's missing in the current stock price. Although it is always hard to quantify with any precision, as a long-term individual shareholder I am much more focused on being directionally right. I think Autodesk will have to do a pretty bad job for me to generate poor returns from here.

AutoDesk Long-Term Opportunity Set

	Driver	# User Impact	$ ARPS Impact	Revenue Impact	Contr. Margin	EBITDA Contr.
Lever 1	CAD Market Organic	+3-4% / yr.	+2-3% / yr.	~$2.6bn (in 10y)	60%	$1.6bn
Lever 2	Piracy Converts	~2mm	~$600	$1.2bn	80%	$1bn
Lever 3	Legacy Perpetual License	~1.5mm	$1,000	$1.5bn	80%	$1.2bn
Lever 4	Direct Selling	~1.5mm	+$120 (+15%)	~$180mm	90%	$160mm
Lever 5	2D -> 3D CAD (Revit)	~350k	+$1,000	~$350mm	90%	$315mm
Lever 6	Construction SaaS	~2mm	~$1,000	$2bn	40%	$350mm
Lever 7	Mfg. Share / Fusion 360	~1mm	~$2,000	$2bn	40%	$350mm
	Total			**~$9.8bn**	**59%**	**~$5.8bn**

	Revenue	Adj. EBITDA
Autodesk Today (LTM 7/31/20)	**~$3.6bn**	**~$1bn**
Autodesk 2030 Opportunity	**~$13.4bn**	**~$6.8bn**
Uplift from Opportunity	*+270%*	*+580%*
2020 - 2030 CAGR if met	*+14%*	*+21%*

Cost structure: As the business has completed its transition from perpetual licensing to subscription, gross margin improved over the last five years. I think any business that has >90% gross margin at scale and operates in an oligopolistic industry with pricing power is perhaps closest thing to superpower in capitalism. And I think not only this superpower is yet to be harnessed well by Autodesk management itself but also remains underappreciated by the market.

Let me explain why. If you start reading any random quarterly earnings transcript of Autodesk from perhaps any of the past 3-4 years, you will see at least one analyst (sometimes more than one) is asking about Autodesk's long-term FCF guidance and whether the company is on track to meet it. I am going to criticize the management here a bit but let me first say that I understand that it is never easy to transition to a new business model. Just pull up your FactSet/Bloomberg/KoyFin and you can see the financial statements appear optically very messy because of the transition. It does take a fair amount of courage to take a business model transition project for a company that was founded in the '80s and was doing mostly "okay", but not GREAT. The current CEO certainly deserves a lot of credit for taking an ambitious project, setting lofty

targets in 2017 after taking the helm, and mostly meeting those targets with impressive precision three years later in FY2020.

Considering the mess a business model transition creates, it makes sense for Andrew Anagnost to try to calm investors' nerves by guiding them to FCF numbers in out years (2020 in this case). While I applaud this transition and the guidance management provided, they again provided long-term (FY 2023) FCF guidance in last year's Investor Day. And sure enough, every single earnings call since then, analysts are asking whether Autodesk is on track to meet that target and Autodesk is reiterating its confidence to hit $2.4 Bn in FY2023.

The problem is I feel Autodesk is somewhat of a prisoner to these long-term FCF targets they provide. For a business that has ~90% gross margin business with pricing power/network effects/high switching cost, it is not difficult to meet a certain FCF number. The real question is how you get there and what the trade-off is. Unfortunately, the trade-off seems to be under-investment in the business, especially in the cash cow products such as AutoCAD and Revit.

Just take a look at R&D numbers below. Autodesk spent $790 mn in R&D in FY2016, a number that is higher than each of the next three years following FY2016. It is not difficult to sense Autodesk tried to manage its expenses to hit the FCF numbers they guided to the street. I have little doubt that they will hit the $2.4 Bn FCF guidance in FY2023 (January 2023) as well, especially given their track record of meeting the target during the business model transition period which was arguably more difficult to forecast.

