# TWIST BIOSCIENCE (NASDAQ: TWST)

## A Cash-Burning Inferno That Is Not A Going Concern, Operating A Ponzi-Like Scheme That Will End In Bankruptcy. Just Another "Synthetic Biology" Swindle, This Time With An Absurd "Silicon DNA Chip" And Financials So Phony It May Be Criminal. Target Price: $0.

**$2.1B market cap | $38/share | ADV 1.1MM shares | Short interest 11%** *per Capital IQ, 11/14/22*

- **Our third "synthetic biology" short report in a year, after Berkeley Lights (-90%) and Ginkgo Bioworks (-78%)**
- **The latest miniaturized "lab-on-a-chip" scam, just like Theranos, Berkeley Lights, and other failures**
- **A ticking time bomb that we believe is resorting to a Worldcom-esque accounting fraud, which sent the CEO, CFO, and accounting staff to prison**
- **Purported "Factory of the Future" in Oregon, which Twist claims to be ramping with ~$100MM of capex, appears deserted based on photographic and other evidence, leading us to believe it is a ruse for improper capitalization**
- **Twist's reported gross margins of 45% are simply implausible, and we think that they are actually negative**
- **Multiple competitors internally refer to Twist's price dumping and customer subsidy scheme as a "Ponzi"**
- **A commodity product in a commodity space with a furious price war and signs of saturation**
- **CFO's previous job was at a "prisoner leasing" company some compare to "a kind of modern slavery," that "employs" incarcerated females who allege exploitation and abuse; Twist appears to be a client**
- **Suspicious transactions with offshore Chinese entities that we find troubling in relation to the Foreign Corrupt Practices Act, involving its largest holder pre-IPO, which was implicated in one of the largest frauds in China**

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## Table of contents

## Table of contents

## Executive Summary

**Part I: Twist is a ticking time bomb, a commodity DNA manufacturer with a low quality, inferior product, operating an unsustainable Ponzi-like scheme based on price dumping and customer subsidies to buy revenue and create the illusion of "growth. Twist sells at uneconomic prices below its cost of goods, such as its marquee deal with Ginkgo Bioworks where we estimate it prices at ~10% of cost and has a negative 500% gross margin. Lacking any intellectual property, Twist's only innovation was launching a suicidal, unwinnable price war – "a race to the bottom" – with "insane" prices that even its low-cost Chinese competitors call "shocking." Competitors refer to Twist internally as a "Ponzi," and even a major customer was dismissive of its future, stating it could "go bankrupt or collapse" because of its pricing scheme.**

1. **Introduction to the real Twist Bioscence; a house of cards resorting to an increasingly desperate cover-up. We conducted 20 research interviews including Twist ex-executives and manufacturing employees, customers, competitors, and DNA manufacturing experts, as well as a private investigator field visit to its purported "Factory of the Future" in Oregon. The entire Twist story rests on its "silicon DNA chip," which our investigation reveals is a farce – a fatally-flawed, decades-old technology that the CEO lifted from her previous employer. Far from being a "cost-effective, high-fidelity, high-throughput" platform, the so-called "chip" is an albatross around Twist's neck, with claims that are so flagrantly false as to constitute a hoax.**

2. **Twist's spiraling losses are due to an unsustainable scheme that purchases "growth" with a price dumping strategy, by subsidizing customers with prices 50-90%+ lower than the competition – well below its cost of goods, described to us as "shipping a $20 bill with every order." Similar to a Ponzi that "robs Peter to pay Paul" and requires a never-ending flow of new money to survive, Twist's giant giveaway is funded by one capital raise after another – with two competitors even stating that they use the label "Ponzi" internally to describe Twist, refusing to match its "shocking" prices and simply waiting it out until the scheme collapses.**

3. **Twist's scorched-earth pricing strategy began at launch ~5 years ago. Lacking any value proposition as a commodity vendor in a commodity space – a glorified CMO – Twist simply resorted to undercutting large US incumbents on one side and low-cost Asian competitors on the other. Twist came "out of the gate" being "shouty shouty" about their price, with ex-employees stating that the only way they could "break into the market" was by "cutting the price in half" – there's "not a very good way to differentiate synthetic DNA"; "the sequence is the sequence." They described it as textbook price dumping: "take market share" by slashing pricing and "assume you could raise the price later."**

# Executive Summary

## Part I: Twist is operating an unsustainable Ponzi-like scheme based on price dumping (cont'd)

4. **Twist's prices are so "insane" that it is essentially giving its product away, a welfare-program that leads it to be dependent on a bottom-of-the-barrel customer base addicted to its 50-90% discounts. As one example, an academic lab indicated they receive a 70% discount off already rock-bottom list pricing, and stated that even a 50% discount would not be large enough to stay - "they dug themselves in a hole by pushing low cost as their primary value proposition," according to a key competitor. Twist attempts to undercut even low-cost Chinese competitors – like taunting ISIS to a suicide bombing contest – with a Genscript executive telling us that Twist burst onto the scene with prices 90% lower than prevailing Asian prices, calling it reckless and mystifying, adding that he doubted their viability.**

5. **Every competitor we interviewed expressed disbelief and skepticism at Twist's pricing scheme, saying that they "never understood it" and that "Twist hadn't invented a better mousetrap…anyone that had deep technical knowledge in the space was kind of like, how are you doing that? It didn't compute." They stated Twist "put a lot of pressure" on the market and ignited a price war in a commodity space already operating with rock-bottom prices, with Chinese players responding by simply undercutting its quotes. An ex-Twist executive used the term "very predatory" to describe the "price matching" cycle that Twist kicked off.**

6. **With rampant discounting now the norm, Twist's only disruption was wrecking the entire industry's economics and devastating its cash flow in the process, like a suicide bomber blowing off its own limbs. An ex-employee stated that by "selling below the cost of their product" – again, textbook price dumping – Twist took "too much value out of the market for it to be profitable for anybody." He indicated that Twist won customers "solely" because of price and now has no way out of the price-death spiral it is trapped in: "once you displace pricing and that badly, it's impossible to lift it again"; "I don't think they've ever going to recover from that." Ominously for Twist, ex-employees and industry experts predict another "seismic shift in the DNA market" as disruptive new entrants collapse pricing another 70% from Twist's giveaway levels.**

## Executive Summary

**Part II: Twist's "DNA chip" narrative - 10,000X higher throughput and lower cost - is fraudulent, covering up a manual, labor-intensive, and fatally-flawed manufacturing process crippled by errors, bottlenecks, and pitiful yields – thereby driving gross margins we estimate to be negative. Similar to Theranos which claimed to have a "lab-on-a-chip" but was secretly running blood tests on standard equipment, Twist's workflow requires the same steps as every other commodity DNA manufacturer, but with a crucial difference: it is a fiasco with radically higher costs than its competitors.**

1. **Twist's DNA production process is in such disarray that ex-manufacturing employees painted it as an operational meltdown, consistent with its losses: "I don't know how they an make it"; "their process and method are not sustainable." A longtime industry executive who has advised the CEO stated he was "shocked" after visiting their manufacturing operations: "When I went out there and saw what they were doing, I was shocked." He stated it's so-called "chip" was such an albatross and "boat anchor" that Twist's only hope was admitting failure and starting over – "an overengineered solution that they called a chip."**

2. **Twist represents their "platform" as automated and "industrialized" but ex-employees indicated it is simply a low-tech, manual body-shop: "the problem is that the whole process is labor intensive"; "what they do is very low margin" and takes "manual labor." Loading the "chip" requires crews of lab technicians working overnight shifts, followed by a long series of manual steps - "that's labor and you need people to do that in each tube" – such as operating liquid handling machines. Ex-staff stated it can take an entire day to fill up a "chip" as it's just a denser plastic well plate, followed by a "one-week process" where "people have to change plates and add things" – and this is just the first synthesis step, before the rest of a long workflow.**

3. **Contrary to Twist's claim of "increasing throughput" - the heart of the story - the "chip" is a massive bottleneck that actually slows down manufacturing with "customers frustrated because they cannot deliver on time." The higher density of Twist's miniatured plastic well plate – all that its "chip" is – has spectacularly backfired, by forcing week-long waits to batch orders, as they would lose even more money per run by only using part of its capacity.**

# Executive Summary

## Part II: Twist's "DNA chip" narrative is fraudulent (cont'd)

4. **Similar to Theranos claiming blood tests were done on their "lab-on-a-chip" while secretly doing them on regular equipment, Twist claims to have "proprietary semiconductor-based synthetic DNA manufacturing," while hiding that its workflow is no different than widespread, commodity, 40-year old methods that are "standard molecular biology," based on a decades-old method used by all of its competitors: "everyone uses phosphoramidite chemistry"; "the basis of everyone's DNA synthesis technology." The steps following synthesis are equally common, like PCR to stitch oligos together. An ex-manufacturing manager stated Twist's steps are the same "as they were in the '90's" and "at the same point that all the vendors are at"; "gene synthesis process is the same as it is everywhere else"; "nothing special."**

5. **A fatal flaw in Twist's "chip" is that can only make negligible volumes of DNA, rendering its claim of "throughput, scalability, and cost" an utter fiction. Twist therefore requires teams of technicians dedicated to amplification, through a process called tiling, where the material has to be scaled to >1000X its volume – yet another costly bottleneck, with personnel performing a long list of repetitive, manual tasks over 12-16+ hours. In other words, Twist's "chip" – a miniaturized well plate – is simply a self-defeating gimmick for the purposes of a stock promotion, which requires numerous compensatory steps.**

6. **The amplification workarounds needed to compensate for the chip's inability to produce sufficient volumes introduces catastrophic fidelity, mutation, and error problems in its DNA sequences – the core of their spiraling manufacturing costs and their "Achilles heel." Sequence errors are a costly, unsolved problem in DNA synthesis that plagues every manufacturer, but Twist has it in spades, which requires time-consuming error-correction and re-work to produce the sequences over and over again to get a usable one: "the error rate is really, really high and that makes [the oligos] not useful'; workarounds force "very long and arduous next generation sequencing" that's "expensive, "slow," and "requires a lot of high-level PhD's."**

7. **Manufacturing error rates and pitiful yields are the key to understanding Twist's extreme losses, and why it is doomed, forcing a dysfunctional, trial-and-error process where it has make multiple, duplicative orders to get one right: "their problem is still error rates…and that's why they're losing money"; "a situation where you need to make multiples of everything just to be able to deliver." Ex-employees indicated Twist has re-make sequences a shocking number of times: "you sequence five and two of them are right…if it's a complicated sequence you sequence 15 and maybe none of them are right."**

# Executive Summary

## Part II: Twist's "DNA chip" narrative is fraudulent (cont'd)

**8. As a result of the re-work and duplicative manufacturing caused by errors, it is simply implausible that Twist has a positive gross margin. Twist is the equivalent of Tesla having to re-make a car 5-10 times to get one right, and then discounting it at 95% off because that's the clearing price for junk – but with a crucial difference that makes the situation even more dire: Tesla in that scenario could re-use the parts, while Twist has to eat the variable cost of chips for each run as well as expensive reagents, enzymes, and other inputs on top of labor. Gen9, a failed company that used the same Agilent chip as Twist, experienced yields of only 30% and minus 30% gross margins, according to an-executive: "the cost of goods are pretty horrendous"; the gross margins "were pretty shitty…yeah, they were negative."**

**9. The sheer dysfunctionality of Twist's errors, yields, and re-work is such an anomaly that we wonder if there's another public manufacturing company with gross margins this catastrophic. A DNA manufacturing expert stated that the chip's fatal flaws mean that "you're definitely going bankrupt"; "you're going to lose money…it's something I don't think [investors] get…you're not long for this world."**

## Executive Summary

**Part III: In order to conceal the spiraling losses from its pricing scheme and manufacturing meltdown - and to prevent its Ponzi-like nature from being self-evident - we believe that Twist has resorted to Worldcom-esque accounting fraud. Our research leads us to conclude that its reported gross margin of 45% - projected to rise to over 60% - is simply false, and that its actual gross margin is negative. We believe that Twist concocts a positive gross margin by 1) misclassifying COGS as R&D expense, and 2) misclassifying COGS as capital expenditure, in part via two vehicles: a) its purported "Factory of the Future," where Twist implausibly claims to have already spent ~$90MM, and which we think is simply a cover; and b) its "DNA Storage Initiative," where Twist claims to be spending $40MM, on a vaporous program with barely any staff. Twist's gross margin "progress" is central to the narrative and its ability to raise capital.**

1. **During our research, we were troubled by a massive discrepancy: ex-employees, competitors, and industry experts provided overwhelming color that Twist sells below its cost of goods, due to 1) its reckless customer subsidy and discounting scheme, and 2) the turmoil in its manufacturing operations. However, Twist's financials report an unusually high gross margin for a commodity manufacturer – a margin that steadily, smoothly increases every year. The CFO frequently pushes the gross margin narrative, asserting recently that "there's no reason that it should not be a 60-plus precent gross margin business."**

2. **As we studied Twist's reported gross margin, we noted a number of striking anomalies, and concluded that that Twist has every motive to fabricate the figure. Its stock price and ability to stay alive via frequent capital raises hinge on two metrics: revenue growth and gross margin. Gross margin achievements feature prominently in earnings releases and guidance, and the centrality of gross margin to Twist's narrative is apparent during quarterly earnings calls, with "gross margin" mentioned 15 times on the last one. Both the CEO and CFO promote gross margin progress, and questions by sell-side analysts indicate a fixation on the issue, with Twist predictably establishing a beat-and-raise narrative around the number.**

3. **We think that Twist's gross margin is negative, and believe that the company has concealed this secret via expense misclassification and improper capitalization. Misclassifying expenses, particularly as capex, is one of the oldest accounting frauds in the book – causing Worldcom's rapid collapse into bankruptcy when it was revealed, and landing its CEO, CFO, and various accounting staff in prison. We note that Worldcom's fraud began by shifting labor costs and only later metastasized into capitalizing various expenses.**

# Executive Summary

## Part III: We believe that Twist has resorted to Worldcom-esque accounting fraud (cont'd)

4. **We believe that shifting direct manufacturing costs to R&D expenses is the first mechanism, with Twist's historical and recently exploding R&D costs straining credibility for a commodity DNA manufacturer. Twist reported R&D expenses of $110MM in the last 12 months - a staggering 60% of revenue. We find it inconceivable that LTM R&D is actually equivalent to COGS – also 60% of revenue. We note that Twist is not a drug development company; has no clinical pipeline or R&D programs like a traditional biotech; runs no clinical trials; and has no real product pipeline beyond tinkering with a legacy micro-array it calls a "chip."**

5. **We believe that the second mechanism is misclassifying COGS as capital expenditure. Twist spent little on capex for most of its life, but capex suddenly spiked in 2021, and then went parabolic in the last 12 months. Capex in the last four quarters is almost double what Twist in its entirety since 2017. We find the sudden spike troubling, as Twist has historically been a low capex business – about $2 to $5MM per quarter. Comments by Twist's CFO state that the bulk of the recent capex is for their new, so-called "Factory of the Future" in Wilsonville, Oregon – about $88MM through FY2022, based on our total of figures provided on calls. We further noted various discrepancies across the CFO's comments, and were further stunned to find no detail for the expenditure in SEC filings, given its vast scale.**

6. **We think that Twist's explanation for the capex spike – the "Factory of the Future" - defies common sense and is a ruse. We sent a private investigator to the Wilsonville, Oregon facility, and encountered a deserted parking lot and a few employees milling around a makeshift entrance area. Our finding is consistent with recent pictures of the facility's interior from Twist's postings on its Facebook page and elsewhere, which indicate no evidence of almost ~$100MM of PP&E and lab equipment. Our opinion is further based on an analysis of Twist's job postings for the facility, and LinkedIn profiles of staff who we believe are mostly seconded from its Bay Area-headquarters and there for kabuki theater. We emphasize that Twist is leasing the Oregon facility for a negligible amount, and that the massive capex is not for greenfield construction.**

7. **We are therefore not surprised that despite talking up the Factory of the Future's ability to turbocharge growth, reverse epic losses, and cure world hunger, the CEO and CFO have already begun to talk down expectations. Ex-employees, competitors, and industry experts shared our skepticism of the company's claims, with one describing the factory as just a "story that I think Wall Street wants to hear"; that it's "unnecessary and won't change their costs"; that he'd be "shocked" if they're out of capacity in San Francisco; and that it will simply "add a bunch of new costs and redundancies."**

# Executive Summary

## Part III: We believe that Twist has resorted to Worldcom-esque accounting fraud (cont'd)

**8. The second mechanism by which we believe Twist is misclassifying COGS as capital expenditure is its "DNA Data Storage" program, which the CFO indicated accounts for another $40MM of spend and is utterly vaporous, with no clear explanation for it even is; descriptions that change wildly depending on the day; nothing to show for it despite talking it up for years; and what we estimate to be about only five staff members even supposedly allocated to it.**

## Executive Summary

**Part IV: Twist has no value proposition beyond price and is a bottom-tier vendor with a poor reputation, viewed as inferior to even Chinese vendors, due a) delays and lead-time problems in delivering sequences, which customer indicate are rapidly deteriorating, consistent with color suggesting an operational meltdown; b) major product limitations vs. competitors, regarding sequence length and complexity; c) a lack of sample purity and quality control; d) inability to manufacture larger, consistent lot sizes required by real customers like pharma; e) an inability to deliver at higher-quality GMP standards. As a result, Twist is essentially shut out of larger customers like big pharma and anything that is mission-critical and FDA-related, relegated to smaller academic labs and biotech startups - the "emperor has no clothes" and "scares the living heck out of anyone in the clinical space" who would be "scared to death" of being "censured by the FDA" for using an "inconsistent panel."**

1. **Ex-employees, customers, and competitors indicate that Twist has no value proposition beyond price, and describe them as a bottom-tier commodity vendor with a poor reputation – inferior to even cheap Chinese players like Genscript - due to severe lead time and quality control problems, as well as numerous product limitations around sequence length and type. A major pharma customer bluntly stated that "they don't offer anything innovative" and was dismissive of their future, stating Twist may "go bankrupt or collapse" because of its insane pricing. An industry executive friendly with the CEO stated it's "well known" that Twist's product is inferior and its quality struggles are a "fairly known problem." An ex-Twist director-level employee indicated that Twist has "no advantage" or differentiation.**

2. **Customers indicate Twist is far slower vs. competitors at delivering DNA sequences, a sharp contrast to its claim of a "high throughput silicon platform." Novartis, a large and frustrated customer, summarized a recurring theme: "they ask for a really long time"; "always been slower than competitors" who deliver in 2-4 weeks vs. Twist at 8-10; can't meet timelines, and now only give them simple orders which even then take 2 months. An ex-Twist employee, a customer via his new employer, is "rarely using Twist now" after delays and quality problems, stating they've shifted to two Chinese vendors that are cheaper and "significantly faster" – delivering orders in 3-4 weeks vs. 2-3 months at Twist: "Definitely we were frustrated, so we just walked away."**

# Executive Summary

## Part IV: Twist has no value proposition beyond price and is a bottom-tier vendor (cont'd)

3. **Customers indicate that Twist's situation is deteriorating, with recently escalating delays and quality issues: "it's getting worse…I can notice…it's just getting worse"; Twist is already "one month" slower than competitors like IDT and Chinese vendors, who are "very cheap and very fast," delivering in 3 days; "they can rarely keep their delivery time…it's always delayed." Abbvie, a large pharma company, confirmed Twist's delays, indicating 4-5 week lead times and highlighted the recent deterioration. A manufacturing expert stated that "it takes them very long these days" due to errors which force "multiple builds, that's where you find they're losing money on every order." An ex-employee outlined an operational meltdown with customers leaving due to missed order dates or incomplete orders, indicating that Twist misses promised turnaround times for ~30% of orders, due to quality failures that require DNA samples to be re-manufactured.**

4. **Competitors provided identical color to that from customers and ex-employees. IDT, its key US competitor, stated they've "positioned themselves as a commodity provider" like an "In and Out Burger" and that even Ginkgo Bioworks, their marquee deal, only resorts to Twist for "very low-priority screening projects." An executive at Twist's key Chinese competitor, Genscript, stated that its reputation among customers was of over-promising and under-delivering, and that they "cannot deliver on time." Similar to IDT's observations, Genscript is seeing customers switch back, after being seduced for a time by Twist's fire-sale prices, after tiring of order delays, the lack of GMP capabilities, and total failure in its antibody business.**

5. **Twist is handicapped by major product limitations vs. competitors, such as its inability to make longer sequences as well as those with higher complexity. An ex-manufacturing employee stated that Twist has "issues in regard to getting that [longer] gene to you"; a "major thing that was wrong"; "we would have to admit failure because our processes were not good enough." An ex- manufacturing manager commented that more complex sequences 'become more difficult to synthesize…we're not even going to try these…we know that our process can't make these." A large pharma customer confirmed that Twist can only make small oligos, while serious applications require ones that are 5-20X longer: "they cannot come up with these really long oligos"; "you only use that in the early, early stages of discovery which is mostly in academia."**

# Executive Summary

## Part IV: Twist has no value proposition beyond price and is a bottom-tier vendor (cont'd)

6 **In addition to delays, customers described a lack of sample purity and quality control. A major customer, one of the largest genomics centers in Europe, stated that the purity of Twist oligos "isn't as high," stating that customers are "better off going through someone like IDT…you'll get much higher purity and much better performance." An ex-IDT sales manager characterized their entire product line as a commodity that struggles with quality, quantity, consistency, mutations, sequence length, and other problems that create "substantial headache" and "substantial expense" for customers. Even Twist's bread-and-butter customers – small, price-sensitive academic labs and biotech startups, hooked on steep discounts and making-do with inferior sequences – were sharply critical. One such academic lab stated Twist's samples lack uniformity and quality control, detailing a recent and "surprising" defect that Twist couldn't figure out despite repeated attempts – "seemed like it was going to ruin our experiment"; "we still don't totally understand it."**

7. **Twist is essentially locked out of larger customers like big pharma, who revealed a critical reason why they can't use Twist in the clinic, where the real volumes and revenue are, and why its claim of a "high-throughput" platform is absurd: it is incapable of manufacturing the larger lot sizes pharma companies need. As a result, they'd have order from different lots, creating major headaches as lot consistency is "very important," given the time and expense to qualify every new lot: "it doesn't make sense because people in the lab lose time, and this means money and time."**

8. **Customers and competitors indicated that Twist's lack of GMP capabilities, quality control, purity, and lot consistency makes it a non-starter for anything FDA-related. A large pharma customer dismissed Twist's non-GMP sequences as basically useless and only relevant for low-value work in academia or early-stage biotech, indicating that 80% of order volumes are for GMP-standard product. A competitor elaborated that Twist's quality control and sample purity issues are so severe that the "emperor has no clothes" - a reputation in the market for low-quality sequences with consistency problems; misleading marketing that would get a grad student called out; and that Twist "scares the living heck out of anyone in the clinical space" who would be "scared to death" of being "censured by the FDA" for using an "inconsistent panel."**

## Executive Summary

**Part V: Twist operates in a commodity, crowded, hyper-competitive space with a me-too offering and has self-selected for a bottom-of-the-barrel price-seeking customer base. Even its competitors bemoan that the entire space is in a "race to the bottom" with a furious price war, "tons of players," "very low barrier to entry," "very low switching cost," and "always someone willing to do it for less margin." In particular, Twist's nascent antibody discovery service – its purported growth driver – is also a commodity and already a failed business, with ex-employees in the division calling it "very generic and nothing special." Twist now finds itself stuck with a customer base dependent on ever-increasing discounts to stay. Multiple competitors indicate that Twist was only able take share among their worst customers, who they were happy to cede, given its low-price, low-quality positioning.**

1. **Twist's customers bluntly stated that it operates in a commodity, crowded space, with a me-too offering across its entire product line whether oligo pools, synthetic genes, NGS, or antibody discovery. Abbvie summarized the ambivalence we encountered even from larger customers: "[T]here's really no big difference. We could switch anytime if needed"; oligos are a "total commodity, "very, very cheap," "very easy to make," and "it's just the same thing." A major research center emphasized that Twist's NGS offering is also a commodity: "quite a crowded market"; "it's a commodity"; "other companies [are] developing platforms that might have similar functionality." An academic lab conveyed indifference even between Twist vs. cheap Chinese competitors: "sometimes we buy from Twist, and sometimes we use some other people like Genscript"; "always found [Genscripts's] stuff pretty good."**

2. **Even Twist's key competitors candidly bemoan that the entire space is just a price-driven commodity. An executive at a major Asian competitor stated that the market is the worst of all worlds: a commodity in terms of "price erosion," but with a high cost to manufacture. The executive characterized Twist as focusing on the worst, most commodity end of the DNA synthesis space – "not a successful strategy" – and described the savage price war: "a lot of competition in the market"; "people expect the price to drop and drop, so we keep dropping it"; "we cannot charge a lot of money"; "we cannot say we are truly differentiated" – adding that he was being unusually honest. Danaher's IDT division echoed the despair: "you can go to a lot of places for" gene synthesis, NGS, and oligo pools; "I don't know that there's any one place really sticking out…it's hard to get people to make changes; a "crowded market" with "lots of people making double-stranded DNA."**

## Executive Summary

### Part V: Twist operates in a commodity, crowded, hyper-competitive space with a me-too offering and has self-selected for a bottom-of-the-barrel price-seeking customer base (cont'd)

3. **Ex-employees corroborated the color from Twist's customers and competitors. A former employee in a senior role stated that there are "tons of players" with "very low barrier to entry" and "always someone willing to do it for less margin." He continued that "everybody who's a customer in this space has at least two key suppliers"; "lot of little local suppliers"; "very low switching cost"; "it's all molecular biology" and "the methods are well published." Another ex-employee stated Twist has "no advantage" and that their offering is a commodity any vendor can offer using traditional DNA synthesis on plastic well plates.**

4. **Twist's antibody discovery offering – its purported growth driver – is similarly a commodity and already a failed business. An ex-employee who played a senior role in this division stated that it's "a typical, traditional hybridoma service" that's "very generic and nothing special." He repeated that "the reality is this is nothing special…it's just like any other biotech company that provides antibody engineering or library services….so, there's not much of a differentiator."**

5. **Given that Twist sells low-quality sequences via a scorched-earth pricing and discounting strategy, it is not surprising that it has ended up with bottom-of-the-barrel price-seeking customer base. A longtime executive in the space stated that its customers are therefore academics and startups: "where I haven't seen them get much traction is…quality controlled places like pharma," adding that Twist's lack of quality control would be "a disaster for a pharma company," suggesting its quality was inferior to even Chinese players – and that the problems preventing it from selling into pharma were specific to Twist, as its competitors all sell there. Twist's customers confirmed that its product limitations make it relevant only for smaller customers and that it has no value proposition beyond price: "Twist is not a big vendor…they have their market, which is laboratories in universities and smaller startups…."**

6. **Competitors indicate that Twist took only their worst customers, given its low-price, low-quality positioning. An ex-Agilent executive stated that they "freaked a little bit because they screwed up the market" with their discounting, but that "then we knew right away that they couldn't compete our quality level, so it was a non-issue. Danaher/IDT indicated the same, describing Twist as "a lower quality provider" that is "not as reliable," leading IDT to just be patient until Twist unravels – "we actively avoided going head-to-head with customers that we knew Twist was offering insane prices [to]." He added that IDT has remained rational and "still commands a price premium," and is therefore profitable vs. Twist's losses.**

## Executive Summary

**Part VI: Twist exhibits telling signs that its "growth" is about to hit the wall, beyond the accounting games that typically signal desperation: a) saturation in its tiny niche of price-sensitive, smaller customers, particularly in NGS; b) struggles in competing against large incumbents that own the market; c) a miniscule TAM, as it lacks the capability to compete in the largest part of the NGS market, which is already shrinking as pricing collapses; d) an imminent flood of disruptive, venture-backed entrants with newer DNA synthesis technologies. Competitors provided various data points illustrating the depth of Twist's struggles: "I still have many friends there, and the mood isn't so great"; "much harder to gain traction"; not having "much of an impact"; a face-plant in its new antibody offering; and competitors "having a substantial amount of success at winning back the customers" that Twist lured with discounts. Even Twist's customers ticked off a list of new players that pose a looming existential threat: "20 different companies developing different technologies."**

1. **Twist exhibits telling signs that growth that has peaked and saturation is imminent, beyond the accounting games that typically signal desperation. LinkedIn indicates that headcount has barely grown over 6 months and that its job opening growth has crashed. Ex-employees and competitors indicated that Twist's growth is beginning to hit the wall, as it has saturated its tiny niche of price-sensitive customers such as academic labs and startups. We spoke with an ex-Twist employee now at its key competitor, which provides him with a unique vantage point. He indicated that Twist took "a lot of share in the beginning" but is now struggling to find growth: "Nowadays it's much harder to gain traction…it's much more competitive": a "plateau of NGS-specific customers within the last year"; "I still have many friends there, and the mood isn't so great"; "there was an exponential curve of customer acquisition that I don't believe is continuing."."**

2. **Twist is becoming especially saturated in NGS – the bulk of its revenue and its driver of recent growth. Competitors indicate that Twist is struggling, particularly in the small number of whale accounts that drive the entire NGS space: "…there's been no traction, no loss of business [to Twist] in what I would consider those whale accounts." An ex-employee stated that Twist's NGS trajectory isn't sustainable and that it lacks the ability to play in the largest segment of the NGS market due to a key weakness: an inability to make primers, which are "a huge portion of the [NGS] market," which means "they are lacking in the ability to grow."**

# Executive Summary

## Part VI: Twist exhibits telling signs that its "growth" is about to hit the wall (cont'd)

3. **Twist's Chinese competitors provided market intelligence similar to US ones, stating that Twist hasn't had "much of an impact" on the market and that they no longer see it as a threat or even as a "major competitor." Genscript called out Twist's nascent, much-hyped antibody discovery business as a flop, listing a number of antibody discovery customers who worked with Twist, only to now return, and indicated that these customers painted Twist's antibody efforts as a face-plant – that they couldn't come up with antibody leads nor honor timelines, taking 7-8 months before failing. We encountered widespread derision of Twist's antibody hype – from ex-employees and other experts – such as a longtime industry executive who called their hopes "naïve" as it's unrealistic "to switch over from a tool company to a drug discovery company and make antibodies."**

4. **IDT, another key competitor, provided additional evidence of Twist's struggles and saturation, stating that Twist initially took "substantial" share – "especially in NGS" – given their "insane prices," but that IDT is now "having a substantial amount of success at winning back the customers they had lost several years before," due to frustrations with Twist's lead times and quality. He observed that "there's definitely a change in customer attitude happening" away from Twist – despite is radically lower prices – and large players have all "released new chemistry" that eliminated Twist's momentary advantage within its little niche in NGS. He continued that he's "not bullish about their NGS products" and described a race to the bottom in pricing – "it's a much more competitive space.".**

5. **A recurring theme during our research interviews was Twist's difficulty in competing against large incumbents that own the market – which is why it's only option for entering the market was discounts and customer subsidies. These larger players are now actively using their fly swatter, and Twist is starting to struggle. For example, a major customer stated that it plans to reduce its spend with Twist in favor of larger vendors that are "dominating more and more of the market," adding that the competitive environment is "very hard right now" for smaller players like Twist – it's "very difficult for smaller ones."**

6. **Twist's total addressable market is tiny, particularly in NGS, and helps to explain why Twist is fast approaching saturation. The NGS market is composed of two segments: hybrid-capture and amplicon sequencing. Hybrid-capture is the smaller of the two, with one former employee saying it's "hundreds of millions…probably less than $500 million" with Twist attempting to compete for a small pie against Agilent, Roche, and IDT. In addition, Twist is locked out of most of the NGS market because its technology can't make enough mass for primers, nor other key components of the NGS workflow like prep kits – "this is well known" – thereby dooming them to a little niche with only a "fixed amount of space": "they don't have the core competency"; space is "owned by their competition like Roche."**

# Executive Summary

## Part VI: Twist exhibits telling signs that its "growth" is about to hit the wall (cont'd)

7. **While Twist, like every "synthetic biology" company, promotes TAM figures in the tens of billions, its insane pricing has already nuked its addressable market size. With Twist discounting in some cases by >90%, volumes have to increase parabolically just for the TAM to stay flat – and comments Twist and key partners like Ginkgo indicate volume growth is modest while prices have collapsed. Ginkgo and Twist announced a new deal in April 2022, in which Ginkgo's CEO stated that "over the past four years, we ordered approximately one billion base pairs of synthetic DNA from Twist" – a comical $15MM in 4 years from the "dominant" player in the space, assuming pricing we believe to 1.5 cents per base pair.**

8. **Twist has one of the most horrific competitive positions we have seen – which helps to explain its mind-bending losses. One side, it competes with cheap Chinese players like Genewiz and Genscript, which recently released its own "silicon DNA chip" with 8x the capacity of Twist's. On the other, it competes against larger established players like Danaher/IDT, Roche, Agilent, and others. And we're ignoring the swarm of smaller, local players proliferating Google ads adverting the lowest price per base pair. Yet it gets worse: an impending flood of disruptive, venture-backed entrants with newer DNA synthesis technologies and approaches that can produce longer sequences, at even lower prices, with better quality.**

9. **Ex-employees and industry experts stated these disruptive entrants pose a looming existential threat. We note that Twist's customers appear to be well-aware of emerging players and are following them closely. An early and key Twist customer stated that Twist basically has no intellectual property, and that there are "20 different companies developing different technologies which have proof of principle…or have the potential to compete quite dramatically with Twist." In particular, he and others mentioned DNA Script, Molecular Assembly, Evonetix, and Elegen Bio, stating that "they can produce oligos twice as long as Twist's…there are lots of new companies coming into the space"; that Twist is "no different from about 45 other companies"; and that newer "enzymatic DNA methods will replace the oligo pools produced" by Twist as "it's going to be super cheap." Industry experts also pointed out the existential threat from whole genome sequencing – as costs plummet to sequence an entire genome, there's no need to buy a Twist NGS panel to sequence part of it.**

## Executive Summary

**Part VII: Twist's management exhibits striking red flags, with suspicious transactions with opaque, offshore Chinese entities, and its largest holders at IPO appear to be a cesspool of bad actors. Aside from the CEO being sued by and settling with her previous employer, the CFO previously worked at a controversial player in the "prisoner leasing" industry, which Twist may still use as a vendor per an ex-employee. Twist's largest holder at IPO was a mysterious Chinese entity we believe is linked to an "unprecedented" $12.7B fraud in China. We detail a troubling "Side Letter" transaction with this entity that reeks of FCPA risks, and a plethora of other investors with concerning histories.**

1. **Twist CFO Jim Thorburn's background is troubling, as immediately prior to Twist he was the Chief Sales Officer of Televerde, a controversial player in the "prisoner-leasing" industry, staffing its call centers with incarcerated women. An ex-employee stated that Twist is a customer and spends "a couple of million bucks a year at most." Televerde is the subject of extensive journalistic scrutiny, including a recent 15-month investigation. The allegations are gruesome, with one article stating that "many compare this to a kind of modern slavery," noting the irony as "federal trade law bans importing goods made by forced prison labor." Prisoners allegedly make 10-50 cents an hour, working for an intermediary that "sells prisoners to private companies that want cheap or captive labor." The articles quote women alleging abuse, exploitation, and retaliation while "working" for Televerde, describing a disturbing hierarchy of "Televerde girls" and alleging 13 hour days working in "trailers with no air conditioning…risk[ing] some women becoming sick from the heat."**

2. **We are alarmed by a suspicious transaction between Twist and a mysterious Cayman Islands-domiciled entity called Ever Alpha L.P., which was listed in Twist's IPO prospectus as its largest holder with 14.9% of the shares. The prospectus indicated that Ever Alpha invested $70MM in Twist's Series D Preferred financing, making it the largest investor in the round, The investment was accompanied by a highly unusual, opaque "Side Letter" between Twist, Ever Alpha, and "certain other parties" that appeared to commit Twist to investing $25MM over three years into an entity in China. The "certain other parties" were not disclosed, nor was the Chinese entity. A transaction with an offshore Chinese entity that invests $70MM with $25MM round-tripped back raises obvious concerns relating to the Foreign Corrupt Practices Act.**

# Executive Summary

## Part VII: Striking red flags among Twist's management and largest holders at IPO (cont'd)

3. **Ever Alpha L.P., per a search in the Cayman Islands corporate registry. was a de novo entity that had only been formed about only two months prior to Twist's Series D, and is linked by a daisy chain of offshore Caribbean entities to one in China, which we believe to be Guangfa Securities aka GF Securities. GF was implicated in a $12.7B fraud in China, centered on one of China's largest public pharma firms, Kangmei Pharmaceutical, which overstated its cash balance by $4.3 billion "using false documents." The fraud was "unprecedented in China" - with the ex-Chairman of Kangmei sentenced to 12 years. GF executives were sanctioned, banned from securities underwriting, and/or "publicly condemned by the Securities Bureau." Two of the sanctioned individuals - Lin Zhihai and Qin Li - appear to be listed in Twist's prospectus as having "voting and dispositive power over the shares held by Ever Alpha Fund L.P."**

4. **Given that Kangmei's ex-Chairman was sentenced to 12 years in prison after it overstated its cash balance by $4.3B "using false documents," we were tunned to see a 2017 press release from Twist stating that Kangmei Group was actually an investor in the company. We could locate no subsequent disclosures from Twist stating whether $25MM of the Ever Alpha L.P. investment was recycled back – and if so, to whom?**

5. **We spoke with an ex-Twist employee involved with its activities in China, who indicated that "an investment was made," but "production never really kicked off" and Twist bailed on manufacturing in China. As we asked about the side letter and the $25MM, the ex-employee became instantly uncomfortable: "I didn't even know the letter was disclosed to the public. Even within Twist, we really downplayed that…I don't feel comfortable elaborating on that one, unfortunately." We asked if the side letter was a touchy topic because it reflected something improper, to which the ex-employee chuckled and said "I think you're a smart guy. You figure it out. I just really don't want to go on that topic, because even within Twist, [redacted] was not allowed to talk about it to other employees." Box of now-forgotten corruption.**

6. **We note that GF Securities – the entity that sits at the top of Ever Alpha and was sanctioned for its involvement with the Kangmei fraud – still sits on Twist's board of directors, via a 35-year old representative named Xiaoying Mai, who conveniently serves on the audit committee, and strikes us as the kind of puppet that's ideal for this sort of thing. When we asked the ex-Twist employee what she's doing there, the ex-employee stated that Emily – Twist's CEO – "wants to be the only channel to talk to her" and that others inside Twist were "instructed directly by the CEO, Emily, that "[redacted] should not disclose…details to her directly."**

## Executive Summary

### Part VII: Striking red flags among Twist's management and largest holders at IPO (cont'd)

7. **As we examined other names in Twist's pre-IPO investor list, we noticed a plethora of opaque Chinese and other offshore entities. For example, 3W Partners Capital strikes us another front, as does another investor, NFT Investment Limited, for which the first search hits are from the ICIJ Offshore Leaks Database concerning the Panama Papers database, which state it's based in British Anguilla. Another hit is from the Securities and Futures Commission of Hong Kong, which states it's based in Hong Kong. The website listed for it in the Hong Kong registry goes to a dead website parked at GoDaddy.com. We find it troubling that both 3W Partners and NFT Investment Limited appear to have the same address in Hong Kong, suggesting that they are linked..**

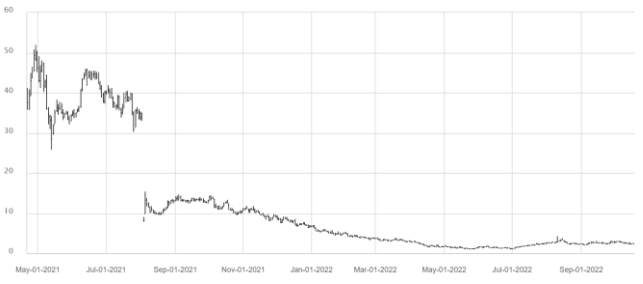
8. **Ever Alpha Fund L.P. aka GF Securities, Kangmei, 3W Partners, and NFT Investment are the not the only fish swimming in Twist's cesspool of investors. Another of its largest holders at IPO was Paladin Capital, which quickly dumped its shares, and was founded by Michael Steed, who appears to go to some lengths to obscure his past in his bio. We discovered that Steel worked for Ullico, the captive insurance arm of various labor unions. Detailing the fraud at Ullico and Steed's role is beyond the scope of this report, but all one has to do is google terms like "Ullico" – the name Steed left off his bio – along with "Steed," "fraud," "organized crime," "insider trading," and "government hearings" to open a Pandora's Box of now-forgotten corruption.**

**If Bernie Madoff and Elizabeth Holmes had a secret love child, it might resemble Twist CEO Emily Leproust and CFO Jim Thorburn. Sometimes we short charlatans peddling some technological gimmick as a world-changing innovation, and other times we look for fraud that is more accounting or financial in nature. Management with the hubris and guile to try both tricks at once is less common. Twist Bioscience is one of these extreme outliers, promoting a preposterous, fatally-flawed, and failed technology that the CEO lifted from her ex-employer, combined with a camouflaged pricing, accounting, and capital-raising scheme that is the closest thing we've recently seen to a textbook Ponzi. In the last year, we published on two sister-scams in the "synthetic biology" cesspool - Berkeley Lights (BLI) and Ginkgo Bioworks (DNA), down 90% and 78% since our reports – and were working on Zymergen (ZY) before it fell 72% in a day. We think Twist could crash and burn even faster.**

***Berkeley Lights (BLI)***


***Ginkgo Bioworks (DNA)***


***Zymergen (ZY)***



Source: Capital IQ stock charts

**To say that Twist's mind-bending losses are *prima facie* evidence of managerial incompetence is to insult run-of-the-mill incompetents. Even in an environment where every other SPAC or VC-backed IPO is a cash-burning dumpster fire, Twist is a spectacle. When we shorted Berkeley Lights (BLI), we noted the level of cash burn and its inability to survive as a going concern. Yet Twist's losses make BLI's look minor – and we think they're even more catastrophic than reported, past the point of no return and with no precedent for reversal. The supernormal level of losses is self-evident proof of a fatal flaw, the elephant in the room that begs the question: with paid-in capital of $1.6B over a decade and nothing to show for it, what went wrong - and how much longer can they keep this circus going?**

| | FY ended Sep 30 | | | | | | |
|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | LTM 6/30 |
| Total Revenue | 2 | 11 | 25 | 54 | 90 | 132 | 184 |
| Gross profit | (7) | (13) | (7) | 7 | 29 | 52 | 74 |
| EBITDA | (39) | (54) | (65) | (103) | (111) | (144) | (220) |
| EBIT | (44) | (59) | (71) | (109) | (118) | (153) | (233) |
| Net Income | (44) | (59) | (71) | (108) | (140) | (152) | (208) |
| | | | | | | | |
| Operatng cash flow | (39) | (51) | (66) | (88) | (142) | (112) | (158) |
| Capital expenditures | (6) | (7) | (4) | (15) | (10) | (27) | (94) |
| Free cash flow | (45) | (58) | (70) | (103) | (152) | (139) | (251) |
| | | | | | | | |
| Net cash & equivalents | 45 | 53 | 71 | 130 | 254 | 415 | 449 |
| | | | | | | | |
| YOY growth | NA | 375% | 136% | 114% | 66% | 47% | 45% |
| Gross margin | (317%) | (123%) | (27%) | 13% | 32% | 39% | 40% |
| EBITDA % | (1,736%) | (497%) | (255%) | (189%) | (123%) | (109%) | (119%) |
| EBIT % | (1,926%) | (543%) | (277%) | (200%) | (130%) | (116%) | (127%) |
| Net margin % | (1,944%) | (551%) | (280%) | (198%) | (155%) | (115%) | (113%) |
| Free cash flow % | (1,974%) | (538%) | (275%) | (189%) | (169%) | (105%) | (136%) |

Source: Capital IQ data; Scorpion Capital analysis and estimates

***Comparison vs. Berkeley Lights (BLI) at the time of our report in Sep 2021***

***EBIT -127% vs. BLI -93%***
***EBITDA -119% vs. BLI -86%***
***FCF % of revenue -136% vs. BLI -87%***

**Twist losses are rapidly accelerating, with cash burn of $74MM in the March 2022 quarter and $75MM in June – roughly double what they were four quarters prior, a $300MM annualized rate with net cash of $450MM. We think Twist is attempting to conceal the true extent of its meltdown by misclassifying COGS as R&D expense and capex – under the guise of a vaporous "Factory of the Future" and "DNA Storage" initiative - in order to concoct a gross margin narrative that gives investors some hope that all is not lost. If one simply adds back to COGS the direct manufacturing costs we believe it is misclassifying via a Worldcom-esque accounting scheme, its gross margin is negative – consistent with color from ex-employees, competitors, and manufacturing experts. If Twist reported negative gross margins – given their centrality to the narrative – it would never raise another dime, with Chapter 7 liquidation around the corner.**

***Twist corporate presentation, Aug 2022***


***Aug 5, 2022 sell-side report title, after Jun quarter results***

Twist Bioscience

Bringing the Gross to the Margin Party

Source: https://investors.twistbioscience.com/static-files/30d2bd1e-4725-4a9a-93bf-3f74486673c0; Barclays equity research report, Aug 5, 2022

**Twist is not a going concern by any stretch - if your only reason for existence is a "chip" that enables "the production of cost-effective" DNA but your EBIT margin is negative 130%, then by definition you have no reason to exist. There is no J-curve at Twist, no operating leverage, no "adjusted EBITDA breakeven" coming "at scale" at $300MM. Until its recent capex frenzy, it was always a low capex, low PP&E, variable cost business with little fixed cost base to amortize. The only reason Twist has not yet received a going concern qualification is because US auditors, unlike IFRS, only look at solvency 12 months out. Whether the guillotine drops after this audit or next is irrelevant, for the endgame is near – and Twist's auditor, Price Waterhouse, seems a harsher mistress than usual in scams of this sort - already firing a warning shot, in the form of an unusually broad material weakness in the last opinion, dated Nov 22, 2021, which in plain English says – "watch out below."**

***Twist 10K filed Nov 23, 2021 – auditor opinion***

"Also in our opinion, **the Company did not maintain, in all material respects, effective internal control over financial reporting** as of September 30, 2021, based on criteria established in *Internal Control - Integrated Framework* (2013) issued by the COSO because material weaknesses in internal control over financial reporting existed as of that date related to **(i) ineffective controls related to segregation of duties** to timely detect and independently review instances where individuals with access to post a journal entry may also have edited or created the journal entry, **(ii) ineffective controls related to the accuracy and occurrence of the accounting for revenues**, including ineffective controls over the accuracy of edits to customer order entry data and segregation of duties during the order entry and revenue processes, and **(iii) ineffective information technology general controls for information systems that are relevant to the preparation of the financial statements**, including ineffective controls over user access and segregation of duties, and user access to certain financial applications and data. A material weakness is a deficiency, or a combination of deficiencies, in internal control over financial reporting, such that there is a **reasonable possibility that a material misstatement of the annual or interim financial statements will not be prevented or detected on a timely basis."**

Source: Twist 10K SEC filing

**Price Waterhouse's summary of material weaknesses in internal controls and financial reporting is striking – "a reasonable possibility that a material misstatement of the annual or interim financial statements will not be prevented or detected…." Ex-employees, as we shall detail, paint Twist's manufacturing operations as a meltdown. An ex-executive characterized the finance organization as just as chaotic, with the potential for "accounting games to occur": "it was a mess…relied heavily on manual processes…only a handful of people worked there…just the tip of the iceberg."**

***Finance organization "was a mess"; "manual processes"; ""just the tip of the iceberg"***

*Q: "Was the finance organization not sophisticated?"*

*A: **"It was a mess.** It was probably **the saddest group I've ever seen. Not the best-trained** group, who are really understaffed...it was a very overworked team. They **relied heavily on manual processes."***

*Q: "What problems did that create?"*

*A: "**The possibility of people doing something on the accounting system and other people making changes.** Not that it happened, but the ability was there as a function of the understaffing and not being able to play ball with SAP…only a handful of people worked there. And not very well in tune with what was going on in the company…. What I would say **was the possibility due to a lack of proper control for accounting games to occur certainly was there…the lack of controls. Can things go undetected? Probably could. That was just the tip of the iceberg."** – Ex-Twist executive*

Source: Scorpion Capital consultation calls with experts

**Twist's subsidy scheme and its Ponzi-like essence appears to be an open secret in the industry. The model is simple – Twist investors on one side, customers on the other, and Twist as the middleman flipping cash from capital raises to customers to create "revenue," with insiders pocketing a vig for the trouble via stock-based comp. The CEO, who we shall shortly get to, volunteered odd comments on a recent earnings call: "so we're definitely not subsidizing…we're not in the business of subsidizing…" – a doth protest too much moment, in our view, and indicia of *mens rea*, Latin for guilty mind. An executive in Twist's space summarized it as "shipping with every gene and every oligo pool a $20 bill to people."**

***Q2 2022 earnings call on May 5, 2022 - comments by Twist CEO***

***"So we're definitely not subsidizing*** *anybody else's drug discovery […] In terms of our ability or our willingness to be flexible on economic terms, we are very flexible. But there's definitely a red line where any deal has to pay for our cost, right? So the bare minimum. We're not going to do a deal that's not a gross margin positive.* ***We're not in the business of subsidizing*** *our customers' research."*

***Shipping a "$20 bill" to customers with each order"; crippled by their pricing and manufacturing flaws; complicated manufacturing scheme" that requires "extensive rework" to get a shippable order***

*"They have a very, very large and complicated manufacturing scheme where they overbuild in order to deliver the product […] The thing I kept on saying is* ***they were shipping with every gene and every oligo pool a $20 bill to people****. That's basically that they were fundamentally flawed, that they were trying to keep up with the price, and they were taking it as a loss every time. But what they have never done is fix the fundamental manufacturing flaw that they have. They need to overbuild or do extensive rework in order to deliver these products." –Longtime executive in Twist's space*

Source: Capital IQ earnings call transcripts; Scorpion Capital consultation calls with experts

**Two of Twist's competitors told us that they've internally used the phrase "Ponzi scheme" to describe Twist, given its "shocking" discounts. A third indicated similar but not exact language, stating that Danaher looked at buying Twist in 2017 or 2018 and "walked very quickly" after getting a whiff, adding that their IDT division, which competes with Twist, is "just waiting it out" until the scheme collapses – "the response was patience…let's see how this plays out."**

***Twist used "shocking" discounts of 75% to lure customers aways from Danaher/IDT, which allegedly used the phrase "Ponzi scheme" in internal discussions***

*A: **"Seventy-five percent discount. That is correct. It was shocking."***

*Q: "It sounds similar to a Ponzi scheme. It's like you're basically giving away product. You're buying market share. You burn money hand over fist to show growth. Then, the only way you can show more growth is by raising more money to give away more money to customers with these obscene prices."*

*A: "**Yeah, I think that was the exact phrase that was used in internal discussions, yeah."***

*Q: "You guys used the phrase "Ponzi scheme," or somebody mentioned it?"*

*A: "Yeah…**it was a word that was used. There was a remarkable amount of skepticism, which is why the response was patience. Let's see how this plays out."***

*Q: "Did you hear that word more than once, just out of curiosity?"*

*A: "Yeah, absolutely." –IDT ex-regional sales manager, left recently*

***Danaher/IDT are just "waiting" Twist out; allegedly looked at buying Twist years ago but walked; sentiment in the space about Twist's similarity to a Ponzi scheme***

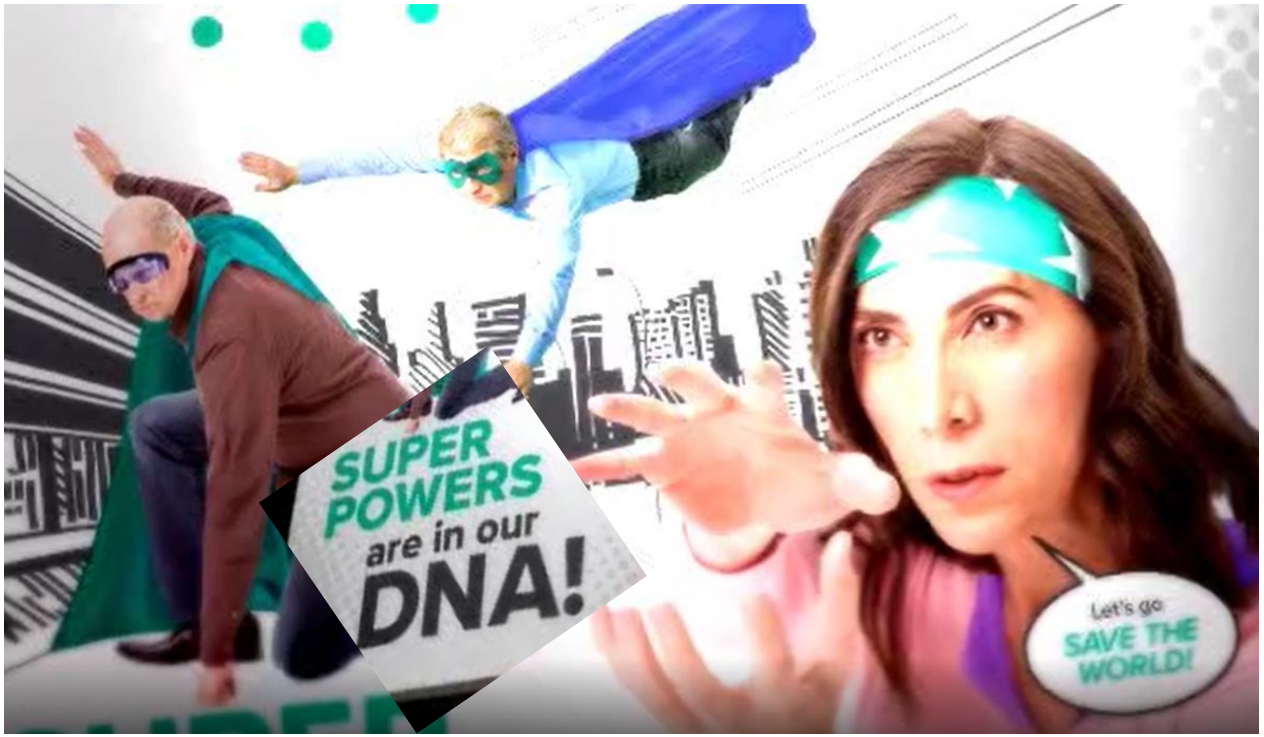
*A: **"I would say, yeah, largely, they're waiting it out. Originally, the buy team was put together to buy Twist, and then they walked very quickly. 2017, 2018**. I think that's when Danaher –"*

*Q: "Have you heard other people in the space using the phrase "Ponzi scheme" or express a similar sentiment?"*

*A: "Sentiment, but I never heard the actual term. **But yes, the Ponzi scheme**, I've never heard it called that. But **yes, similarly, yes, I've heard people say things like that**. Most of it is the revenues they're putting together. They're just buying market share and continually buying more and more." –Longtime executive in Twist's space*

Source: Scorpion Capital consultation calls with experts

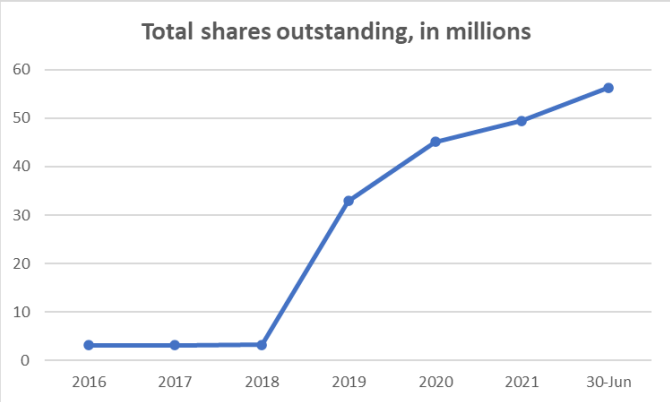
**The visionary behind this cash-burn catastrophe is Twist CEO Emily Leproust, who seems prone to flights of fancy and has built a culture based on delusion, denial, and operational dysfunction. It appears she even blew money on a comic book where she's the superhero – the caption says "Let's go save the world!" We're not experts in cosplay, but rather than posing as Wonder Woman, may we suggest the Human Torch from The Fantastic Four, as Leproust's only superpower seems to be incinerating cash.**




Source/notes: Image on left is a superimposition of two still frames from a video of the comic book, which may be viewed in full here - https://wandp.co.uk/twist-bioscience/; https://www.rimonthly.com/our-favorite-cosplays-from-rhode-island-comic-con-2021/

**Perhaps our assessment is unfair, as Leproust's pump-and-dump tactics suggest she's more clear-eyed about Twist's future than it might appear. She pumps the stock with one hand, while dumping her own shares with the other. Twist is a serial capital raiser and stock dilution machine. Its earnings calls swarm with sell-side analysts, for Twist is the perfect junkie - the crackhead that staggers back to the den once or twice a year for one last bag of rocks. Serial capital raisers make fantastic shorts, as they dilute stockholders into oblivion just like a Ponzi: the share count expands with each new raise, crushing the value of each share. Just like hyper-inflation eventually turns paper currency into toilet paper, dilution does the same to stock certificates – and hyper-inflation is the correct term to describe the near-doubling of Twist's share count since IPO.**

| | FY ended Sep 30 | | | | | | |
|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 30-Jun |
| Total shares outstanding | 3.1 | 3.2 | 3.2 | 32.9 | 45.1 | 49.5 | 56.3 |
| Issuance of common stock | $0.2 | $0.2 | $0.3 | $161.1 | $309.5 | $343.4 | $282.0 |
| Paid-in Capital | $3.7 | $6.2 | $9.3 | $470.4 | $794.6 | $1,190.8 | $1,599.4 |

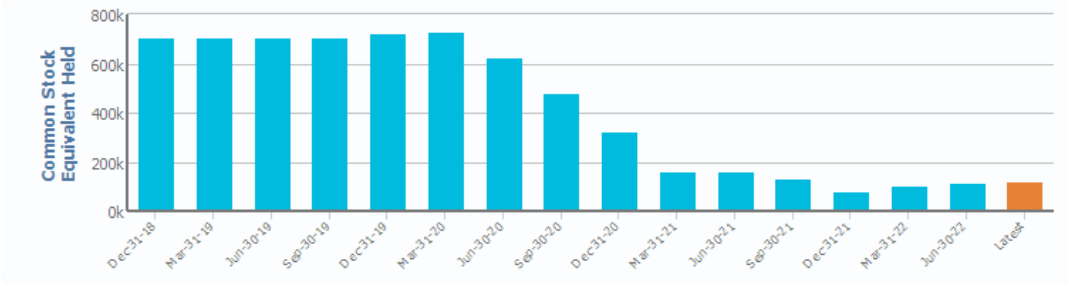



Source: Capital IQ data

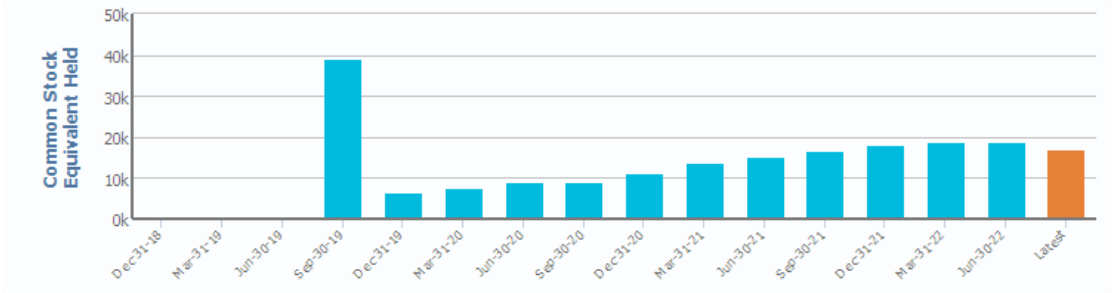
**Leproust says she tries to "approach everything with as much savagery as possible" and that "you just have to go big or go home" – an accurate description of her stock sales, as well as those by the management team. We estimate she has sold ~$70MM of stock; co-founder and SVP Bill Banyai, ~$42MM; CFO Jim Thorburn, ~$15MM; and President/COO Patrick Finn, ~$11MM – a total of $135MM across these four alone.**

"I try to approach everything with as much savagery as possible because life's too short to make small increments," Leproust told me. "You just have to go big or go home." ***-Emily Leproust, Twist CEO, Aug 2022 interview***

***Emily Leproust, CEO - common stock equivalent held per Capital IQ***



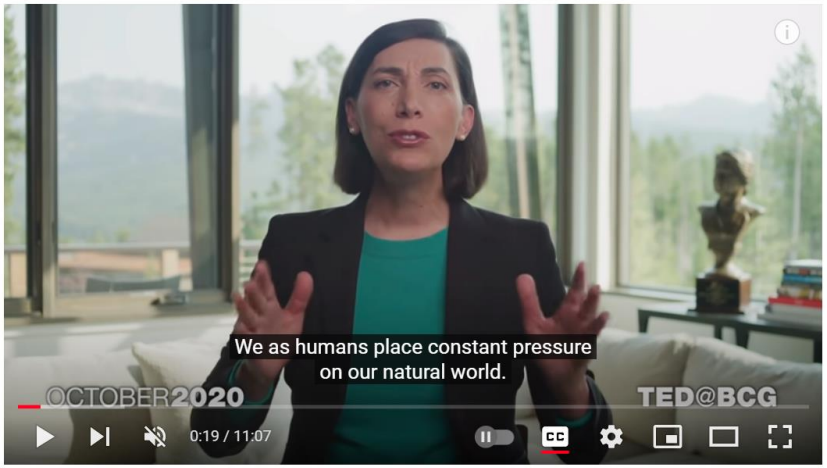

***Jim Thorburn, CFO - common stock equivalent held per Capital IQ***




Source: Capital IQ data; Scorpion Capital analysis and estimates; https://www.bizjournals.com/bizwomen/news/latest-news/2022/08/most-admired-ceo-emily-leproust.html?page=all

**We find the pump-and-dump ironic given the CEO's virtue signaling and wokeness, to the point that the E in ESG may stand for Emily – "we've initiated monthly Culture Conversations where we explore identities and systems of power using an intersectional lens…LGBTQIA+, ageism, Latinx identity." Twist has an Anti-Corruption Policy, yet remains a safe space for nepotism, as an ex-employee told us that Leproust hired her wife as Twist's Director of Growth, who the company still appears to use as a consultant. Twist has an Anti-Money Laundering Policy, yet engages in suspicious transactions with offshore Chinese entities. It even has a Modern Slavery Act Statement that opposes "compulsory or forced labor," which we find cute as the CFO's last job was at a "prisoner leasing" company that "employs" female inmates – with Twist as a client.**

***Twist CEO TED talk on ESG topics***




How synthetic biology can improve our health, food and materials | Emily Leproust

***Kris Corzine, who an ex-employee stated was Leproust's wife, lists Twist as a client and employer***

Kris Corzine · 2nd
It's a new day in the After Times!
San Francisco, California, United States · Contact info

Principal
Kris Corzine Consulting
Apr 2016 - Present · 6 yrs 8 mos
San Francisco, CA

Clients include::
Flo Health, Inc
Oova, Inc
MoneyVoice
Skilled, Inc
Twist Bioscience

Director of Growth
Twist Bioscience
Oct 2016 - Aug 2017 · 11 mos

Source: https://www.youtube.com/watch?v=bjhvoNlTn60; https://www.linkedin.com/in/kcorzine/details/experience/. We have not verified whether Kris Corzine is or was the Twist CEO's spouse or partner, and refer you to our disclosures on page 2 regarding the potential accuracy or lack thereof of statements made to us by paid experts.

**We're curious what Twist's Code of Ethics says about theft, as Leproust was sued by her previous employer, Agilent Technologies, where she worked for 13 years, before leaving in 2013 to found Twist. Far from being an innovation, Twist's "DNA chip" is simply a cut-and-paste of an old technology that Agilent developed in the early 2000's – which eventually ended up as an epic flop. Nonetheless, Agilent alleged that she "secretly laid the groundwork for a theft of Agilent technology" for "more than a year before she resigned." Twist paid Agilent $22.5MM to settle the lawsuit – we're going to guess right on the eve of trial.**

***Feb 2016 article***

**Twist Bio's hard-charging CEO hit by claims she stole Agilent's trade secrets**

***Feb 2020 article***

**Twist Bioscience to pay $22.5 million in settlement with Agilent**

Deal will resolve dispute over DNA synthesis trade secrets allegedly brought to Twist from Agilent

Source: https://www.fiercebiotech.com/biotech/twist-bio-s-hard-charging-ceo-hit-by-claims-she-stole-agilent-s-trade-secrets

**An executive in the space, who has had extensive dealings with Twist's CEO and whose identity we therefore keep vague, diplomatically called the ethics around Leproust's conduct "questionable" and "reprehensible," and stated that "she got off light, if I'm being very honest with you." The executive stated that Twist's co-founders were also "never shy about borrowing IP without licensing."**

***Twist CEO's alleged theft of Agilent's technology was ethically "questionable"; "got off light" with the settlement***

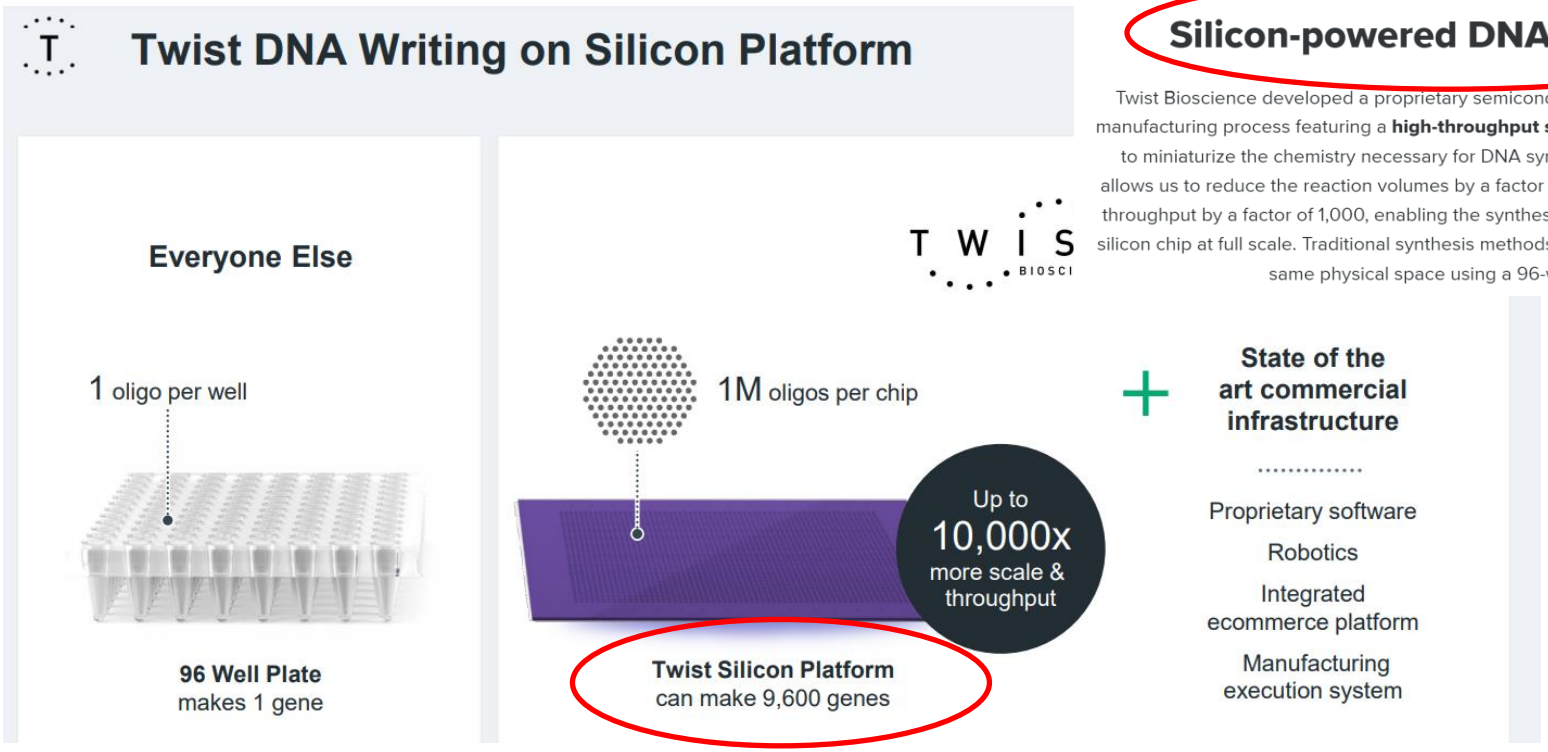
*"We had worked with her to help develop the technology at Agilent. When we did the deal with Agilent as a sole supplier, we were the only ones who were going to be able to build genes from Agilent. She left and took some pieces of the technology and went and started this other company.* ***In terms of ethics, I would say it's questionable. I wouldn't have done that. That's a very dangerous thing to do. I think she got off light, if I'm being very honest with you. She even registered the domain and sent out her first pitch decks using her company computer on the company internet. Not what I would do."*** *– Senior executive and longtime expert in Twist's space*

***Twist CEO's alleged actions were "reprehensible"; other co-founders also allegedly engaged in questionable practices***

*"She started the company on the Agilent computer on the Agilent network, registered the domain and sent out her first pitch decks. That was part of the lawsuit, too. I think it's just questionable.* ***I wouldn't have done it. I find it kind of reprehensible if it's true****. I'll say allegedly because, although it seemed really likely. So, I would never have done that.* ***Her other two co-founders, Bill and I always forget the other guy's name, were never shy about borrowing IP without licensing*** *when they did Complete Genomics or whatever their company was in the sequencing by synthesis space." - Senior executive and longtime expert in Twist's space*

**We suspect that most of Twist's holders have little clue what it actually makes or sells, much less any grasp of the so-called "silicon DNA chip" that the entire story rests on. The 10K opens by declaring that "the core of our platform is a proprietary technology that pioneers a new method of manufacturing synthetic DNA by 'writing' DNA on a silicon chip." The chip supposedly has 10,000X the throughput of traditional DNA synthesis, enabling a glorious age of "cost-effective, high-fidelity, high-throughput DNA." Its site contrasts its chip with a plastic well plate - a $2 lab accessory with 96 test tubes in which DNA is traditionally made.**

***Excerpts from Twist corporate presentation and website***



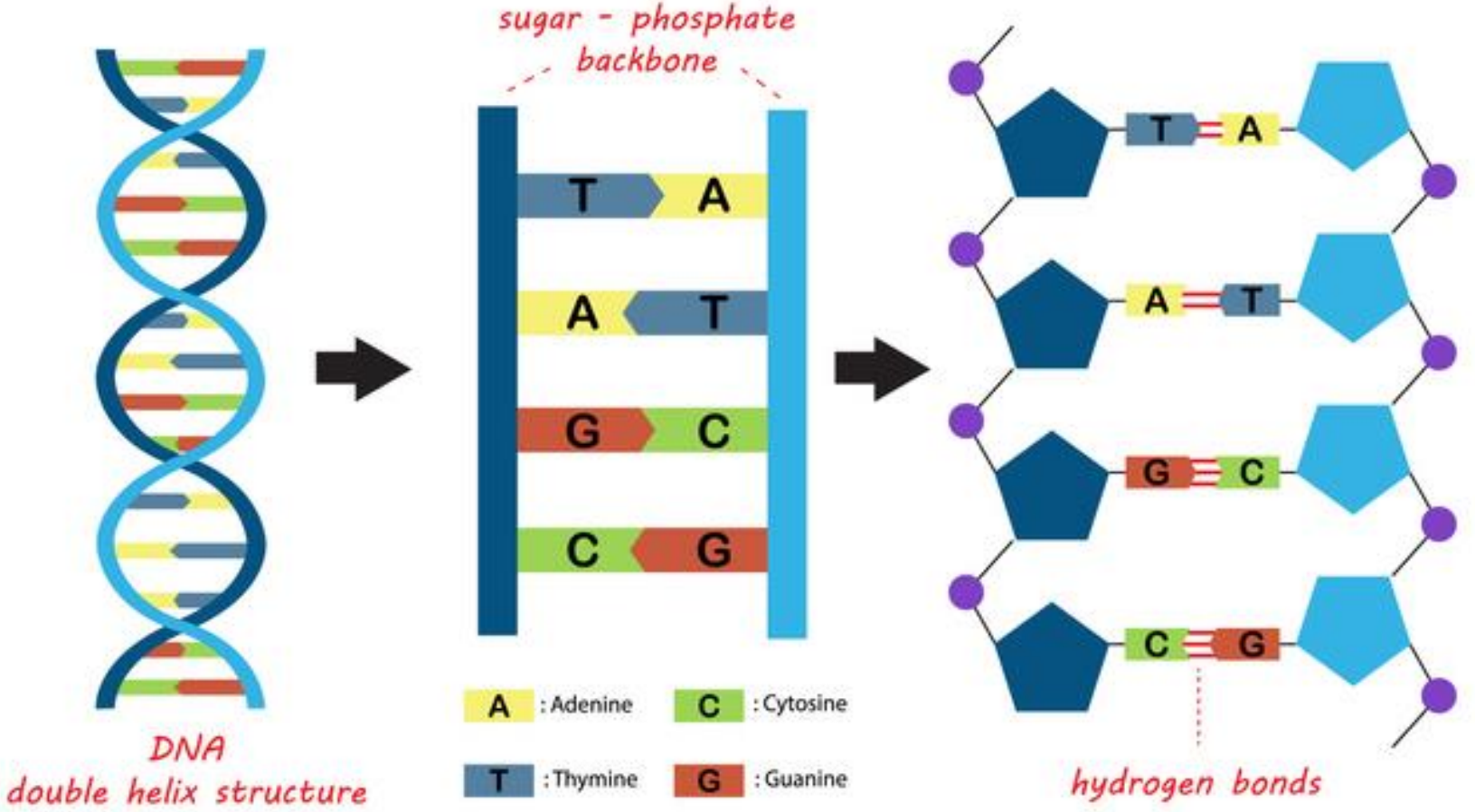

**Silicon-powered DNA synthesis**

Twist Bioscience developed a proprietary semiconductor-based synthetic DNA manufacturing process featuring a **high-throughput silicon platform** that allows us to miniaturize the chemistry necessary for DNA synthesis. This miniaturization allows us to reduce the reaction volumes by a factor of 1,000,000 while increasing throughput by a factor of 1,000, enabling the synthesis of 9,600 genes on a single silicon chip at full scale. Traditional synthesis methods produce a single gene in the same physical space using a 96-well plate.

Source: https://investors.twistbioscience.com/static-files/30d2bd1e-4725-4a9a-93bf-3f74486673c0; https://www.twistbioscience.com/technology

**DNA is a molecule made of <u>two strands, similar to a twisted ladder</u>. The two strands are linked by "base pairs," just as the two legs of a ladder are linked by rungs. <u>Four bases make up the rungs of the DNA ladder</u>: adenine (A), cytosine (C), guanine (G), and thymine (T). A only links to T, and G only links to C, so each rung is either an AT-pair or GC-pair.**

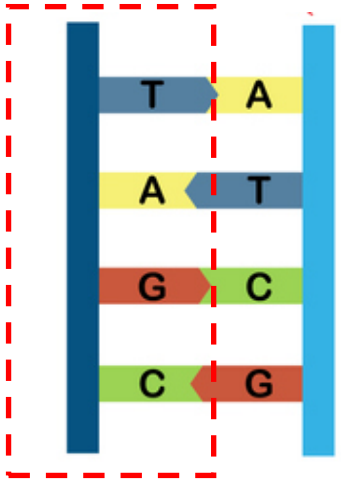
***<u>Structure of DNA</u>***




Source: iStockPhoto.com

**Synthetic DNA is made out of smaller sequences called oligos, which is short for oligonucleotide, using the Latin word for small to signify a small strip. An oligo is simply a single-stranded DNA fragment – that is, the left or right half of the DNA ladder, and typically only a few rungs long. Twist is nothing more than an oligo manufacturing company, and claims it can make one million oligos per "chip." Oligos are the raw material and building block for almost everything Twist sells, turning them into two by-products that comprise 80% of its revenue – 1) synthetic genes and 2) NGS panels, referred to as next generation sequencing or target enrichment. The customers are academic labs, start-up biotech companies, and other researchers.**

***An oligo is a short strip of single-stranded DNA***

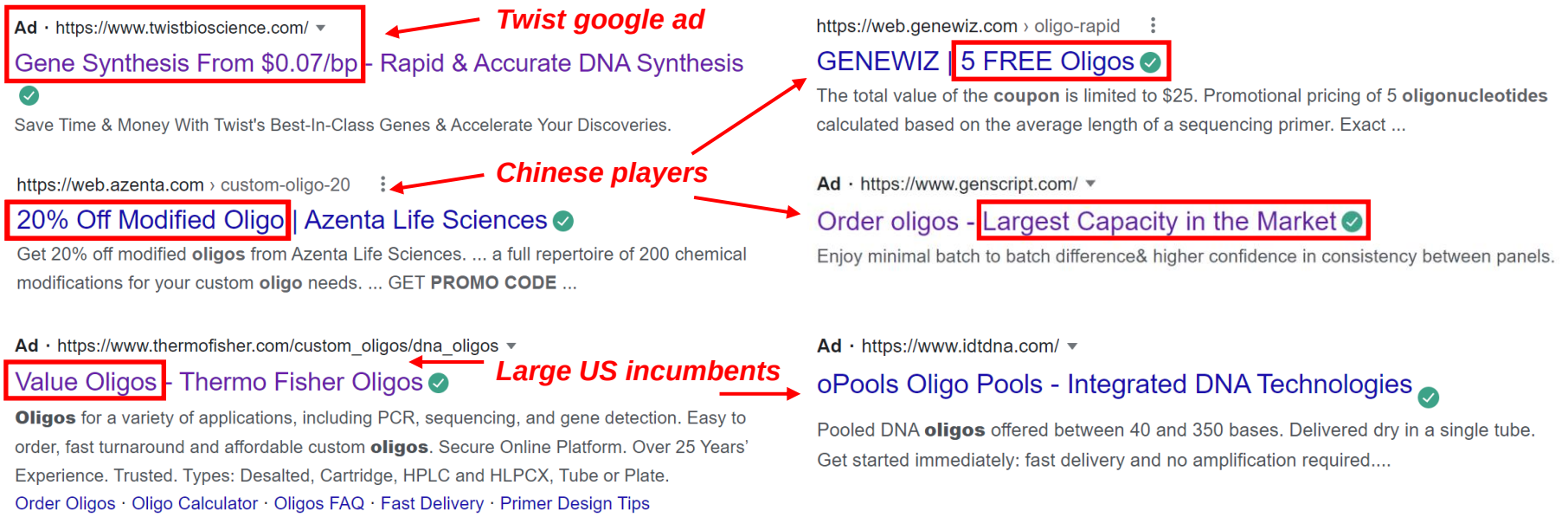



***Twist revenue by product segment - ~80% is NGS and synthetic genes***

| | FY2021 | | Quarter ended Jun-22 | |
|---|---|---|---|---|
| NGS tools | 72,667 | 55% | 27,790 | 50% |
| Synthetic genes | 38,964 | 29% | 17,400 | 31% |
| Oligo pools | 8,039 | 6% | 3,259 | 6% |
| DNA libraries | 12,663 | 10% | 1,422 | 3% |
| Antibody discovery | - | - | 6,242 | 11% |
| Total revenue | 132,333 | 100% | 56,113 | 100% |

Source: iStockPhoto.com; Twist SEC filings; Capital IQ data

**Synthetic genes, ~30% of Twist revenue, are just two single-stranded oligos fused together, which results in a double-stranded sequence. NGS panels, ~50% of revenue, are the primary driver of Twist's recent growth. They are simply a single-stranded oligo with a chemically modified tip. The tips are complementary to and bind with small sections of a genome, enabling researchers to fish out and amplify specific sequences such as cancer-causing genes. Unfortunately for Twist, oligos and their by-products are a pure commodity, as synthetic DNA is just a specialty industrial chemical, priced by length like nylon rope at Home Depot, at pennies per base pair. Google searches for cheap or discount oligos spew a flood of paid ads by Twist, Chinese vendors, large US players like Danaher and Thermo Fisher, and mom and pop's in an intense price war.**




Source: Google searches for terms such as oligos, oligo price, cheap oligo, etc..

**Manufacturing oligos – that is, synthetic DNA - is nothing special. It is a standard, commodity industrial process using a method that is 40 years old, called phosphoramidite chemistry. Twist and each of its competitors – and every student in a lab – use the same method. The four bases – ATCG – are added one at a time to form a growing chain of DNA, sort of like an inkjet printer squirting black, green, red, and blue ink one layer at a time. The process involves reagents and solvents, and is typically done in a well plate with 96 or more test tube-like chambers. Given the need to repetitively pipette various chemicals into each well, it's standard to automate with liquid handling machines that squirt and dart like old dot matrix printers. Dozens of vendors sell them – as do eBay merchants.**

***Twist's website admits it uses standard phosphoramidite chemistry for DNA synthesis***

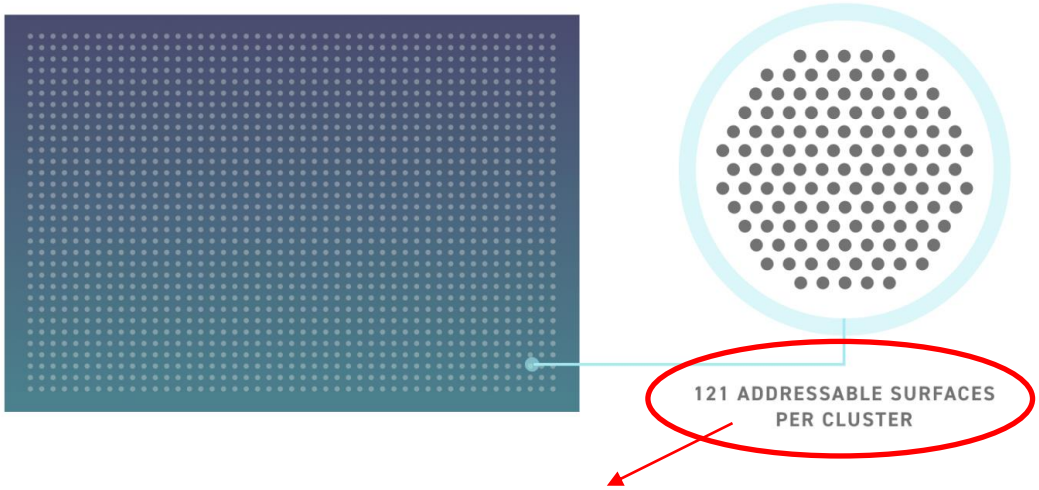
**A Simple Guide to Phosphoramidite Chemistry and How it Fits in Twist Bioscience's Commercial Engine**

***96-well plates with automated liquid handling machine from a widely-used vendor Twist also uses***

Source: https://www.hamiltoncompany.com/automated-liquid-handling; https://www.twistbioscience.com/blog/science/simple-guide-phosphoramidite-chemistry-and-how-it-fits-twist-biosciences-commercial

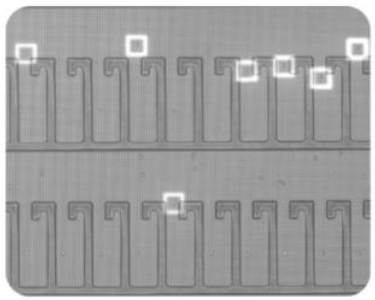
**Twist's similarity to Berkeley Lights (BLI) is eerie - which we again note is down 94% since our report - as its only "innovation" is a miniaturized well-plate with a lot more chambers, exactly like BLI claiming that their "Optoselect chips replace typical well plates" with "thousands of Nanopen chambers which are like wells on a microplate." Twist's signature claim is that it is "high-throughput" by a factor of 1,000 or 10,000 - we're not sure which, as the figure bounces around by a factor of 10 depending on the page. Just like BLI whose only purported value proposition was speed, we find it remarkable that Twist's only claim to fame is that it's faster at making a commodity chemical – synthetic DNA – just because it drilled more holes, not that it's making anything different.**

***Twist's DNA synthesis "chip"…***




***"121 addressable surfaces per cluster"***

***…identical claim to Berkeley Lights chip: "NanoPen chambers are 100,000 times smaller in volume than a microwell"***



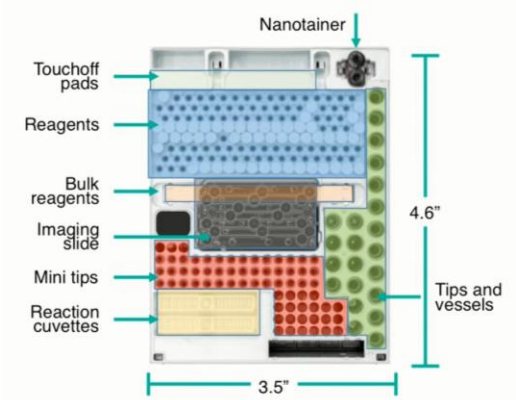
Source: https://www.twistbioscience.com/products/oligopools; https://www.berkeleylights.com/systems/beacon/

**Twist, Berkeley Lights, and Theranos are examples of a recurring and amusing category of fraud going back to the 1990's - "the company with a magic chip." Chips are the Wall Street equivalent of a charm or amulet, an object believed to confer extraordinary powers and riches upon whoever possesses it, as well as the ability to cast spells and part fools from their money. Theranos was predicated on a miniaturized "lab on a chip," exactly like Twist and Berkeley Lights – as well as Affymetrix and Fluidigm, the godfathers of lab-on-a-chip stock flops.**

## The incredible shrinking laboratory or 'lab-on-a-chip'

***- The Guardian, 2011***

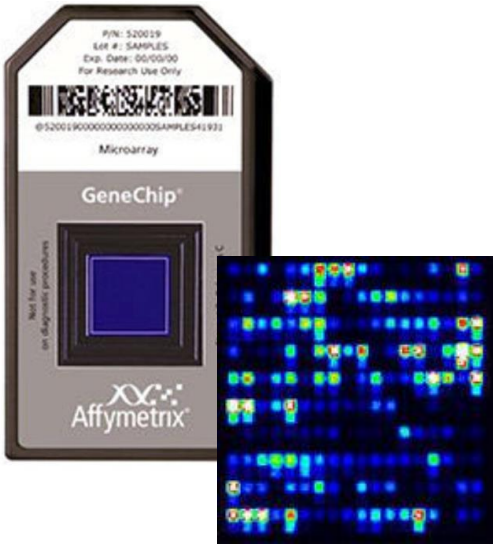
***Theranos miniaturized lab-on-a-chip***



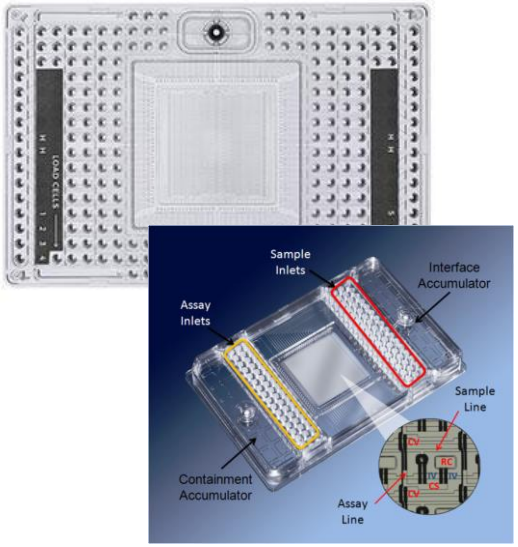

Source: https://www.theguardian.com/science/2011/nov/28/incredible-shrinking-laboratory-lab-chip; https://www.youtube.com/watch?v=n6JRG733ReQ

**Theranos is a cliche analogy among short-sellers, but we find it stunning how each of these "lab on a chip" scams has the same playbook: taking decades-old micro-fluidics technology and promoting it as something new. Micro-fluidics use an ancient CMOS semiconductor – known as a micro-array – to manipulate cells and fluids. The chips have been around for decades and are a $50 commodity. The micro-fluidics space is littered with IPO's that spiked on early hype only to crash and burn. Affymetrix launched its "GeneChip" in 1994 and went public in 1996. Fluidigm launched its "Integrated Fluidics Circuits" in 2003 and went public in 2011. Both illustrate the horrific losses and tiny market caps in the space.**

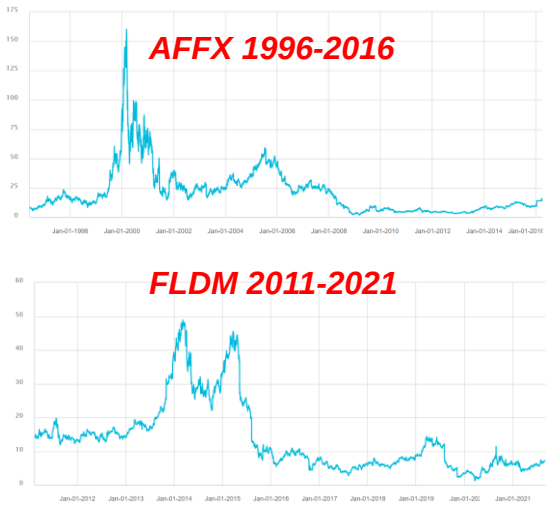
***Affymetrix "GeneChip" – launched 25 years ago***




***Fluidigm "Integrated Fluidics Circuits" – launched 20 years ago***




***Affymetrix and Fluidigm stock charts***




Source: https://www.thermofisher.com/order/catalog/product/902113#/902113; https://www.researchgate.net/figure/A-4848CS-dynamic-array-showing-the-position-of-the-sample-inlets-and-the-assay-inlets_fig1_40037108; https://store.fluidigm.com/Genomics/ApplicationsGenomics/SingleCell/C1%E2%84%A2%20Single-Cell%20Open%20App%E2%84%A2%20IFC-%2010%E2%80%9317%20%C2%B5m

**Twist's "chip" is nothing more than a DNA micro-array, a legacy 40-year old technology – invented in 1981 per Wikipedia - where thousands of tiny holes - miniaturized test tubes - are etched onto a solid surface whether a glass slide, silicon, or plastic. Microarrays are a commodity, with vendors and custom fabrication shops coming and going for decades, each with its own marketing spin whether a special surface with better adhesion, some coating, or other short-lived innovation.**