I really hope they stop focusing on long-term FCF guidance after that. For long-term investors, I don't really need this guidance. What I really need my company to focus on is improving the products, penetrating the market further, and beating the competitors in different markets year-in-year-out. Instead of giving these explicit FCF targets and being prisoner to them, Autodesk management should teach the street about the underlying earnings power that they have. I am not sure why it is so pressing for Autodesk to hit the $2.4 Bn FCF target two years from now. They could easily hit that number in FY2025 and valuation of the company would perhaps remain unaffected if they were focused on just explaining what a mammoth FCF machine Autodesk potentially is. I am sure some of my readers are high-profile enough to perhaps get a one-on-one meeting with Andrew Anagnost or other senior management at Autodesk; I will request you to let them know that long-term investors do not need to know what the company will generate FCF 2-3 years down the line.

Well, that almost sounded like a rant, but it is from a good place. Of course, the R&D will eventually enjoy scale benefits, and thanks to recent shift from resellers to focusing on direct sales will lead to improved margins.

Direct sales used to be 17% of total sales in FY2015 which increased to 30% today and over the long-term, Autodesk thinks it may reach 50%. As I mentioned in section 1, by going direct there's potentially 15-30% potential accretive margin for Autodesk. But targeting specific year and promising certain FCF numbers can potentially lead to too much optimization to meet those numbers. It should be clear to anyone who spent some time on Autodesk's business that this business can easily generate ~30% EBIT margin at scale in the long-term. No serious investor should really question how incredibly profitable this business can be, and the only thing Autodesk should focus on (and we should debate on) is how fast they can grow their topline. If faster growth requires more R&D and S&M investment, for everyone's sake (customers and shareholders), Autodesk should do it.

My personal opinion on whether Autodesk can be a homerun or just a decent IRR generating stock will be hinged on this pivot from optimizing for FCF to optimizing for topline growth. I have taken my position with the expectation of latter but a slight hope of the former.

Amount in USD Mn, except %	2016A	2017A	2018A	2019A	2020A	2021A	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Cost of revenue	371	342	303	286	325	337	380	403	460	492	540	577	626	676	724	761
Cost of subscription and maintenance	156	151	214	216	224	242	272	301	343	379	417	460	500	540	578	608
As % of subscription and maintenance revenu	11.3%	9.8%	11.4%	8.9%	7.1%	6.6%	6.5%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
Cost of other revenue	215	191	73	54	67	64	65	51	58	48	53	39	42	45	49	51
As % of other revenue	19.1%	39.3%	42.0%	41.1%	49.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
Amortization of developed technology			16	16	35	31	43	51	58	64	71	77	84	91	97	102
As % of total revenue	0.0%	0.0%	0.8%	0.6%	1.1%	0.8%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Gross Profit	2,133	1,689	1,753	2,284	2,949	3,453	3,938	4,713	5,378	5,927	6,513	7,172	7,787	8,411	9,004	9,467
Gross Margin	85.2%	83.2%	85.2%	88.9%	90.1%	91.1%	91.2%	92.1%	92.1%	92.3%	92.3%	92.6%	92.6%	92.6%	92.6%	92.6%
Marketing and Sales	1,016	1,023	1,087	1,184	1,310	1,440	1,555	1,791	1,985	2,118	2,257	2,402	2,524	2,726	2,918	3,068
As % of revenue	40.6%	50.3%	52.9%	46.1%	40.0%	38.0%	36.0%	35.0%	34.0%	33.0%	32.0%	31.0%	30.0%	30.0%	30.0%	30.0%
R&D	790	766	756	725	851	933	1,080	1,228	1,372	1,476	1,587	1,705	1,809	1,908	1,994	2,046
As % of revenue	31.5%	37.7%	36.7%	28.2%	26.0%	24.6%	25.0%	24.0%	23.5%	23.0%	22.5%	22.0%	21.5%	21.0%	20.5%	20.0%
G&A	293	288	305	340	406	414	475	537	584	642	705	775	841	909	973	1,023
As % of revenue	11.7%	14.2%	14.8%	13.2%	12.4%	10.9%	11.0%	10.5%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Amortization of purchased intangibles	33	32	20	18	39	38	43	51	58	64	71	77	84	91	97	102
As % of revenue	1.3%	1.6%	1.0%	0.7%	1.2%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Restructuring and other exit costs, net	-	81	94	42	1	-	-	-	-	-	-	-	-	-	-	-
Total Operating Expenses	2,132	2,189	2,262	2,309	2,606	2,824	3,533	4,010	4,459	4,792	5,161	5,536	5,884	6,310	6,706	7,000
Growth		2.7%	3.4%	2.1%	12.9%	8.4%	25.1%	13.5%	11.2%	7.5%	7.7%	7.3%	6.3%	7.3%	6.3%	4.4%
EBIT	1	(500)	(509)	(25)	343	629	786	1,106	1,379	1,626	1,893	2,213	2,529	2,777	3,021	3,228
EBIT Margin	0.1%	-24.6%	-24.8%	-1.0%	10.5%	16.6%	18.2%	21.6%	23.6%	25.3%	26.8%	28.6%	30.1%	30.6%	31.1%	31.6%

Autodesk guided revenue growth+ FCF margin (aka “efficiency”) to be 55%-65%. My model implies ~51% in FY2022 and ~65% in FY2023. Autodesk certainly clears the rule of 40 as a SaaS business with flying colors. It is interesting to see what some of the companies with comparable or below efficiency score are trading at right now. I should mention as a long-term investor, this information has little value to me as multiples are product of fundamentals, sentiment, and interest rates and how the fundamentals/sentiment/rates will change in the long-term, I have no idea, so I don’t find looking at comparable multiples super helpful given my investing style.

Amount in USD Mn, except %	2016A	2017A	2018A	2019A	2020A	2021A	2022E	2023E	2024E	2025E	2026E	2027E	2028E	2029E	2030E	2031E
Cash Flow from Operations (CFO)	414	170	1	377	1,415	1,437	1,706	2,485	2,611	2,776	3,139	3,547	3,880	4,209	4,477	4,603
Margin	16.5%	8.4%	0.0%	14.7%	43.2%	37.9%	39.5%	48.6%	44.7%	43.3%	44.5%	45.8%	46.1%	46.3%	46.0%	45.0%
Free Cash Flow (FCF)	342	94	(50)	310	1,362	1,346	1,598	2,382	2,494	2,648	2,998	3,392	3,711	4,027	4,283	4,398
Margin	13.6%	4.6%	-2.4%	12.1%	41.6%	35.5%	37.0%	46.6%	42.7%	41.3%	42.5%	43.8%	44.1%	44.3%	44.0%	43.0%

Section 6: Capital allocation and management incentives

As per my model, Autodesk will generate ~$32 Bn cumulative FCF in the next 10 years which is almost half the current market cap of the company. Capital allocation will be of paramount importance and can become one of the driving forces for the actual realized IRR for shareholders. So far, management has indicated they primarily buyback shares to manage share dilution and there hasn’t been strong indication of big, opportunistic share repurchase potential. I wouldn’t rule out the potential for opportunistic share buybacks and wouldn’t judge Anagnost’s capital allocation philosophy based on the last three-year track record.

While Anagnost’s primary focus could not possibly be share buybacks given the onus of business model transition, once Autodesk starts minting FCF in 2023 and beyond, he may evolve into a more capital allocator mode. However, if I had to bet, my guess is Anagnost will probably lean onto more acquisitions as evidenced by recent acquisitions of Spacemaker and Innovyze. Acquisitions are not a problem if they can enhance the value proposition and add to the topline

without cannibalizing the existing software products. These acquisitions can add to the talent pipeline but does enhance integration risks as well.

The size of the recent deals increased compared to Autodesk's history, but even then, ~$32 Bn is a lot of money and unless Anagnost goes for a sizable acquisition that amounts to $5-10 Bn, bulk of his capital allocation decision may lean to share buybacks. Although Autodesk spent $1.5 Bn in the last 6 years for acquisitions, I have set aside $3.7 Bn for acquisitions in the next 10 years. I think Anagnost and Autodesk should start talking more about the capital allocation framework they have in mind. When they spend a decent amount to acquire a company, they should also give investors a framework in terms of how to evaluate these decisions or how they are evaluated internally. Given the amount of cash Autodesk will generate, investors need to have faith in management's ability to make prudent capital allocation decisions.

I should note that during my due diligence everyone I spoke to had glowing remarks on Anagnost's leadership (even the ones who weren't thrilled with Autodesk). I found his twitter bio endearing: "Husband, Math Tutor, Frustrated Writer and CEO". A whopping 96% approve him as CEO, according to Glassdoor.

Even though he has been CEO only since 2017, he joined Autodesk in 1997 and if you spend at a place for more than two decades, it probably starts to feel like your own place (I wish he owned more shares; currently he owns just 78k shares) which probably gave him the courage to take the business transition route.