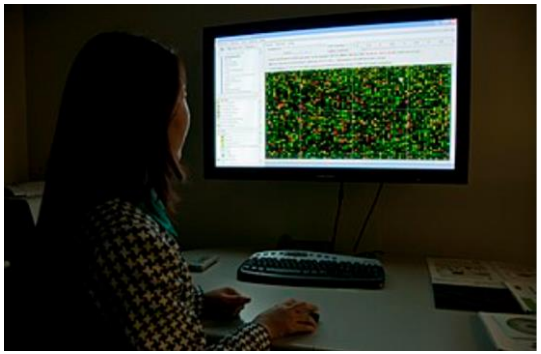
***Wikipedia entry for "DNA microarray" states they were invented in 1981***

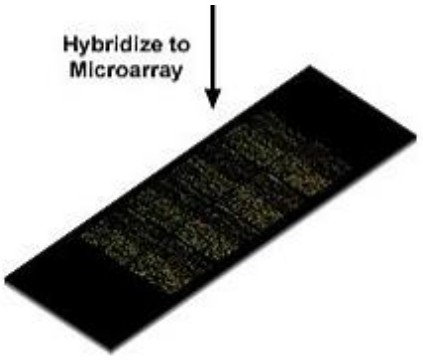
# DNA microarray

From Wikipedia, the free encyclopedia

A **DNA microarray** (also commonly known as DNA chip or biochip) is a collection of microscopic DNA spots attached to a solid surface. Scientists use DNA microarrays to measure the expression levels of large numbers of genes simultaneously or to genotype multiple regions of a genome. Each DNA spot contains picomoles ($10^{-12}$ moles) of a specific DNA sequence, known as *probes* (or *reporters* or *oligos*). These can be a short section of a gene or other DNA element that are used to hybridize a cDNA or cRNA (also called anti-sense RNA) sample (called *target*) under high-stringency conditions. Probe-target hybridization

***The entry shows a microarray being printed by a robot and examples of microarrays for DNA synthesis and experiments***






Source: https://en.wikipedia.org/wiki/DNA_microarray#A_typical_protocol

**Ex-employees, competitors, customers, and manufacturing experts ridiculed the notion that Twist's contraption is a "chip" or an innovation, indicating that "there's nothing like a microchip involved"; that it's just a miniaturized well-plate; that it's a standard lab accessory as "other people use microchip-like things for the synthesis of DNA." An ex-director-level employee stated that the chip is just "some sales pitch," and that "when promoting that it sounds good but in reality" it's not "anything special."**

*"**Chip" is actually not a chip; just a miniaturized version of a plastic well plate; but still rather large***

*A: "They do high-throughput DNA synthesis where they print base by base - **they have a wafer plate**. Imagine a very thin plate with a whole bunch of silicon bowls, approximately 96,000. They can do 300 base pairs in each tiny bowl on this patented wafer chip and then after they've printed these pieces of the gene, they are then pooled together discretely to make that gene, and then they go through quality control, next-generation sequencing –"*

*Q: **"So, they have this miniaturized well plate, basically.** How big is it?"*

*A: "**Yes. It's a big one…It's the size of your hand**. It's about the size of a 96-well plate if you've ever seen those."*

*Q: **"So, it's not really a microchip.** It's just made out of plastic and has a bunch of tiny holes in it?"*

*A: **"Yeah, simply put, yes."** – Ex-Twist employee in manufacturing, now a research professor*

***"Nothing like a microchip involved"; similar to commodity micro-array technology commonly used for synthesis***

*"As far as I know, **there's nothing like a microchip involved. Other people use microchip-like things for the synthesis of DNA oligos**." – Current Twist customer, professor with a protein therapeutics lab at a major university*

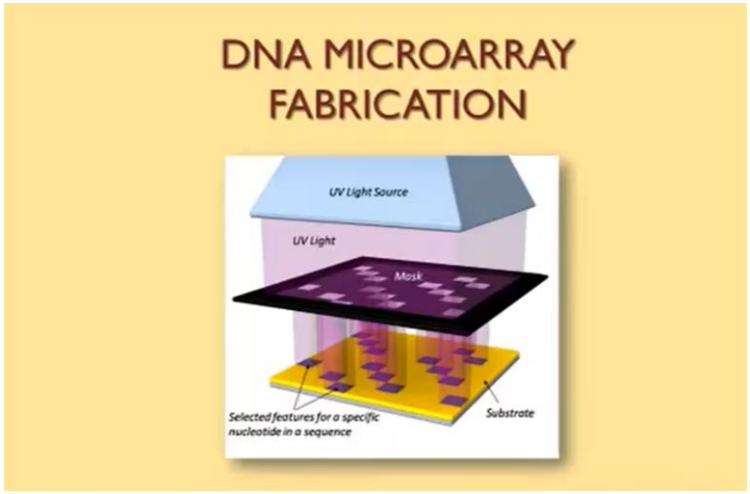
***Chip is just "some sales pitch"; doesn't provide any advantage "in reality"; "just average"; "nothing special"***

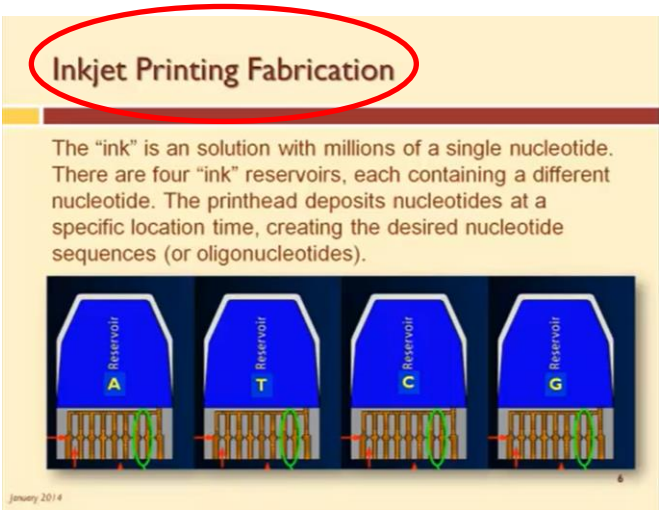
*"The business is based on service. On that front, I think that **they are just average. That's my observation. I don't think that they are anything special**. The only thing unique is that at initiation they could synthesize a million different oligos at a much smaller scale…**They have some sales pitch, but even I am not 100% sure that actually is a real advantage, even when promoting that it sounds good, but in reality, I don't know whether it translates to a better product or better outcomes**." – Former Twist employee, director-level*

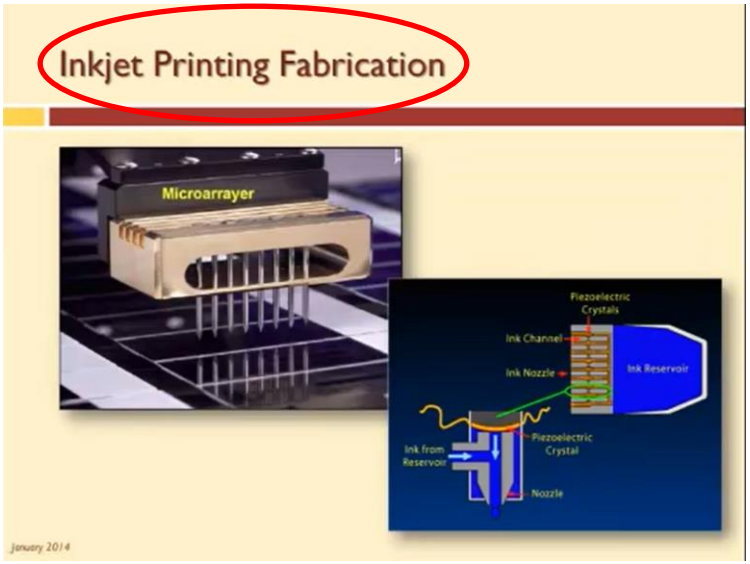
Source: Scorpion Capital consultation calls with experts

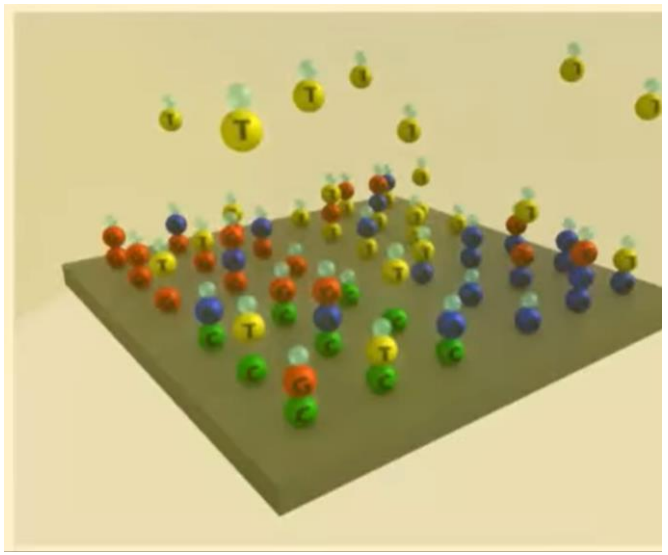
**Silicon/CMOS-based DNA synthesis arrays are such an ancient commodity that one can watch decade-old YouTube videos on how to replicate Twist's "proprietary technology" and "new method of manufacturing synthetic DNA by 'writing' DNA on a silicon chip."**

***YouTube video on "DNA Microarray Fabrication" – 2014***



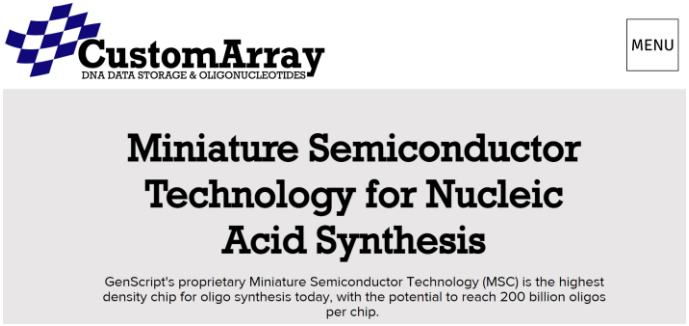



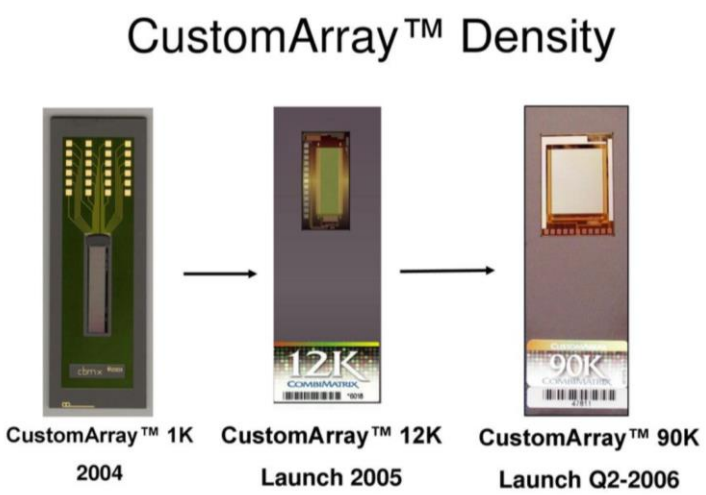
Source: https://www.youtube.com/watch?v=DjcxE1tdB8c

**As just one example, a fabricator called Custom Array has been selling silicon-based arrays for DNA synthesis for at least 20 years - a decade before Twist and it's so-called "proprietary platform" - with steadily increasing oligo manufacturing capacity per "chip." The latest array has 8x the oligo throughput that Twist claims for its own contraption.**

***Custom Array website***




***Silicon DNA arrays a decade before Twist was formed – 2004 to present***




***Latest Custom Array "chip" has 800% the throughput of Twist's array, shown next to its "Oligo Synthesizer" where up to "32 million oligos can be synthesized simultaneously"***

**CustomArray's Miniature Semiconductor Chip (MSC) - Up to 8 million oligos per chip.**


Source: https://www.customarrayinc.com/msc-technology; https://slideplayer.com/slide/13221537/

**In 2017, Custom Array was purchased by Genscript - Twist's key Chinese competitor. The acquisition illustrates the negligible value of Twist's "chip" and the lack of any intellectual property – an inexpensive, commodity technology readily available from numerous mom-and-pop fabricators. Custom Array lists only 9 employees on LinkedIn, was presumably purchased for peanuts, yet produces an array with throughput that leaves Twist in the dust. Note that Custom Array describes itself with identical language: "semiconductor chip technology to electrochemically synthesize DNA right on the chip surface."**

***Dec 2017 press release***

# GenScript Biotech Acquires CustomArray to Expand Synthetic Biology Product Portfolio

CustomArray uses semiconductor chip technology to electrochemically synthesize DNA right on the chip surface. The patented and proprietary technology allows the creation of large numbers of different oligonucleotides in a highly parallel, high-throughput, high-density, and cost-effective manner. CustomArray, as a market leader in oligonucleotide pools, with one of the world's leading array-based synthesis technologies, strengthens GenScript's leadership in synthetic biology, such as gene synthesis, CRISPR library, shRNA library, enzyme and antibody engineering.

Source: https://www.prnewswire.com/news-releases/genscript-biotech-acquires-customarray-to-expand-synthetic-biology-product-portfolio-300575432.html

**The Genscript/Custom Array chip that leaves Twist in the dust was announced about 6 months ago, and Twist's investors appear blissfully ignorant of it. Genscript's array has the capacity to manufacture 8.4 million DNA strands simultaneously vs. Twist's claim of >1 million – an almost 10X difference. A former Twist employee told us it "even surpasses Twist's ability to play in that space" and that Genscript's "manufacturing platform" is "extremely similar to Twist." We note that Genscript is also a cash-burning dumpster fire - the announcement is less a validation of the space or technology than a reminder that Twist is not even the fastest pig at the county fair.**

***Dec 2017 press release***

GenScript Debuts Industry's Highest Throughput DNA Synthesis Platform for Commercial DNA Digital Data

***Each CMOS DNA chip carries 8.4 million unique oligos***

***Ex-Twist employee: GenScript chip "surpasses Twist's ability"; "extremely similar to Twist"***

*"However, recently, I don't know if you caught* ***the announcement from GenScript with their new semiconductor synthesis platform and their ability to make, I think it's over 8 million unique oligos, which even surpasses Twist's ability to play in that space****. GenScript is focusing on synthetic biology. I would argue that's Twist's core focus. If you look at all of their products, most of them are synthetic biology driven.* ***GenScript just came out with a semiconductor manufacturing platform that's extremely similar to Twist****, so I wonder about the future uniqueness of their ability to play in both markets, NGS and synthetic biology, in the five-year stretch."" –Former employee now at a key competitor*

Source: https://www.prnewswire.com/news-releases/genscript-debuts-industrys-highest-throughput-dna-synthesis-platform-for-commercial-dna-digital-data-storage-301525131.html

**Leproust's previous employer, Agilent, had its own version of Custom Array's DNA chip – and it turned out to be a disaster. Twist simply copied the Agilent chip, and is now crippled by the same losses that led Agilent to throw in the towel. Leproust worked on micro-array fabrication at Agilent, and wrote various papers on their array using language identical to that now splashed across Twist's materials.**

***2008 Agilent paper by Emily Leproust, when she was an employee***

## Agilent ' s Microarray Platform : How High-Fidelity DNA Synthesis Maximizes the Dynamic Range of Gene Expression Measurements

E. Leproust • Published 2008 • Biology, Chemistry

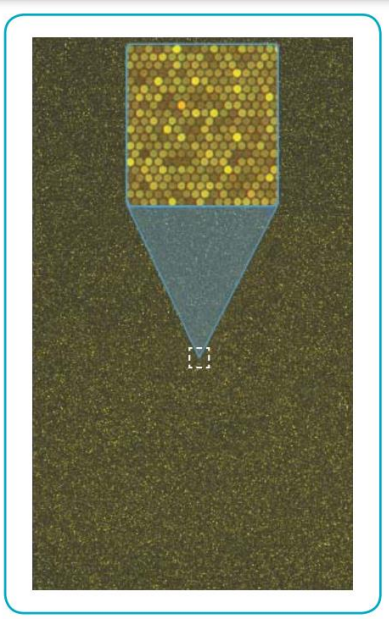
Agilent Technologies manufactures probes for microarrays using a proprietary DNA synthesis method based upon inkjet printing technology. The method, in which layers of DNA nucleotides are "printed" onto desired microarray feature locations to synthesize probes, circumvents many of the limitations of light-based synthesis methods, and is capable of producing oligonucleotide probes of unprecedented quality and length.

***2010 Agilent paper by Leproust***

## ABSTRACT

We have achieved the ability to synthesize thousands of unique, long oligonucleotides (150mers) in fmol amounts using parallel synthesis of DNA on microarrays. The sequence accuracy of the oligonucleotides in such large-scale syntheses has been limited by the yields and side reactions of the DNA synthesis process used.

***Graphic of Agilent array in 2008 paper***



**Agilent's million-featured microarray.**

Source: https://www.semanticscholar.org/paper/Agilent-%E2%80%99-s-Microarray-Platform-%3A-How-High-Fidelity-Leproust/da1310fa8968f90b59f393bb69c07ab424893afd; https://academic.oup.com/nar/article/38/8/2522/3112266

**Agilent first sold its DNA arrays - for a mere thousand or two each - to a startup called Gen9, a failed venture in which it also invested - the canary in the coal mine for Twist investors. Gen9 was Twist's identical twin, employing the same Agilent "chip" to manufacture DNA. We spoke with multiple people from Gen9's management team, who alleged that Twist's founder simply copied the arrays that Gen9 was purchasing from Agilent and hyped them as something new: "Emily had heard the story from us when she was at Agilent. Then she left Agilent to start Twist." Another ex-Gen9 executive stated "Essentially it's the same"; "very, very similar to the technology Twist is using as their starting point..."**

***Twist's entire model is based on the same Agilent array as Gen9 was, yet Gen9 blew up***

*A: "Gen9 had a partnership with Agilent. So, the technology that we were using to build our genes from was very, very similar to the technology Twist is using as their starting point as well. They had comparable starting products because of this Agilent-like technology…**Essentially, it's the same**. They actually have some limitations on their process that we didn't have."*

*Q: "**Isn't that damning for Twist that Gen9 had the same technology from Agilent that Twist is built on, and Gen9 basically blew up** and had to sell to Ginkgo?"*

*A: **"It should be, yeah. But people keep giving them money."** -Executive recently at a key Twist competitor, as well at Gen9, another competitor; currently employed at another synthetic biology player*

***Twist's "chip" technology was taken from Agilent, which resulted in a lawsuit; other companies used the same technology, for which "there weren't a lot of customers"***

*"At the end of the day, Emily was at Agilent, and she worked for Agilent before she started Twist. And we went to Agilent, and we said to Agilent, right now we're buying your chips at whatever retail; we're using other vendors…. So, Agilent did become a strategic investor in Gen9, which is part of what led to that lawsuit because ultimately, **Emily had heard the story from us when she was at Agilent**. Then she left Agilent to start Twist. And you can read the legal everything there…**However, Agilent had that technology. They weren't sure how to commercialize it, which is why the partnership with Gen9 was so good because there weren't a lot of customers for those chips, and we were one."** – Founding member of Gen9, an almost identical company to Twist*

Source: Scorpion Capital consultation calls with experts

# Twist's key competitors, like Danaher's IDT division, echoed that Twist's microarray is just Agilent's failed technology with "some sexy marketing" - "This is Agilent. This is Agilent again…I don't see how you can call it a microchip"; "That's what I would call Twist and Agilent's technology…it's an array panel."

***Twist's "chip" is just a re-hash of an old Agilent technology; "don't see you can call it a microchip"; just "sexy marketing"***

*A: "In the case of Twist, that reaction takes place on basically a slab of silicon that's laser-etched to have little, tiny nanoscopic wells, and they can make an individual oligo in this very, very small size…they just can't make a lot of a single oligo.*

*Q: "Is that really an innovation? They say they have this microchip, and* ***it just looks like a miniaturized well plate with a silicon coating on it."***

*A:* ***"That's exactly what it is."***

*Q: "What was the reaction at IDT – is there any kind of innovation? How did you guys react to this thing?"*

*A: "I think most people reacted like, oh, cool.* ***This is Agilent. This is Agilent again. The form factor, I mean, I don't see how you can call it a microchip.*** *It's a laser-etched slide. It doesn't have, to my knowledge, transistors on the slide, but whatever,* ***Twist has some sexy marketing."*** *–IDT ex-regional sales manager, left recently*

***Twist's "chip" is just a legacy array panel; can only make negligible amounts of material, while most applications need 1,000 to 1,000,000 more grams of DNA***

*"****The catch is that they can only make femtograms of that material****, which for some applications is fine, such as screen applications or single-use experimental hybridization capture pools. However, for most applications, you need at least picogram quantities of DNA, if not nanogram quantities. So, many orders of magnitude greater than what you can make on* ***these array synthesizers. That's what I would call Twist's and Agilent's technology. They are an array synthesizer. I wouldn't call their chip a microchip. I'd call it an array. It's an array panel."*** *–IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**An ex-Agilent executive involved with their Gen9 investment described the "DNA chip" - the same technology that Twist uses - as a colossal failure plagued by errors, out-of-control costs, and unfixable quality control and yield defects, leading Agilent to exit the oligo manufacturing business entirely: "too many errors"; "very time-consuming and very costly"; "no way to make money"; "extraordinarily expensive process"; long turnaround times leading to a "bunch of pissed off customers."**

***Agilent exited oligo manufacturing because "there was no way to make money"; "very time-consuming and very costly"; errors and quality control were the fatal flaw; "extraordinarily expensive process" resulting in "pissed-off customers"; "have to go down the drain"***

*A: "Even **at Agilent, we decided that doing next-generation sequencing on these oligonucleotides is very time-consuming and very costly**. As a result, we started to develop a much more rapid mass spectroscopy solution to determine the base pair errors in oligonucleotide sequences. I don't know where they are. They haven't completed it yet. When we made the decision to back out of the Gen9 deal, we sold our 62% to Ginkgo, and I think we pretty much got out of the oligonucleotide sales business to a synthetic biology company."*

*Q: **"And you guys got out of it because there was no way to make money? Was it too laborious and difficult?"***

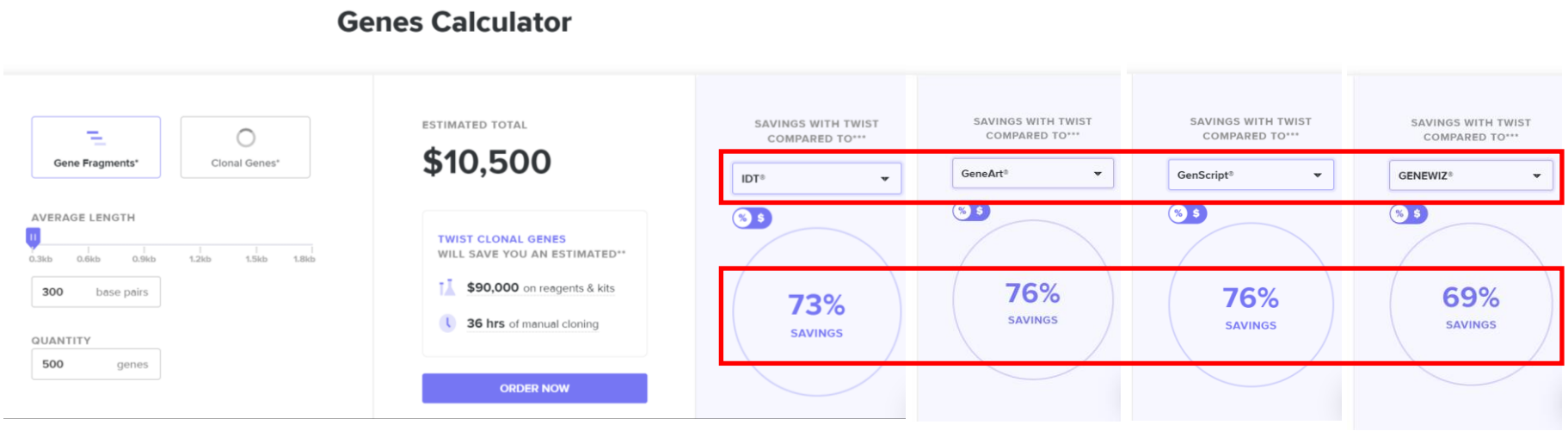
*A: **"Yeah, there was no way to make money. I can't tell you the details, but every month at [redacted], we reviewed the revenues, and it was just a very costly process, most of which was in quality control**. It was also very costly because it required a very long turnaround time. So, contract generation with the customer base was very slow. **We ended up most of the time with a bunch of pissed-off customers** because we promised them 30 days, and we were out in 60 days, and we still didn't have the quality control. When you move it down the process, when you get to the point in the process where you need to do a sequence on the gene, and you find out that it has **too many errors and has to be wasted, that is an extraordinarily expensive process** because you've put in so much value in making the DNA, making the oligos, stitching the oligos together to create DNA, genes, and then you're all the way down the process, and you found out that you have too many errors in the sequence and you have to then basically waste the process. You can't recycle any of it. **You basically have to go down the drain with it."** -Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

Source: Scorpion Capital consultation calls with experts

**Part I: Twist is a ticking time bomb, a commodity synthetic DNA manufacturer and glorified CMO, operating an unsustainable Ponzi-like scheme based on price dumping and customer subsidies to buy revenue and create the illusion of "growth."**

**Twist's entire strategy is to lead with price, prominently showcasing prices it says are a fraction of the competition, across its entire product line. For example, the website page for ordering synthetic genes displays a price calculator with a drop-down box for Twist's discount vs. various competitors - 73% and 76% below US competitors Danaher/IDT and Thermo Fisher/Geneart, and even 76% and 69% below two Chinese competitors, Genscript and Genewiz. The fact that Twist undercuts Asian companies this severely – ones with identical capabilities and a fraction of its labor cost – illustrates the lunacy of its strategy and a key driver of its losses.**

***Synthetic genes pricing calculator on Twist's website – we cut and paste price comparisons vs. competitor options in the drop down box***




Source: https://www.twistbioscience.com/products/genes?tab=clonal-genes

**Twist's approach at launch about 5 years ago was to radically underprice the competition in an effort to purchase market share and "growth." A longtime industry executive recently at Danaher/IDT, a key competitor, explained that Twist launched by posturing at 5 cents a base pair when 35 cents was considered cheap – an 85% discount, which he "never understood as a finance person." He stated that they came "out of the gate" being "shouty shouty" about their price, yet weren't even "succeeding in building people's orders."**

***Longtime executive in the space is mystified at why Twist entered the market posturing with a 85% discount to already low industry price points***

*"What happened was Twist started to come out—so, right out of the gate, as a finance person,* ***what I never understood was you price DNA by the base, and at the time, a low price point for a gene was something like 35 cents a base*** *and normally a fragment would be 1,000 to 2,000 bases. When Gen9 came out, I think they came out at 15 cents a base. But I never understood why they dropped so low when there was a little bit of room there." -Executive recently at IDT, a key Twist competitor, currently employed at another synthetic biology player*

***Twist entered the market and was "shouty shouty" about pricing at 5 cents a base pair; yet couldn't build and deliver orders***

*So,* ***Twist came out very early out of the gate, talking about 5 cents a base****. Of course, with everything, people want things bigger, faster, and cheaper, so people started listening. They also had a very, very good marketing department. Everywhere they go, they're very shouty-shouty…But when I would listen to Twist speak,* ***I could read between the lines and know that things they said meant that they weren't succeeding in building people's orders. They weren't succeeding in delivering people's orders on time. I could tell****…it would be comments about this many shipments per order. So, you would know they couldn't build it all in the first shipment, which means that the second shipment was almost certainly late." -Executive recently at IDT, a key Twist competitor, currently employed at another synthetic biology player*

Source: Scorpion Capital consultation calls with experts

**He continued that Twist "put a lot of pressure" on the market and started a "race to the bottom," selling what is "very much a commodity product" which "at 5 cents a base pair doesn't add up very, very quickly." Two other longtime industry executives, both from key competitors, provided identical color: Twist crushed pricing to "half or a quarter" of prevailing rates, replying "Absolutely, yup" when we asked if they "were just giving money away to people" to buy market share.**

***Twist "put a lot of pressure" on the market and started "a race to the bottom"; "commodity market"; their pricing "doesn't add up"***

*That kind of thing. And she [Twist CEO] was asked about the 5-cent price point, and she would say that's what we're driving towards. But **it put a lot of pressure in the market, kind of a race to the bottom. So, it is very much a commodity product. Selling things at 5 cents a base pair doesn't add up very, very quickly."** -Executive recently at IDT, a key Twist competitor, currently employed at another synthetic biology player*

***Twist slashed industry pricing to new lows, more than 2/3 below the then-prevailing price***

*"**With Gen9, if we were at 15 cents a base**, they might come in at like 10. Before Twist came out, it wasn't going below 10. **They've always been driving towards 5 cents**." -Executive previously at Gen9, a key Twist competitor with a similar model, as well at other competitors; currently employed at another synthetic biology player*

***Twist tried to get share by selling at "half or a quarter" of prevailing prices; giving money away to buy market share***

*A: "IDT started the move to 20-cent base pairs. The one thing that I have to remind people when I say that is that even though it was a similar product, it was a lower-quality product, and they marketed it that way. **Twist came on and promised clonal DNA for half or a quarter of that price to try to disrupt the market and get early share."***

*Q: "When you said Twist took pricing to a quarter or half, what did that translate into in cents per base pair?"*

*A: "They were doing deals at 5, 6, 7, 8, 9, and 10 cents a base pair right out of the gate."*

*Q: "So, they **were just giving away money to people, just purely buying market share."***

*A: **"Absolutely. Yup."** –Ex-senior executive of another key competitor and longtime expert in Twist's space*

Source: Scorpion Capital consultation calls with experts

**Every single Twist ex-executive and employee we interviewed echoed the comments by competitors, that the only way they could "break into the market" or "elbow in" vs. incumbents was by "cutting the price in half." They described an explicit price dumping strategy – selling far below cost, hoping you can make it up later - indicating that they had no other option given there's "not a very good way to differentiate" synthetic DNA: "the sequence is the sequence." Another ex-employee bluntly stated that "gene synthesis was never meant to make money."**

***Twist entered the market with a price dumping strategy, in a commodity market where synthetic DNA Is identical from every competitor and there "is not a very good way to differentiate the product"***

*"**Essentially, the way that Twist was able to elbow its way into the market compared to other competitors like IDT or GenScript is they came in operating at a loss, offered the DNA at half the price**, expecting that their technology would improve over time and enable them to make a profit. But if you want to enter a market, you either have to offer something that is differentiated, or you have to offer something at a lower price. **And in the case of synthetic DNA, there is not a very good way to differentiate the product. The sequence is the sequence**. It's hard to say we offer a better-quality DNA product because the quality is the sequence, and if you meet the specs—is it clear what I'm trying to say?" – Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

***Twist had to cut price by half "in order to break into the market"; "had to beat everyone on price": thought costs would improve but they didn't; "will never be a high-margin product"; "was never meant to make money"***

***"In order to break into the market, they had to beat everyone else on price, and so, they thought that okay, let's cut the price in half compared to other competitors**. We'll make up the difference when we improve our technology. They thought that they had more headroom with their technology. They thought the competitors were basically unable to continue optimizing, whereas their technology **they thought had a lot of room for optimization**. The way that I understood when I was an employee back then is that gene synthesis, **no matter how well you optimize it, will never be a high-margin product**. So, what they were thinking was we would use the gene synthesis product line to develop our synthesis platform, which could then be used to develop different products with higher profit margins. **Essentially, gene synthesis was never meant to make money**. It was meant to give them a way into DNA synthesis technology. They built a platform and then leveraged that platform to sell other products that have higher margins." – Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

Source: Scorpion Capital consultation calls with experts

**An ex-employee in product/sales who was at Twist during launch outlined the textbook price dumping approach that was employed – "take market share" by slashing pricing and "assume you could raise the price later," which they were never able to do given that their products are a pure commodity. An ex-executive concurred, replying "Oh, of course" when we asked if Twist was simply trying to buy market share.**

***Twist entered the market with a textbook price dumping strategy, offering prices 50-60% below average, hoping to slash prices and raise them later, which never happened***

*"So, we were building—and we had four salespeople in North America and one or two salespeople in Europe that were just starting to get to the market. I think* ***the strategy was to take market share and assume you could raise the price later. Average cost for a non-complex gene was somewhere between 18 cents and 25 cents a base, and they were charging 10 cents a base.****" -Ex-employee in senior product management and sales leadership roles*

***Twist's strategy is focused on buying market share, hoping the economics will catch up to them***

*Q:* ***"So, you're saying they were trying to buy market share?"***

*A:* ***"Oh, of course****. As a new entrant, they were trying to penetrate, but they had on their belt the fact that they intuitively at the beginning, look, we can do so much more in such a short amount of time that it makes logical sense if the economics play out." – Ex-Twist executive*

Source: Scorpion Capital consultation calls with experts

**The immediate effect of Twist's pricing strategy was to ignite a price war in a commodity industry already operating at rock-bottom prices, not only devastating Twist's P&L and cash flow but allegedly forcing at least one competitor - Gen9 – out of business. A former employee stated that key competitors IDT and Genscript – both larger than Twist – had to "drop their prices in response" and that the move "really put a squeeze" on other vendors. A customer confirmed that Twist lowered pricing in the industry, stating that "everyone" was "conditioned" by their actions.**

***Twist launched with a price dumping strategy at least 50% lower than the competition, forcing an industry price war and putting "a squeeze" on other vendors***

*"When Twist entered the market when I joined, **they were targeting about 10 cents a base pair. Competitors at IDT and GenScript were at about 20 cents per base pair. What I've seen is that it has actually driven GenScript and IDT to drop their prices in response**. Especially for larger customers, folks like GenScript and IDT are able to apply bulk discounts. But you can tell that it's **really put a squeeze on some of those other vendors who are struggling** to offer that price point and still make a profit. I know it's definitely hard for those other vendors to make a profit at those price points." – Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

***Twist started a race to the bottom in pricing; competitors were "conditioned" by Twist's pricing***

*Q: "My understanding is that when Twist started growing, they cut price dramatically, and other people had to cut their price. **Did Twist lower the pricing in the industry?"***

*A: **"Yeah**. These mid-sized, smaller ones, yes, probably **everyone was a little bit conditioned by Twist."***

*Q: "What did GenScript and IDT price at before Twist came on the scene?"*

*A: **"Back then, if Twist was 20, it was maybe 30 or 25 [per base pair]."** - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**An ex-employee in a senior role stated that by "selling below the cost of their product" – again, textbook price dumping – Twist wrecked the industry for everyone and took "too much value of the market with their pricing for it to be sustainable for anybody." He indicated that Twist won customers "solely" because of price and now has no way out of the downward spiral: "once you displace pricing and that badly, it's almost impossible to lift it again"; "I don't think they're ever going to recover from that."**

***"Selling below the cost of their product"; wrecked pricing in the industry and put companies out of business by price dumping; destroyed the industry and made it unsustainable for everyone***

***"I think they're selling below the cost of their product**. They set their pricing based on assumed cost and the fact that they have cash to weather it. They did change pricing in the industry and have hurt some people there. **They put Gen9 out of business using that pricing**, and Gen9 had fairly good fundamentals from a manufacturing standpoint. Profitability wasn't shared grossly internally. **I can do my own math. I can run a business unit and see what things are costing**, and I have a pretty good feeling we were losing a lot of money, and, of course, when we went public, that was reported. **Honestly, I think they've taken too much value out of the market with their pricing for it to be sustainable for anybody**." -Ex-employee in senior product management and sales leadership roles*

***Only got business due to extreme pricing; "impossible" to recover from price death spiral; never "going to recover from that"; competing against players with other sources of revenue vs. Twist with only one loss leader***

*"They went to market against a bunch of entrenched competitors and **won customers with price solely because what you're receiving is a commodity**, and it's assumed to be all equivalent to some extent, at least for your purpose, your intended use. So**, they displaced people with pricing. Once you displace price and that badly, it's almost impossible to lift it again** because there's been some market follow into that space, which I'm sure is hurting everybody else as well. **I don't think they're ever going to recover from that**. We are probably going to see more competitors drop out. **They're competing with companies that have other sources of revenue**, and gene synthesis is just something that helps support maybe their downstream businesses like GenScript. GenScript charges a little more for the gene synthesis, but they also do all sorts of work with the gene synthesis that generates revenue." –-Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

## An ex-Twist executive used the phrase "very predatory" to describe the "price matching" and "extremely competitive" dynamic that Twist unleashed into its market. A competitor added that discounting is now rampant with everyone discounting an additional 25-50% off already bargain-basement list prices.

***"Price matching" and "predatory" pricing in Twist's market; "extremely competitive"; customization means losing even more money at those prices***

*A; "The company's trying to deliver on all three: the fastest, the best, and the cheapest. And the cheapest is almost a foregone conclusion because* ***if you know the competitive nature, the price matching, price is very predatory in that market."***

*Q: "You're saying the pricing in this market is very predatory?"*

*A: "It's extremely competitive. It doesn't matter if it's in the U.S. or across the pond.* ***It's extremely competitive, and what happens is due to the high degree of Twist customization*** *and trying to do it as fast as you can. What also happens sometimes is that there's always the risk if you're customizing something would require, let's call it, a bit of a re-pricing, i.e., there's not an apples-to-apples, say an IDT or Codex or whoever else is bidding for that customer. Sometimes what happens is* ***money can be left on the table if you're pricing something for the first time because it has a different type…of customization."*** *-Ex-Twist executive*

***Discounting is rampant in the industry, with typical discounts of 25-50% off list***

*"I will say, and this probably doesn't surprise you at all.* ***Nobody pays list price****. You go to IDT, Thermo, GENEWIZ—and of the competitors in that space, very, very few people actually pay the list price that you see on the website. But for a ballpark estimate, I would conservatively, if I were in your shoes, would say that* ***people were paying between 50% and 75% of list price that you find on the website of various companies****." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Twist's pricing is so reckless that it attempts to undercut even ultra-cheap, ultra-low cost Chinese DNA manufacturers like Genscript, where an executive told us he was "was shocked" at Twist's list prices, doubting they "will ever be profitable." The executive indicated they were pricing at 50 cents per base pair when Twist burst onto the scene in 2019 – versus Twist prices now 90% lower than then-prevailing Asian prices. AbbVie, an occasional Twist customer, stated that Chinese companies now list at 7c – and noted that 50%-75% discounts off list are the norm.**

***Asian competitor "shocked" at Twist's list pricing – before even accounting for massive discounts off list; will never "be profitable"***

*"I think **Twist is not profitable because I was shocked when you mentioned the pricing of 7 cents to 10 cents a base pair**. At that rate, **I don't think they will ever be profitable**. I think they may be doing that to increase market share, maybe doing some kind of marketing campaign to win the market." –Executive at Genscript, key Twist competitor*

***Twist launched by dramatically underpricing even cheap Chinese competitors; still underprices them***

*"**Back in 2019, when Twist came into the space, it was about 50 cents per base pair for GenScript**, and now we're down to like 35 cents per base pair." - Executive at Genscript, key Twist competitor*

***Twist quotes prices radically cheaper than even the lowest-cost Chinese manufacturers***

*"I don't know anyone today who would be pricing at 20 cents per base pair. I think that's a thing of the past, and actually, I don't remember this being that expensive. Some companies charge more for more complex genes. Certain gene sequences are harder to synthesize. I think 9 cents is very reasonable. **There are lost-cost providers that can do things in China for maybe 7 cents."** – Abbvie R&D Director; Twist customer*

Source: Scorpion Capital consultation calls with experts

**Twist's strategy started a price war with Chinese manufacturers, sort of like challenging ISIS to a suicide bombing contest. Twist's US-based competitors expressed disbelief similar to Genscript's, indicating that it's now a "race to the bottom" and were mystified that Twist would try to take on larger Asian companies with longer operating histories and staying power. A key Twist competitor stated that Chinese companies will now "just find out what we quoted and undercut the quote."**

***Twist is faced with large, longtime players ready to undercut on price; cheap Asian competitors will underprice any quote and throw cheap labor at the order***

*"It's an interesting market. I was going over some stuff the last time I really dove deeply into this. For example, the top competitors for Twist are GenScript, Thermo Fisher - sometimes people refer to them as GeneArt, and IDT - and these are* ***big companies that have been around a long time****. Sometimes to get a contract, we had an experience at Gen9 that* ***GenScript, for example, would just find out what we quoted and undercut the quote****. And then, our understanding of the market was GenScript tended to throw more people on a project because they have a low waiver cost in China. " - Executive recently at IDT, a key Twist competitor; currently employed at another synthetic biology player*

***"Race to the bottom"; Twist and Asian competitors are in a price war; Twist is just a commodity supplier to synthetic biology players, not a key player itself***

*Q: "What did you observe about Twist's strategy? Was it basically just undercut everybody, kind of like GenScript? Is that the dynamic in the market between GenScript and Twist? Like a race to the bottom?"*

*A: "****The phrase "race to the bottom" came up a lot, yeah****. I think what happens with the investment community is they hear that the synthetic biology market is so many billions of dollars, and they think Twist is a synthetic biology company. Really, they are a provider to synthetic biology companies who are making biologics. The multibillion-dollar estimate includes all of that downstream work that Twist is an input for.* ***I can't help but wonder if that's where people get confused, thinking this market is growing to blow up****, that their segment of it, Twist's segment of it, the DNA synthesis piece." -Executive recently at IDT, a key Twist competitor; currently employed at another synthetic biology player*

Source: Scorpion Capital consultation calls with experts

**As a result of its fire-sale pricing strategy, Twist now finds itself dependent on a bottom-of-the barrel customer base – price junkies that need bigger hits to stick around the crack den. A regional sales manager at IDT, who competed against Twist in a large east coast region, stated that Twist only picked off "price-sensitive" customers vs. ones that cared about "the most accurate DNA" or "turnaround time, reliability, low mutation rates" which they "had a hard time grabbing." The predictable outcome: Twist "dug themselves in a hole by pushing low cost as their primary value proposition."**

***Key competitor: Twist could only pick off "price-sensitive" customers that didn't care about quality and "turnaround time, reliability, low error rates" or "the most accurate DNA"***

"*I went up against Twist many times as a sales rep. For the* ***customers that cared most about things like turnaround time, reliability, low mutation rates*** *in the case of dsDNA or many other metrics that are quantitative.* ***Those customers, I think Twist had a hard time grabbing. But the more price-sensitive*** *and/or the ones that didn't care as much for one reason or another, depending on what research you're doing, you might not need the most accurate DNA in the world, like it might not matter to what you're doing. Twist would win. I lost to them many, many times as a competitor. That's my experience." –IDT ex-regional sales manager, left recently*

***Twist's entered the market based on price, targeting "price conscious" customers; "dug themselves a big hole" as no other value proposition; poor business model "if you don't have an order of magnitude lower cost" of manufacturing "to accompany it"***

***"Pricing was kind of their main thing*** *if you're wondering about that.* ***That is basically how they entered the market****. They said we are a low-cost competitor. Buy your DNA from us; buy your NGS panels from us because we're cheaper.* ***They didn't suck, at least at the beginning. They weren't awful. So, hey, if you're a price-conscious lab manager, they had a compelling offering to customers****. Actually, they got better on all of their product lines over the years, but I do wonder if they just* ***dug themselves a big hole by pushing low cost as their primary value proposition****. That's not the greatest business model in the world if you don't have an order of magnitude lower cost manufacturing to accompany it. That is what I experienced." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Customer interviews clearly indicated Twist's dependence on extreme discounting to hold on to accounts. The head of a research lab at a major university, a significant account, was representative. He stated that he only switched from Agilent to Twist "because of the discount," which he indicated was 70% off list – a giveaway, at a price we estimate at a mere 1.3 cents per base pair. He emphasized that the discount was essential to sticking with Twist, and that "even with a 50% discount, we wouldn't buy it" – "we would not buy DNA from them."**

***Twist discounts off list by 70%; only shifted from Agilent to Twist because of discount; implies paying 1.3 cents***

*A: "A typical oligo pool that we'll order is like 700,000 sequences that are 250 long, and that costs $60,000 or $70,000, but then they heavily discount it for us. They discount us because we're academic and they also discount us because, first of all, 700,000—I don't know how many people are buying pools that large from them."*

*Q: "You've been working with them for a long time. Has the pricing stayed consistent? Has it gone up/down?"*

*A: "I worked with them for the first time five or six years ago. And then, for three or four years,* ***I was buying all of my oligo pools from Agilent…So, for the last two years, we've been doing everything by Twist because of the discount*** *and in the two years, it stayed constant."*

*Q: "What was the pricing per unit on list, and then what is the discount?"*

*A: "Let me see if I can find this. So, 700,000 oligos of length 250, the list was $76,000, and they offered an academic 35% discount, and because of the bulk that we're ordering, it went a lot lower than that…"*

*Q: "So, $76,000 list, 35% academic discount, and then what sort of other discounts are they throwing around?"*

*A: "It went below 70%."*

*Q: "****You're saying the net discount was more than 70%? So, you're paying 30% of list?"***

*A: "****We're paying 30% of list, yeah or below—in that neighborhood."*** *– Current Twist customer, professor with a protein therapeutics lab at a major university*

***Adamant that even a 50% discount wouldn't be enough to persuade them to buy from Twist***

*"And the other thing is being academic,* ***without that discount, we would just not do the project. We would not buy DNA from them at list, cost, or even with a 50% discount; we wouldn't buy it****…I haven't looked recently, but I don't know, [Agilent's pricing is] maybe 20-25% higher or something. We also haven't really tried to bargain Agilent down because Twist is being very favorable." – Current Twist customer, professor with a protein therapeutics lab*

Source: Scorpion Capital consultation calls with experts

**Competitors indicated that "shocking" discounts of 75% were key to Twist's ability to initially lure away some customers form incumbents like Danaher/IDT. An ex-IDT sales manager stated that they internally used the phrase "Ponzi scheme" to characterize the pricing, and that "there was a remarkable amount of skepticism" about Twist's sustainability. He noted that the customers Twist took are now returning to Danaher – "a change in customer attitude is happening."**

***Twist used "shocking" discounts of 75% to lure customers aways from Danaher/IDT; "change in attitude" among customers toward Twist as they now return to Danaher, which allegedly used the phrase "Ponzi scheme" in internal discussions to describe Twist***

*A: "I think there's **definitely a change in customer attitude happening. How quickly that happens, I don't want to get wildly excited about it, but I think it's happening."***

*Q: "How much lower were they on price to steal all of that business like NGS? What was the magnitude of the price disruption they caused?"*

*A: "I had customers that left me for prices at 25% of what I was charging them."*

*Q: "So, they were offering a 75% discount?"*

*A: **"Seventy-five percent discount. That is correct. It was shocking."***

*Q: **"It sounds similar to a Ponzi scheme**. It's like you're basically giving away product. You're buying market share. You burn money hand over fist to show growth. Then, the only way you can show more growth is by raising more money to give away more money to customers with these obscene prices."*

*A: "**Yeah, I think that was the exact phrase that was used in internal discussions, yeah."***

*Q: "You guys used the phrase "Ponzi scheme," or somebody mentioned it?"*

*A: "Yeah…**it was a word that was used. There was a remarkable amount of skepticism, which is why the response was patience. Let's see how this plays out."***

*Q: "Did you hear that word more than once, just out of curiosity?"*

*A: "Yeah, absolutely."*

*Q: "How is this sustainable?"*

*A: "I don't know. I didn't buy Twist stock when they went public." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Twist discounts aggressively not just for academics and start-ups - the bread-and-butter of its low-end customer base – but also for larger players that toss some business its way. An R&D Director at Abbvie stated that they receive a 20% discount and that Twist has been recently dangling larger discounts in exchange for more regular orders. As another example, we note Twist's much-hyped deal with Ginkgo Bioworks, which we discuss later. Our interviews suggest that Twist charges Ginkgo 1.5 to 2 cents per base pair – an 80-90% discount off typical list prices.**

***Twist discounts heavily even for a larger player like Abbvie; currently dangling even larger discounts***

*We got a maximum of **20% discount**, and that's for larger volume. They keep telling us - they told me if you can give us some visibility into the year at the beginning of the year, **we can work out a better discount if you tell us how much you're going to order**. But, in the end, it wasn't worth it for us. We got maybe 15% and no more than 20%." -Abbvie R&D Director; Twist customer*

***Industry experts believe Twist offered rock-bottom pricing to Ginkgo Bioworks, at around 2 cents per base pair; significantly lower than the 5 cent pricing which ex-Gen9 employees indicate contributed to Gen9's failure***

*A: "I can tell you it's consistent with what the buzz was, which **I believe they were at 2 cents a base."***

*Q: "So, you think the Ginkgo deal was completely uneconomic around 2 cents a base pair."*

*A: "I know the Gen9 deal with Ginkgo was not economic at the time, and that put Gen9 in a vulnerable position to be bought from the price they were bought."*

*Q: "What was Gen9 selling at?"*

*A: "We did a promo where if you ordered a certain volume, you got 5 cents a base. And then what they did was guarantee that price for the following year instead of increments where you had to keep ordering certain amounts."*

*Q: **"So, Gen9 was at 5 cents, and Twist went to 2 cents, you think?"***

*A: **"I believe Twist went to 2 cents**. That's my understanding. I mean, I didn't see the contract." - Executive previously at Gen9, a key Twist competitor with a similar model, as well at other competitors; currently employed at another synthetic biology player*

Source: Scorpion Capital consultation calls with experts

**Twist discounts in two other ways that add to the destruction of its P&L – offering minimum order sizes that are a fraction of the economically viable minimums its competitors require; and offering customization that others charge premiums for given the cost of manufacturing. In other words, while a competitor may require a minimum of 100 cars with the same configuration, Twist is willing to sell you 5, each completely different – and at a fraction of the cost per car its competitors charge.**

***Twist sells hard-to-manufacture customized panels with absurdly small and uneconomic minimum order sizes***

*"One of the big benefits of Twist is the lower entry point if you've got a custom panel.* ***You can get a custom panel from Twist for around $2,000. With the likes of Agilent, the minimum is something like $10,000 to $20,000****, depending on the panel size… So, whereas you could go to another oligo provider like IDT, who are probably the industry leaders in standard oligos.* ***IDT, their minimum level of synthesis is like 1,000 times higher, and you will pay $10 per oligo, whereas, with Twist, you're getting millions of oligos for $1,000. Each oligo costs way less****." – Major Twist customer, one of largest genomics centers in Europe*

***Twist's losses driven by the expense of customizing orders, in a crowded market and inherently low margins***

***"Customization is sort of an inherent aspect of the DNA synthesis industry****. The sequences have to be different because each of those sequences encodes a different experiment, if you will. And so, there is no DNA manufacturer out there that is the equivalent of a Model T manufacturer; they're all custom.* ***To your question about why are they so unprofitable? DNA synthesis is extremely low margins, and the reason is there are so many competitors out there."*** *– Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

***Twist has a minimum order size that's a fraction of the competition's yet its pricing doesn't reflect the radically higher cost of the customization and lack of standardization in its orders***

*A: "The minimum order from Agilent at $20,000 might do you 1,000 samples or 10,000 samples of the same sequence. The price per panel might be the same. The price per sample, but you need to buy a bigger pack.* ***It's like going to the supermarket and buying a pack of 1,000 eggs. Twist will sell you six eggs; Agilent will sell you 1000 eggs."***

*Q:* ***"How much is Twist charging per egg, the same?"***

*A: "****Per sample, yes."*** *– Major Twist customer, one of largest genomics centers in Europe*

Source: Scorpion Capital consultation calls with experts

**Ex-employees and competitors we interviewed repeatedly used the phrase "race to the bottom" to describe the pricing dynamic. A former Twist manufacturing manager predicted another "seismic shift in the DNA synthesis market" as disruptive entrants like Rootpath collapse pricing another 70% from already rock-bottom levels. Another ex-employee stated that NGS pricing– the majority of Twist's revenue and its source of growth – was similarly tanking: "I'm not bullish about their NGS products"**

***Oligo pricing is a race to the bottom; "seismic shift" as new players cut prices another 70%***

*A: "There are a lot of vendors out there that are in the phase where they've received money to scale up, and they're looking for customers, and I've heard a lot of talk but have not actually received any physical sequences to back up their claims. But some of the vendors you could consider looking at is Rootpath. Interestingly enough, they actually use the oligos - they can either use Agilent or Twist oligo pools. Their innovation is in the way that they do the steps for assembly and cloning, and sequencing.* ***Rootpath was quoting us 3 cents a base pair, which, obviously, is a huge price cut compared to the current price of about 10 cents to 11 cents per base pair.*** *If Rootpath is able to deliver on the 3 cents per base pair, they will probably get bought by someone, and one of these DNA synthesis vendors and their process may get subsumed into one of these DNA synthesis vendors.* ***If that pans out, I do see a seismic shift in the DNA synthesis market; if one of these vendors can actually hit those prices and deliver consistently."***

*Q: "Have you ordered from Rootpath?*

*A: "I probably shouldn't go into details about current relationships with my current employer." - Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

***"Not bullish" on their NGS offering; race to the bottom in pricing; competitors' NGS chemistries have caught up***

*A: "****I'm not bullish about their NGS products****. They had a dominant position in hybrid capture when chemistries weren't caught, and performance wasn't caught up in their ability to sell the unique relationship. I think the business models have changed at their competitors to catch up. So, it's a much more competitive space. "*

*Q: "****Is it a race to the bottom in pricing?"***

*A:* ***"Usually, sequencing comes first, and that's what's happening****. Everyone's going to focus on the race to the bottom for sample prep next. I think if sequencing costs less than sample prep, then the market has to adapt." –Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

## Our interviews indicate that in contrast to Twist's reckless Ponzi-like pricing, incumbents like Danaher/IDT and Thermo Fisher are disciplined, charging prices that are many multiples higher – 15 to 100X Twist's 1.5c to 10c deals – and focusing on complex, value-added DNA sequences, while Twist focuses on low-quality, commodity sequences that it has to basically give away to drive revenue.

***Twist's competitors are disciplined and not pricing insanely; charging $1.50 to $2 per base pair while Twist caters to the commodity end of the market and charges 10 cents or less; Twist has no capability for real DNA sequences***

*"I think they're losing money partially because of pricing, obviously, and partially because their system isn't as efficient as they expected.* ***The people who are making money in this space are doing the volume that Twist is, and they're not doing it at 10 cents a base. They have much, much higher pricing, but they will make any sequence you want. Some sequences are really complex to make, and pharma customers will put a value of $1.50 or $2 a base or more*** *on those, depending on how hard they've tried to make them before they look for someone who can do it for them. There is money to be had there, but* ***you can't go after the entire commodity market****. I don't think Twist has the capability to make that harder stuff yet. I know they've talked about building it. They even talked about doing it when I was there, but it's a different kind of manufacturing to make that work. It requires a different approach to what you're doing, and I don't think they've established that ability." – Ex-employee in senior product management and sales leadership roles*

***Twist's competitors like Thermo Fisher are disciplined and charge double the price; "don't lose money" as they price properly vs. Twist's price dumping approach***

***"They charge a lot higher prices for their work. Almost double. No, they don't lose money****. Thermo wouldn't tolerate that. They also have a better algorithm for scoring them so that you can say the average gene is going to cost you 18 cents a base. This one's really complex and long. It's going to cost you 45 cents a base. They're right most of the time." -Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

**Part II: Twist's "DNA chip" narrative - 10,000X higher throughput and lower cost - is fraudulent, covering up a manual, labor-intensive, and fatally-flawed manufacturing process crippled by errors, bottlenecks, and pitiful yields – thereby driving gross margins we estimate to be negative, not unlike Theranos which claimed to run blood tests on its "chip" but wasn't.**

Source: https://www.sec.gov/Archives/edgar/data/1581280/000119312518291186/d460243ds1.htm

**Twist claims that its "chip" enables it to manufacture DNA at a 1,000X higher throughput and "at a significantly lower cost than our competitors." Former employees stated the claims are false and described a fatally flawed, manual, labor-intensive process plagued by errors, delays, and horrific losses. Far from being automated and efficient, an ex-senior employee started that "what they do is very low margin and labor-intensive"; "takes manual labor"; and "has a very low value." He stated that "the problem is that the whole process is labor-intensive," and that "their process and method are not sustainable." He further indicated that "customers are frustrated because they cannot deliver on time," and competitors are actually "faster than them."**

***"Labor intensive" and "very low value" product; requires "manual labor" for customization and testing***

*"What they do is **very low margin and labor-intensive** to provide that service. You can see the gene oligo synthesis. You can probably automate it. They try to automate all of the processes. They try to decrease the cost, but the problem is **DNA oligo synthesis has a very low value**. You cannot sell it very high, even for the DNA and, yes, the panel; you **have to customize it. You have to have someone test and design** those oligos and test those oligo sets to demonstrate it works. You have to improve it. **It takes manual labor**." – Former Twist employee, director-level*

***Labor-intensive and "not sustainable" manufacturing process; can't delver on time; chip is a massive bottleneck***

*A: "Right now, **their process and method are not sustainable. I think one of the big reasons is that the customers are frustrated because they cannot deliver on time**. They cannot keep their promise in two days."*

*Q: "What is wrong with their process, such that they can't deliver on time? They can't hire staff or don't want to hire staff because they already lose so much money? What's going on?"*

*A: "They already hired as many staff as possible. They do 24/7, and they have two shifts, a day shift and a night shift, and people work over the weekend. They still cannot keep their promised delivery time, like 15 days. Fifteen days is not an industry's best speed. **There are other companies that can deliver at a similar speed or even faster than them. So, it's a very competitive market. I think the problem is that the whole process is labor-intensive."**– Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**The ex-employee described a manual-labor body shop where it takes "a few days" to make oligos – that is, the "chip" requires crews of lab technicians working 24/7 shifts similar to traditional DNA synthesis on well plates – followed by a long series of manual steps across large numbers of test tubes: "that's labor, and you need people to do that in each test tube." He laid out steps no different than decades-old, legacy DNA manufacturing methods – harvesting oligos, annealing, adding enzymes, de-naturing with PCR, and so forth: "people have to do it" vs. a chip magically solving the problem.**

***Labor-intensive body shop; takes "a few days" to synthesize oligos on a chip, then labor for numerous individual steps in countless test tubes by lab technicians***

*Q: "They pitch themselves as a technology company with this cool chip but are they basically like a **manual-intensive body shop** - a bunch of lab technicians at the end of the day?"*

*A: **"Yes, yes. That's true**. Twist tries to automate the process, but I can give you one example of how gene synthesis works."*

*Q: "Yes, walk me through an example of making an oligo and then an NGS sample, so that I can really understand the economics and how manually intensive it is."*

*A: "I'll give you one example: gene synthesis. That's their core business. They call it synthetic biology inside the gene. So, a customer orders the gene through the website. Then they synthesize the gene oligo based on the gene, they break them into pieces, different DNA fragments, then oligos. Because each chip can have up to one million different oligos, usually, they have to wait a few days to accumulate enough orders and then start to synthesize the DNA because of the chip and all of the reagents. **The process is expensive. It takes them a few days, a couple of days, to synthesize the oligos on the chip. After two days of the synthesis on the chip, they call it "harvest**," so cut the oligos from the chip, and recover the DNA oligos. Once they recovered the oligos in the chip, all the DNA oligos for one gene, so they can mature and anneal and fill in the gaps. From there, they take the oligos, **that's labor, and you need people to do that in each test tube**. You can probably do a 96-well format. Each well is one gene. So, each well has 100 oligos, anneal them together, and fill in the gaps, and **people have to do it.** Add enzymes, de-nature with different PCR." – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**Another ex-employee, who worked in a manufacturing role, detailed the chip's dependence on manual labor, stating that it required "humans" working 12-hour shifts around the clock – "manual labor, yeah" – operating liquid handling machines "over and over" and moving plates: "Imagine 16 people with their own [liquid handling] robots." He stated that it took about a dozen people an entire day just to fill up the chip's chambers.**

***"Chip" requires teams of humans doing "manual labor" "over and over" to fill up chamber, with the assistance of widely-used liquid handling machines, across a number of different laboratories; takes 12-16 humans a day***

*A: "But basically, we make tiny pools of DNA base pairs, and then we discretely pool them together with the help of automated liquid handlers. So, we do these things called rolling circle amplification and preliminary cycling assembly."*

*Q: "How much manual labor is involved in that order? When you say automated liquid handling machines, **you probably need a lab technician on that stuff**. How does it work?"*

*A: "**Correct. So, you can imagine every automated liquid handling machine has sort of like a robotic person** that will do these, and they are operational 24 hours a day. Every hour, every minute, every day, the operations are continuing, and orders are being filled. **So, manual labor, yeah**, split between about three or four different laboratories, inside of Twist."*

*Q: "Is it an automated liquid handling machine that's basically filling up each of those plates?"*

*A: **"Yeah, it's a combination of many automated liquid handlers being directed by humans and then plates being transferred from one lab into another lab."***

*Q: "How many humans does it take to fill all 96,000 of those chambers? How long does it take?"*

*A: "Less than a day."*

*Q: "Does it take one person working all day to fill up all 96,000 of those wells in that chip or more than one person?"*

*A: **"Imagine 16 people with their own robots, and the robot is what's handling the sample, and the person is just putting the plates on there and pressing buttons."***

*Q: "But how many times do they need to repeat that to fill up the whole plate?"*

*A: "Each person is directed into their own job, into their own robot. And when they come in, they will work a 12-hour shift and do the same process over and over."*

*Q: "**So, it takes 12 people to fill up all of the little holes in that 96,000 miniaturized well plate**, and that takes about how many hours total for all 12 of those people?"*

*A: "Assisted by robots, yes. **Less than 12 hours.**" -Ex-Twist employee in manufacturing, now a research professor*

Source: Scorpion Capital consultation calls with experts

**The labor-intensive nature of Twist's manufacturing process – a stark contrast to its claims of "silicon-powered DNA synthesis" – came up repeatedly in interviews with ex-employees, who detailed a workflow no more efficient than legacy DNA synthesis with plastic well plates. They described "very labor-intensive" steps over a "one-week process" where "people have to change different plates and add things." As a result, "their cost is much higher than, say, Genscript" – a Chinese competitor with cheaper labor.**

***Long series of "very-labor intensive" steps that take at least a week; just using well-plates; high-cost process***

*A: "In each spot, each chip can make one million different DNA oligo fragments. But the fragment can only be a length of 200 to 300 base pairs.* ***Oligos probably take a few hours, three to four hours. Once they've done that, then they have to put it into the vector, so they can do recombination and flip it into the vector. It takes probably another one to two hours of manipulation****. Once you've added the reagent enzyme, then you have to—we call it transformation—you have to add bacteria—competent cell—to do the transformation. Then the DNA gets into a plasmid, and once the DNA gets in the plasmid, you add media and then you have to recover. Let them grow overnight, and they probably have to grow overnight from 10 to 12 hours. With the growth, you don't need people. But the rest of that process,* ***you have people to change different plates and add things. It's very labor-intensive."***

*Q: "****So they're basically using these well plates, just like everybody else****. Do they have any advantage versus people like GenScript and others? I'm trying to understand what Twist's advantage is."*

*A:* ***"You are absolutely right****. You are right. There are two separate steps: gene synthesis, and once you synthesize the gene, Twist is not the cheapest one because* ***their cost is much higher than, say, GenScript****, for whom most of their products are generated in China, and their labor cost and everything is cheaper. For the final product, just based on cost, Twist is not the lowest one.* ***The advantage basically disappears once you go through the labor-intensive process*** *when you have a gene. Also, you have to overnight, and you have to isolate half of it. And when you grow bacteria, you have to take a few colonies and spread them on the plates, let them grow, and then pick a colony, grow—we call it mini-prep—you take four colonies to sequence it. So, they have to do NGS sequencing prep and isolate the DNA using a kit.* ***Those are very labor-intensive. It's like a one-week process. The steps all need people's attention, maybe just a few hours in-between, but most are a very labor-intensive process****." – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**A former director-level employee stated that the chip is a massive bottleneck that slows down manufacturing - "I don't know how they can make it"- as Twist has to batch orders and wait 4 or 5 days rather than only use part of the capacity of each chip: "Otherwise they lose too much money…[I]t's just too costly. It's not cost-effective." In other words, the 96,000 test-tube equivalent capacity of the chip has spectacularly backfired – sort of like a plane that's a thousand times larger than a typical one and has to spend days at the airport gathering passengers to amortize the fuel and labor. We asked if the chip is "a giant scam, to be blunt," which led the former employee to laugh and say "yeah, yeah."**

***Chip can waste 4 or 5 days while waiting to fill it up to capacity; replied affirmatively if asked the chip is a "giant scam"; "don't know how they can make it"***

*A: "I think the problem is that the whole process is labor-intensive. They cannot bunch orders together because currently,* ***they have to wait a few days; otherwise, they lose too much money, and they cannot stay utilizing 1/10th of the chip. They have to utilize the whole chip for a million oligos or rather 80% or 90% capacity, then start synthesizing. Otherwise, it's just too costly. It's not cost-effective. Right now, they have to wait sometimes for four or five days to start printing on the chip****. Another one is I don't know how they can streamline the process and also build up the scale parallel so people have a more manageable workload and split the work.* ***I don't know how they can make it."***

*Q: "Would they do better if they didn't have this chip? Because somebody like GenScript or other people don't have a chip, and they're faster.* ***So, is this chip thing a giant scam, to be blunt?"***

*A:* ***"[Chuckles] Yeah, yeah.*** *You can interpret it that way." – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**An ex-executive of a key competitor who remains friendly with the management team and has advised the CEO stated he was "shocked" after visiting their manufacturing operations: "When I went out there and saw what they were doing, I was shocked." He indicated that he would "be surprised" if they had a positive gross margin, and replied "definitely" when we asked if they were running a negative gross profit business.**

***Executive skeptical they have a positive gross margin; "shocked" after visiting their manufacturing operations and seeing "what they were doing"***

*A: "They've taken the approach, and they've had the investor base to focus on revenue growth, not operational efficiency and profitability. So, even though they sunk a lot of money into operations, they sunk much more into R&D and continue to sink more into R&D. So, even if they could get operationally profitable, which they're not—you still have to pay for the remainder of the company, which they can't. That ends up being your huge loss right there.* ***I don't even think they're getting a positive margin on the product if you exclude R&D and G&A. That's my personal opinion from looking at their financials."***

*Q: "So, you're saying* ***you don't even think they're profitable in terms of gross margin?"***

*A: "I think that if they are,* ***I'd be surprised."***

*Q: "So, you think they're running a negative gross profit business?"*

*A: "On the genes, definitely. The oligo pools may be a slightly different cost structure because you don't need to do cloning and things like that. But, yeah, I would find it hard to believe.* ***When I went out there and saw what they were doing, I was shocked."***

*Q: "What were you shocked by?"*

*A: "In my world, you focus on building things inexpensively but with the highest quality. They're focusing on trying to turn it around as fast as they can. So, get everything you can done in a short period of time and hope that you're going to get the quality at the back end. That's just one example." –Ex-senior executive of key competitor and longtime expert in Twist's space*

Source: Scorpion Capital consultation calls with experts

**The executive elaborated on why Twist is a high-labor body shop with "a lot of people who work around": "they have quite a bit of labor, even though they're 'fully automated.'" As he described individual manufacturing steps, we commented that it appeared to be "tremendous human intervention," to which he replied "Yup I'm right there with you…I never understood Twist and Ginkgo. I never understood the two of them…the hype…the darlings of the synthetic biology community…I never understood either of their business models."**

***Twist is a high-labor body shop despite being supposedly "fully automated"***

*A: "You sure do. Yeah, you need a new chip for each run. And each of those chips is not super expensive. They've got to be a couple of thousand bucks. They're not cheap either. The actual reagents that they flow over it are not cheap. When you're working in a micro-fluidic or nano-fluidic environment, you need super high-quality base reagents. Those aren't cheap. To make the oligos, your A's, C's, G's, and T's, those are not cheap. The other enzymes and reagents, they've done some fantastic deals, but those aren't cheap either. The most important thing that got* ***a lot of people who work around and have to make sure that all of these things are connected together, and so they have quite a bit of labor, even though they're "fully automated."***

*Q: "It basically seems like a body shop. It doesn't seem like very much is automated. Everything requires* ***tremendous human intervention."***

*A:* ***"Yup. I'm right there with you. For me, I never understood Twist and Ginkgo. I never understood the two of them****, who were in market pole position, if you will, had the hype and were the darlings of the synthetic biology community. I never understood either of their business models. I understood what they were selling. I didn't understand how they were going to make money." –Ex-senior executive of Gen9 and longtime expert in Twist's space*

Source: Scorpion Capital consultation calls with experts

**Even though DNA microarrays like Twist's "chip" miniaturize plastic well plates into thousands of tiny test tubes on a glass or silicon surface, the chambers still require the same liquid handling machines as the well plates they're meant to replace - that is, injecting each chamber with the bases that make DNA is still constrained by hours of human-directed operation, just like legacy synthesis. An ex-manufacturing employee indicated that Twist's so-called "robots" are the same liquid handlers that everyone else uses, widely-sold by numerous vendors.**

***Liquid handlers Twist uses are widely-available tools made by dozens of vendors***

*Q: "What are these robots? Are these robots just basically liquid-handling machines?"*

*A: "Yeah.* ***Like automated liquid-handling machines, like Hamilton, Carterra, Perkin Elmer."*** *- Ex-Twist employee in manufacturing, now a research professor*

***Example of liquid handling machines made by one vendor, Hamilton***


Source: Scorpion Capital consultation calls with experts; https://www.hamiltoncompany.com/automated-liquid-handling

**Twist hypes its chip but is less than candid on a critical point: it's only used for the first step in a long manufacturing workflow, and the remaining steps are the same as any commodity DNA manufacturer. Even if the chip was the automated, turnkey device they claim, it would drive no throughput or cost efficiencies, given the numerous manual steps that follow the oligo synthesis stage. An ex-employee detailed these steps, each involving large teams of lab technicians – operational 24 hours a day - for amplification, purification, quality control via next generation sequencing, all of which are legacy methods that have nothing to do with the chip.**

***Ex-manufacturing employee: numerous manual manufacturing steps following oligo synthesis stage, each involving large teams of lab technicians, for amplification, purification, quality control next generation sequencing***

*Q: "So, it takes 12-16 people a day to fill up that well plate. Then what happens on day two – how much labor is there?*

*A: "It takes about half a day to get those genes into what we call an oligo pool.* ***Then those oligo pools are discretely pooled together for rolling circle amplification, and then they're amplified in the Escherichia coli bacteria cells****. Basically, after that half-day, on the second day, these clonal genes that are on plasmid vectors will be scaled up. So, you'll start with a low amount of DNA, a low amount of gene order to a higher amount of a gene order—that's what will be happening after that 12-hour period. And that bleeds on into the second day.* ***So, then after that second day****, after a purification run to get these gene orders after they've been expanded into more material, after that, a small amount of sample will be used for quality control.* ***We'll do a next-generation sequencing****, and we'll make sure before we send out that order that everything is as expected."*

*Q: "How many hours of labor is that roughly?"*

*A: "It's hard to say because* ***they're 24 hours operational. My team had five technicians in one lab. And we would receive a plate from another lab that had 16 technicians. It would be a gene lab. From the gene lab, they gave us a plate in that 16 people worked for 12 hours on this specific order****. That gene lab then gives us, the maxiprep group these stocks, so then that way we can expand and then make more material. And* ***then we send that off to a quality control group that is made of probably like 6-10 people*** *who can work from home. They're the ones who release that product and say, yes, this has passed quality control."– Ex-Twist manufacturing employee*

Source: Scorpion Capital consultation calls with experts

## Another ex-manufacturing employee stated that Twist's workflow is just "standard molecular biology" steps, and that the chip in fact creates time-consuming bottlenecks such as the need for amplification, as the chip can only product negligible amounts of DNA material, which has to then be scaled 1000x with lab personnel performing a dizzying array of repetitive manuals tasks over 16 hours.

***Just "standard molecular biology" manufacturing steps after synthesis; time-consuming bottlenecks such as DNA amplification, as the "chip" can only produce negligible amounts of material; have to scale up material 1000x***

*Q: "I was just reading that they're using this microarray approach, but does it generate enough DNA for what customers need? Then you've got to do a lot more downstream work? What are the different steps here?"*

*A: "Good observation, and that's great that you picked it up.* ***Basically, you start off with a very small amount of DNA and then we have to use molecular biology techniques to make more DNA****. Once we have the amount necessary for the order, then we'll do quality control and make sure to get that sent out to them."*

*Q: "You do all of this stuff in the microarray. What's the process for making a bigger volume?"*

*A: "The process for making a bigger volume- let's say you printed the gene successfully, and it's not that much DNA. You have to then put the gene into - imagine an incomplete circle – that completes it, and now you have a vector.* ***You put the vector into an E. coli cell, and then you grow these E. coli cells,*** *and they'll have the same exact DNA in each one as they replicate, and then you purify all of that DNA. You amplify one nanogram of DNA into - "*

*Q: "Is that also happening on the chip, or is that a standard molecular biology process?"*

*A: "****That's a standard molecular biology process****. Luckily, it's been optimized with automated liquid handlers."*

*Q: "How long does that process take, and how many people have to get involved?"*

*A: "That was my primary part in the company, scaling up the DNA to have enough for these customers…In the team that I was with,* ***we'd have to scale up the cells for 16 hours. So, that's a bottleneck for maxiprep."***

*Q: "What is the input that you received? How much DNA material would you receive? How long would it take?"*

*A: "Let's say, 10 nanograms* ***and then when I'm done processing it, there's 1 microgram, 1000 times more****…Ten nanograms of DNA come in on a vector, and it's resuspended. And then, I put that DNA into cells for transformation. Usually,* ***you use a technique called electroporation****. DNA is now inside of this E. coli cell. That's like five minutes.* ***I just take a pipette. I take 1.5 microliters of the resuspended DNA, and then I put it into competent cells. It'll be about five to ten minutes until a colony is transformed****. And then, I recover those cells in media, and then they just grow out, and* ***then I move those cells into a bigger space to grow out even more. And then I just purify them*** *all at the end." – Ex-Twist employee in a manufacturing role*

Source: Scorpion Capital consultation calls with experts

**The chip's inability to make sufficient amounts of DNA vs. traditional methods, and the need for additional, time consuming, expensive steps to amplify the material into usable quantities for orders is a second critical bottleneck and fatal flaw, on top of the multi-day delays while batching orders to fill up a chip. An ex-employee outlined the multiple shifts and large numbers of people involved in the amplification process.**

***Manufacturing process is based on standard, manual lab work; multiple shifts with large numbers of people; "very hard to keep track" and "keep count"***

*Q: **"So, this all sounds like very manual, traditional laboratory work at that stage."***

*A: **"That part is, yeah."***

*Q: "So, you have these tiny, little volumes. To amplify, how many hours does it take to amplify a sample?"*

*A: "To get them grown, all these cells are grown with the appropriate DNA inside; **it takes about 16 hours**…We use 100 ml flasks, and they'll sit in a shaking incubator at a certain temperature, and it'll look clear the morning before…"*

*Q: "And how many people was the amplification group?"*

*A: "**We established four shifts and five people on each shift, so 20 people with four team leads."***

*Q: "How many orders would each shift amplify/process?"*

*A: "It's very hard to keep count. Thousands and thousands, an endless Excel list."*

*Q: "Did you guys make errors or mess up orders? It sounds like a lot to keep track of."*

*A: "It's definitely a lot to keep track of. I would create things like tracker sheets, and we have a lot of really sophisticated interfaces to keep everything in order. **But building the pipeline, you're right; it was definitely hard to keep track of."** - Ex-Twist employee in a manufacturing role*

Source: Scorpion Capital consultation calls with experts

## Ex-employees, customers, and competitors all indicated that Twist's DNA manufacturing DNA process is based on a decades-old method used by "virtually all" other companies: "everyone uses phosphoramidite chemistry"; "the basis of everyone's DNA synthesis technology." The single stranded DNA strands (oligos) are then stitched together with PCR, another standard, decades-old process: "everyone uses this method."

***Twist's manufacturing is based on a 70-year old method of DNA synthesis used by "virtually all" other companies***

*Q: "Their entire oligo pool manufacturing process is based on this compound?*

*A: "It's a method that was* ***developed 70 years ago to link DNA bases together and from an oligo. So, it's not proprietary, and virtually all of the oligo companies that are out there use this chemistry****." – Major Twist customer, one of largest genomics centers in Europe*

***Twist uses the same ancient method as everyone - phosphoramidite - else to make oligo pools; only difference is the surface that different companies use whether ceramic or silicon, in Twist's case***

***"For single-stranded DNA, everyone uses phosphoramidite chemistry, which was an organic chemistry DNA synthesis method created in the '80s*** *or something like that. The variation is basically the size of the reactions and the method of catalyzing the reactions….The phosphoramidite reaction is the reaction that allows you to make single-stranded DNA from raw, organic chemical inputs. It's straight organic chemistry, with no biology involved. And that is* ***the basis of everyone's DNA synthesis technology****. The innovation that various companies have had on that is in the form of that reaction, i.e., the physical space that that reaction is taking place. For example—and this is public—IDT and folks like Thermo, that reaction takes place in a relatively large ceramic matrix.* ***In the case of Twist, that reaction takes place on basically a slab of silicon that's laser-etched to have little, tiny nanoscopic wells****, and they can make an individual oligo in this very, very small size…they just can't make a lot of a single oligo." –IDT ex-regional sales manager, left recently*

***Twist uses the same method as everyone else – PCR – to turn single-stranded oligo pools into double-stranded DNA***

*"The current method of assembly of double-stranded DNA constructs is called* ***PCR, polymerase chain reaction - that's what everyone uses to assemble double-stranded DNA constructs*** *from IDT to Twist to Thermo. Everyone uses this method." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

## An ex-Twist manager in a manufacturing role - "I was involved in the entire manufacturing process" – stated that the majority of their steps are the same as "they were in the '90's" and "at the same point that all of the other vendors are at"; that "the gene synthesis process is the same at Twist as it is everywhere else"; and that this is all "pretty standard molecular biology technique…nothing special."

***"Gene synthesis process is the same at Twist as it is everywhere else"***

***"I was involved in the entire manufacturing process**. All the way from extracting the oligos from their DNA synthesis chip to assembling those oligos into full-length genes through to the QC process and shipping out to the customers. **I'll start off by just saying that the gene synthesis process is the same at Twist as it is everywhere else**…The first step is to take the individual nucleotides, ATG, and C, and string those together into oligonucleotides, which are single-stranded DNA sequences around 50-200 base pairs, depending on what the error rate is. And then, they take those oligos and assemble them into approximately 2000 base pair fragments. Those fragments are then cloned into a replicating plasmid and put into E. coli. At that point, the E. coli can self-replicate those plasmids. That's **a very common form to provide synthetic DNA to customers** is in a replicating plasmid in an E. coli host. That's the deliverable." – Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

***Most of Twist's manufacturing steps are same as "they were in the '90's"; same place as "all the other vendors"***

*"It's the steps that come after that, the assembly and QC that are operating **like they were in the '90s. Yeah, we have automated liquid handlers, but they have to do the same steps that they were doing in the '90s.** The first step is to extract the oligos off of the chip. The extraction process gets those oligos into a standard microtiter plate. At that point, you're sort of at the **same point that all of the other vendors are at**. You've got these oligos in a micro-well, and the next step is to process them, assemble them, clone them, sequence them, and then ship out the good sample." – Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

***"All standard molecular biology stuff"; "nothing special"***

*"Once it's assembled, they would do a process of error correction. **It's a pretty standard molecular biology technique**. Once it's error-corrected, then it goes into cloning, where they put it into a circular plasmid. **By the way, this is all standard molecular biology stuff, nothing special**. They clone it into a plasmid. That plasmid, when it's put into an E. coli host, it's self-replicating. So, they clone it and put it into E. coli." – Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

Source: Scorpion Capital consultation calls with experts

## Three ex-employees noted that Twist's much-hyped NGS offering – the majority of their revenues and sole driver of recent growth – is especially "laborious," "time-consuming," and "quite expensive": "involves a lot of people"; not like "they push a button and it prints out"; and is an error-plagued process that takes "months to turn around a pool."

***NGS panels can take 3-6 months to develop; "very time-consuming" and "not off the shelf"***

*"A hospital comes in and says we want to use NGS to detect the mutation. Usually they have to work with a customer, with a hospital, to say what panel, what gene do you want? They say we have these 200 oncology, like BRAF and all those oncology-related genes. Could you demonstrate your oligos work? They call that customization. So they have to work with a hospital. The hospital provides them with a sample, and they have the design in the lab at Twist to develop it. It* ***takes them probably three to six months to develop*** *those assets and validate those. Then they'll say we'll buy your custom NGS panel. Then they will be their customer. You can see here that it's* ***not off-the-shelf, so it's a very time-consuming effort to demonstrate that it works, making it work with the customer to customize the NGS panel. That's what they do for NGS. That's half of their business.****" – Ex-Twist director-level employee*

***Manufacturing NGS is "laborious" and expensive; not like "they push a button and it prints out"; "involves a lot of people" and "touches a lot of hands"***

*"It* ***involves a lot of people*** *just given that from sequence origination to supporting their algorithms to go to their chips, and then the post-manufacturing formulation, QC testing.* ***It touches a lot of hands, and it is laborious. It's not that they push a button, and it prints out****, and they ship it." –Former employee now at a key competitor*

***NGS is extremely expensive to manufacture; "takes them months to turn around a pool"; error-prone process that then takes months of re-work and duplicative manufacturing cost***

***"NGS is oligo pools that are manufactured in a special way*** *and tuned for their specific needs, so they're not just pools of oligos amplified in big groups. And then the design of those also contributes significantly to the value about how well you can design to what a customer needs data-wise, whether it be whole-exome enrichment or specific pieces. One of the diagnostic companies, all they want is to sequence the genes they're interested in reporting on, not everything.* ***It takes them months to turn around a pool, and it's a full-scale synthesis, so it's quite expensive****, and it's pooled on robots, so as individual oligos, they have a bit of* ***error introduced by the pooling process. If you don't like the pool once they've made it for you, the rework time on it to make another pool and tune it is the same months and the same cost****. Because of the pooling process, you'll never get exactly the same performance." - Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

**Twist's fatal flaw is the impossibility of manufacturing DNA strands – oligos, the foundation and building block of its entire product line – without errors and mutations. Known as "sequence fidelity," the issue is a long-standing, unsolved challenge in the industry, driving massive problems around re-work, turnaround time, and cost. The dilemma was outlined by a longtime oligo manufacturing expert who worked at Agilent, the Twist CEO's prior employer, and who was closely involved with Gen9, a DNA synthesis player that was identical to Twist and failed.**

***Sequence fidelity is an unsolved challenge in the industry; leads to errors, mutations, turnaround time, costs***

*"The issue at Gen9 was the number of - **it's called fidelity of the oligonucleotide sequence.** The control target was one base pair error per 200. If you go much above that, what happens is you put that oligonucleotide into the gene and then it starts making - you know what happens, right? You go from the oligonucleotide, and then you create this long chain, one kilobase or longer piece of DNA, which is a gene. That DNA is used by the customer, the industry to create a protein in an incubator, basically. So, **if you have a lot of error in the oligonucleotide sequence, the protein that it's producing is going to have a lot of mutations, and basically, that costs lots of money. The pharmaceutical industry doesn't want a protein drug with lots of sequence errors** in it because it's going to give them issues and major problems. So, **the two major challenges for the synthetic biology industry that's producing genes is fidelity, in other words, errors and turnaround time, getting the product to the customer**." –Longtime oligo manufacturing expert; ex-Agilent executive expert and executive; ex-Agilent*

***Error-free, "sequence validated" products are extremely expensive to make; take weeks; can't be delivered without errors even at 15-20 cents per base pair which is multiples of Twist's pricing***

*"IDT makes a very low-cost, in the 15 to 20 cent per base pair range, a very fast turnaround time oligonucleotide. Unfortunately, it's not sequence-validated, so you don't know what the hell you're getting when you get it. Not too many synthetic biology companies actually purchase the IDT product. **There's a whole group of companies that are in what's called the "sequence-validated**, one kilobase gene standard vector." This ranges from a 10-day turnaround time. Companies like GeneArt, GenScript, and IDT have got a product as well, **but they're at a very high-cost range now because they have to apply a lot of diagnostics like next-generation sequencing or mass spectrometry in order to validate the sequence of the oligonucleotide. It takes weeks to do that. So, this is a bottleneck** in the logistics chain going from an oligonucleotide to a gene and a gene sequence." –Longtime oligo manufacturing expert; ex-Agilent executive*

Source: Scorpion Capital consultation calls with experts

**Twist falsely claims to have solved the sequence fidelity problem, but numerous ex-employees, competitors, and industry experts highlighted it as the core of their losses and their Achilles Heel. The ex-Agilent manufacturing executive indicated that the DNA "printing process" that Twist flaunts inherently has "tons of room for error," and that other players who attempted a low-cost oligo product "struggled with turnaround time" and cost issues, leading to lost customers and their ultimate demise.**

***The DNA "printing process" that Twist flaunts inherently has "tons of room for error"***

*"If you look at the process, the process is like a jet ink dot matrix printer. It's the same thing. It has four heads, and they use piezoelectric crystal to spit out these droplets containing the base pair, A, T, G, and C. So, you have four heads, one has A, one has T, one has G, and one has C. The customer will order an oligonucleotide gene sequence of 1000 pairs. This thing goes through multiple times where* ***it spits out a little bubble of adenosine to put them in the right place. There's tons of room for error."*** *–Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

***Other players that have attempted a low cost oligo product "struggled with turnaround time" and cost issues; lost customers; and therefore failed***

***"There are other companies in there like Biomatic. Gen9 had a product that had a fairly low cost on the oligonucleotides. They struggled with turnaround time****. They were probably the longest turnaround time in the 20-30 day range. The customers basically can't tolerate that because it affects their supply to their customer. This is really a B2B play, and your timing has to be fairly accurate because the customer has to time their manufacturing process.* ***They kept missing dates, and as a result, they started losing contracts****. They were then acquired by another company who redirected them a little bit now onto more reagents than actually synthetic biology genes." –Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

Source: Scorpion Capital consultation calls with experts

**Another DNA synthesis expert, who was part of the founding team of Gen9 – which used the same Agilent "chip" as Twist and blew up – detailed numerous ways that "very high error rates" get introduced when oligos are stitched together, to the point that a sequence gets garbled into a completely different gene than intended. This results in expensive and time-consuming error-correction and re-work: "the error rate is really, really high and that makes [the oligos] not useful" and is "way more expensive because they probably have to built it multiple times."**

***Numerous ways that "very high error rates" get introduced during stitching; errors are so high that they turn a sequence into a completely different gene than intended; requires error correction***

*"Short is generally 20 base pairs. You need 4 on each end at least to create the overlap in order to stitch them together, which means your payload is—each one of these is about 10 to 12 base pairs, which means you're going to need a lot of little pieces.* ***Every time you come to stitch those together, there's a potential error****. The wrong pieces may connect because they're too close in what they look like. And so now, the wrong one is in the wrong place, and it starts to connect, and it's a different whole set, and that happens often. Or, they overlap incorrectly, so even if you miss by one, it's off. Those things are happening when you have this massive pool, and they're all trying to come together, and you're trying to create this reaction to bring them together. It ends up being what could be* ***very high error rates*** *because even if we're off by one on that stitch, that's one in, with a 12 payload, it's one every 20. It used to be that people were ordering an average of about 1500 to 2000 base pairs, but today, everybody's claiming they can go up to 10,000. So, even in just 1000, there's a good chance that you're having 50 errors.* ***That's a lot. That's a different gene. So, you have to have error correction that can come in and fix those."*** *–Founding member of Gen9, a virtually identical company to Twist*

***"Really, really high" error rates from stitching short strands of oligos together which makes them "not useful"; "way more expensive" as Twist then has to re-manufacture "multiple times"***

*"The ability to take* ***these short strands of these oligos and stitch them together and make them really, really long, that's fine, except for the error rate is really, really high, and that makes them not useful****. So, if you're looking today at their numbers when you look at different services that they offer, you'll see that besides the pools, they also offer specific genes. That is* ***way more expensive because they probably have to build it multiple times****." –Founding member of Gen9, a virtually identical company to Twist that failed*

Source: Scorpion Capital consultation calls with experts

**Experts underscored the inevitability of errors during oligo manufacturing and their stitching into longer strands, which can only be caught by examining them - one by one - with "very long and arduous next-generation sequencing" that's "expensive, "slow," and requires "a lot of high-level PhD's." The ex-Agilent executive who witnessed Gen9's demise implied that Twist is in the same death knell – "Twist is going through the same set of issues since it's basically the same technology as Agilent…when we were trying to create oligonucleotides for Gen9."**

***Errors in oligo manufacturing are inevitable and require "very long and arduous next-generation sequencing" that's "expensive," "slow,: and requires "a lot of high-level PhD's"***

*"Once you get the sequences made, you need a special process for removing these oligonucleotides off this glass slide, and that's proprietary chemistry that was developed at Agilent. They've been in this business for quite a long time, so they really understand how to make oligonucleotides. You use the chemistry to get the oligonucleotide off the plate, which is glass most of the time, and now your quality control starts.* ***Now you have to examine every one of those oligonucleotides and determine how many errors were created in the oligonucleotide base pair sequence and then cull*** *out those that meet the customer requirements, which in my time was one error in 200 base pairs. When you think about it, it could be one base pair, and there were 200 passes with that printer. There's a high probability—and you could calculate the probability—that* ***you're going to get errors****, and then you have to cull out at the end. It takes a long time. In order to determine the sequence of an oligonucleotide, you have to do a* ***very long and arduous next-generation sequencing. It's expensive, it's slow, and it requires a lot of high-level PhDs to run it.****" —Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

***Difficult to manufacture low-error, high-fidelity oligos; Twist experiencing same problems as other companies that therefore exited the space or failed; same technology and same problems as Agilent***

*"I think that's why the market adoption is somewhat slowed relative to the early-on growth estimates because of the* ***error rates. It's pretty difficult to get high-fidelity oligonucleotides in a time to be competitive in the marketplace. I would think that Twist is going through the same set of issues*** *since it's basically the same technology as Agilent. It's the same set of issues that we went through when we were trying to create oligonucleotides for Gen9." –Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

Source: Scorpion Capital consultation calls with experts

**Twist's fatal flaw around errors and lack of sequence fidelity is driven not only by unsolved problems inherent to synthesis, but is compounded by a massive problem specific to its chip: it can only synthesize negligible amounts of DNA and can't scale to the volumes required for individual orders. As a result, Twist resorts to other methods to amplify the DNA – and amplification introduces additional errors and mutations, which cause their manufacturing costs to spiral out of control: "that is exactly their issue….they have to replicate it many, many times…which runs the risk of introducing mutations…which degrades the quality."**

***Key flaw in Twist's "chip" is the inability to make sufficient amounts of DNA material; "they can't get to scale"***

*Q: "Why is this chip technology not helping them? Why did they lose so much money?"*

*A: "Because **they can't get to scale.** If you're designing a new hybridization capture panel, you're going to test out a whole bunch of different designs, and you're probably going to only test those designs a couple of times. So, having a Twist panel is actually kind of nice because you can make these thousands of individual oligos that will go into your panel, and you can test out a bunch of different designs. **However, especially in a regulated space like oncology, once you've decided on your design, you want to repeat it over the course of thousands and thousands of patients. So, you need not small femtogram amounts of each of the oligos that go into that panel. You need pico to nanogram amounts** of that, that you can then divide out onto many, many panels." –IDT ex-regional sales manager, left recently*

***Twist's "chip" is a self-defeating technology with no way to win: any efficiencies it creates are destroyed by the workarounds required for its inability to make sufficient amounts of DNA***

*Q: "It sounds like you're identifying a **fatal flaw**. Is it that their micro-array plate makes volumes that are too small, so whatever efficiency they get there, they destroy because then they have to do a bunch of work correcting for those problems?"*

*A: "**Yeah, totally. Exactly. That is exactly their issue**…They need to both make more material, which degrades - they're using up their capacity for lots of various pieces of DNA to make more of a similar piece of DNA, and then they have to do what's called "amplify" that piece of DNA, i.e., **they have to replicate it many, many times using polymerase chain reaction again, which runs the risk of introducing mutations, which degrades the quality of the output material."** –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Experts indicated that the workaround Twist uses to amplify the infinitesimal quantities of DNA produced by the chip is called "tiling" – a finger in the dike which is "how Twist has kind of stayed relevant": "they literally amplify out their panels using polymerase chain reaction [PCR]." However, the workaround comes at a steep cost in terms of errors, mutations, and lack of consistency – rendering Twist's "chip" a self-defeating gimmick with no way to win, as any efficiencies are quickly destroyed by the workarounds required for its inability to make usable amounts of DNA.**

***Twist's workaround to address their inability to make sufficient amounts of DNA – an amplification process called "tiling" – introduces quality problems like mutations and lack of consistency***

*"Twist has kind of tried to solve that problem by basically doing two things. They do what's called "tiling," which is - theoretically if you want to sequence a single segment of a genome with this hybridization capture method, you only need one piece of DNA to match up with that area of the genome that you want to sequence.* ***The way Twist has gotten around the fact that they don't have enough of that one piece of DNA to replicate out over many panels and/or have consistency with their results is by adding many, many pieces that target the same area of the genome that you want to sequence and that's called tiling****. They literally amplify out their panels using polymerase chain reaction. That kind of has solved their problems.* ***Whenever you amplify out a panel, you have the risk of introducing mutations and each piece of DNA that you replicate. And if you do that too many times, your consistency of the use of that panel****, the consistency of the data that would come out of using that panel, degrades because you're introducing variation by amplifying it. But if you add enough oligos, you can make up for that, and that's how Twist has kind of stayed relevant." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

## Ex-Twist employees across multiple functions corroborated the high prevalence of errors during the manufacturing process and the workarounds and re-work to try and correct them: "during the synthesis process, random errors are introduced and most customers want sequence-perfect clones"; "some that fail at a pretty high rate because the sequence is hard."