I will keep my eyes on to understand the capital allocation priorities, and I will request my readers to probe these questions to management if they get a chance to meet them. Anagnost's legacy can turn from good to great if he can also prove himself to be a fantastic capital allocator.

Autodesk's long-term CFO (since 2014) Scott Herren has recently left for Cisco Systems and Autodesk appointed Debbie Clifford who was SurveyMonkey's CFO for the last one and half year. Clifford is an Autodesk veteran who worked at various Finance roles for 14 years within the company before leaving for SurveyMonkey. Anagnost indicated Clifford was groomed to be CFO but wanted her to gain some experience outside Autodesk before handing over the role.

In terms of incentives, it is tied to total revenues (60%), Non-GAAP operating income (40%) as well as relative TSR (longer term).

Section 7: Final words

Autodesk is a wonderful business at a very reasonable price (***my opinion***), and when I come across such a situation, I want to express my opinion through weights in my portfolio. That is why

ADSK is in my top 3 holdings, only followed by BRK and ETSY. I want to make it abundantly clear that none of this is a recommendation to buy/sell any security; MBI Deep Dives is absolutely NOT a substitute to your own due diligence work. I want to explicitly mention my position because I want you to know my opinion and biases on the company and the stock. I am not an expert on anything, and my personal goals, constraints, and philosophy in investing may have no resemblance to yours. I am just an individual investor trying to compound my own capital. MBI Deep Dives is not only the vehicle for my livelihood but also my personal exploration to be a good analyst AND a good investor. Being a good analyst is a necessary, but not a sufficient condition to be a good investor. I am just journaling both my joy and agony in investing through my monthly deep dives, and I thank you for being part of this journey.

Ticker	Avg. Cost	Current Weight*	Unrealized Gain/loss %
BRK.B	194.9	20.6%	29.9%
ETSY	114.6	17.9%	75.2%
ADSK	291.2	15.7%	-8.2%
FB	211.6	13.9%	24.9%
IAC	124.2	13.3%	89.5%
ANGI	11.7	4.6%	33.8%
GOOG	1,184.6	4.2%	78.0%
ISRG	558.6	3.5%	27.7%
ANSS	364.0	3.1%	-15.4%
AMZN	1,849.2	3.0%	62.3%
Cash		0.2%	
Total		100%	40.9%

**Based on prices as of March 07, 2021 (time-weighted YTD: +6.0%)*

To fund my ADSK purchases, I utilized the cash in portfolio and sold DLTR shares at $106.6 which I bought at $72.4 in March 2020. While ~47% gain may seem like a lot in such a short time, it actually underperformed S&P 500 by 6% during the time. The one-line thesis was DLTR has a history of being an excellent performer during recession and as I was fearing a prolonged, deep recession in March 2020, I took a position on the stock. Thankfully, those concerns are outdated by now and hence DLTR's utility in the portfolio has largely diminished in my portfolio.

I also want to briefly comment on ANSS which is down by ~15% since I bought the stock (I would encourage you to read my thread on the latest earnings). It had a fantastic Q4 which led to 2.5% higher revenue than was modeled in my reverse DCF model. However, Ansys' guidance for 2021 was disappointing. Some of the recent quarter's outperformance was basically pulled forward from 2021 and hence will pose a tougher comp for this year. The new CFO may have been sandbagging a bit when she guided to 3-8% topline growth in 2021, and Covid impact on the SMB segment may persist for a little while which may have dampened the growth expectations. The increased seasonality of Q4 makes it more difficult to forecast even for management. Despite considering all these, I still think the guidance was disappointing. The embedded expectations in the stock still imply revenue growth acceleration in 2022 and beyond and will require sustained

double digit topline growth to support the stock price. If it does not materialize, the stock may be in a tough spot for a while. Ansys is a terrific business, and I am willing to be a patient shareholder, but unless and until I have more clarity on the topline situation, I personally would think long and hard before averaging down. Thank you for reading.

I encourage you to subscribe for the annual plan; annual subscribers receive the full schedule of deep dives in 2021. ***In case you are curious, I am covering Shopify next month****. Please feel free to encourage your colleagues/acquaintances to subscribe to my work. Your support is deeply appreciated.*

Recommended reading

1. SouthernValue thread
2. Fourmilab: Autodesk Founder John Walker's website
3. Procore S-1 (Jamin Ball)
4. Earnings thread (ETSY, ANSS, CPRT)

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