***"Random errors" are introduced in the sequencing process, while "customers want sequence-perfect clones"***

*"From there, you have to account for the fact that* ***during the synthesis process, random errors are introduced, and most customers want sequence-perfect clones. So, there's a whole process whereby you pick out the good clones and discard the bad clones****. That's what you were talking about with the NGS sequencing process. And then, once they've identified a perfect clone, they go through the process of growing up that clone to provide the material required for downstream applications." – Former Twist manager in a manufacturing role, previously and currently employed by key competitors*

***Failure and re-work rates in the manufacturing process are all over the place***

*Q: "What percentage of orders would require this kind of rework and this kind of effort?*

*A:* ***"On average, something like 15% to 20% of the genes had to have that done****, not single genes. Depending on what people are working with, you can have much higher failure rates on single orders. Some go through just fine because they're short and simple, and they have* ***some that fail at a pretty high rate because the sequence is hard****." -Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

## Ex-employees indicated the magnitude of Twist's struggles with errors, quality control, and extensive re-work rates, with led to the promised turnaround time being missed "probably 30% of the time because something needed to be reworked," resulting in "upset" customers who defected.

***Customers leave because of Twist missing the turnaround time for orders or receiving incomplete sequences; missed the turnaround window "probably 30% of the time" due to re-work and quality problems***

*Q: "Were there any customers that left because of quality or other issues?"*

*A: "Turnaround time.*

*Q: "Was that the biggest issue"*

*A: **"Yeah, missing your turnaround time and percent of the order complete by far."***

*Q: "How often did each of those two things happen?*

*A: "**The turnaround time was probably 30% of the time because something needed to be reworked**. When they really needed something, they had to have it complete, that was probably 10% of the time, and people would be upset by it not being complete just because they needed to have everything; they needed to have all the genes to start their experiment.*

*Q: "How much did they miss it by? How long did the customer expect the order to take from the day they made the order, and how long would it typically take?*

*A: **"They usually expected it to take 10 days, and sometimes it would take 15 days to get it back because some of them you had to start the process again** or you weren't going to make it."*

*Q: "What percentage of the time would they have to rework it?"*

*A: **"Probably 20% of the genes, at least."***

*Q: "And that's before they sent it to the customer, or they would send it to the customer, and the customer would be like, hey, it's wrong?"*

*A: "No-no. Customers don't sequence it. If you send it wrong and they discover it, you've probably lost that customer."*

*Q: "You guys would have to redo it 20% of the time, so you would start the entire manufacturing process from scratch?"*

*A: "It depends on what the failure was like but maybe. It would either be scratch or go back to somewhere in the middle." - Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

**Manufacturing error rates and pitiful yields are the key to understanding Twist's extreme losses and why it is doomed, forcing a dysfunctional, trial-and-error process where it has make multiple, duplicative orders to get one right. A longtime industry executive who is friendly with and has advised Twist's management summarized the problem: "their problem is still error rates…and that's why they're losing money"; "a situation where you need to make multiples of everything just to be able to deliver"; "very high error rates that require that either they create duplicates or multiples or each order, which makes it non-economic, or they have to apply complicated error correction…that also is very expensive."**

***Error rates are a key driver of Twist's losses; requires a trial-and-error process of making multiple, duplicative orders to compensate as well as "very expensive" and "complicated error correction" techniques***

*My guess would be that **their problem is still error rates. And because of that, they need to do multiples of every order, and that's why they're losing money**. That would be my theory. Error rate is the biggest problem for going from short DNA sequence to long DNA sequence. Everybody assumes that the cost of DNA has gone down, which it has, just like sequencing DNA went down significantly enabled this and just like the computational power cost has gone down. This has been the synthetic biology revolution—these three elements of cost driving that are all really the lowest ever. However, **because the error rate is still high, you have a situation where you need to make multiples of everything just to be able to deliver. I think that that's where they're still getting stuck**…if you ask me what their challenge is today, I would imagine that it would have to do with the fact that they have **very high error rates that either require that they create duplicates or multiples of each order, which makes it non-economic, or they have to apply complicated error correction** either doing CRISPR, and that would be by hand and having people work on each one, and that also is **very expensive**." –Longtime industry executive who has advised Twist's management*

Source: Scorpion Capital consultation calls with experts

**A former Twist employee in senior product and sales roles also framed "very high error rates" and re-work as the key reason why manufacturing costs and losses have spiraled out of control: "you sequence five and two of them are right…if it's a complicated sequence, you sequence 15 and maybe none of them are right." He indicated that the problem worsens exponentially with sequence length, and that "they don't have the capabilities to do a lot of it," confirming their niche as a low-quality, commodity manufacturer that competes solely on pricing and discounts.**

***Rework is a key driver of Twist's manufacturing and cost problems; have to keep re-making genes due to errors; "very high failure rates"; inability to properly make longer or more complex sequences***

*Q: "When you say they didn't get the efficiencies that they want, what did you observe that was inefficient? Was it the amount of labor? The speed? The cost of the inputs? There must be a big driver."*

*A: **"Reworks. When you're making a fixed-length gene and they do 1.8 KB or something is their largest size, and if it's an easy sequence, you sequence five and two of them are right. If it's a complicated sequence, you sequence 15, and maybe none of them are right. So, your costs very quickly change since sequencing is a big driver of the cost there."***

*Q: "Is it that the longer the sequence, the more quality problems you have and the more attempting to redo it?"*

*A: **"The longer the sequence and the higher complexity** of the sequence. So, that can be GC percentages, so how much of a GC versus AT. If you go from a low of like 20% to up to 65% or 70%, you can handle that. When you get outside those bounds, some organisms definitely have genes outside those boundaries, and even some of the human genomes are outside those bounds. It's much harder to assemble. So, when you introduce the GC complexity - and sequence complexity. So, if you have a lot of the same sequence repeated, which a lot of genes do, that's also very complex to assemble. So, you introduce all three of these complexities: GC content that's somewhere out of range, repetitive sequence, and long, you start getting **very high failure rates**"*

*Q: "Where and how much of a problem was that for Twist? How much time, effort, and people did that take for them?"*

*A: **"They don't have the capabilities to do a lot of it.** It was a lot of effort and the cost of the sequencing, so you had to go back and get other clones, and that's just someone putting a work list together to redo that. **Sequencing is a pretty big percentage of the cost of making a gene, so it gets expensive. Of course, the longer the gene is the higher your failure rate**." –-Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

**Far from being a technological "innovation," Twist's chip is an albatross around their neck, a fatally flawed gimmick that is much more expensive and error-prone than legacy DNA synthesis methods employed by the rest of the industry. The comments by a founder of Gen9 – which used the same Agilent chip as Twist – are damning. He called the chip "a boat anchor" that is impossible to quality control, detailing why flow-based legacy DNA manufacturing is cheaper and higher quality than Twist's so-called disruptive platform.**

***Twist's chip is an albatross around their neck – "a boat anchor"; much more expensive and error-prone than the legacy DNA synthesis methods that competitors use; chip is impossible to quality control***

*A: "I just don't think that they're bringing in the right type of people to fix those things.* ***But is their array a boat anchor, so to speak? Yeah****. If you can't fill up the chip, it's going to be really hard to create such high-value product that amortizes that chip over how many genes or pools you're going to get. You've got to use that entire landscape of a chip.* ***If you use half a chip or a quarter chip, you're going to lose money because each of those things is really expensive****. It's slightly over-engineered. They thought that solvents and temperature were going to solve everything, and it does make some improvements, but, at the same time,* ***if you compare that to IDT using a flow-based oligos system, IDT is so much more profitable."***

*Q: "What is IDT's manufacturing process? What is flow-based versus this chip that that Twist has?"*

*A: "Think about a tube, and you flow reagents down the tube, and then in a well, you're actually doing the actual synthesis of the reagents. So, every time you add a base, it adds the base, then you flow in your next reagent, and it does a de-protection. Then you throw in another base and add the base after that.* ***In the array system, you're flowing the bases over hundreds or thousands of spots at the same time****, and sometimes, you're not meeting that base, but you're flowing it over because you have to. So, instead of focusing on the reagent, you need to build a growing oligo.* ***You have to worry about different ways of protecting and de-protecting to make sure that the base only goes to the wells or the nano-wells that need it and then doing it again. And you're doing it on a planar surface with these little convex holes in it. It's a very different thing. The way you quality control that****. The way that you minimize reagents, all of those things are very different. I'm not saying that the way IDT does it is best. They focused on operational efficiency, and that's why they did really well." –Ex-senior executive of Gen9*

Source: Scorpion Capital consultation calls with experts

**The expert implied that the chip's fatal flaw means "you're definitely going bankrupt." Confirming color from ex-employees, he stated the flaw forces massively redundant and duplicative manufacturing, up to potentially 10-20X – that is, having to make a DNA strand 10-20 times to get one right. When we replied that's like Tesla having to make 5 cars to get one that works, the expert indicated that Twist's situation is even more dire - Tesla can at least re-use the parts, while Twist has to use new chips for each run on top of expensive inputs like labor and materials.**

***Twist's chip requires massively redundant and duplicative manufacturing, up to 5-10X redundancy; similar to a Tesla "definitely going bankrupt" if it had to re-make each car 5 times – but worse because Tesla could re-use the parts while Twist needs new ones for each re-make; even worse in their nascent antibody business***

*Q: "What do you have to redo to make an order—they have to duplicate an order to get the right outcome? Are they doing that all-in-one chip? Or are they having to use a new chip for each of those duplicate runs? How does that work?"*

*A: "Usually, what they're doing is they say here's an order. We'll build this one gene in five different ways on this chip. If one of those five doesn't work out, it will kick over and be re-synthesized on the next day's chip. So, it's a* ***combination of both. Redundancy on a single chip, but if it doesn't work, then they'll go back and use a second chip."***

*Q: "What is the actual number for a single gene, an oligo pool – the amount of redundancy that they typically need?"*

*A:* ***"I would say 4 to 5x, as much as 10x, depending on what they're trying to do. In the oligo pool world, it might even be 20x****, but in that particular case, you're going for the concentration of a particular oligo at the end yield. So, that might be okay. For the genes, it doesn't make any sense."*

*Q:* ***"Is this the critical flaw in their economic model that people don't understand, this need for redundancy and duplicates?*** *If you're like Tesla and you've got to build five cars to get one that works, you're going bankrupt."*

*A: "****You're definitely going bankrupt****. The one thing Tesla can do is pull apart the cars and reuse the parts."*

*Q: "if you have to do something with that much redundancy, cost of goods sold, labor, I mean, you're screwed. That's how you get a -120% margin."*

*A: "****That's exactly right. It only gets worse on the drug side****. For every one antibody you make, you're doing hundreds of thousands or at least tens of thousands of characterization tests to determine that you need to do it again. I just* ***hope that they've got the stomach and the wherewithal to really understand this going forward****." –Ex-senior executive of Gen9*

Source: Scorpion Capital consultation calls with experts

**When we asked the executive – who, we repeat, used the same Agilent chip that Twist's entire story is built on – to explain their fatal flaw in simple terms and what investors fail to grasp, he stated that it's like a subway shop having to make a ham sandwich "three different ways to make it right once": "you're going to lose money…it's something that I don't think [investors] get…you're not long for this world."**

***Twist is like a money-burning subway shop that has to make a ham sandwich "three different way to make it right once"; investors are oblivious to the actual manufacturing dynamic***

*Q: "If you were at a Christmas party and had to explain to your aunt what the market's missing, what are those bullet points that would summarize why this is not the kind of animal that people think it is?"*

*A: "If you're a sub shop owner and* ***you have to make a ham sandwich three different ways to make it right once, you're going to lose money. That's that analogy. It's something that I don't think they get****. For my aunt or someone along that line, I would just say, think of any business, if you have to do it multiple times to make one product, you have to make sure that every time you do it, that cost is extraordinarily low and that you know how to price it to get the appropriate positive gross margins to eventually achieve at least operational net zero. But if you can't make a profit,* ***you're not long for this world."*** *–Ex-senior executive of Gen9*

Source: Scorpion Capital consultation calls with experts

**The expert elaborated on the subway shop analogy, explaining why errors, duplication, and re-work cause Twist's cost of goods to spiral out of control. Twist can't re-use material, leading to a "lot of waste." Critically, Twist needs "a new chip for each run"; "super high-quality base reagents" that "aren't cheap"; "other enzymes and reagents" that "aren't cheap either"; not to mention "quite a bit of labor" despite supposedly being "fully automated."**

***Cost of goods spins out of control with re-work; can't re-use materials and "lot of waste"; need a new chip for runs as well as other expensive inputs, as well as a lot of labor despite claim of being "fully automated"***

*Q: "The ham sandwich is actually a great analogy.* ***Are they also losing cost of goods every time they make that sandwich, like reagents and supplies and stuff?"***

*A:* ***"Yes, absolutely. There's no reuse****. There's no adaptive reuse in that system. Let's say you wanted a ham sandwich with lettuce, tomato, and mustard. But you have to make three sandwiches in order to get that combination, but you use the same amount of lettuce, tomato, mustard, and especially ham, your most important ingredient.* ***You've got a lot of material cost there, and you get a lot of waste."***

*Q: "What are their biggest costs here?"*

*A: "The actual fabrication –"*

*Q: "Is the chip disposable, like you need a new chip for each run? Or can they do a lot of runs? How does a chip work?"*

*A:* ***"You sure do. Yeah, you need a new chip for each run****. And each of those chips is not super expensive. They've got to be a couple of thousand bucks. They're not cheap either. The actual reagents that they flow over it are not cheap. When you're working in a micro-fluidic or nano-fluidic environment, you need* ***super high-quality base reagents. Those aren't cheap. To make the oligos, your A's, C's, G's, and T's, those are not cheap. The other enzymes and reagents, they've done some fantastic deals, but those aren't cheap either****. The most important thing that got a lot of people who work around and have to make sure that all of these things are connected together, and so they have* ***quite a bit of labor, even though they're 'fully automated.'****" –Ex-senior executive of Gen9*

Source: Scorpion Capital consultation calls with experts

**He slammed their manufacturing platform as "an over-engineered solution that they called a chip"; a "fundamental manufacturing flaw" that requires "extensive rework"; "a very, very large and complicated manufacturing scheme where they overbuild in order to deliver." We found his characterization reminiscent of a textbook Ponzi scheme – "The thing I kept saying is they were shipping with every gene and every oligo pool a $20 bill to people."**

***Twist is crippled by their pricing and manufacturing flaws; shipping a "$20 bill" to customers with each order; "complicated manufacturing scheme" that requires "extensive rework" to get a shippable order***

*Q: "Why do they lose so much money - what's broken? You know the space. You tried to build a similar business."*

*A: **"They have a very, very large and complicated manufacturing scheme where they overbuild in order to deliver the product**. So, when I used to tell people why I was getting out of this business because we were actually making money, profit when we sold the business at Gen9. But we were only 35 people, and Emily's was 200 or something at the time. **The thing I kept saying is they were shipping with every gene and every oligo pool a $20 bill to people. That's basically that they were fundamentally flawed**, that they were trying to keep up with the price, and they were taking it as a loss every time. But what they have never done is fix the **fundamental manufacturing flaw** that they have. **They need to overbuild or do extensive rework in order to deliver these products**." –Ex-senior executive of Gen9*

***Chip is an "over-engineered" technology that requires them to re-manufacture an order many different times in order to get one that's error-free; "multiple redundancies"***

*A: "They **over-engineered a solution that they called a chip** with the fundamental idea that if they could fill up the chip successfully, you could make a lot of genes and make a lot of money. But **what they have to do is do what I call multiple redundancies**. So, instead of using 10 spots on a chip to build a gene of 1,000 base pairs, just as an example, they would be using hundreds because they don't design and build it in one way. **They build it five different ways to get a successful build."***

*Q: "You're saying to actually make what they want, **they have to make it five different ways and hope one of those five actually produces the right product free of errors?***

*A: "That's **correct**." –Ex-senior executive of Gen9 and longtime expert in Twist's space." –Ex-senior executive of Gen9*

Source: Scorpion Capital consultation calls with experts

**We find it stunning that Twist's chip, their purported secret sauce, is actually "their Achilles Heel" – in the words of DNA manufacturing experts that relied upon the same Agilent technology. They stated the situation is so dire that Twist is better off ditching the chip and using off-the-shelf equipment just like the competition, describing a dilemma with no way out as they have high errors even after over-engineering expensive workarounds.**

***Twist's "chip" and purported secret sauces is actually "their Achilles' Heel"; executive has "thought so for many years"; suggests ditching the chip and switching to legacy synthesis technology instead***

*Q: "They've locked themselves into this production process around this chip. It's actually extraordinary that the thing they flaunt as their secret sauce is actually ruining them."*

*A: **"It's their Achilles' Heel at the same time."***

*Q: "Yeah, that's a better way of putting it. Why don't they ditch it and change it and do like what IDT does with this flow-based system?"*

*A: "If I were there, I'd go in, and the first thing I'd do is reduce the redundancy. I'd see what my actual yields are based on those qualities, and then **I would supplement my array system with individual gene synthesizers to do final product or finished product**…The second thing I would do is reduce the number of clones they pick by focusing on the quality of the oligos. But that's me."*

*Q: "They're screwed."*

*A: "**I have thought so for many years."** –Ex-senior executive of Gen9*

***Even after "over-engineer[ing] and "over-produc[ing]" Twist still has high errors and poor delivery rates on orders; "no way" to ever be profitable at 5-10 cents a base pair much less 1.5 cents***

*"Instead of using the minimum number of spots to make a gene, **they over-engineer or over-produce in order to guarantee that they're going to get a gene** and even with that, they still only have a 90% delivery rate or something like that…Then because of their oligos, they're wonderful, but at the same time, even with Emily's claim of a miniaturized error rate—so **every certain number of bases, you get a wrong base. It's a problem with polymerases and synthesis, in general**. Once you find the gene you want, you put it into a clonal system and then you have to keep cloning and picking clones and **then sequencing those to verify that you've got the final gene that you want**. When you're doing it that many times, there's **no way that you can sell a gene at 10 cents a base pair or 5 cents a base pair or to Ginkgo at 1.5 cents a base pair and hope to be profitable."** –Ex-senior executive of Gen9*

Source: Scorpion Capital consultation calls with experts

**Multiple industry experts indicated that Twist is selling below it cost to manufacture – in other words, a negative gross margin vs. a reported ~45% in the last quarter. An ex-Agilent executive and oligo manufacturing executive estimated that Twist's COGS is a lot higher than indicative list pricing of 9-10 cents per base pair, given errors and the cost of quality control: "you put a lot more money into just 9 cents a base pair"; "we found it really hard to make money." Another longtime executive stated that Twist's "investors are subsidizing" the company's customers and giving them a "$20 bill" with each order – "to be honest with you, I've never understood."**

***Twist's pricing doesn't cover cost of goods sold, given errors and quality control; putting in "a lot more money"***

*Q: "What do you make of their pricing? Is that another reason why they're so unprofitable?"*

*A: "**Yeah, it's crucial because at 9 cents a base pair is pretty low**, and you're talking about—just think about that. You make 10,000 or a gigabyte of base pairs. So, it **gets pretty expensive. You have to put it through so much testing and quality control protocols. That's where we found it really hard to make money."***

*Q: "Because of the quality control and testing protocols?"*

*A: "Yeah, and the quality control comes so far down the process that you've added significant value only to find that you have too many errors in your base pairs. **So, you put a lot more money into just 9 cents a base pair by the time you have a gene product ready for market."** -Longtime oligo manufacturing expert and executive; ex-Agilent*

***Pricing below manufacturing cost; Twist loses money on a gross margin basis; their "investors are subsidizing" the free money that Twist metaphorically ships to customers with every order; "I've never understood"***

*Q: "It appears that they started pricing at like 10 cents a base pair and even less in this Ginkgo deal. What do you think it actually costs them to make it? It has to be way north of 10 cents per base pair, just looking at their financials?"*

*A: "That's my guess, yeah. I flippantly said they ship a $20 bill [to every customer with every gene], so if a gene costs $50 or $100 because you're building hundreds or, say, 1000 bases, they give you that and then they give you a $20 bill. Or **their investors are subsidizing for that $20 to get marginally even. To be honest with you, I've never understood."** –Ex-senior executive of Gen9*

Source: Scorpion Capital consultation calls with experts

**Gen9 is the canary in the coal mine for Twist investors, as it was an identical manufacturing business using the same Agilent "chip" as Twist. An ex-Agilent executive involved with their failed investment in Gen9 stated it was running a negative 30% gross margin as "the cost of goods are pretty horrendous" – the gross margins "were pretty shitty…yeah, they were negative for sure." Similar to Twist's rampant problems with errors and quality control, he explained the driver was high waste and negligible yields: "…the waste at the manufacturing plant exceeded 60%. They only had like a 30% yield. My guys were there almost every week trying to figure out how to improve the manufacturing process."**

***Massively negative gross margin due to manufacturing problems: "pretty shitty, "cost of goods are horrendous"***

*A: "So, if they're selling whole genes, that's a really expensive process. I can't put a price on it without telling you what the Gen9 P&L looked like The below-the-line cost and the* ***cost of goods are pretty horrendous."***

*Q: "Was Gen9 running a negative gross margin at that point?"*

*A:* ***"They were negative gross margin, yeah."***

*Q: "How negative was the gross margin? One almost never comes across a negative gross margin business."*

*A: "****It was because the waste at the manufacturing plant exceeded 60%. They only had like a 30% yield. My guys were there almost every week trying to figure out how to improve the manufacturing process."***

*Q: "Do you remember roughly what the gross margin was there at Gen9? Like, are we talking double-digit negative or triple-digit negative?*

*A: "****They were pretty shitty. Yeah, they were negative for sure****. I'm trying to figure out the percentage in my head here. They were like* ***30% negative on revenue****." -Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

Source: Scorpion Capital consultation calls with experts

**Twist's losses indicate identical struggles to those that doomed other companies that used the same Agilent "chip" as the foundation of their manufacturing. An ex-Agilent oligonucleotide manufacturing expert who noted that Twist's platform is "basically the same as Agilent's technology," stated that DNA synthesis on the chip is extremely expensive given costly reagents and enzymes and that errors "go up geometrically" as sequences get longer: "the detection of those errors gets more costly and more expensive." An ex-Twist employee in a senior role corroborated that "the enzymes are not cheap, and the sequencing reagents are not cheap, and it takes a lot of time."**

***Chip-based synthesis is extremely expensive given costly reagents and enzymes; "pretty complex"; cost and errors "go up geometrically" as sequences get longer; Twist has same problems because "same as Agilent"***

*"It's based on the processing of rather sophisticated molecular biology science. It's pretty complex.* ***The number and type of reagents are critical in their manufacturing process, and these are expensive as well****. You have to use enzyme technology. You have to use molecular biology technology to stitch the oligonucleotides together in the appropriate sequence. The challenge is to make very long genes. And most of the time, initially, they were starting out with moderately-sized genes. We had three types of products: one went from about 0.4 kilobases to 1 kilobase. Then we had a product called Gene Bite, which is 1 kilobase to 4 kilobases. And then we had 4 kilobases to 10,000 kilobases. So,* ***when you go up that high in the number of bases in your gene sequence, the errors go up geometrically, and the detection of those errors gets more costly and more expensive.*** *It's the difference between sequencing 0.4 kilobases and 10 kilobases, and that's a huge cost. And the technology that goes into it is protected in every aspect of this process, going from the production of the oligonucleotide,* ***which in Twist's case is basically the same as Agilent's technology****." - Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

***Twist's manufacturing inputs like enzymes and reagents "are not cheap"***

*Q: "What are the other costs? "*

*A: "Molecular biology downstream. Enzymes for assembly, enzymes for cloning, and then sequencing. You provide sequence-verified clones...****the enzymes are not cheap, and the sequencing reagents are not cheap, and it takes a lot of time.****" - Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

**We previously shared comments by an ex-executive of a key competitor who remains friendly with the management team and has advised the CEO, who stated he was "shocked" after visiting their manufacturing operations: "When I went out there and saw what they were doing, I was shocked." We note his statements on Twist's gross margin specifically - he indicated that he would "be surprised" if they had a positive gross margin, and replied "definitely" when we asked if they were running a negative gross profit business.**

***Executive skeptical they have a positive gross margin; "shocked" after visiting their manufacturing operations and seeing "what they were doing"***

*A: "They've taken the approach, and they've had the investor base to focus on revenue growth, not operational efficiency and profitability. So, even though they sunk a lot of money into operations, they sunk much more into R&D and continue to sink more into R&D. So, even if they could get operationally profitable, which they're not—you still have to pay for the remainder of the company, which they can't. That ends up being your huge loss right there.* ***I don't even think they're getting a positive margin on the product if you exclude R&D and G&A. That's my personal opinion from looking at their financials."***

*Q: "So, you're saying* ***you don't even think they're profitable in terms of gross margin?"***

*A: "I think that if they are,* ***I'd be surprised."***

*Q: "So, you think they're running a negative gross profit business?"*

*A: "On the genes, definitely. The oligo pools may be a slightly different cost structure because you don't need to do cloning and things like that. But, yeah, I would find it hard to believe.* ***When I went out there and saw what they were doing, I was shocked."***

*Q: "What were you shocked by?"*

*A: "In my world, you focus on building things inexpensively but with the highest quality. They're focusing on trying to turn it around as fast as they can. So, get everything you can done in a short period of time and hope that you're going to get the quality at the back end. That's just one example." –Ex-senior executive of key competitor and longtime expert in Twist's space*

Source: Scorpion Capital consultation calls with experts

**As further evidence that Twist's gross margin is negative, we highlight its signature, much-hyped deal with Ginkgo Bioworks. We estimate that Twist sells to Ginkgo at 1.5 cents per base pair, and experts indicate that the cost to manufacture is "probably 9-10 cents at his point," which by our math comes out to a gross margin of negative 533% (minus 8 cents of gross profit divided by 1.5 cents of revenue). When we asked how Ginkgo views the deal, an expert who we believe to be on friendly terms stated that "they love it…it's so cheap" and that buying from Twist costs them "next to nothing." We asked if Ginkgo is laughing at Twist, and the expert stated that "Ginkgo loves them because it allows them to be sloppy with their work too."**

***Ginkgo uses Twist for ultra-cheap, bottom-of-the-barrel, commodity product; basically giving away product to Ginkgo at prices that are a fraction of its cost of goods***

*Q: "This Ginkgo deal that they have - what does Ginkgo think of Twist? Are they bending over a barrel with pricing?"*

*A: "**Yes, they love it. At the beginning, Ginkgo wanted to shave and reuse oligos DNA. Now it's so cheap. It's cheaper than storing it in their freezer. They just reorder it from Twist**. Then they used the Gen9, what we called the assembly technology, to build up their organisms. But, yeah, **they buy really cheap what I'll call semi-high-quality DNA from Twist at next to nothing. I think it's a cent-and-a-half a base pair."***

*Q: "And **what do you think it costs Twist** to make the stuff that they're giving them at a cent-and-a-half? "*

*A: "For that particular product, which are mainly 500 pairs, **probably 9-10 cents at this point."***

*Q: "So, they're **running a negative 70-80% gross margin** on this stuff to Ginkgo?"*

*A: "On the Ginkgo deal, yeah."*

*Q: "Is Ginkgo just laughing at them?"*

*A: "**Ginkgo loves them because it allows them to be sloppy with their work, too**. What's Ginkgo have for revenue? $177 million or something like that. They have similar operational challenges, we'll call it. Both companies. But Ginkgo loves them because it's so cheap. It allows them to cut out a whole big part of their business that they don't have to worry about." –Ex-senior executive of a key Twist competitor and longtime expert in Twist's space*

Source: Scorpion Capital consultation calls with experts

**Part III: In order to conceal the spiraling losses from its manufacturing meltdown and pricing scheme – and to prevent its Ponzi-like nature from becoming obvious - we believe that Twist has resorted to Worldcom-esque accounting fraud, fabricating a 45% gross margin that it promotes will rise to 60%. Negative gross margins would have shut off its access to ongoing capital raises years ago - its only lifeline - and already thrown it into Chapter 7 liquidation.**

**During our research, we were troubled by a massive discrepancy: ex-employees, competitors, and industry experts provided overwhelming color that Twist sells below its cost of goods, due to its 1) its reckless customer subsidy and discounting scheme, and 2) the turmoil in its manufacturing operations from errors, re-work, redundancy, etc. However, Twist's financials report an unusually high gross margin for a commodity manufacturer – a margin that steadily, smoothly increases every year. The CFO frequently pushes the gross margin narrative, asserting recently that "there's no reason that it should not be a 60-plus precent gross margin business."**

***Twist has reported rapidly rising gross margins every year, projected to keep rising per CFO comments***

| | FY ended Sep 30 | | | | | | | Consensus estimates | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | LTM 6/30 | 2022E | 2023E | 2024E |
| Total Revenue | 2 | 11 | 25 | 54 | 90 | 132 | 184 | 203 | 265 | 331 |
| Gross profit | (7) | (13) | (7) | 7 | 29 | 52 | 74 | - | - | - |
| EBITDA | (39) | (54) | (65) | (103) | (111) | (144) | (220) | (236) | (249) | (220) |
| EBIT | (44) | (59) | (71) | (109) | (118) | (153) | (233) | (251) | (273) | (237) |
| Net Income | (44) | (59) | (71) | (108) | (140) | (152) | (208) | (240) | (267) | (230) |
| | | | | | | | | | | |
| YOY growth | NA | 375% | 136% | 114% | 66% | 47% | 45% | 54% | 31% | 25% |
| Gross margin | (317%) | (123%) | (27%) | 13% | 32% | 39% | 40% | 40% | 39% | 49% |
| EBITDA % | (1,736%) | (497%) | (255%) | (189%) | (123%) | (109%) | (119%) | - | - | - |
| EBIT % | (1,926%) | (543%) | (277%) | (200%) | (130%) | (116%) | (127%) | - | - | - |
| Net margin % | (1,944%) | (551%) | (280%) | (198%) | (155%) | (115%) | (113%) | (118%) | (101%) | (69%) |

Source: Capital IQ data; CFO comments excerpted from Capital IQ transcript of conference Q&A on Aug 9, 2022

**As we studied Twist's reported gross margin, we noted other anomalies. First, Twist was a negative gross margin business for three years, until 2019, reporting a minus 27% gross margin despite meaningful 2018 revenue of $25MM. Manufacturing companies with negative gross profit are exceptionally rare, indicating a horrific, structural flaw in their business model that rapidly puts them out of business. Moreover, Twist's asset base at the time - net PP&E - was negligible, ~$12-15MM with barely any D&A – that is, it was basically a variable cost business with little fixed cost to explain the missing gross margin and COGS leverage. Even Tesla, once it released a car, posted only a single year with negative gross profit – 2008, when the roadster shipped, when gross margin was (40%) on $15MM revenue. We further noted how well-timed Twist's transition to positive gross margins was – a sharp V right after IPO.**

***Twist had negative gross margins as recently as 2018, despite meaningful revenue of $25MM and a negligible asset base, turning sharply positive immediately after IPO***

| | FY ended Sep 30 | | | | | | |
|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | LTM 6/30 |
| Total Revenue | 2 | 11 | 25 | 54 | 90 | 132 | 184 |
| Gross profit | (7) | (13) | (7) | 7 | 29 | 52 | 74 |
| Gross margin | (317%) | (123%) | (27%) | 13% | 32% | 39% | 40% |
| | | | | | | | |
| Net PP&E | 15 | 15 | 12 | 21 | 59 | 106 | 203 |

Source: Capital IQ data;

**We think that Twist has every motive to fabricate its reported gross margin. Its stock price and ability to stay alive via frequent capital raises hinge on two metrics: revenue growth and gross margin. With stratospheric losses since inception and profitability nowhere in sight, Twist has only the usual carrot that keeps growth investors around: the eternal promise of operating leverage and profitability "at scale." A rapidly improving gross margin is therefore essential to luring new money. Gross margin achievements feature prominently in Twist's earnings releases and financial guidance, particularly after the company began providing annual gross margin guidance in 2019 – again illustrating its importance to the narrative.**

***April 30, 2019 press release***

*"Leproust continued, "This quarter, we **reported a positive gross margin** of $1.8 million, and we expect to continue to improve our operational synergies…"*

*Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-reports-second-quarter-fiscal-2019-financial*

***Aug 1, 2019 press release***

*"…commented Jim Thorburn, CFO of Twist. "In addition, **we delivered continued improvements in our gross margin**, which increased to 16 percent of revenue in the third quarter…"*

*Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-reports-third-quarter-fiscal-2019-financial*

***Dec 11, 2019 press release***

*"We posted **a positive 21% gross margin** for the fiscal 2019 fourth quarter and 13% for the full year as our revenue scaled and **we leveraged our cost structure**," commented Jim Thorburn, CFO of Twist…*

***"Financial Guidance…Gross margin is expected to be approximately 32% for fiscal 2020"***

*Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-reports-fourth-quarter-and-full-year-fiscal*

***Nov 23, 2020 press release***

*Fiscal 2021 Financial Guidance…**Gross margin is expected to be approximately 32% for fiscal 2021***

*Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-reports-fourth-quarter-and-full-year-fiscal-0*

**The centrality of gross margin to Twist's narrative is apparent during its quarterly earnings calls. On the last call in August, "gross margin" was mentioned 15 times, and 14 times in the call prior. Both the CEO and CFO repeatedly emphasize gross margin accomplishments, and questions by sell-side analysts indicate a fixation on the issue in the new environment. We note how often the CFO projects gross margins of 60% or more.**

***Q3 2022 earnings call on Aug 5, 2022 – excerpts from Capital IQ transcript***

***James M. Thorburn, Twist CFO***
*Thank you, Emi.* ***We had another good quarter…Gross margin for the quarter was 44.8%****... Our gross margin for the quarter was approximately $25.2 million or 44.8% of revenue as compared to 40% in Q3 FY '21 and up from 38.3% in Q2. The increased gross margin reflects the impact of higher revenues in particular higher NGS revenues and* ***thus leveraging our fixed costs****.*

***Puneet Souda, SVB analyst***
*Jim, on gross margin came in strong this quarter.* ***You're guiding to a number that is higher*** *than what we had for the year…And how should we start to think about* ***gross margin cadence*** *here over the next couple of quarters?*

***James M. Thorburn, Twist CFO***
*…And as we continue to scale the business* ***we're looking at gross margin range of 55% to 60%. I think it's notable*** *this quarter that we achieved gross margin of 45%...So the setup is extremely strong for us….*

***Conference Q&A on Aug 9, 2022 – excerpts from Capital IQ transcript***

***James M. Thorburn***
*…So there's* ***no reason that it should not be a 60-plus percent gross margin business****.*

***Unknown Analyst***
*And I guess that's a great point on the margins there. Any way to talk about the long-term margin profile for Twist?*

***James M. Thorburn***
*Yes….****We're targeting gross margins of 60%*** *in terms of getting to adjusted EBITDA breakeven….*

Source: Capital IQ transcripts

**Press releases in the last four quarters indicate that gross margin is becoming even more central and timely than in previous years. Predictably, the company has established a beat-and-raise narrative around its gross margin achievements. It originally guided to a FY2022 gross margin of 35-37%; tightened the guidance in May to 37%, the upper end; raised it in August to 40%. In textbook fashion, Twist then "beat" the 40% projection last quarter, when it delighted the Street with 44.8%.**

***Nov 22, 2021 press release – provided gross margin guidance of 35-37% for FY2022***

*"We reported record revenue for both the quarter and the fiscal year, as well as* ***a gross margin of more than 40%*** *for the quarter and 39% for the year," commented Jim Thorburn, CFO of Twist.*

*Fiscal 2022 Financial Guidance*

- ***Gross margin is expected to be between 35% and 37% for fiscal 2022*** *which reflects the impact of costs associated with ramping our Wilsonville "Factory of the Future" facility comes online; excluding these costs, gross margin would be 42% to 44%*

*Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-reports-fourth-quarter-and-full-year-fiscal-1*

***May 5, 2022 press release – tightened gross margin to the upper end of the range***

*Updated Fiscal 2022 Financial Guidance*

- ***Gross margin is expected to be 37% for fiscal 2022*** *which reflects the impact of expected costs associated with ramping our Wilsonville, Oregon "Factory of the Future" facility to bring it online; excluding these expected costs, gross margin would be 42% to 44%*

*Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-reports-second-quarter-2022-financial-results*

***Aug 5, 2022 – raised the gross margin guidance to 40%***

*Updated Fiscal 2022 Financial Guidance*

- ***Gross margin is expected to be 40% for fiscal 2022***

*Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-reports-fiscal-third-quarter-2022-financial*

**We think that Twist's gross margin is negative, and believe that the company has concealed this secret with a scheme that misclassifies cost of goods - on a staggering scale - through two mechanisms: 1) improperly expensing direct manufacturing costs like labor as R&D, an operating expense; 2) capitalizing manufacturing costs as capital expenditures. Misclassifying expenses, particularly as capex, is one of the oldest accounting frauds in the book – causing Worldcom's rapid collapse into bankruptcy when it was revealed, and landing its CEO, CFO, and various accounting staff in prison. We note that Worldcom's fraud actually began by shifting labor costs from one category into another, and only later metastasized into capitalizing them.**


Celebrated WorldCom CEO cries as 25-year sentence read


Ex-WorldCom CFO Sullivan gets five years in jail

Received reduced sentence after cooperating with prosecutors


Former Worldcom Controller Pleads Guilty to Fraud Charges


2 workers sentenced in WorldCom scandal

One accountant gets prison, another probation

Source: https://www2.ljworld.com/news/2005/jul/14/celebrated_worldcom_ceo_cries_25year_sentence_read/; https://www.computerworld.com/article/2558072/ex-worldcom-cfo-sullivan-gets-five-years-in-jail.html; https://www.pbs.org/newshour/economy/business-july-dec02-worldcom_09-26; https://www.deseret.com/2005/8/6/19905771/2-workers-sentenced-in-worldcom-scandal

**We begin with the first mechanism – R&D expenses. Twist's historical and recently exploding R&D costs make no sense and strain credibility for a commodity DNA manufacturing company and glorified CRO. Twist reported R&D expenses of $110MM in the last 12 months - a staggering 60% of revenue. We find it inconceivable that LTM R&D is actually equivalent to COGS – also 60% of revenue. We note that Twist is not a drug development company; has no clinical pipeline or R&D programs like a traditional biotech; runs no clinical trials; and has no real product pipeline beyond tinkering with a legacy micro-array it calls a "chip." Even the "Research and development" section of its 10K admits that its R&D activities are manufacturing-related, such as "process development," "optimization," and "process and chemistry development."**

| | FY ended Sep 30 | | | | | | |
|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | LTM 6/30 |
| Revenue | 2 | 11 | 25 | 54 | 90 | 132 | 184 |
| Cost of goods sold | 9 | 24 | 32 | 47 | 61 | 81 | 110 |
| Gross Profit | (7) | (13) | (7) | 7 | 29 | 52 | 74 |
| SG&A | 18 | 26 | 43 | 80 | 103 | 136 | 197 |
| R&D | 18 | 19 | 20 | 36 | 43 | 69 | 110 |
| Operating costs | 37 | 45 | 64 | 116 | 146 | 205 | 307 |
| Operating Income | (44) | (59) | (71) | (109) | (118) | (153) | (233) |
| | | | | | | | |
| COGS as % of revenue | (415%) | (223%) | (127%) | (87%) | (68%) | (61%) | (60%) |
| R&D as % of revenue | (803%) | (178%) | (80%) | (66%) | (48%) | (52%) | (60%) |

Source: Capital IQ data;

**The recent trend in R&D expenses is even more unusual. R&D as a percent of sales has spiked from 48% in 2020 to 60% in the last 12 months - while revenue has doubled, which should drive down a mostly fixed expense not tied to revenue. The trend became even more troubling in the last two quarters, with R&D rising to 66% of sales, while COGS was a mere 55%. We struggle to understand how a manufacturer can report R&D expenses significantly higher than direct labor and materials costs.**

***On an annual basis, R&D as % of sales has spiked from 48% to 60% despite revenue doubling***

***Trend has become even more troubling over last 8 quarters, as R&D as % sales has almost doubled to 66%, exceeding COCGS which is 55% of sales.***

| | FY ended Sep 30 | | | | | | |
|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | LTM 6/30 |
| Revenue | 2 | 11 | 25 | 54 | 90 | 132 | 184 |
| Cost of goods sold | 9 | 24 | 32 | 47 | 61 | 81 | 110 |
| R&D | 18 | 19 | 20 | 36 | 43 | 69 | 110 |
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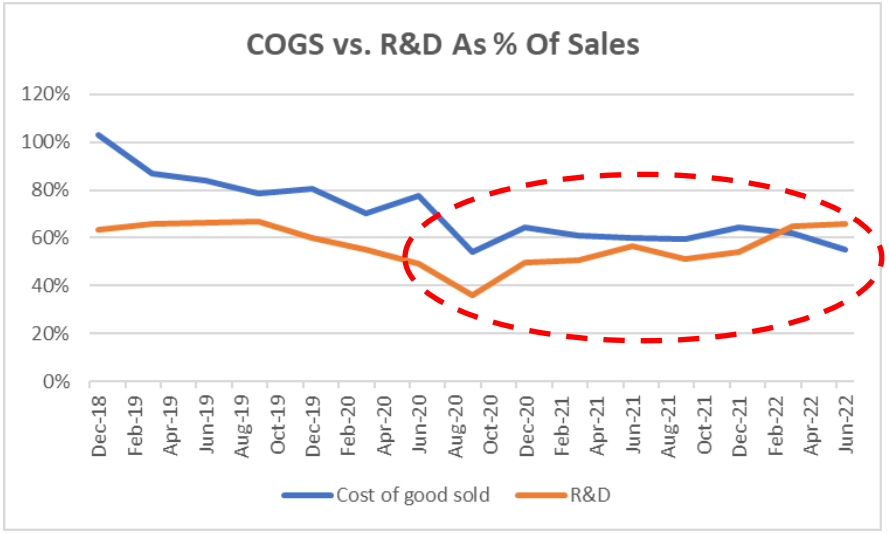
| R&D as % of revenue | (803%) | (178%) | (80%) | (66%) | (48%) | (52%) | (60%) |

| | Quarter ended | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Sep-20 | Dec-20 | Mar-21 | Jun-21 | Sep-21 | Dec-21 | Mar-22 | Jun-22 |
| COGS as % of revenue | (54%) | (64%) | (61%) | (60%) | (59%) | (64%) | (62%) | (55%) |
| R&D as % of revenue | (36%) | (50%) | (51%) | (57%) | (51%) | (54%) | (65%) | (66%) |

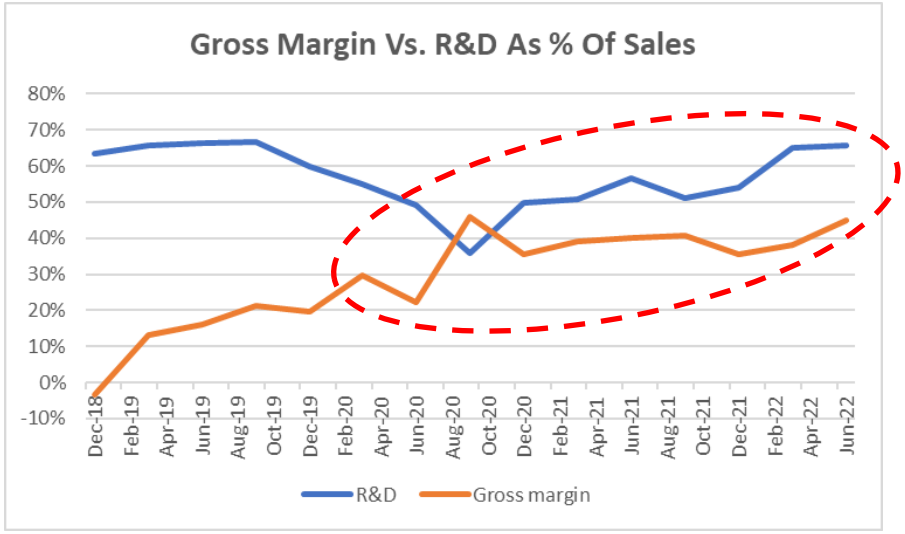
Source: Capital IQ data;

**Two simple charts help illustrate why we think that Twist is stuffing COGS into R&D to show improving gross margin. The first shows that COGS was significantly higher than R&D, as one would expect for a manufacturer. However, the gap has steadily narrowed and recently flipped to where R&D is higher than COGS – that is, the decline in COGS is accompanied by a rise in R&D increases. The second chart shows that the recent increase in gross margin closely tracks a simultaneous spike in R&D – that is, taking from hand to feed the other.**

***In the last two years, COGS has steadily fallen as R&D has increased, both as % of sales***




***Gross margin spike has been accompanied by escalating R&D expenses***




Source: Capital IQ data;

**Revealing language buried in Twist's SEC filings confirms our belief that Twist is misclassifying manufacturing expenses as R&D - the kind of language that lawyers add in an attempt to cover-your-ass, which nonetheless conflicts with the CEO and CFO's strong, unambiguous statements using the phrase "gross margin." We compare wording changes in the prospectus filed in Oct 2018 right before the IPO, with the 10K filed a few months later. In the prospectus, the language in the R&D expenses section is clear and unambiguous, using only the phrase "research and development" without muddying it with any qualifiers. The employees section of the filing also refers to employees who are "dedicated to research and development" - full stop.**

***S-1/A filed Oct 29, 2018 - excerpts***

"***Research and development expenses*** *consist primarily of costs incurred for the development of our products, which include personnel costs, laboratory supplies, consulting costs and allocated overhead, including IT and facility costs. We expense our research and development expenses in the period in which they are incurred. We expect to increase our research and development expenses as we continue to develop new products."*

***"As of June 30, 2018, we had 56 full-time employees dedicated to research and development****. Of these employees, 26 hold advanced degrees in engineering and biology or other sciences, including either a Ph.D. or master's degree…As of June 30, 2018, we had 221 full-time employees and a team of 14 dedicated commercial consultants across the European Union and United Kingdom and five dedicated commercial consultants across Asia.* ***Of these full-time employees, 56 full-time employees are engaged in research and development activities."***

Source: Twist SEC filings

**The 10K filed two months later introduced entirely new language in the R&D expense section, adding a critical qualifying phrase to "research and development activities" -- "are conducted in collaboration with manufacturing activities…." The language in the employees section changed as well, eliminating the phrase "dedicated to research and development," and instead indicating that R&D employees are engineers who happen to also engage in some R&D: "…primarily engaged in engineering and research and development activities." Subsequent filings, including the most recent 10K, retain this new language – but replace "and" with "as well as," signaling that R&D has become even more ancillary to what official R&D staff do.**

***10K filed Dec 20, 2018***

*"Research and development activities **are conducted in collaboration with manufacturing activities** to help expedite new products from the development phase to manufacturing and to more quickly implement new process technologies."*

*"At September 30, 2018, we employed 289 employees, **of whom 75 were primarily engaged in engineering and research and development activities**, 68 in marketing, sales and customer support, 109 in operations and manufacturing and 37 in general and administration."*

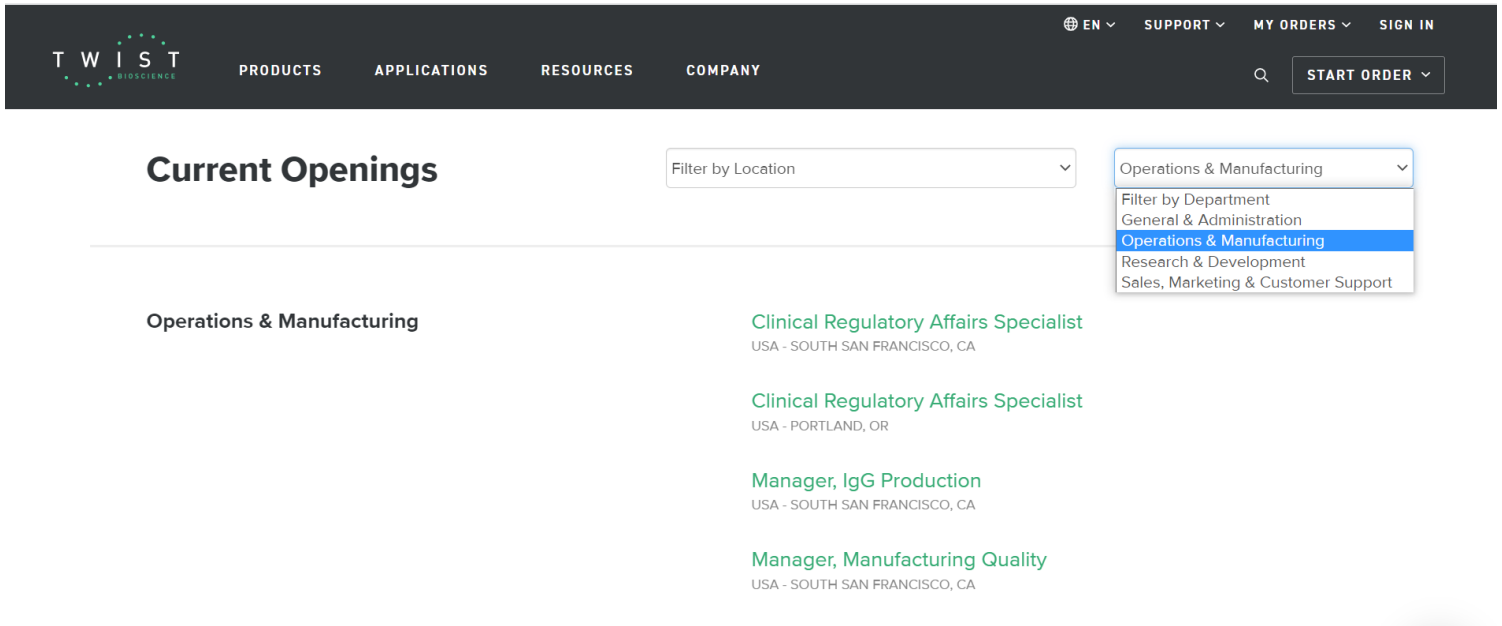
***10K filed Nov 23, 2021***

*Research and development activities **are conducted in collaboration with manufacturing activities** to help expedite new products from the development phase to manufacturing and to more quickly implement new process technologies."*

*"As of September 30, 2021, we had 652 employees…Of these employees, 192 were primarily engaged in engineering **as well as research and development activities.."***

Source: Twist SEC filings

**Twist's job postings confirm what its SEC filings bury, that so-called R&D staff are basically manufacturing personnel, as part of what we believe to be a large-scale scheme to misclassify COGS as R&D, in order to fabricate the gross margins upon which its stock price, fundraising, and survival depend. The jobs page on Twist's website allows one to sort open listings by department, such as R&D, manufacturing, SG&A, etc. We first note the striking imbalance in so-called R&D openings vs. manufacturing ones – 36 R&D postings vs. 24 in manufacturing. We would expect a rapidly growing manufacturing company – particularly one that claims to be in the midst of scaling a "Factory of the Future" - to seek far more manufacturing hires than R&D ones, while in fact the opposite is the case.**




Source: https://www.twistbioscience.com/company/careers/openings; count of current job postings by department is as of 10/28/2022

**As we examined the job titles and descriptions for Twist's open R&D positions, its gross margin scheme became obvious. Twist simply uses misleading job titles that sound like R&D - such as "Research Associate" or "Scientist" - but then lists responsibilities in the job description that clearly indicate that they are focused on manufacturing and production. For example, it lists several openings in its R&D department for "Research Associate, Specialty Production" – but the job descriptions state the primary responsibility is to "Fulfill orders for custom products…." Another posting with the title "Research Associate, Process Development" starts off with the same role – "Fulfill orders for custom products…." Both job descriptions are actually identical, and rattle off responsibilities that are unequivocally production-focused.**

***R&D job posting descriptions list responsibilities that are manufacturing and production-focused***

**Research Associate, Specialty Production**

Source: https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4200797

**Research Associate, Process Development**

Source: https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=3661159

**Responsibilities**

- Fulfill orders for custom products that deviate from standard Operations workflows.
- Prepare work instructions, batch records, QC reports and Collateral documents for custom orders.
- Support day-to-day operations, service, and troubleshooting for manufacturing.
- Generate and maintain stocks and intermediates for manufacturing operations team using established molecular biology processes.
- Test highly custom intermediates and establish SOPs.
- Write work instructions, SOP and training documents for manufacturing operators.

Source: https://www.twistbioscience.com/company/careers/openings; current job postings by department as of 10/28/2022; bullet points shown under '"Responsibilities" are excerpts from the job descriptions

**The pattern is apparent in one so-called R&D job posting after another, where the titles and/or job descriptions outline responsibilities that are clearly manufacturing-related or directly related to fulfilling lab-based production orders or services for customers. We struggle to understand how job titles like "Operational Excellence System Analyst," "Systems Engineer," or "Automation Service Engineer" can be classified under the R&D department.**

***Current job postings and excerpts from job descriptions***

## Automation Service Engineer

https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4269583

## Operational Excellence System Analyst

https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4269583

## Scientist, Protein Analytics

Source: https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4341883

## Sr Systems Engineer

Source: https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4263910

## Research Associate - Flow Cytometry

Source: https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4626726

Job Responsibilities:

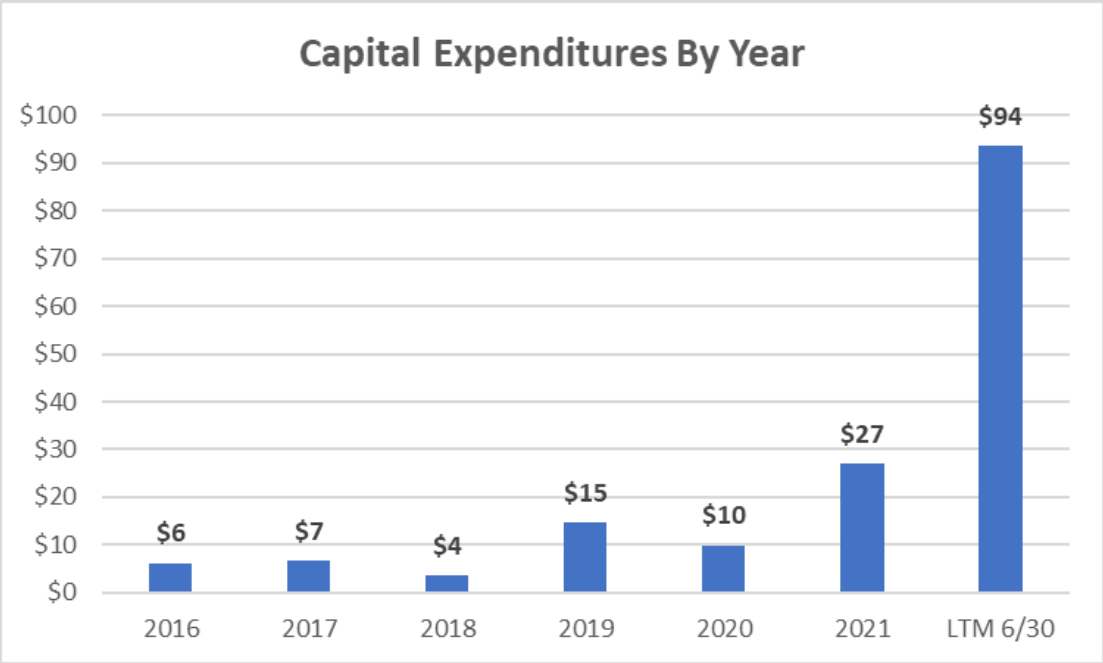
- Install, troubleshoot, repair and maintain laboratory automation equipment
- Perform routine preventative maintenance and oversee service calls on instruments.
- Support Operations by providing hands-on instructions, on-call assistance and training documentation and maintaining equipment records in computerized maintenance management system

**Specific responsibilities include:**

- Collaborate with operations team to resolve production equipment and system issues

Source: https://www.twistbioscience.com/company/careers/openings; current job postings by department as of 10/28/2022

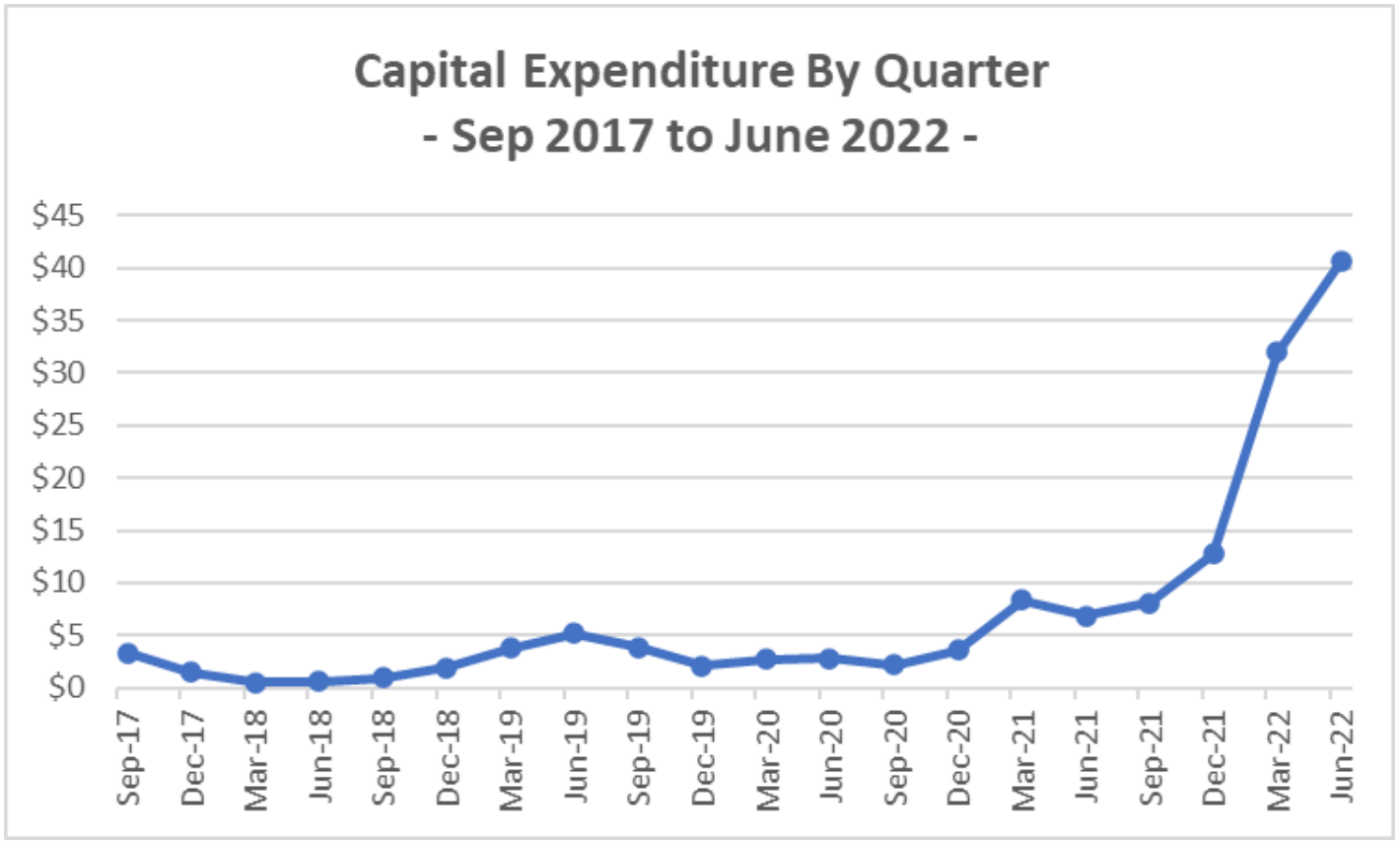
**Apart from what we believe to be rampant misclassification of COGS as R&D expenses, we believe that the other mechanism by which Twist fabricates it gross margin is by capitalizing COGS as capital expenditure. Twist spent little on capex for most of its life, but capex suddenly spiked in 2021, and then went absolutely parabolic in the last 12 months.**




| | FY ended Sep 30 | | | | | | |
|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | LTM 6/30 |
| Revenue | 2 | 11 | 25 | 54 | 90 | 132 | 184 |
| Operating Income | (44) | (59) | (71) | (109) | (118) | (153) | (233) |
| Operatng cash flow | (39) | (51) | (66) | (88) | (142) | (112) | (158) |
| | | | | | | | |
| Net PP&E | 15 | 15 | 12 | 21 | 59 | 106 | 203 |
| | | | | | | | |
| Capital expenditures | (6) | (7) | (4) | (15) | (10) | (27) | (94) |

Source: Capital IQ data;

**The quarterly trend is just as stunning – capital expenditures in just the last four quarters are almost double what Twist in its entirety since 2017. From Sep 2017 to June 2021, total capex was $50MM, versus the Sep 2021 period to the last reported quarter in June 2002, where Twist spent $94MM. We find the sudden spike troubling, as Twist has historically been a very low capex business – roughly a mere $2 to $5MM per quarter for years, prior to the spike**




Source: Capital IQ data;

**Comments by Twist's CFO on recent earnings calls state that the vast majority of the recent capex is for their new, so-called "Factory of the Future" in Wilsonville, Oregon – about $88MM through FY2022, based on our total of figures provided on various calls. On the Aug 5, 2022 call, he stated that Twist had already spent $73MM in capex for the "factory." His past comments suggest $13MM in capex for the factory in FY2021; $22MM capex in the quarter ended Dec 2021, "mostly associated with our Factory of the Future investments"; $22MM for the Mar 2022 quarter, although SEC filings indicated it was $32MM, far higher than the number in his prepared comments; and $30MM for the June 200 quarter.**

***Earnings call excerpts – Nov 22, 2021***

*"CapEx for the year was $27 million, **including $13 million for Wilsonville**, mostly for equipment deposits and facility improvements…Our CapEx for FY '22 is projected to be $80 million to $90 million with approximately **$75 million investment in Wilsonville."** -James M. Thorburn, Twist CFO*

***Earnings call excerpts – Feb 4, 2022***

*"CapEx for the quarter was **$22 million, mostly associated with our Factory of the Future investments**." - James M. Thorburn, Twist CFO*

***Earnings call excerpts – May 5, 2022***

*"CapEx for the quarter was **$22 million, mostly associated with our Factory of the Future investment**…In terms of CapEx, we're projecting approximately $90 million to $100 million for CapEx. So that should help you frame the cash burn. So if you step back and look at that, it's approximately around about $260 million for the year…I mean, obviously, a good chunk of that is being invested in ramping up R&D for biopharma, reinvesting in the core business. We're investing about $40 million in Data Storage. And obviously, for overall CapEx, the bulk of the CapEx investment, **approximately $75 million of the $100 million this year is for the Factory of the Future."** -James M. Thorburn, Twist CFO*

***Earnings call excerpts – Aug 5, 2022***

*"CapEx for the quarter was $40 million including approximately **$30 million for the factory of the future. And this now brings a [sic] factory to future CapEx investment to approximately $73 million."** -James M. Thorburn, Twist CFO*

Source: Capital IQ earnings call transcripts

**As we went through the CFO's comments, we began to notice large discrepancies in his prepared comments vs. the 10Q's filed later. For example, on the Feb 4, 2022 call covering the quarter ended Dec 2021, he stated that "capex for the quarter was $22MM mostly associated with our Factory of the Future investments." Yet the 10Q filed five days later indicated total capex was only $12.8MM. Then the following quarter, as we noted on the previous page, his comments indicated capex was $22MM while the 10Q filed the following day indicated it was $32MM.**

***Comparison of CFO comments vs. 10Q, for Dec 2021 quarter***

***Earnings call excerpts – Feb 4, 2022***

*"CapEx for the quarter was **$22 million, mostly associated with our Factory of the Future investments**." - James M. Thorburn, Twist CFO*

***10Q filed Feb 9, 2022***

***Investing activities***

*In the three months ended December 31, 2021, our investing activities used net cash of $226.6 million. The use of net cash resulted primarily from the net impact of purchases and maturity of investments of $205.6 million, new businesses acquired of $8.2 million and **purchases of laboratory property, equipment, and computers of $12.8 million.***

***Comparison of CFO comments vs. 10Q, for Mar 2022 quarter***

***Earnings call excerpts – May 5, 2022***

*"CapEx for the quarter was **$22 million, mostly associated with our Factory of the Future investment**…" - James M. Thorburn, Twist CFO*

***10Q filed May 6, 2022 – provides capex for last six months, which when combined with previous 10Q allows one to calculate capex for the quarter***

***Investing activities***

***In the six months ended March 31, 2022**, our investing activities used net cash of $239.9 million. The use of net cash resulted primarily from the net impact of purchases, sale and maturity of investments of $187.0 million, new businesses acquired of $8.2 million and **purchases of laboratory property, equipment and computers of $44.8 million.***

Source: Capital IQ earnings call transcripts; Twist SEC filings; Scorpion Capital analysis and estimates

**We further observed that the CFO's answers were incoherent and didn't add up when asked to explain the capex and cash burn. On the May 5, 2022 call, he indicated that the $90-100MM of projected FY2022 capex was "associated with increased investment in our Biopharma business" – contradicting his comments on previous calls, as well as later in the same call, which attributed most of the capex to the Factory of the Future. He then broke out the $90-100MM of cap ex as follows: "a good chunk…in ramping up R&D for biopharma," although R&D is an operating expense, not capex; "reinvesting in the core business"; "$40MM in data storage"; and "the bulk of the capex…approximately $75MM…for the Factory of the Future."**

***Earnings call excerpts – May 5, 2022***

***James Thorburn, Twist CFO***

*"CapEx for the quarter was $22 million, mostly associated with our Factory of the Future investment…Projected CapEx for fiscal '22 is expected to be in the range of* ***$90 million to $100 million, associated with increased investment in our Biopharma business."***

***Luke England Sergott, Barclays analyst***

*"Can you just update us on what your cash burn was on an organic basis ex the raise? Just trying to get a sense there of how you guys are thinking about that through the rest of the year."*

***James Thorburn, Twist CFO***

***"…In terms of CapEx, we're projecting approximately $90 million to $100 million for CapEx****. So that should help you frame the cash burn. So if you step back and look at that, it's approximately around about $260 million for the year…*

***I mean, obviously, a good chunk of that is being invested in ramping up R&D for biopharma, reinvesting in the core business. We're investing about $40 million in Data Storage. And obviously, for overall CapEx, the bulk of the CapEx investment, approximately $75 million of the $100 million this year is for the Factory of the Future."***

Source: Capital IQ earnings call transcripts

**Given the vast scale of the capex and its sudden spike, we were stunned to find no details of the $90-100MM expenditure in Twist's SEC filings – and were surprised that sell-side analysts have glossed over the issue and failed to ask for a breakout. The last three 10Q filings, in the "Investing Activities" section, each offer only a half sentence of explanation, all stuffed into one giant bucket: "…purchases of laboratory property, equipment, and computers of $___ ," with the blank being the actual capex amount. Notably, the key capex sections don't even mention the Wilsonville, Oregon "Factory of the Future."**

***10Q filed Feb 9, 2022***
***Investing activities***
***In the three months ended December 31, 2021****, our investing activities used net cash of $226.6 million. The use of net cash resulted primarily from the net impact of purchases and maturity of investments of $205.6 million, new businesses acquired of $8.2 million and* ***purchases of laboratory property, equipment, and computers of $12.8 million.***

***10Q filed May 6, 2022***
***Investing activities***
***In the six months ended March 31, 2022****, our investing activities used net cash of $239.9 million. The use of net cash resulted primarily from the net impact of purchases, sale and maturity of investments of $187.0 million, new businesses acquired of $8.2 million and* ***purchases of laboratory property, equipment and computers of $44.8 million.***

***10Q filed Aug 8, 2022***
***Investing activities***
***In the nine months ended June 30, 2022****, our investing activities used net cash of $235.7 million. The use of net cash resulted primarily from the net impact of purchases, sale and maturity of investments of $142.2 million, new businesses acquired of $8.2 million and* ***purchases of laboratory property, equipment and computers of $85.4 million.***

Source: Twist SEC filings

**Despite the lack of detail around where the capex spend is going, Twist's SEC filings make one critical fact clear: the term capex – including the $90-100MM projected for 2022, refers strictly to "purchases of laboratory property, equipment, and computers." Which then raises the obvious question – how is Twist possibly stuffing $75MM of lab equipment into its Oregon facility, when it required only a small fraction of this spend for its primary manufacturing base in California? Previous filings state that Twist spent only $9.9MM on lab equipment in 2020 – yet now it suddenly needs to spend 8X in Oregon? In just the last four quarters, Twist appears to have spent double on lab pp&e vs. what it spent in its entire history since 2017. Until 2020, Twist's total capex requirement was a mere $5-10MM per year.**

***2021 10k, filed Nov 23, 2021***

***Investing activities***

*In fiscal year 2021, our net cash provided by the investing activities was $156.2 million primarily as a result of net impact of purchases and maturity of investments of $183.7 million and purchases of laboratory property, equipment and computers of $27.1 million.* ***In fiscal year 2020****, our investing activities used net cash of $114.7 million. The use of net cash resulted primarily from the net impact of purchases and maturity of investments of $104.8 million and* ***purchases of laboratory property, equipment and computers of $9.9 million.***

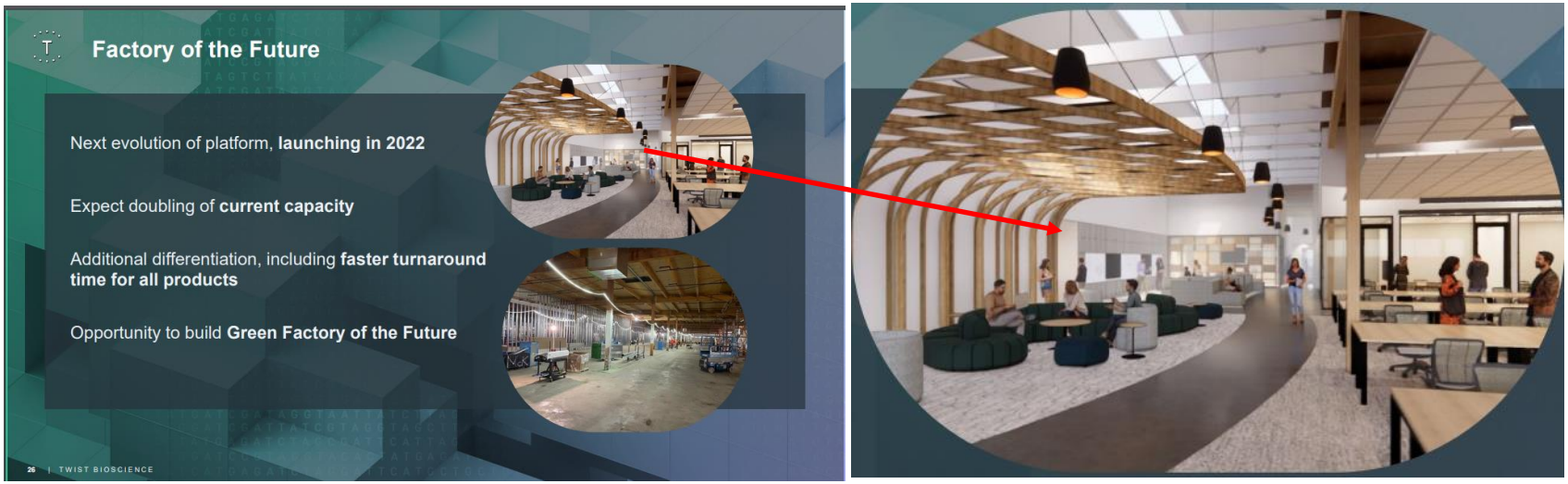
***Historical capex - ie, "purchases of laboratory property, equipment, and computers" - was negligible through 2020***

| | FY ended Sep 30 | | | | | | |
|---|---|---|---|---|---|---|---|
| *in millions USD* | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | LTM 6/30 |
| Capital expenditures | (6) | (7) | (4) | (15) | (10) | (27) | (94) |

Source: Capital IQ data;; Twist SEC filings

**As we investigated Twist's purported rationale for its 2021 capex of $27MM and its 2022 capex of $90-100MM – and the $73MM it's already spent through Aug 2022 for its "Factory of the Future" – we concluded that Twist's claims are simply implausible and defy common sense. We believe that the "Factory" is an epic hoax, and think that it is little more than a ruse to conceal an additional $100MM of losses by misclassifying COGS and operating expense as capital expenditures – one of the oldest accounting frauds in the book. The evidence is hiding in plain sight, such as in its most recent corporate presentation dated Aug 2022. Twist claims to have spent $73MM in capex on the factory as of Aug 5, 2022 – yet if one enlarges two small photos on the "Factory of the Future" slide, the first is still only a computerized rendering of a reception area.**

***Page 26 of Twist's Aug 2020 corporate presentation – first pic still only shows a rendering despite $73MM of capex***




Source: https://investors.twistbioscience.com/static-files/30d2bd1e-4725-4a9a-93bf-3f74486673c0

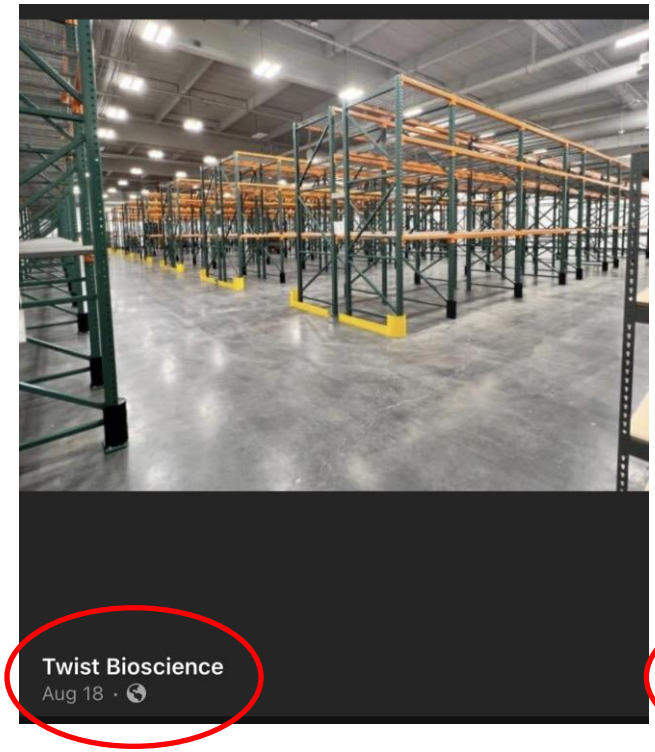
**The second photo, upon enlargement, is more damning, as it shows a vast, empty space with no lab equipment visible. Common sense indicates that if a company has already spent $73MM to outfit a "Factory of the Future" with "laboratory property, equipment, and computers," the promotional page for it in its investor presentation would show it.**

***Page 26 of Twist's Aug 2020 corporate presentation – second pic shows no laboratory pp&e***

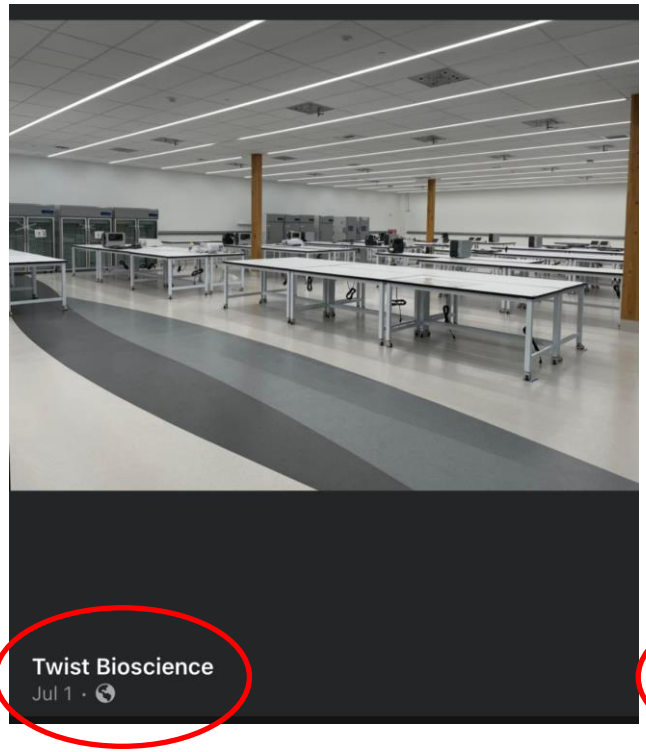

Source: https://investors.twistbioscience.com/static-files/30d2bd1e-4725-4a9a-93bf-3f74486673c0

**Additional photos of the facility's interior, from posts on Twist's Facebook page, show an empty facility with no evidence of ~$100MM spent on laboratory equipment and related manufacturing PP&E. We note this pics are recent, from August 18 and July 1. It appears the CFO and social media manager failed to coordinate their stories.**

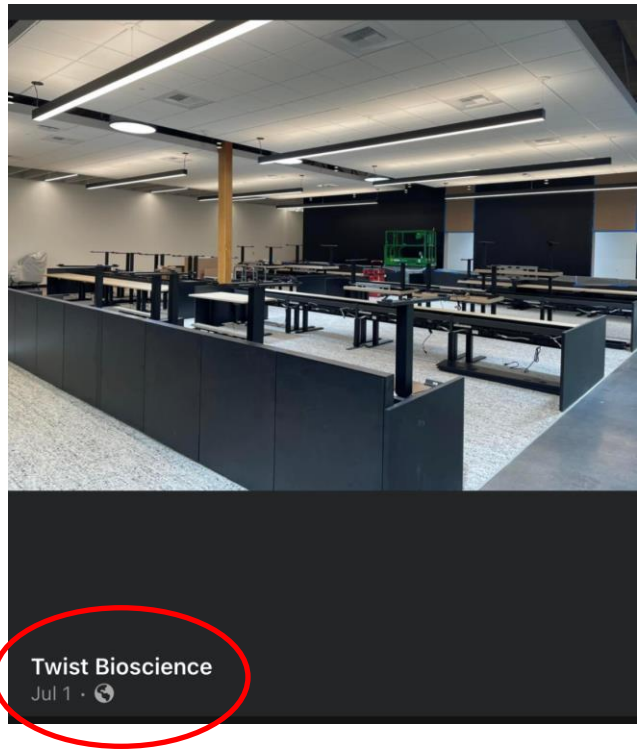
***"Factory of the Future" photos from Twist's Facebook page***




***Aug 18, 2022***




***Jul 1, 2022***

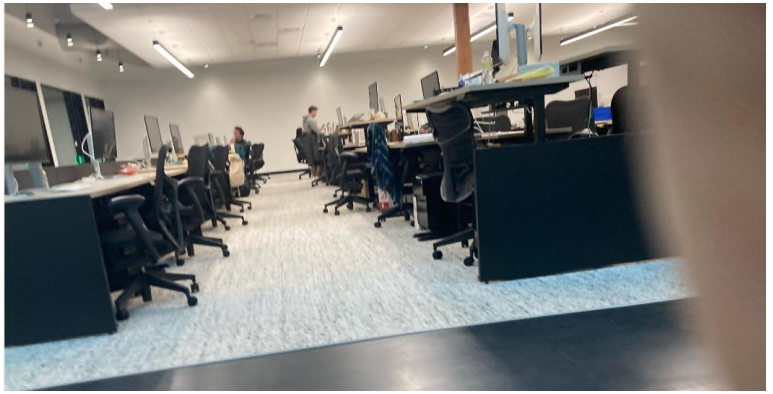


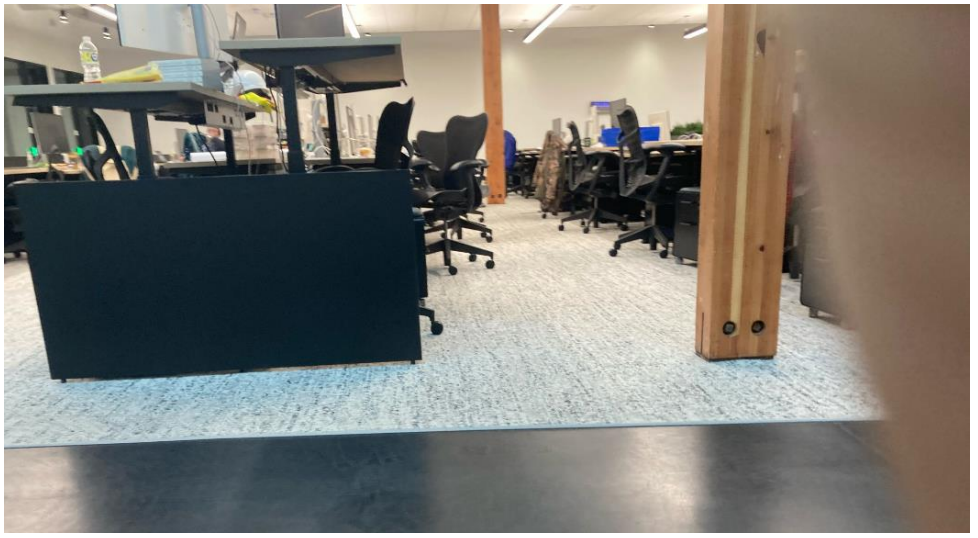

***Jul 1, 2022***

Source: Twist Facebook page https://www.facebook.com/TwistBioscience

**We sent a private investigator to the Oregon facility, who encountered a deserted parking lot, a quiet loading dock/construction area, and about a dozen office employees sitting in an open and mostly empty floorplan – no evidence of manufacturing activity or an impending production scale-up. The facility did not appear to even have a normal reception area.**

***Photographs of Twist's "Factory of the Future"***



Source: Private investigator field visit to Twist Oregon facility

**We show additional photos of the loading dock, which suggests no activity ahead of a purported ramp-up, as well as various angles of the parking lot that indicate it is basically deserted.**

***Photographs of Twist's "Factory of the Future"***






Source: Private investigator field visit to Twist Oregon facility

**We emphasize that Twist is leasing the Oregon facility for a negligible amount, and that the stratospheric capex is not to fund greenfield construction of a 212,000 square foot facility. The 10K indicates that the initial base rent is a mere $2.9MM/year, which appears to be offset by $17.6MM of tenant improvement allowances – so it appears that Twist is even being subsidized by the landlord. In addition, as we studied this section of the 10K, we realized that Twist explicitly states that the facility is for "DNA Data Storage," not manufacturing, which it lists as the use case only for its South San Francisco HQ – contradicting numerous statements the CEO has made about its intended purpose.**

***"Factory of the Future" lease details from 2021 10K filing***

| Principal Facilities | Approximate Square Footage | Lease Expiration | Use | Owned or Leased |
|---|---|---|---|---|
| South San Francisco, CA | 91,791 | 2028 | General & Administration, R&D and Manufacturing | Leased |
| Carlsbad, CA | 7,206 | 2023 | Sales & Marketing | Leased |
| Tel Aviv, Israel | 9,332 | 2022 | R&D | Leased |
| Guangzhou, China | 11,583 | 2024 | Office Space & Biopharma Services facility | Leased |
| Singapore | 1,353 | 2022 | Sales & Marketing | Leased |
| Wilsonville, Oregon | 211,995 | 2034 | DNA Data Storage facility | Leased |
| Brisbane, CA | 15,538 | 2026 | General & Administration | Leased |
| Shanghai, China | 2,067 | 2022 | Sales & Marketing | Leased |

***Use stated as "DNA Data Storage facility,' not manufacturing***

*"In December 2020, we entered into a 12-year operating lease for an approximately 111,000-square foot facility in Wilsonville, Oregon […] we expect monthly rent payments on the new facility to commence in the first quarter of 2022.* ***We will pay an initial annual base rent of approximately $1.7 million*** *[…] We have been provided a tenant* ***improvement allowance of $13.3 million*** *[…] The total future minimum lease payments under the agreement are $27.9 million. On April 13, 2021, we entered into the First Lease Amendment, which amends the terms of the Wilsonville, Oregon lease agreement dated December 18, 2020. The First Lease Amendment increases the premises originally leased within the same building by approximately 101,000 square feet […]* ***Additional rent under the First Lease Amendment for the additional premises commences April 1, 2022 with approximately $1.2 million in rent payments due the first year*** *and approximately $17.6 million in aggregate estimated rent payments due over the total initial term of the First Lease Amendment […]* ***The landlord will provide a tenant improvement allowance in connection with our improvements to the additional premises of approximately $4.3 million."***

Source: Twist 10K filed Nov 23, 2021

**In an August 2022 interview with a local newspaper, Twist's CEO stated "We're in a very aggressive hiring spree in Wilsonville" – "the production site should be fully up and running in January, Twist CEO Emily Leproust said in a Tuesday interview." Presumably sharing the CEO's comments, the article stated that renovations "are complete and the equipment is in place…the equipment is brand new and underdoing various quality checks currently"; "once we have that, we'll be able to start taking orders and ship product, Leproust said."**

***August 2022 interview with Twist CEO - excerpts***

# California biotech's $100M investment in Oregon is on track

"We're in a very aggressive hiring spree in Wilsonville," Leproust said.

The South San Francisco-based, publicly traded bioscience company (Nasdaq: TWST) first announced its lease of an 111,000-square-foot industrial building in December 2020. The production site should be fully up and running in January, Twist CEO Emily Leproust said in a Tuesday interview.

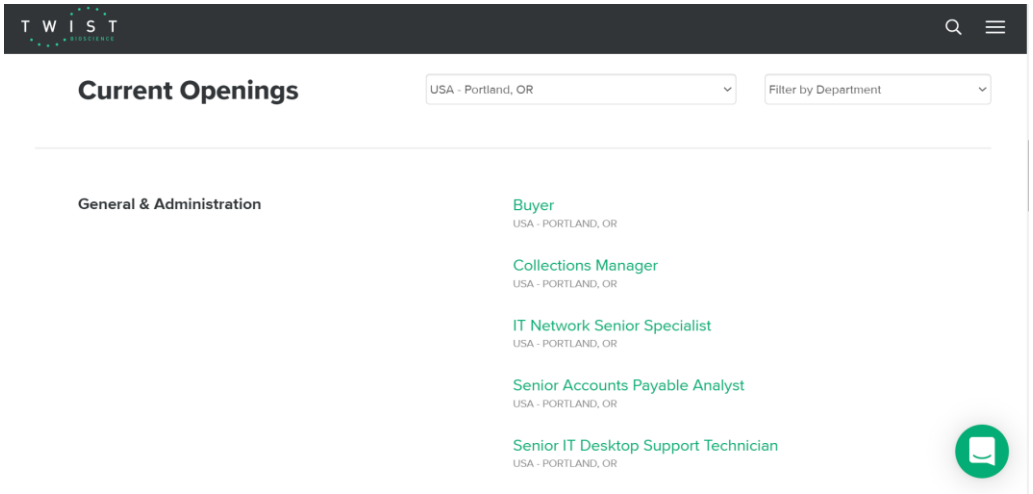
Renovations at the Wilsonville building, a former Xerox plant located at 26600 S.W. Parkway Ave., are complete, and the equipment is in place. Twist received a certificate of occupancy from the city on Tuesday. The equipment is brand new and undergoing various quality checks currently.

"Once we have that, we'll be able to start taking orders and ship product," Leproust said.

Sourcehttps://www.bizjournals.com/portland/news/2022/08/16/twist-bioscience-wilsonville.html

**While the CEO claims "We're in a very aggressive hiring spree in Wilsonville," Twist currently lists only 12 manufacturing job openings in Oregon, 6 in G&A, and 2 in R&D – which makes no sense if one has just spent $75MM to get a "Factory of the Future" equipped and ready. The titles and job descriptions lead us to believe that most of these jobs – even those for manufacturing - are remote-work supporting the company's activities in the Bay Area. Twist appears to be stuffing a few bodies into Oregon in an attempt to create superficial legitimacy. For example, of the few "manufacturing" jobs listed, one is for a "VP Regulatory Affairs" where the spec makes clear it's a "global" role; another is for a "Clinical Regulatory Affairs Specialist," where the spec says it's based in South San Francisco or Oregon.**

***Job listings section of Twist's website***




Source: https://www.twistbioscience.com/company/careers/openings

***Sample "manufacturing" jobs listed***

VP, Regulatory Affairs

USA - PORTLAND, OR

Source: https://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4659892

Clinical Regulatory Affairs Specialist

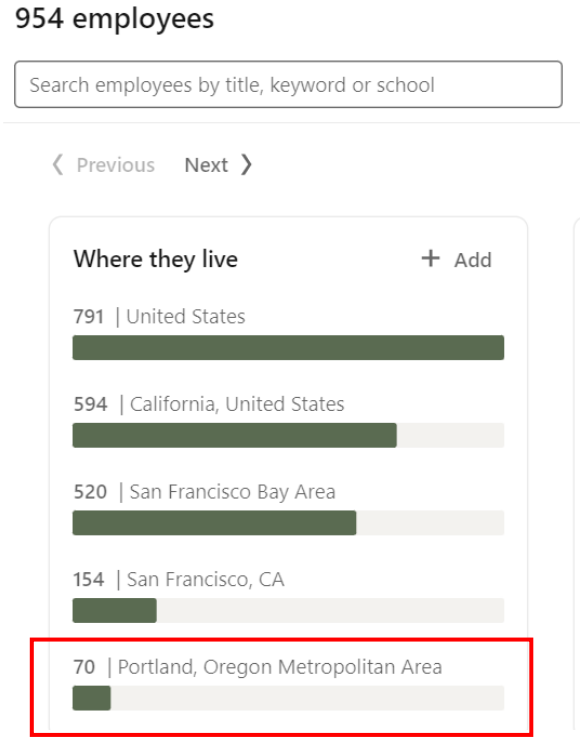
USA - PORTLAND, OR

Locations: South San Francisco, CA OR Portland, OR

Sourcehttps://www.twistbioscience.com/company/careers/openings/detail?gh_jid=4651155

**Furthermore, LinkedIn shows only 70 Twist Bioscience employees in Oregon, out of roughly 1,000 total – and recent comments by the CFO imply that 40 of these are simply California-based workers they've seconded, leading us to conclude they are simply remote-workers supporting its core Bay Area operations, once again indicative of kabuki theater. We reviewed each profile, and consistent with the CFO's comments, they strike us as either remote workers to support its California-based manufacturing, or as low-level positions with generally inexperienced employees straight out of school.**

***LinkedIn page for Twist shows geographic mix***




***Twist CFO Jim Thorburn at conference – Aug 9, 2022***

*"To date, we've invested a total of $73 million in the factory of the future. Total investments can be,* ***from a CapEx point of view, it's going to be roughly about $110 million****. So in terms of where we're at, we've actually hired from our San Francisco site. We've got 2 sites in San Francisco and factory of the future. Factory of the future comes online, shipping revenue in January next year. We're going through testing.* ***We've actually hired 40 people from our San Francisco site to move up to the Factory of the Future****. So we're well positioned in terms of ramping that, the factory. So the outcome is that we'll have faster turnaround time. We'll be able to scale the business to potentially $500 million a year looking at the combined footprint. It allows us to go after the fast gene market."*

Source: https://www.linkedin.com/company/twist-bioscience/people/?facetGeoRegion=90000079; Capital IQ transcripts

**We are therefore not surprised that despite talking up the Factory of the Future's ability to turbocharge growth, reverse epic losses, and cure world hunger, the CEO and CFO have already begun to talk down expectations. When asked on the Aug 2022 call "how quickly" it would contribute to revenue, the CFO evaded the question and shifted the topic to "we've increased our capacity in San Francisco," saying only that the facility would "start to record revenues" in Jan 2023. When asked again, he said "we're going to underutilize capacity" and that "I mean our goal is to skill [sic – scale]" it "as quickly as possible." He ended on a rather confident note: "We're excited about the potential opportunities…"**

***Twist earnings call, Aug 5, 2022 – excerpts from transcript***

***Luke England Sergott***
*"…So on factory of the future, can you give a sense of the backlog that you're seeing there? **And how quickly the new capacity is going to fill and contribute to revenues?**..."*

***James M. Thorburn***
*"Factory of the future, we're going through qualification right now. And we anticipate over the rest of this year we will start to do the initial debugging and testing and running initial runs. So we don't start shipping revenue until early next year. This quarter we had a really solid quarter in terms of orders, NGS and Synbio. **We've increased our capacity in San Francisco. So we are well poised to grow the business and we're really well positioned to see the impact of the factory of the future next year as we start to record revenues in January of '23."***

***Puneet Souda***
*"…when we think about a factory of the future coming online, shouldn't that impact gross margins at least initially in 2023?..."*

***James M. Thorburn***
*"As we launch the factory of the future, **we're going to underutilize capacity** that will impact gross margin. However, line of sight is to scale the factory of the future as quickly as possible…**I mean our goal is to skill factory of the future as quickly as possible."** We haven't broken out the guidance for next year yet and we'll do that on our next earnings call…[…] as Emily highlighted, we have increased capacity in San Francisco and we're **excited about the potential opportunities** to continue to scale up in factory of the future…"*

Source: Capital IQ transcripts

**As we interviewed ex-employees, competitors, and industry experts, we encountered skepticism of the company's claims. A longtime executive in the space, who has advised the company's management and was affiliated with a close competitor, described the "Factory of the Future" as just a "story that I think Wall Street wants to hear"; that it's "unnecessary and won't change their costs"; that he'd be "shocked" if they're out of capacity in San Francisco; and that it will simply "add a bunch of new costs and redundancies." An ex-Twist executive expressed similar skepticism, stating that is will actually worsen their cost structure with "artificial double expenses" – "that's an anomaly there."**

***"Factory of the Future" is just "a story for Wall Street"; "unnecessary and won't change their costs; will just "add a bunch of new costs and redundancies"***

***"As soon as I saw that, I knew it was a story, right? [for Wall Street]****. In the Bay area, she's got the most expensive labor. Your ML scientists are making $300-400k. Your senior executives are making - up in Oregon, you'll get people a lot less expensive. Your space is a lot less expensive, but* ***you're still going to have the same challenges****. If you're not going to change the process, it'll be slightly cheaper because you'll have cheaper labor, but does that really make that much of a difference? It might in some product areas.* ***I can't imagine it's fundamentally going to change their operational efficiency*** *or be profitable, for that matter. I think she's just going to* ***add a second site. Add a bunch of new costs and redundancies*** *unless they're at capacity, which I would be shocked.* ***It's unnecessary. It just fills into a story that I think Wall Street wants to hear.****" —Longtime executive in Twist's space*

***"Factory of the Future" creates redundancy and doubles expenses***

*"The plan is—as you've probably seen—that the factory of the future was eventually going to take over anything of what was being built and manufactured in south San Francisco. I haven't seen financials currently. I imagine that you're going to be building it out, then you're going to be starting to turn it on for tests, and there's going to be a period of time—I think we're in the middle of it—in which* ***you're going to have artificial double expenses because you are producing in one place for real in south San Francisco and you have basically everything in place as you test and whatnot. That's an anomaly there."*** *– Ex-Twist executive*

Source: Scorpion Capital consultation calls with experts

**In addition to its "Factory of the Future," Twist suggests it is spending tens of millions in capital expenditure on its "DNA Storage Initiative." In a recent earnings call, CFO Jim Thorburn stated that "we're investing about $40 million in data storage," in response to a question on the cash burn. In its 10K, Twist even implies that the "Factory of the Future" and the DNA storage initiative are one and the same, as the filing explicitly states that the "Use" of the Factory is as a "DNA Data Storage facility."**

***Earnings call excerpts – May 5, 2022***

*"CapEx for the quarter was $22 million, mostly associated with our Factory of the Future investment…In terms of CapEx, we're projecting approximately $90 million to $100 million for CapEx. So that should help you frame the cash burn. So if you step back and look at that, it's approximately around about $260 million for the year. I mean, obviously, a good chunk of that is being invested in ramping up R&D for biopharma, reinvesting in the core business.* ***We're investing about $40 million in Data Storage****. And obviously, for overall CapEx, the bulk of the CapEx investment, approximately $75 million of the $100 million this year is for the Factory of the Future." -James M. Thorburn, Twist CFO*

***"Factory of the Future" lease details from 2021 10K filing***

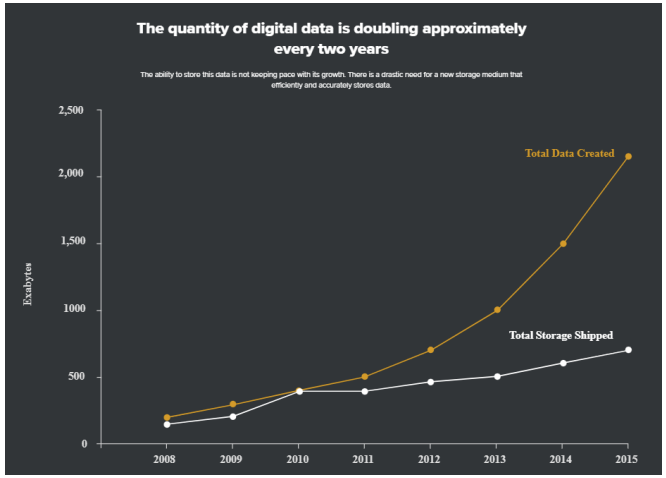
| Principal Facilities | Approximate Square Footage | Lease Expiration | Use | Owned or Leased |
|---|---|---|---|---|
| South San Francisco, CA | 91,791 | 2028 | General & Administration, R&D and Manufacturing | Leased |
| Carlsbad, CA | 7,206 | 2023 | Sales & Marketing | Leased |
| Tel Aviv, Israel | 9,332 | 2022 | R&D | Leased |
| Guangzhou, China | 11,583 | 2024 | Office Space & Biopharma Services facility | Leased |
| Singapore | 1,353 | 2022 | Sales & Marketing | Leased |
| Wilsonville, Oregon | 211,995 | 2034 | DNA Data Storage facility | Leased |
| Brisbane, CA | 15,538 | 2026 | General & Administration | Leased |
| Shanghai, China | 2,067 | 2022 | Sales & Marketing | Leased |

***Use stated as "DNA Data Storage facility,' not manufacturing***

Source: Capital IQ earnings call transcripts; Twist SEC filings

**We believe the DNA data storage initiative is vaporous, simply a scam to keep promoting the stock with vague, incoherent aspirational statements – and mostly to provide another cover for what we believe to be its rampant misclassification of COGS as R&D expenses or capex. The CFO can't seem to keep his story straight, suggesting at times that the $40MM data storage spend is classified under R&D, and at other times under capex. It is unclear what the data storage initiative even is – at times Twist represents it as just another version of its micro-array, with more density. At other times it portrays it as some futuristic chip. The product's page on its website shows virtually nothing, featuring only a conceptual rendering of how much data the world needs to store, and says "we're helping customers like Microsoft and University of Washington with their data storage research." Amusingly, the article is from 2017.**

***"DNA Data Storage" page from Twist's site and corporate presentation show only abstract, conceptual renderings***





Source: https://www.twistbioscience.com/products/storage; https://investors.twistbioscience.com/static-files/30d2bd1e-4725-4a9a-93bf-3f74486673c0

**Twist's CEO has been repeating the same promises on earnings calls since IPO, about how "the next-generation silicon chip specific to DNA data storage" is imminent, as is its commercialization – with of course nothing to see or show. In 2019 she stated it was only "multiple quarters" away from production. In 2020, the timeline was another 18 months. In 2021 and the most recent call in Aug 2022, timelines are now simply dispensed with, replaced by rambling monologues of intention and potential – "the alpha chip writes DNA…we believe those will preserve crucial heritage, as well as media and entertainment organization."**

***Aug 1, 2019 earnings call – Emily Leproust, Twist CEO***

*"We're also excited to announce that in anticipation of this program, we are* ***proceeding forward with the design of our next-generation silicon chip specific to DNA data storage****. The CMOS driver chip will be designed and fabricated to be compatible with multiple device design and will be a key part of our methodological development path to our [ semiconductor ] feature density.* ***The CMOS chip will require multiple quarters for design and production****, after which we will continue to execute the engineering road map dramatically increasing feature densities…..So as a reminder, once the CMOS driver chip is obtained, different device designs can be found, fabricated and tested relatively quickly, so this represents a key milestone…"*

***Aug 6, 2020 - earnings call – Emily Leproust, Twist CEO***

*"Now I'll move to data storage. Last year,* ***we reported that we were pursuing the fabrication of our first silicon chip, specifically for data storage. As we shared before, it takes 18 months*** *for the design-build-test cycles on a chip in the semiconductor industry. Though we did not expect to have an update on DNA data storage, we recently made some important technical breakthroughs that we believe will facilitate further miniaturization of our silicon technology. And overall,* ***we remain on track*** *with the internal goals we have set for ourselves."*

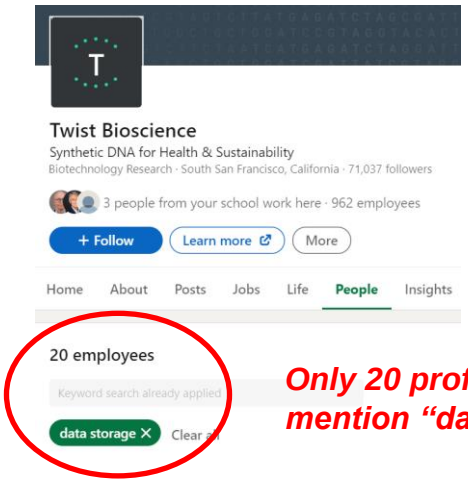
***Aug 6, 2021 - earnings call – Emily Leproust, Twist CEO***

*"Moving to data storage,* ***we continue to make solid progress*** *as we drive towards commercialization, working with a proof-of-principle chip at 1-micron pitch.* ***We're building an integrated chip*** *that includes both the CMOS and MEMS components needed to commercialize the product for data storage. Once the integrated chip is working, our next step is to create an integrated alpha silicon chip, miniaturizing the feature size even further. We expect that once the alpha chip writes DNA consistently, this chip will support our first early access commercial offering. And the target customers, we believe those will preserve crucial heritage, as well as media and entertainment organization."*

Source: Capital IQ earnings calls transcripts

**It is utterly implausible that Twist is spending $40MM on data storage, as it appears to have hardly any staff working on it. A LinkedIn search of its employee base returns only 20 profiles that mention "data storage," out of 962 total employees shown. After removing interns and incorrect search hits, only 4 of these profiles suggest any related scientific background, of which two are recent post-docs and one is a recent college grad – and we suspect they spend most of their time supporting its core manufacturing activities. We note that LinkedIn is a very accurate representation of Twist's employee distribution. The last employee count we found is in Twist's 10K filed Nov 23, 2021, which states that as of Sep 30, 2021, it had 652 employees – almost identical to LinkedIn's data, which counted 651 employees as of May 2021 and 712 as of Nov 2021. The average is 682, almost identical to LinkedIn's 652 figure.**

***LinkedIn search result of Twist employee profiles with "data storage"***




***Only 20 profiles total even mention "data storage"***

***Only four profiles indicate any remotely credible scientific background***

Scientist, DNA Data Storage at Twist Bioscience | PhD, Chemical Engineering

Research Associate at Twist Bioscience I DNA Data Storage | Berkeley ChemE 2020

Scientist | DNA Data Storage at Twist Bioscience | Ph.D., Chemical Biology

Director, Enzyme / Protein Engineering (DNA Data Storage) at Twist Bioscience

Source: LinkedIn search https://www.linkedin.com/company/twist-bioscience/people/?keywords=data%20storage; https://www.linkedin.com/in/mpreddick/; https://www.linkedin.com/in/christinewu58/; https://www.linkedin.com/in/kishore-kakani-phd-9450a811/;

**Part IV: Twist has no value proposition beyond price and is a bottom-tier vendor with a poor reputation, viewed as inferior to even Chinese vendors, due to escalating manufacturing delays, product limitations, a lack of sample purity and quality control, and other problems that have shut it out of pharma, clinical work, and anything FDA-related.**

**Novartis, a large and frustrated Twist customer, summarized a number of recurring themes across our due diligence calls regarding Twist's value proposition, product quality, and differentiation vs. competitors. A Novartis scientist, in a leadership role, indicated that Twist is slow at manufacturing orders, sub-scale, and incapable of meeting order timelines for large customers – in sharp contrast to Twist signature claim of a "high throughput silicon platform": "they ask for a really long time"; "always been slower" than competitors like Sigma and Thermo, who deliver in 2-4 weeks vs. Twist at 8-10 weeks; and that simply can't meet timelines "20% or 30% of the time"**

***Twist is slow, sub-scale, can't meet order timelines; "always been slower" than competitors; need "a really long time" to deliver; giving orders to competitors instead***

*Q: "What happens when you try to do a large order? They just say it's going to take too long? Or we don't have the capacity?"*

*A: "Yes, either or. What happens sometimes is that **they ask for a really long time** because they don't have the capacity right now."*

*Q: "Have they always been slower than the other vendors?"*

*A: "They've **always been slower** compared to Sigma and Thermo Fisher because Sigma and Thermo Fisher are much bigger, and they have more capacity. They probably have more production staff."*

*Q: "What is the lead time with Twist versus Sigma or Thermo?"*

*A: "I think we're talking about between **2-4 weeks with Sigma and Thermo and then with Twist for these orders; you are talking more about 8-10 weeks."***

*Q: "You're basically saying they can't really scale manufacturing. How often have they said no, we can't do it or they just quote you lead times that are too long?"*

*A: "That happened more in the past that they were saying yes, and then they didn't meet the timelines and then after a couple of times, I asked them, are you really going to meet the timeline? And now they are more honest. I would say **20% or 30% of the time, when we ask, and they say that they cannot meet the timelines**, that I need to move to another vendor." - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**Novartis indicated that they now only give Twist simple, commodity orders and that the orders actually take many multiples longer than the few days that Twist promotes, providing an example where they expected an order within 10 days but where it took Twist 8 to 12 weeks. Even for non-complex orders, they indicated that Twist's lead times are 6 to 8 weeks.**

***Stopped giving Twist complex orders, only simple, commodity ones; orders take multiples longer than the short lead times Twist advertises; weeks to months vs. days as Twist states on its site***

*Q: "What timelines were you expecting in the past, and what timeline was it actually?"*

*A: "What I understand is that they needed at least 10 days to 2 weeks. I expected it to be 4 weeks. What we were getting sometimes were 8 weeks."*

*Q: **"You were expecting things within 10 days, but it was taking them 8 weeks to do it."***

*A: **"Right, or even 12 weeks**….for example, last year, this was a long oligo took them a really long time, almost three months. I would say Thermo [would have taken] probably one month because it was complicated to synthesize."*

*Q: **"Now you just don't give them anything complex - just simple stuff?"***

*A: **"That's right."***

*Q: "When did you say forget it, I'm not going to do this anymore?"*

*A: "After this last experience in June 2021."*

*Q: "How are their lead times with the other simpler stuff?"*

*A: "**Six to 8 weeks normally."***

*Q: "They say that they do it within days or within a week or two. Is that not true?"*

*A: "Not when you have GMP stuff, it takes longer." - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**In particular, Novartis indicated that Twist is terrible at manufacturing GMP orders – that is, DNA manufactured to the higher standard of quality called "Good Manufacturing Practices, which is required for clinical-stage work by pharma/biotech companies. Novartis dismissed non-GMP as basically useless and only for low-value work in academia or early-stage biotech, indicating that 80% of order volumes are for GMP-standard product. They added that Twist is more relevant for small price-sensitive customers than real customers like big pharma.**

***Twist is exceedingly slow for GMP orders; non-GMP used for low-quality, low-risk use cases like academia, while GMP required for preclinical work, trials, and FDA submissions***

*Q: "How are their lead times with the other simpler stuff?"*

*A: "Six to 8 weeks normally."*

*Q: "They say that they do it within days or within a week or two. Is that not true?"*

*A: "**Not when you have GMP stuff, it takes longer.** GMP means good manufacturing practices, and if you check in Google, it's number 21CFR, part 11. It's a document that describes the way that you have to work. And it just means that everything is very well-documented, inspected, that all the products have to be compliant. The way of producing these things is actually the same, it's just that they charge you more because it's the highest quality product. **Where do you use non-GMP? In academia, research, biotech - whatever you are doing more like research stuff. As soon as you start with preclinical work and that would be submitted to the authorities, which means that will go into a phase one clinical trial**. From that moment, everything is GMP. In the end, 80% is GMP and 20% us non-GMP.*

*Q: **"And Twist, you're saying, isn't very good at GMP? They're just slow?"***

*A: "Exactly. At least 40%, sometimes 60% slower for GMP."*

*Q: "So, the other people are twice as fast, basically." - Novartis, a large Twist customer, scientist in a leadership role*

***Twist is more relevant for price-sensitive customers like start-ups or academics, not real customers like pharma companies***

*A: "When you work **in academia or in a startup or biotech, the first thing that you do is actually compare the price**. You will leave enough for the quote to different companies and then say which one is cheaper with the best quality? We don't do that in the pharma. You never ask two different companies for the same product and the quote because, for us, that's a waste of our time."*

*Q: "You're saying they're basically **targeting smaller price-sensitive customers vs. big ones** like you who can pay?"*

*A: "**I think that would be their best strategy."** - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**Novartis referred to Twist as "definitely" a commodity vendor, dismissing their NGS offering - now the majority of Twist's revenue and their key growth driver – as old news: "it's all standard manufacturing technology"; "these things were already discovered years ago." They further indicated that Twist is far behind competitors in terms of newer oligo manufacturing capability.**

***Vendors like Twist are a commodity, especially their NGS product; "standard manufacturing technology" that was "already discovered years ago"; Twist lack newer oligo capabilities its competitors already offer***

*Q: "Are these vendors all basically a commodity? They just sell the identical product?"*

*A: "Yes, definitely, especially because **the genomics NGS space exploded around ten years ago**. So, everything right now, I think you have more things because of CRISPR and new innovative technology, but **a lot of these things were already discovered years ago."***

*Q: "So, you're saying it's nothing new. This is all standard manufacturing technology?"*

*A: **"It's all standard manufacturing technology**. The only thing that changes is that right now, it's becoming more important and chemically modified oligos, especially when you talk about mRNA, not DNA, mRNA. For many years, we used mRNA in therapy, but it failed because the stability on the mRNA degraded. And now, for a couple of years, we've discovered that actually, if you modify the mRNA with chemical modification during the production, that's more stable, and that also helps the stability and prevents the degradation of the mRNA. **For example, Twist is still not into this field, but other companies like Thermo and Sigma, they already provide a lot of chemically-modified oligos**." - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

## Novartis slammed Twist as a has-been company with no value proposition, once again characterizing their entire offering - whether oligos or NGS - as a commodity: "they were innovative 5-10 years ago"; "no longer something special"; "everybody uses [NGS] in a high-throughput manner"; "they don't offer anything innovative, and they don't offer anything….so if for Twist, if you don't offer anything new…"

***Twist was innovative "5-10 years ago"; NGS is a commodity and "no longer something special"***

*A: **"I think they were innovative 5-10 years ago**. Next generation sequencing, library preparation. Oligos were something very important, and it was more trendy. I mean, nobody 10 years ago, 8 years ago, and I think right now we moved on from that, we learned. We're using all of those tools, but we are in another chapter. Right now, NGS is not the latest technique, so of course, we use a lot of NGS, but it's no longer something that very few people can do, know how to do, and also sell the products. I don't know if the word is "normal." But we all now use NGS so much that right now, it's not anymore something special but something that we use every day in the lab. Like, I don't know, 10 or 20 years ago, PCR, or western blot. **It's no longer something special. Everyone does PCR. Now, it's NGS."***

*Q: "And you're saying there's **nothing special with NGS, everybody does it?"***

*A: **"Exactly because right now, NGS has become so used, like everybody uses it** in a high-throughput manner. Library preparation, everybody does it. It's a very useful technique, but everybody uses it. It's no longer something unique.*

*Q: "Who are the other providers of NGS?"*

*A: "For NGS, you have Thermo, LGC, Agilent Technologies, Biorad, Qiagen - many providers." - Novartis, a large Twist customer, scientist in a leadership role*

***Twist has no value proposition for pharma companies; just a commodity for price-seeking customers; nothing "innovative or better"; "don't offer anything" or "anything new"***

*Q: "Does Twist have a big business with big pharma? Or they just don't?"*

*A: "I don't think they are the biggest provider…**Twist doesn't have a lot of room for improvement right now because they don't offer anything that is very innovative or better than anyone else. They don't offer anything innovative, and they don't offer anything** - I think when you're in big pharma, you will mostly purchase from one of the big vendors, like Merck, like Thermo. And the only way that you will go to someone smaller is because they have a product that the only ones don't have….**so, for Twist, if you don't offer anything new**…" - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**Novartis shed light on a critical reason why pharmaceutical companies can't use Twist for real work such in the clinic, where the real volumes and revenue are, and why its claim of a "high-throughput" platform is absurd: Twist is incapable of producing the lot sizes pharma companies need. As a result, they'd have order product from different lots, creating a major headache as lot consistency is "very important," given the time and expense to qualify every new lot: "it doesn't make sense because people in the lab lose time, and this means money and time."**

***Twist is incapable of producing lot sizes pharma companies need; lot consistency is "very important"; no value proposition for pharma vs. competitors that provide other value-added services vs. Twist's commodity offering***

*"When I order something on phase two/phase three because of these big quantities, they are also really big orders that may be one oligo where one lot is $50,000. But then we will use that lot for the next probably six to nine months. And then something that may be interesting that they could also offer is that because when we order these very big lot, for us,* ***it's very important that everything is from the same lot because when you work on the GMP, every time that you change the lot, you need to qualify it. If we had to qualify every kind of two months, it doesn't make sense because people in the lab lose time, and this means money and time for the company****. Some companies, for example, Thermo, even offer that they will produce this big lot for us and they will store it for us because also our storage is not unlimited and most of these products need to be under -80 or even colder. And then they say, we'll produce this lot for you specially. We will store them for you, and we will—depending on the product—we will send every six months these amounts or every time that you need them, you call us, and they'll send them to you. They even kind of anticipated our problem and they said we can offer a storage solution. You don't even need to occupy a lot of space in your freezers." - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**Novartis further criticized Twist's poor customer service vs. customers they called "exceptional" - "I never get a query from a Twist sales representative." Novartis praised various value-added services from larger players like Thermo vs. Twist's commodity offering, adding that the competitive environment is "very hard right now" for smaller players like Twist as "the big vendors are dominating the market and will dominate the market and that's very difficult for smaller ones."**

***No value prop for pharma vs. competitors that provide other value-added services vs. Twist's commodity offering***

*Q: "So, you're saying you just get other services from their competitors."*

*A: "Additional services that are really convenient."*

*Q: "You said you need to store these things because they have certain temperatures and other requirements?"*

*A: "Yes, we have freezers, but we don't have an unlimited number of freezers. So, I use them to store other reagents, samples of—if suddenly I can save half a freezer because I don't need to store of these different oligos, I'm really happy about it. Why wouldn't I do it? They don't charge anything extra. They just suggested they can do it, and they can send it to us whenever we want. Probably that's why* ***Thermo is 20%, is always more expensive than anyone. But on the other hand, you have such a quality and afterward, just a nice service that, yeah****." -Novartis, a large Twist customer, scientist in a leadership role*

***Twist customer service is poor vs. competitors that are "exceptional"***

***"Thermo is exceptional.*** *I don't know if you know BioTechne. They also bought a lot of different kinds of protein companies like R&D Systems, especially R&D Systems is also exceptionally good. And it's part of BioTechne. Promega is exceptionally good. There are some companies that have very good relationships, they care, and their sales representatives contact me from time to time.* ***They check on us. I never get a query from a Twist sales representative.*** *I don't know." - Novartis, a large Twist customer, scientist in a leadership role*

***Competitive environment is difficult for smaller vendors like Twist as larger vendors are "dominating the market"***

*"I think other companies have much more customers buying from them compared to Twist. I think the* ***competition is very hard right now and I think the big vendors are dominating the market and will dominate the market and that's very difficult for smaller ones*** *to take over and gain part of this benefit." -Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

## An ex-Twist employee in a senior role provided color identical to that from Novartis. He was a Twist customer at his new employer but is "rarely using Twist now" after being "frustrated" with delays and quality problems. He indicated they have shifted their business to two Chinese companies that are cheaper and "significantly faster" – delivering orders in 3-4 weeks vs. 2-3 months at Twist: "Definitely we were frustrated, so we just walked away."

***Ex-senior manufacturing employee was a Twist customer at his new employer but "frustrated" with quality problems and delays; "rarely using Twist now"; shifted business to a "significantly" faster Chinese manufacturer that takes 3-4 weeks vs.2-3 months at Twist***

*Q: "Are there customers that got upset and stopped working with them for quality issues or delays?"*

*A: **"Oh yeah, yeah, yeah. I'm frustrated currently. I'm at a different company now**. Sometimes, we have to contract out gene synthesis with Twist. And they're **delayed a few months, a couple of months. Definitely, we were frustrated, so we just walked away** and worked with other companies. Also competition is building up."*

*"There's a lot of competition. You probably realized we're **shifting a lot of the business away from them, actually. We're rarely using Twist now.** That's my current company's situation. So, a lot of gene synthesis, the majority of gene synthesis is called protein expression. It's a protein or an antibody**. We can actually use a different company in China** called Biointron. They synthesize DNA from DNA synthesis to deliver protein in three weeks. That's three weeks. Twist can barely deliver DNA construct. And the other company can deliver proteins."*

***"We pretty much stopped it all now because after we found out, there's a company Biointron that can make the protein in two weeks plus shipping, a total of three weeks**. If you use all the agents and protein, they can make the protein in three weeks, plus one-week shipping from China to here; it's four weeks for protein, and in that time, we can get a DNA construct. Essentially, it's **significantly faster**, so we completely shifted to Biointron for most of the services we need. For most of our DNA synthesis, we do the coupling ourselves, just order the gBlock from IDT, or we get the service from GENEWIZ. **It Twist takes two to three months to get protein from DNA synthesis. Two to three months. This is three or four weeks plus shipping."** – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**The ex-employee described a fiasco and recent deterioration in attempting to order from Twist: manufacturing is "one month" slower than competitors; "it's getting worse…I can notice…it's just getting worse"; competitors like IDT, in addition to the Chinese vendors, are "very cheap and very fast," delivering in 3 days; "they can rarely keep their delivery time…it's always delayed"; "competition is building up….there's a lot of competition"; and added that service is poor.**

***Twist's manufacturing is a month slower than the competition; "getting worse" recently; can't scale***

*Q: "How long does the competition take if Twist takes a couple of months - how much slower are they?"*

*A: "They are **slower than one month over the competition**. Sometimes, a couple of weeks is very routine."*

*Q: "Are they always delayed and slower, or is this a recent thing?"*

*A: "I would say **it's getting worse. I can notice**. They used to be not that delayed. They could still keep a majority of their orders on time. But recently, I think it's **just getting worse**."*

*Q: "And why do you think it's getting worse?"*

*A: "I think that they **cannot scale up enough. Also competition is building up. There's a lot of competition."** – Former Twist employee, director-level*

***Ex-Twist employee used to give 20% of his new employer's business to Twist; make it themselves or use IDT which is "very cheap and very fast"; can deliver in 3 days***

***"We gave probably like 20% of our business to Twist before** because we have different ways to generate our construct. Half of them we make the DNA construct ourselves. For the other half, we use different vendors. We use IDT to synthesize the gene and then just code them into the vector ourselves. We do one step. **IDT is very cheap and very fast**. They can synthesize the gene fragments to use in the oligos to make the fragments. They call it "gBlocks," and **they can deliver in a few days, three days."** – Former Twist employee, director-level*

***Poor service quality; rarely meet their promised delivery time; "always delayed"; average delivery time "at best"***

***"Honestly, I don't think their service quality is that great**. What happened is they advertised that their turnaround time is 15 days for gene synthesis. But they can **rarely keep their delivery time. Usually, there's a delay. It's always delayed**, pretty much. So, their service turnaround time for customers who want a quick turnaround time, to expedite research, generate data faster and generate protein faster - they are not faster. I would say probably an **average level in the industry at best**." – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**Abbvie, another large pharma company, confirmed Twist's delays and lead time problems, indicating 4-5 week lead times and noting a recent deterioration. Another expert, a longtime executive and investor in the space, stated that "it takes them very long these days" due to manufacturing errors which force "multiple builds, that's where you find they're losing money on every order"; and that his portfolio companies avoid ordering from Twist given low quality and high error rates.**

***Twist needs about  month even for a "very simple, shorter gene"; currently "slower than usual"***

*Q: "And how long does it take Twist to do a more complex gene?"*
*A: "You probably are looking at **four to five weeks**. It varies quite a bit. More recently, they've had a lot of orders, and they were a little bit slower than usual."*
*Q: "And what are the lead times and delays right now?*
*A: "I would say you'd be safer if you **add one or two weeks to the regular time.**"*
*Q: "So, what does that end up being total?*
*A: "Total **for very simple, shorter gene, it's going to be three to three-and-a-half weeks."** – Abbvie R&D Director*

***Lead times due to quality issues, forcing rework and multiple builds, resulting in "losing money on every order"***

***"That's another issue, that it takes them very long these days**. So, I think we're starting to see that they understand they have to deliver, but if it's taking them that long and they're not getting it right, so **they're making multiple builds, that's where you find that they're losing money on every order**. So, if they could push people more to pool their libraries, they probably have a better chance, but they can't charge as much for that." –Founding member of Gen9, an identical company to Twist*

***Longtime executive in the space says his companies avoid ordering from Twist, unless the order can make-do with lower quality and error rates of 20%***

*"I can tell you, though, from my portfolio companies' perspective, **they will order from IDT without hesitation when they need something that IDT can make**…The only thing that becomes competitive is really those pools or libraries, and that, again, goes to quality control. So, if they can give them a reliable quality—which, let's say, is an 80% correction, so they have a 20% error rate. In a pool, you could probably manage that. It's okay. In a library, you can get away with that. When you need the one gene you're ordering to work; you can't. –Founding member of Gen9, an identical company to Twist*

Source: Scorpion Capital consultation calls with experts

**We spoke with an ex-regional sales manager at IDT, a key Twist competitor, who left only recently and competed head to head for years. We found his knowledge of Twist's product line, manufacturing process, and competitive positioning to be detailed. He stated that the "emperor has no clothes" - a reputation in the market for low-quality sequences with consistency problems; misleading marketing that would get a grad student called out; and that Twist "scares the living heck out of anyone in the clinical space" who would be "scared to death" of being "censured by the FDA" for using an "inconsistent panel."**

***Misleading marketing; reputation in the market for low-quality sequences with consistency problems; "scares the living heck out of anyone in a clinical space" who would be "scared to death" of being "censured by the FDA"***

*A: "When you see marketing material, especially for a highly technical audience that **doesn't have things like legends or scales, you might get a little bit skeptical**. And they produce a lot of that kind of marketing material. **That's your first hint.** I have seen Twist marketing material that shows stuff like on-target percentages for - this is getting into the weeds of next-gen sequencing, but they will display data for different quality metrics that researchers will use to judge the effectiveness of a next-generation sequencing lockdown panel, hybridization capture panel. But **they won't do scales or legends consistently, which makes you think that's weird. Any scientist is going to be like, if you were a graduate student and you presented that to your research professor, they'd be like, you're an idiot. Why are you here? You don't do that."***

*Q: "Are you saying their products are fairly inferior? You said they got the price-sensitive, less quality-sensitive customer that you described as a cut above McDonald's. So, their genes, NGS, oligo pools, the fact that they aren't using legends - **are you essentially saying that their stuff isn't as high quality? Is that how they're perceived in the market?"***

*A: "Yeah, yeah. I think that is how they're perceived in the market. Actually, I don't think. **I know that's how they're perceived in the market**. Depending on your application, you might not care. But yeah, **they have a quality and more importantly, especially for regulated spaces like oncology sequencing, they have a consistency problem. The consistency problem is what scares the living heck out of anyone in a clinical space** because the last thing that those lab directors want is the FDA to be knocking on their doors and be like, show me the variants of your results. And they're **scared to death that because they used an inconsistent panel, they're going to get censured by the FDA."** –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**A longtime executive in Twist's space, who has advised the management team and remains on friendly terms, indicated that it's "well-known" that Twist's product is inferior and that its quality issues are also a "fairly known problem" – adding that the problems afflict their entire product line from oligos to genes to NGS. When we remarked that his comments made Twist sound like a basket case, he stated "It's one of those companies that's always been a question mark for me. I didn't get it. It went against everything that I learned in my science career."**

***Well-known" that Twist's product is inferior; quality issues also a "fairly known problem"; across the entire product line of oligos and genes***

*Q: "How do you know that Twist's product is inferior? Is it anecdotal from customers? Just well known?"*

*A: "**I think it's fairly well known**. There's final product yield for what I'll call it. If you order 100 genes, how many do you deliver? That's a **well-known challenge with Twist**. You don't have the ability to go back and make something individually. You've got to make it as part of a big, grand manufacturing thing. So, that's where IDT excels, and that's where GenScript excels. They can make the one gene that they need to individually and put a pair of hands on it. **You don't get that at Twist. So, that's a fairly known problem."***

*Q: "Are you talking about everything or oligos, NGS, single genes, or just something in particular?"*

*A: "It would be the genes, and it would be the pools at the same time. If you're looking at a panel where you're looking at 1000 genes, but not all 1000 genes are in that pool, you recognize that pretty quick when you're doing your NGS run."*

*Q: "This thing sounds like a basket case. Pricing, quality, manufacturing. It all, of course, is not surprising given how unprofitable they are. You have to have a bunch of things like that that are just catastrophically misfiring."*

*A: "Mm-hmm. It's one of those companies that have **always been a question mark for me. I didn't get it. It went against everything that I learned** in my science career." –Longtime executive in Twist's space*

Source: Scorpion Capital consultation calls with experts

**Ex-employees and customers outlined major limitations in Twist's ability to fulfill orders vs. competitors, notably its inability to make longer oligo pools and gene sequences with more base pair. An ex-manufacturing employee stated that Twist has "issues in regard to getting that [longer] gene to you" – "major thing that was wrong" - and a customer indicated a similar issue with oligo pools, the building block of Twist's product line. In addition, Twist struggles to make GC-rich sequences – ATCG are the four nucleobases in DNA strands, and Twist fumbles with sequences with more GC-base pairs: "we would have to admit failure because our processes were not good enough to provide a GC-rich gene."**

***"Major thing that was wrong" with Twist's manufacturing; "issues" in making large genes and GC-rich sequences***

*"When I was there, one major thing that was wrong - I'm going to give you an example. You are a customer, and you order* ***a gene that is pretty large. First of all, that's going to give us issues in regard to getting that gene to you****. It's going to take a little bit longer because the science is harder for us to get that onto a vector for. Another thing that was not going well for us was if you order a gene that is what we call "GC-rich," meaning that there are a lot of G's and C's in this gene,* ***it would also be hard for us to print that gene for you*** *and get that to you within a short amount of time. Sometimes, people put in that order with Twist and PacBio at the same time because they want to do a test to see who gets it to me faster. .. if you order a gene that's GC-rich, sometimes,* ***we would have to admit failure because our processes were not good enough to provide a GC-rich gene.*** *" -Ex-Twist employee in manufacturing, now a research professor*

***Twist has difficulty making oligo pools with longer sequences***

*"And then an oligo pool is a mixture of any number of individually-specified sequences that all come together in one tube. When you get all the molecules and all the different sequences are mixed together, but as the orderers, we specify I want this list of 500,000 sequences, and then they send us one tube that has molecules—there are billions of molecules in the tube, but some of them encode each of the 500,000 things in the list of sequences that we gave them. And* ***those oligo pools are typically restricted like the longest Twist can make them is 300 nucleotides to 300 letters long. It's a bit of a limitation*** *compared to ordering single genes." -Current Twist customer, professor with a protein therapeutics lab at a major university*

Source: Scorpion Capital consultation calls with experts

**Another former Twist employee, a manager in a manufacturing role now at a key competitor, confirmed that Twist struggles with high complexity DNA sequences as well as high or low GC-content ones: "those become more difficult to synthesize"; "they screen for…GC content sequences and high complexity sequences…we're not even going to try these…we know that our process can't make these."**

***Twist has great difficulty with high complexity DNA sequences as well as high or low GC-content ones – "not even going to try" to make them***

*"When you start to divert from an even distribution of those letters to what they call a* ***GC-rich sequence, those become much more difficult to synthesize****. So, at about 70% GC content, they will say we're not even going to try making this sequence. There are also other complexities involved in the way that sequences interact with each other. One of the fundamental properties of DNA is this thing called base pairing, where A's pair with T's and G's pair with C's, and so if you have stretches of sequences that are inverses of each other, they will base-pair with each other. I would just call that sequence complexity. So,* ***they screen for high GC or low GC content sequences and high complexity sequences, and then they tell a customer we're not even going to try these. We know that our process can't make these****." – Former Twist manager in a manufacturing role, previously and currently employed by key competitor*

Source: Scorpion Capital consultation calls with experts

**Novartis elaborated on Twist's manufacturing failures, indicating that its chip can only make small oligos, while customers need ones that are 5-20X longer for more serious applications. They stated that when Twist attempts larger oligos, it has to use standard technology and not its chip: "they cannot come up with these really long oligos"; "you only use that in the early, early stages of discovery which is mostly in academia…then you don't use that technology anymore"; "they take much longer because they need to use another technology."**

***Twist's chip can only small oligos; useless for larger pools where use standard techniques; can only make short sequences that are 10% of the length needed; short sequences useless beyond early-stage, academic work***

*Q: "Is there anything special about this synthesis chip? It's the size of a well plate that has some kind of a silicon coating on it. If they can't produce fast enough for you and at scale, I don't really understand how it helps them."*

*A: "But the problem is that yeah, they have this - with all these different plaster surfaces - but I think they can also produce oligos up to 200 or 300 nucleotides, so* ***they cannot come up with these really long oligos in that oligo pool."***

*Q: "And what about Thermo and IDT? Do other people produce longer oligos?"*

*A: "Yes. When you need to produce genes and things, you need at least 1000, 2000, and even longer nucleotides. That pool that you mean, that oligo pool, that one is very useful for CRISPR libraries. But the problem is that these CRISPR libraries and the application of this tool are very limited.* ***You only use that in the early, early stages of discovery, which is mostly in academia, biotech, or in some labs in the pharma. You use them, you discover a gene or a pathway, and then you move forward and then you don't use that technology anymore."***

*Q: "You're saying that Twist can't even make longer oligos beyond 250, while the other vendors can?"*

*A: "No. They can but not with this technology. "*

*Q: "But do they sell oligos more than 250?"*

*A:* ***"They do sell oligos longer than 250, but then they take much longer because they need to use another technology. So, this oligo pool that you explained, that they claim that they can do things so fast and so many at once, is for small oligos****, and this is for library preparation for the CRISPR."*

*Q: "Now I get why you order a lot more from Thermo and others. Can everybody do longer oligos faster etc. than Twist?*

*A: "Not everyone, but for sure, Sigma and Thermo can."*

*Q: "How about IDT and Genscript?"*

*A: "Probably they can also do it faster. Genscript would probably be similar." -Novartis, a large Twist customer*

Source: Scorpion Capital consultation calls with experts

**Novartis was dismissive of Twist's future, stating that the market is limited for the small oligos they're capable of – a "niche." We found their blunt, bleak assessment to be striking: that customers are consolidating around larger vendors with "a better offering" that are "getting bigger and bigger and dominating more and more of the market"; that Twist may "go bankrupt or they collapse" with their insane pricing; and that Novartis will continue to decrease spend with Twist vs. larger vendors.**

***Twist's chip can only make smaller oligos, which are a small niche; limited growth opportunity; larger vendors will continue to dominate; Twist may "go bankrupt" or "collapse" because of their pricing; Novartis will reduce spend***

*A: "What I'm trying to say is **how many times you need these small oligos, 90 to 100 at once**. In a year, maybe five times because this only help you create these libraries to perform an experiment and afterward, you need to focus on the results of the experiment, but you're not constantly doing this experiment."*

*Q: "So, you're saying the vast majority of oligos that people need are much longer oligos?"*

*A: "Exactly.*

*Q: "You're saying these guys have a niche in very early-stage research with a very short oligos product.*

*A: "Exactly. For that product, yes. **It's a very dedicated niche…I don't think the stock will suddenly in two years or in five years that everybody will buy from Twist."***

*Q: "Why is that?"*

*A: "Because I think the **big ones are getting bigger and bigger and dominating more and more of the market, and big pharma is consolidating with a smaller number of vendors that have a better offering**. And Twist is not a big vendor, and they cannot offer many different things. I think they have their market, which is laboratories in universities, smaller startups, and some part of pharma, but **they will not suddenly grow like crazy…what could happen in the future is that they go bankrupt or they collapse because at some point, if they are selling everything at a lower price, I don't know how they are going to compensate for that."***

*Q: "Do you plan to spend less or more with them or about the same per year?"*

*A: "Probably every year, **it will decrease because we will invest more into the Thermo's and the Sigma's because they will dominate more and more."***

*Q: "When you say they're dominating more and more, is it just because they're bigger or have other services?*

*A: "Both. Exactly. Because they have other services, because they are bigger, and because they are also very present." - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**Other customers flagged different types of problems in ordering from Twist, such as a lack of purity and quality control. A major customer, one of the largest genomics centers in Europe, stated that the purity of Twist oligos "isn't as high," stating that customers are "better off going through someone like IDT…you'll get much higher purity and much better performance." An ex-IDT regional sales manager characterized Twist's entire product line as a commodity – whether single stranded NGS or double stranded constructs – that suffers from numerous flaws regarding quality, quantity, consistency, mutations, sequence length, and other problems that create "substantial headache" and "substantial expense" for customers."**

***Purity of oligos "isn't as high" vs. competitors which offer "much higher purity and much better performance"; "better off" going with key competitor IDT***

*"I would say that **the purity of each individual oligo in those pools isn't as high as it is with IDT**, which is why if you're buying a smaller number of oligos, you're **better off going through to somebody like IDT. You'll get much higher purity and much better performance."** – Major Twist customer, one of largest genomics centers in Europe*

***Twist's entire product line suffers from a multitude of problems that create "substantial headache"***

*Q: "The reason you say it's a lower-end product - how do you define low end? Easier to make? It doesn't sell for much?"*

*A: **"In the case of next-generation sequencing [NGS], their hybridization capture panels have higher variability** amongst a number of metrics, and they make many lots. Like if you're a clinical sequencer, you're going to be running hundreds of samples from patients in a given time period. **Twist will have to deliver that in more lot numbers than their competitors, which creates a substantial headache for quality control teams** because quality control for these kinds of applications is a **substantial expense** because of the regulated space."*

*Q: "This just comes back to the fact that they can only make small volumes of a lot of different things?"*

*A: "Correct. And **then for the double-stranded DNA space, I would call the low quality would come out in slower turnaround time, a higher chance of mutation, and inability to make large constructs**, like many kilobase constructs." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Large pharma players like Novartis, Abbvie, and leading genomics centers were not the only ones critical of Twist. Small, price-sensitive academic customers and biotech startups with lower quality requirements are Twist's bread and butter – hooked by aggressive discounts and making-do with its commodity sequences – yet they highlighted similar dissatisfaction. We spoke with several. One such academic lab indicated that Twist's samples lack uniformity and quality control, detailing a recent "surprising" quality problem that Twist could never figure out despite repeated manufacturing attempts – "seemed like it was going to ruin our experiment"; "we still don't totally understand it."**

***"Surprising" quality issues; Twist couldn't fix them despite repeated attempts; almost "ruin[ed] our experiment"***

*"We actually did have a **surprising quality issue with Twist in January, and we still don't totally understand it**. We ordered an oligo pool, and on a few technical dimensions, the chemical material was not as uniform and high quality as when we were ordering last year. At first, it **seemed like it was going to ruin our experiment**, so we asked them to redo it, and they did, and then that second print was no better than the first, or maybe it was very slightly better than the first. And so, we went through a bunch of troubleshooting with them to try to understand what was going on. They were very accommodating as far as redoing things without charging us and talking to us to investigate all of the possible causes, but it **didn't actually get anywhere**. But we figured out how to work with the lower quality material on our end. – Current Twist customer, professor with a protein therapeutics lab at a major university*

*T**wist samples lacked the necessary uniformity and quality control***

*"Uniformity is the idea that if you count up the number of molecules of each sequence, you want approximately the same amount because when you do your experiment, **you want an equal amount of testing for all of the different sequences that you sent…in this library, a portion of the sequences that we ordered were heavily underrepresented** in the library…we haven't ordered the next library to see if the same issue from January is still recurring. But we've ordered maybe seven of these really large pools, and it was the two in January that had the quality issue." – Current Twist customer, professor with a protein therapeutics lab at a major university*

Source: Scorpion Capital consultation calls with experts

**Twist's inability to make large NGS lot sizes is driving customers back to competitors, who stated that while they lost customers initially due to Twist's aggressive discounting, they are "having a substantial amount of success at winning back the customers that they had lost several years before." Twist's chip requires an amplification step to compensate for its inability to meaningful amounts of DNA, which "impedes their ability to make a "consistent product" from lot to lot – "they need consistency, they need fewer lot numbers."**

***IDT initially lost customers to Twist but now having "substantial success at winning" them back, due to Twist's quality/consistency problems and its inability to make sufficient lot sizes***

*Q: "How much share did you guys lose to them, and what kind of customers? It sounds like it was the price-sensitive, less quality-sensitive customers. What was the impact on IDT's business at the time?"*

*A: **"Actually, early on, it was substantial, especially for NGS. They made a really big splash, and I think that their low prices compelled a heck of a lot of even tightly regulated clinical labs to switch over to them**. But, of course, you don't necessarily recognize low consistency in the short term. You recognize that after multiple years. At least **at the time that I left IDT, the team was having a substantial amount of success at winning back the customers that they had lost several years before."***

*Q: "And what did those customers say?"*

*A: **"That they need consistency. They need fewer lot numbers**. They need data that is going to be as close to perfectly replicated patient after patient after patient. And **because of the need for Twist to both amplify their panels and potentially introduce mutations and the inability to make very large lot sizes, that impedes their ability to make a consistent product**. To put it in perspective, a company like an IDT could make one lot to last a clinic one to two years. Whereas Twist could make one lot to last them a matter of weeks. There are massive cost savings from the intake quality control standpoint. The quality control team of the clinics doesn't have to be running experiments all the time."*

*Q: "And you're referring to NGS here?"*

*A: "Yes, I'm referring to NGS here, yes." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Twist heavily promotes its platform as high throughout, yet one customer, ex-employee, and competitor after another stated it was the exact opposite, that it is only capable of making infinitesimal amounts of DNA that require time-consuming and expensive amplification which then compounds its quality control problems – "their main issue is scalability"; "they cannot produce large quantities of their single pieces of DNA, that causes all kinds of downstream application problems….they have repeatedly high mutation rates." We note that quality and consistency issues are most acute for their NGS product, which is low-end, causing them to "struggle" where the "big money is in the clinic."**

***Twist is unable to scale; their chip's inability to produce sufficient amounts of single pieces of DNA causes major downstream manufacturing problems, resulting in high mutation rates; inconsistency; and poor turnaround times***

*"**I think their main issue is scalability. They cannot produce large quantities of their single pieces of DNA, and that causes all kinds of downstream application problems because they have to compensate** for that in one way or another through methods like amplifying the material that they do have and tiling in the case of NGS. And consistency and turnaround time for double-stranded DNA constructs and keeping mutation rates down. **They have repeatedly higher mutation rates in their double-stranded DNA."** –IDT ex-regional sales manager, left recently*

***Twist's quality and consistency problems are most acute for their NGS product, which is low-end; "struggle" where "the big money is in the clinic"***

*Q: "Which of their products does this affect? The NGS?*
*A: **"That affects NGS. That's most important to NGS."***
*Q: "So, their NGS product is basically the low end of the NGS market?"*
*A: "I would say so. I think it's a useful tool when you're designing panels or if you're doing research projects **where you don't necessarily care about really high consistency. But the big money is in the clinic, and that's where I think they struggle."** – IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**A former Twist employee in a senior product and sales roles described a fiasco with customers leaving due to missed order dates or receiving incomplete orders. He indicated that Twist missed the promised turnaround time for about 30% of its orders, mainly due to quality failures that required the company to re-manufacture the sample.**

***Customers leave because of Twist missing the turnaround time for orders or receiving incomplete sequences; missed the turnaround window "probably 30% of the time" due to re-work and quality problems***

*Q: "Were there any customers that left because of quality or other issues?"*

*A: "Turnaround time.*

*Q: "Was that the biggest issue"*

*A: **"Yeah, missing your turnaround time and percent of the order complete by far."***

*Q: "How often did each of those two things happen?*

*A: "**The turnaround time was probably 30% of the time because something needed to be reworked**. When they really needed something, they had to have it complete, that was probably 10% of the time, and people would be upset by it not being complete just because they needed to have everything; they needed to have all the genes to start their experiment.*

*Q: "How much did they miss it by? How long did the customer expect the order to take from the day they made the order, and how long would it typically take?*

*A: **"They usually expected it to take 10 days, and sometimes it would take 15 days to get it back because some of them you had to start the process again** or you weren't going to make it."*

*Q: "What percentage of the time would they have to rework it?"*

*A: **"Probably 20% of the genes, at least."***

*Q: "And that's before they sent it to the customer, or they would send it to the customer, and the customer would be like, hey, it's wrong?"*

*A: "No-no. Customers don't sequence it. If you send it wrong and they discover it, you've probably lost that customer."*

*Q: "You guys would have to redo it 20% of the time, so you would start the entire manufacturing process from scratch?"*

*A: "It depends on what the failure was like but maybe. It would either be scratch or go back to somewhere in the middle." - Ex-employee in senior product management and sales leadership roles*

Source: Scorpion Capital consultation calls with experts

**Danaher's IDT division, Twist's key competitor, indicated that Twist was only able to take some of its worst, most price-sensitive customers – "we knew Twist was offering insane prices" – and that they simply let Twist have them without going head to head, and that the more attractive customers remained with IDT as Twist is slow, "not as reliable, and "a lower quality provider." He noted massive skepticism within IDT, stating that they are patiently waiting out Twist until they blow up – "As far as we could tell, Twist hadn't invented a better mousetrap…anyone that had deep technical knowledge …was kind of like, how are you [bringing down prices]? It didn't compute."**

***Key competitor sees through Twist's strategy and is waiting them out; thinks Twist will either blow up or only capture the worst customers with "insane prices," given they're "not as reliable," "lower quality," and slow***

***"Without going into a lot of details, the reaction from IDT was like, okay, let's see how this plays out****. The folks at IDT, there are a lot of very smart people that know everything there is to know about DNA synthesis. We had a pretty darned good guess that they were either making very little money or maybe even losing money. So,* ***IDT's reaction was—and I think still is—just patience****. IDT lowered prices a little bit in key markets like Boston and the Bay area, but IDT actively avoided going head-to-head with customers that* ***we knew Twist was offering insane prices*** *for because we figured that either Twist is going to run out of venture capital steam and pitter out, and we're going to preserve our price premium, which in the long run is going to be good.* ***Or Twist, because they're not as reliable, they don't have as great of a turnaround time, they're a lower quality provider, they might eat at our customer base, at least the high price sensitivity customer base, and that's going to suck. And that's eventually what happened****…IDT still commands a price premium." –IDT ex-regional sales manager, left recently*

***Twist hasn't invented "a better mousetrap" that enables them "to bring down prices"; "didn't compute"***

*"Looking at our own margins, not that we were so arrogant to think somebody couldn't possibly invent a better mousetrap to bring down prices, but* ***as far as we could tell, Twist hadn't invented a better mousetrap. Anyone that had deep technical knowledge in the space was kind of like, how are you doing that? It didn't compute."*** *–IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**We interviewed an executive at Genscript, Twist's key Chinese competitor, who stated that Twist's reputation among customers was of over-promising and under-delivering - "The number one thing I hear…they promise a lot and they overcommit"; "cannot deliver on time." Providing color identical to IDT, Twist's other key competitor, he indicated that Genscript is seeing customers switch back, after being seduced for a time by Twist's fire-sale prices, after tiring of order delays, the lack of a real GMP capability, and total failure in its antibody development offering.**

***Customer feedback suggests pattern of overpromising and under-delivering; "cannot deliver on time" ; trying to offer bespoke services they have little capability for, like GMP; customer returning to competitors***

*"**The number one thing I hear from them is that they promise a lot of sweet things in the beginning. They promise a lot, and they overcommit**, which is fair because we're all trying to win the business here. Number two is that they all like Emily. She is a very strong CEO. The third thing I hear is that they really **cannot deliver on time**. In a way, they overpromise and try to do stuff out of their comfort zone, but they don't really deliver. And **number four is that they try to offer a lot of the services that are not on their menu**. Like GMP plasma manufacturing, like MRNE manufacturing. Emily and the team claim that they can do that quickly and efficiently, but they have to deliver on the promise. Now the customers are telling us that they've gone away, and they **tried Twist, but they want to come back and use us again**. I might be biased because the customers that we are talking to are our customers. There's got to be a reason why they come back to us." -Executive at Genscript, key Twist competitor*

***Customers that Genscript lost to Twist are coming back due to various setbacks and limitations; antibody screening offering is a dud; couldn't deliver orders in time; lack of a GMP offering***

*"There are some significant gene assay therapy companies based in southern California that switched back us. There's a company in Boston that switched to us. That was very recent. I just had a meeting with them like last month, and the ones in Boston were maybe three months ago. **At least in this year, I at least met like five clients that switched to us**. They told us that the **antibody screening result did not end up giving them that many lead candidates. And number two was the timeline**. They promised that they could deliver quicker than GenScript, but they couldn't meet the timeline. And the **third thing is their GMP system** is still getting ready, so while they claim they can do that…" -Executive at Genscript, key Twist competitor*

Source: Scorpion Capital consultation calls with experts

## An ex-Twist employee in a director role indicated that Twist has "no advantage" or differentiation, as oligo's and NGS are a commodity that anyone can "easily" manufacture with "traditional chemistry, just typical DNA synthesis" you can get from any vendor. A key competitor added that they've "positioned themselves as a commodity provider" like an "In and Out Burger" and that even Ginkgo Bioworks, their marquee deal, only resorts to Twist for "very low-priority screening projects."

***Twist has "no advantage"; manufacturing oligos is a commodity process any vendor can do using traditional DNA synthesis steps on plastic well plates***

*Q: "Is there anything that Twist sells that you can't get from 10 other companies?"*

*A: "No. You can get it from other companies. Even the NGS panel—you can imagine if you need a few hundred cancer-related genes, you probably need a few thousand oligos. For each gene, you can have three pair of primers, three or four pairs of primers that well covers the whole transcript. So, you can imagine, you only need a few at the most, a few hundred oligos or a few thousand oligos.* ***A few thousand oligos, people can say I could use 384, and I can use ten 384 plates, just like one chip. There's nothing we can't do easily—it would be a similar process, a similar approach, similar synthesizing. DNA is like traditional chemistry, just typical DNA synthesis method using phosphoramidite. So, there is no advantage."*** *– Former Twist employee, director-level*

***Key competitor: "Positioned themselves as a commodity provider" similar to a fast food burger shop***

*"They've* ***certainly positioned themselves as a commodity provider****. They certainly have positioned themselves as a maybe not quite McDonald's. They're* ***like an In and Out Burger****, maybe." –IDT ex-regional sales manager, left recently*

***Even key partner Ginkgo Bioworks allegedly only uses Twist for "very low-priority screening projects"***

*Q: "What did Ginkgo people say to you about Twist?"*

*A:* ***"Twist is for their very low-priority screening projects*** *to where they don't have the ability to devote their internal resources. So, Twist is like their overflow. From my understanding because Ginkgo has its own double-stranded DNA construction capacity, which they're going to rely on first." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Part V: Twist operates in a commodity, crowded, hyper-competitive space in which it ignited a furious price war and "race to the bottom," with a me-too offering and a bottom-of-the-barrel price-seeking customer base.**

**Twist's customers and ex-employees bluntly stated that it sells a commodity product in a commodity space, across its entire product line whether oligo pools, synthetic genes, NGS, or antibody discovery. Even its key competitors candidly bemoaned that the entire space is little more than a price-driven commodity. Abbvie, a Twist customer, occasionally places orders but expressed ambivalence and couldn't explain why they buy anything from Twist at all: "[T]here's really no big difference. We could switch anytime if needed"; oligos are a "total commodity, "very, very cheap," "very easy to make," and "it's just the same thing."**

***Oligos are "a total commodity"; "very, very cheap"; no difference between vendors; can "switch any time if needed"; customer orders some from Twist but ambivalent***

*A: "From IDT, we also order some clonal genes. We order a lot of oligos, so IDT is our main oligonucleotide supplier. They also do a lot of services. So, the only kind of clonal genes that we order from them are in the context—if it's in the same project that requires a lot of oligos and a lot of other things. We bundle, and we buy from one. Other than that, it's all related to sequencing, library props, and things like that. We buy the agents and some services from them."*

*Q: "Why don't you buy oligos from Twist and only clonal genes? Why do you buy those from IDT?"*

*A: "Good question. I don't know. It's a history; we validated their product, their oligos are fine, they're not expensive, so I don't know. I think there's* ***really no big difference. We could switch any time if needed. Oligos are much more of a commodity. Oligos are just very short gene fragments. They are easy to make, they're cheap, and they're much more of a commodity*** *than a gene. Oligonucleotides are just very short gene fragments. They could be like 20 nucleotides long. They are single-stranded, and they're* ***very, very cheap."***

*Q: "It sounds like you don't really perceive any difference from Twist in oligo pools. The way you're talking makes it sound like an oligo pool is just a total commodity where nobody's innovative, nobody's differentiated from the other person, so it doesn't really matter who you work with. Is that accurate - do I hear you right?"*

*A: "Yes, it is accurate. Like I said in the beginning, genes are not a total commodity; oligos are.* ***So, oligos are very easy to make****. It's a short sequence. You have some difference on purity maybe, a couple of other things, but it's really easy.* ***It's just the same thing****; it's a gene sequence, but it's single-stranded, and it's short. We're talking 2 KB, which is a 2000 nucleotide sequence. Here, we're talking 20. The only thing that can be different is purity and maybe some accuracy. But* ***that's a total commodity, oligos."*** *-Abbvie R&D Director; Twist customer*

Source: Scorpion Capital consultation calls with experts

**Other customers echoed the same sentiment. A major genomics center stated the NGS market is a commodity, as is Twist's offering within it: "becoming quite a crowded market"; "it's a commodity"; "other companies [are] developing platforms that might have similar functionality." An academic lab stated indifference between Twist vs. cheap Chinese competitors: "sometimes we buy from Twist, and sometimes we use some other people like Genscript"; "always found [Genscripts's] stuff pretty good."**

***NGS market is a commodity, and so is Twist; "crowded market" with competitors "improving all the time" and new entrants offering better product than Twist with more efficient manufacturing methods***

*A: "All the other companies, Roche, IDT, Agilent - all of the capability. They don't have quite the flexibility for the custom panels, but they are always iterating and producing better-performing exome panels.* ***I would guess that it's the exome stuff that globally is at least half if probably not 75% of all the target enrichment that's used. So, there's a threat there that it's a commodity*** *and given economies of scale, even if they're not as good with custom."*

*Q: "Do you see the competition catching up to a point where they would regain your business and ends up being a major threat to Twist?"*

*A:* ***"Yeah, they're improving all the time****. Also, there are other companies starting to make synthetic DNA with lots of different other technologies such as enzymatic methods and true microchip printing that claim that they can get* ***longer oligos than Twist, claim to be cheaper and do it in a more highly parallel fashion to reduce the process. It's becoming quite a crowded market."***

*Q:* ***"Is what they do essentially a commodity?"***

*A:* ***"Yeah.*** *Their only real IP is in the miniaturized equipment that they use for printing, and there are other companies developing platforms that might have similar functionality." – Major Twist customer, one of largest genomics centers in Europe*

***Twist customer indifferent between them or a cheap Chinese competitor***

*"When we buy single genes,* ***sometimes we buy Twist, and sometimes we use some other people like GenScript****, but that's totally - we haven't done a lot of research to try to figure out who's the best people.* ***I've worked with GenScript before and always found their stuff pretty good."*** *– Current Twist customer, professor with a protein therapeutics lab at a major university*

Source: Scorpion Capital consultation calls with experts

**An ex-employee in a senior role stated that there are "tons of players" with "very low barrier to entry" and "always someone willing to do it for less margin." He continued that "everybody who's a customer in this space has at least two key suppliers"; "lot of little local suppliers"; "very low switching cost"; "it's all molecular biology" and "the methods are well published." Another ex-employee stated Twist has "no advantage" and that their offering is a commodity any vendor can offer using traditional DNA synthesis on plastic well plates.**

*"**Tons of players"; "very low barrier to entry"; "always someone willing to do it for less margin"***
*"Yes, there are **tons of players**. If you don't want to manufacture on a global scale, there's a **very low barrier to entry**. There's **always someone willing to do it for less margin** than you'd like to make, so you have to do something to differentiate it." -Ex-employee in senior product and sales roles*

***"Everybody" has "at least two key suppliers"; "very low switching cost"; "lot of little local suppliers"***
***"Everybody who's a customer in this space has at least two key suppliers because people do make mistakes. And there's a very low switching cost** to go from one to another. Every major pharma company has someone they're using as a primary supplier and someone as a secondary supplier for a project. GeneArt, which is now part of Thermo Fisher, GenScript, and IDT does a little bit in the oligo space. Sigma in Europe does DNA. Eurofins does oligos and genes. And there are a **lot of little local suppliers** where they have a personal relationship with the supplier. **The barrier to getting into the gene synthesis business if you're a small supplier is pretty low. You can buy the hardware to sequence oligos. It's all molecular biology. The methods are well published**." -Ex-employee in senior product and sales roles*

***Twist has "no advantage"; manufacturing oligos is a commodity process any vendor can replicate***
*Q: "Is there anything that Twist sells that you can't get from 10 other companies?"*
*A: "No. You can get it from other companies. Even the NGS panel—you can imagine if you need a few hundred cancer-related genes, you probably need a few thousand oligos. So, you can imagine, you only need a few at the most, a few hundred oligos or a few thousand oligos. **A few thousand oligos, people can say I could use 384, and I can use ten 384 plates, just like one chip. There's nothing we can't do easily—it would be a similar process, a similar approach, similar synthesizing. DNA is like traditional chemistry, just the typical DNA synthesis method using phosphoramidite. So, there is no advantage."** – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**Ex-employees further indicated that Twist's antibody discovery offering – its purported growth driver – is already a failed business, based on the acquisition of Abveris which is "a typical, traditional hybridoma service" that's "very generic and nothing special." He repeated that "the reality is this is nothing special…it's just like any other biotech company that provides antibody engineering or library services….so, there's not much of a differentiator." We note that this expert played a senior role in Twist's antibody division.**

***Antibody engineering is "nothing special"; no differentiator; just "like any other biotech company"***

*Q: "Why didn't the antibody business grow more? What was the issue in scaling it - was this a key growth area that they had hoped and that didn't work out?"*

*A: "That's right. They really pushed it. Twist - why is their cost so high? I'll give you an example. They very aggressively promote and advertise their business.* ***But the reality is this is nothing special. It's like any other biotech company that provides antibody engineering or library services. So, there's not much of a differentiator.*** *They're really hard to sell, but with that many people [in sales], that's why they do get business." – Former Twist employee, director-level*

***Abveris acquisition, the foundation of their antibody business, is "very generic and nothing special"; "typical, traditional"***

*"Abveris is* ***a typical, traditional hybridoma service*** *that provides immunization services and hybridoma generation to customers so they can generate antibody discovery services. It's* ***very generic and nothing special****." – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**An executive at Genscript, a publicly traded Chinese competitor, stated that the market is the worst of all worlds: a commodity in terms of pricing, but with a high cost to manufacture, adding that "price erosion" requires offering customers "something extra" to try and compete. The executive characterized Twist as focusing on the worst, most commodity end of the DNA synthesis space – "not a successful strategy" – and described the price war ravaging the industry: "a lot of competition in the market"; "people expect the price to drop and drop, so we keep dropping it"; "we cannot charge a lot of money"; "we cannot say we are truly differentiated" – adding that he was being unusually honest.**

***Twist focuses on the worst, extreme commodity end of the DNA synthesis market; ongoing price war; no one has a differentiated offering; will "continue to be a commodity"; Twist's market focus is "not a successful strategy"***

*Q: "Gene synthesis, oligo pools - **you're saying that's the worst part of the market?"***

*A: "**In terms of profit margin, it's got to be one of the lowest. There's a lot of competition in the market, and over time, people expect the price to drop and drop, so we keep dropping it**. Relative to other types of more sophisticated services, **we cannot charge a lot of money for that. We cannot say we are truly differentiated in gene synthesis**. That's not something that is conventional to say…I don't think for gene synthesis, and I think we have gone past that time point where we can say that. So, I think going forward; **it will probably continue to be a commodity**. Just banking on the one service to make all of the profit is not a successful strategy at this point." – Executive at Genscript, key Twist competitor*

***Commodity market in terms of pricing but still expensive to manufacture; "price erosion"***

*A: "Gene synthesis **may be a commodity market, but it's not easy to do that 100% accurately** and to guarantee something. I don't think Twist guarantees anything."*

*Q: "But is the gene synthesis and oligo market? Is that a commodity?*

*A: "**Yes, in general, that's a commodity**. So, we are doing something extra now to retain the market share… it's a commodity market, and it all comes down to the flexibility, service, and how much more you can offer in addition to that…**It's a commodity market. There's price erosion and will continue to be. So, you've just got to do something extra."** -Executive at Genscript, key Twist competitor*

Source: Scorpion Capital consultation calls with experts

**Danaher's IDT division, Twist's other key competitor, similarly called it a commodity market where "you can go to a lot of places for" gene synthesis, NGS, and oligo pools – "I don't know that there's any one place really sticking out…it's hard to get people to make changes." He continued that it's a "crowded market" with "lots of people making double-stranded DNA."**

***Commodity market without any major player that is "really sticking out"***

*Q: "Are regular single-gene synthesis, oligo pools, NGS's, **basically a commodity product you can go to 10 different players for?"***

*A: "**Yeah, you can go to a lot of places for that."***

*Q: "Is it basically identical?"*

*A: "Your turnaround time might be different by a little bit. Your quality might be a little bit different. **I don't know that there's any one place really sticking out**. IDT has a great reputation for quality and being reliable, and a lot of people stick with them because of that. Some big companies just already have GenScript in their ordering system, and it's hard to get people to make changes." -Executive recently at IDT, a key Twist competitor; currently employed at another synthetic biology player*

***Key Twist competitor: "crowded market" with "lots of people making double-stranded DNA"***

*"I was listing off examples of what I would include in the synthetic biology applications arena. The products that usually go into that space are double-stranded DNA constructs. These would be the IDT G-blocks. **It's a crowded market. There are lots of people making double-stranded DNA constructs in a variety of sizes**, from half a kilobase to 10 kilobases at the very largest end.." – IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**Given that Twist sells low-quality sequences via a scorched-earth pricing and discounting strategy, it is not surprising that it has ended up with bottom-of-the-barrel price-seeking customer base. A longtime executive in Twist's space stated that its customer base is therefore mostly academics and startups: "where I haven't seen them get much traction is selling their product into…quality controlled places like pharma"; "a lot of them are the startup biotech's in the Bay Area, less so the Amgen's and GSK's." He indicated that Twist's lack of quality control would be "a disaster for a pharma company," suggesting its quality was inferior to even Chinese players – and that the product issues preventing it from selling into pharma were unique to Twist, as its competitors all sell there.**

***Bottom-of-the-barrel price-seeking customer base that doesn't care about quality; not "much traction" in real customers like pharma; quality issues are unique to Twist as competitors sell to pharma; inferior to Asian vendors***

*Q: "I've heard they're getting the lower-end, really price-sensitive, kind of like the crappy customers that don't want to pay. I don't know if that's accurate. What are your thoughts on their customer base and customer profile?"*

*A: "Yeah, they get a lot of academics, and they get a lot of places like Ginkgo, which is a super-high volume user. Where I* ***haven't seen them get much traction is selling their product into what I'll call quality-controlled places like pharma****. You'll find that a lot of them are the startup biotech's in the Bay Area, less so the Amgen's and the GSK's."*

*Q:* ***"Is that because their product isn't as reliable or as high quality?"***

*A: "****That's correct****. Generally, in pharma, if they order 100 genes, you better deliver them 100 genes. You can't turn around after three or four weeks and say, here is 90. Good luck getting the rest of the 10. That's not going to last long. That will be a disaster for a pharma company. Emily's business was academic."*

*Q:* ***"So, this is unique to Twist, basically. Is IDT selling to pharma****, and are other people selling to pharma?"*

*A: "Oh yeah.* ***Yeah, GenScript, GeneArt, Thermo—they all sell to big pharma."***

*Q: "Even GenScript. So, you're saying they are* ***lower quality than even these Asian companies?"***

*A: "GenScript, for all their challenges, even though it's handmade each time with cheap hands, they deliver. I hate to say it because they were our Achilles' heel. But they deliver, and it's hard to compete with them when they deliver the way that they deliver." –Longtime executive in Twist's space; ex-founder of a key competitor*

Source: Scorpion Capital consultation calls with experts

**Novartis stated that Twist's product limitations make it relevant only for smaller customers like academic labs and startups, and that they lack the capability and value proposition for pharma players – which is why Novartis plans to reduce its spend with Twist in favor of larger vendors that are "dominating more and more of the market": "Twist is not a big vendor, and they cannot offer many different things. They have their market, which is laboratories in universities and smaller startups…."**

***Twist's chip can only make smaller oligos, which are a small niche; limited growth opportunity; larger vendors will continue to dominate; Twist may "go bankrupt" or "collapse"; Novartis plans to reduce spending with Twist***

*A: "What I'm trying to say is **how many times you need these small oligos, 90 to 100 at once**. In a year, maybe five times because this only help you create these libraries to perform an experiment and afterward, you need to focus on the results of the experiment, but you're not constantly doing this experiment."*

*Q: "So, you're saying the vast majority of oligos that people need are much longer oligos?"*

*A: "Exactly.*

*Q: "You're saying these guys have a niche in very early-stage research with a very short oligos product.*

*A: "Exactly. For that product, yes. **It's a very dedicated niche…I don't think the stock will suddenly in two years or in five years that everybody will buy from Twist."***

*Q: "Why is that?"*

*A: "Because I think the **big ones are getting bigger and bigger and dominating more and more of the market, and big pharma is consolidating with a smaller number of vendors that have a better offering**. And Twist is not a big vendor, and they cannot offer many different things. I think they have their market, which is laboratories in universities, smaller startups, and some part of pharma, but **they will not suddenly grow like crazy…what could happen in the future is that they go bankrupt or they collapse because at some point, if they are selling everything at a lower price, I don't know how they are going to compensate for that."***

*Q: "Do you plan to spend less or more with them or about the same per year?"*

*A: "Probably every year, **it will decrease because we will invest more into the Thermo's and the Sigma's because they will dominate more and more."** - Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**Twist's entire positioning – ever since it launched – has been to target the low-price, low-quality segment. An ex-Agilent executive, a longtime manufacturing expert in the space, stated that they "freaked a little bit because they screwed up the market" with their discounting, but that "then we knew right away that they couldn't compete our quality level, so it was a non-issue" – in other words, Twist was left with sucking up price-seeking customers instead.**

***Twist's positioning is low price/low quality; now realizing cost to prevent errors is "significant"; "screwed up the market" with their pricing but "non-issue" in the end as their quality issues made them uncompetitive***

*Q: "I just wanted to come back to this point that I thought was very interesting. Essentially, you were defining market segments by fidelity and price point. Where does Twist fit into that and somebody like a GenScript?* ***Is Twist the bottom of the barrel—low pricing, low fidelity?"***

*A:* ***"That's how they came out of the shoot. They came out as low pricing, and I think what they're finding out now is the verification of the oligonucleotide sequence, and then the verification of the gene sequence is going to cost them a significant amount of money."***

*Q: "Did Twist basically destroy pricing in the industry? I heard that they showed up when it was 20 or more cents a base pair and they were at 7-9 cents. It was a race to the bottom. Is that your understanding?"*

*A: "Yes. We initially were* ***freaked a little bit because they screwed up the market like that. But then we knew right away that they couldn't compete with our quality level, so it was a non-issue****." -Longtime oligonucleotide manufacturing expert and executive; ex-Agilent*

Source: Scorpion Capital consultation calls with experts

**Key competitor Danaher/IDT stated that Twist took only their worst, most price sensitive customers - and that they let them have them. He described Twist as "a lower quality provider" that is "not as reliable," leading IDT to just be patient until Twist unravels – "we actively avoided going head-to-head with customers that we knew Twist was offering insane prices [to]." He added that IDT has remained rational and "still commands a price premium," and is therefore profitable vs. Twist's losses.**

***Key competitor sees through Twist's strategy and is waiting them out; thinks Twist will either blow up or only capture the worst customers with "insane prices," given they're "not as reliable," "lower quality," slower***

***"Without going into a lot of details, the reaction from IDT was like, okay, let's see how this plays out****. The folks at IDT, there are a lot of very smart people that know everything there is to know about DNA synthesis. We had a pretty darned good guess that they were either making very little money or maybe even losing money. So,* ***IDT's reaction was—and I think still is—just patience****. IDT lowered prices a little bit in key markets like Boston and the Bay area, but IDT actively avoided going head-to-head with customers that* ***we knew Twist was offering insane prices*** *for because we figured that either Twist is going to run out of venture capital steam and pitter out, and we're going to preserve our price premium, which in the long run is going to be good.* ***Or Twist, because they're not as reliable, they don't have as great of a turnaround time, they're a lower quality provider, they might eat at our customer base, at least the high price sensitivity customer base, and that's going to suck. And that's eventually what happened****…IDT still commands a price premium." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**A former employee now at a key competitor provided the same color – that Twist leads with price "right off the bat" vs. competitors who incorporate quality into their value proposition. He indicated that in their largest segment - NGS – Twist's business model is to slash prices on NGS panels and upsell a library prep kit that they're merely a reseller for: "they're going for a cost win versus a quality one right off the bat"; "they sell them on a lower-costing hybrid capture panel than they're used to getting from IDT, Agilent, or Roche."**

***Twist leads with price "right off the bat" vs. competitor's who incorporate quality into their value proposition***

*"**They're going for a cost win versus a quality one right off the bat. IDT's pitch is more quality, a little bit more expensive**, and is able to compete with Twist. There are customers that won't sacrifice quality over cost because what they're doing is extremely important in the syn-bio space and extremely well-funded in the academic market." –Former employee now at a key competitor*

***Twist's NGS business model is to slash prices on panels and upsell a library prep kit that they're a reseller for***

*"Their NGS business is they find a targeted sequencing customer, and then **they sell them on a lower-costing hybrid capture panel than they're used to getting from IDT, Agilent, or Roche and hopefully, add on to that by selling them library prep**. Therefore, getting a lot more money than just the hybrid capture probes, but once those probes are in, they get sent to headquarters and then get shipped directly to the customer after going through manufacturing and QC." – Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

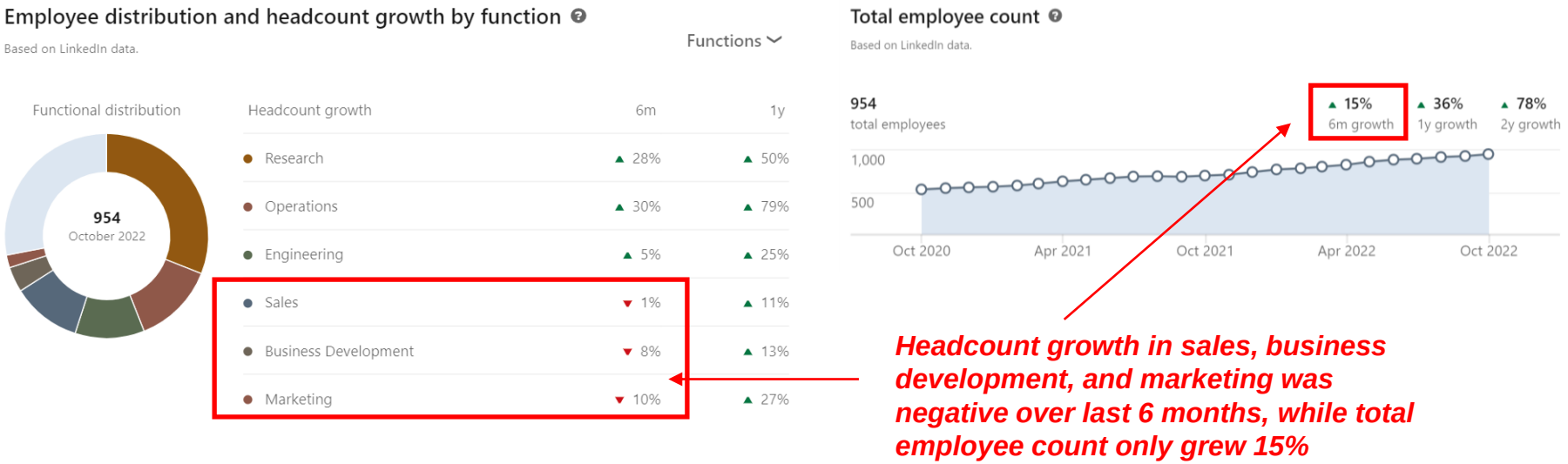
**Part VI: Twist exhibits telling signs that its "growth" is about to hit the wall and that the end is near, beyond the accounting games that typically signal desperation: saturation in its tiny niche; competitive struggles; and an impending flood of disruptive, venture-backed entrants with newer DNA synthesis technologies, which even Twist's customers describe as an existential threat.**

**Twist exhibits telling signs that growth has peaked and indicating saturation. For example, the company is merely milking current customers vs. driving revenue from new ones. Its last 10K stated that 98% of revenue was from what it defines as "repeat customers," which it portrays as an impressive metric despite the implication. We further noted LinkedIn stats indicating that its total headcount only grew 15% over 6 months – far below its previous rate – and that headcount growth in sales, business development, and marketing was actually negative over the period, per its LinkedIn page.**

***Twist 10K filing for 2021***

*"We shipped products to approximately 2,900, 2,200, and 1,300 customers in fiscal years ended 2021, 2020, and 2019, respectively.* ***Our percentage of revenue from repeat customers were 98%****, 97% and 97% for the fiscal years ended 2021, 2020, and 2019, respectively."*

***LinkedIn "Insights" page for Twist***




***Headcount growth in sales, business development, and marketing was negative over last 6 months, while total employee count only grew 15%***

Source: https://www.linkedin.com/company/twist-bioscience/insights/; Twist 10K filing

**In addition, <u>total job opening growth – also per LinkedIn analytics – has fallen 32%</u> over the previous 3 months, particularly in <u>sales where it is minus 60%</u> over this period – particularly telling as Twist is supposedly in an "aggressive hiring spree" for its "Factory of the Future" in Oregon.**

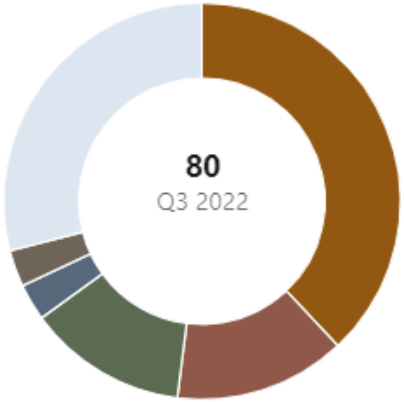
***<u>LinkedIn "Insights" page for Twist</u>***

## Total job openings

Based on LinkedIn data. Excludes subsidiaries.

Functions

Functional distribution




| Job openings growth | 3m | 6m | 1y |
|---|---|---|---|
| Research | ▼ 39% | ▼ 29% | ▲ 114% |
| Engineering | ▼ 8% | ▼ 27% | ▼ 8% |
| Operations | ▼ 23% | ▼ 23% | ▲ 150% |
| Business Development | ● 0% | ▼ 33% | ▲ 200% |
| Sales | ▼ 60% | ▼ 71% | ▼ 67% |
| Other | ▼ 31% | ▼ 44% | ▼ 4% |
| Total | ▼ 32% | ▼ 36% | ▲ 29% |

Source: https://www.linkedin.com/company/twist-bioscience/insights/

**Former employees and competitors indicated that Twist's growth is beginning to hit the wall, as it has saturated its tiny niche of price-sensitive customers willing to trade deep discounts for lower quality, such as academic labs and startups. We spoke with an ex-Twist employee now at its key competitor – we shield the company's name to protect his identity - which provides him with a unique vantage point. He indicated that Twist took "a lot of share in the beginning" but is now struggling to find growth: "Nowadays it's much harder to gain traction…it's much more competitive": a "plateau of NGS-specific customers within the last year"; "I still have many friends there, and the mood isn't so great"; "there was an exponential curve of customer acquisition that I don't believe is continuing."**

***Twist took "a lot of share in the beginning" but now "much harder to gain traction"; customer acquisition has plateaued in the last year; "mood isn't so great" inside Twist***

A: *"I think **Twist took a lot of share in the beginning** because of the fact that the market wasn't well-supported by IDT or Agilent. So, it's very easy to gain traction in the beginning. **Nowadays, it's much harder to gain traction…so, it's much more competitive. There was an exponential curve of customer acquisition that I don't believe is continuing**. if you look at their number of customers and you plot it on a graph, you could probably see a good **plateau of NGS-specific customers within the last year."***

*Q: "Are there signs that you see that they're having growth or saturation challenges in their NGS business?"*

*A: "Yes."*

*Q: "What are those signs that you're seeing?"*

*A: "I'll put it like this: if they were only an NGS company, I would not look favorably in their - "*

*Q: "Well, they basically are because NGS is 60% of their revenue now, and it's their main growth driver."*

A: ***"The first two years I was with Twist, it was like customer acquisition - I got a new customer two, three times a week. And I still have many friends over there, and the mood isn't so great.*** *–Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

**The former employee indicated that Twist is getting especially saturated in NGS – the bulk of its revenue and its driver of recent growth. He stated that in his current role at a key competitor, he now has "visibility into a lot more than I had at Twist" and that he can "see the progression of the business, who has what, a lot more clearly." Based on his competitive intelligence, he stated that Twist has hit the wall: "since moving over, there's been no traction, no loss of business [to Twist] in what I would consider those whale accounts." He explained that the entire NGS market is driven by "only a handful of very, very large, what I'd call whales, the big, big, big NGS customers" that are "the driver" of NGS market growth. Based on their purchase activity, he stated Twist isn't gaining any share.**

***NGS market is driven by a handful or "very, very large customers"; Twist has now hit the wall per competitive intel***

*A: **"I'll say that there are only a handful of very, very large, what I'd call whales, the big, big, big NGS customers in the American market."***

*Q: "For hybrid capture or NGS specifically?"*

*A: "Yes, well, both. Library prep and hybrid capture. **Twist was able to gain traction with two of those within the time that I was there, but since joining [key competitor name redacted], I have visibility into a lot more than I had at Twist**, given it was all business development and [competitor name redacted] has had primer business in every molecular biology lab in the U.S., so I had a lot more visibility. **I could see the progression of the business, who has what, a lot more clearly. Since moving over, there's been no traction, no loss of business in what I would consider those whale accounts, and that really is the driver of a lot of sustainable and profitable growth in the NGS market or hybrid capture."***

*Q: "Who are those whales that are well-known in the hybrid capture market? Sounds like every competitor knows them."*

*A: "GeneDx, Regeneron, The Broad Institute, Ambry Genetics, and Tempus. They're are in the clinical market, as a service provider for health systems or hospitals for NGS. **That's where I would say all the run-rate, all the predictable and growable business is**. The other part of the market is the academic one, which is much smaller orders."*

*Q: "**You're looking at these customers' purchase activity** at [current employer name redacted, key Twist competitor] and whatever they're telling you, **and you're concluding that Twist is not going to gain any share?***

*A: **"Yeah, exactly."** –Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

**He stated that Twist's NGS trajectory isn't sustainable, that they lack the ability to play in the largest part of the NGS market, and that everything Twist offers within NGS is a "commodity." He explained that one of Twist's fundamental competitive weaknesses in NGS was its inability to make primers, which are "a huge portion of the [NGS] market," which means "they are lacking in the ability to grow" – "everyone makes a kit that's just as good as the other…it's not a huge difference…if I were to run all kits side-by-side, you wouldn't see much difference."**

***Twist's trajectory in NGS is unsustainable; lack ability to play in the largest part of the NGS market; essentially everything Twist offers is "commodity"; every player's NGS "as good as the other"***

*Q: **"Do you think that their NGS business or their trajectory is sustainable?"***

*A: "**I don't think it is**. I think they need to specialize more in library prep to compete with players who dominate that market like Roche, NEB, and even now IDT, and to making primers…where I think they are **lacking in the ability to grow is they can't make primers. That's a huge portion of the market**. That's one of the reasons why they said they were investing in enzymatic DNA synthesis. If they can pull that off, yeah, they would have the ability to make primers and enter that market but one that is a very saturated space, and it's very transactional."*

*Q: "Is their NGS offering basically a commodity?*

*A: "**I would say everything that they offer, with the exception of their probes, are a commodity."***

*Q: "Would you say the same thing about IDT and others? Or are you saying they actually have unique technology?*

*A: "I would say **the probes are also a commodity**. IDT acquired a specialized library prep company that made library prep chemistry that is unique to the market and applications, so a kind of niche player in that. Library prep, yes, is a commodity across the board. **Everyone makes a kit that's just as good as the other. It's not a huge difference** between the two. If I were to run all kits side-by-side, you wouldn't see much difference. Before there were bigger competitors in library prep, Roche and NEB dominated the market as they still do today." –Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

## An executive at Genscript - Twist's key Chinese competitor - provided similar market intelligence, stating that Twist hasn't had "much of an impact" on the market or companies like Genscript. He stated that they no longer see Twist as a threat nor even as a "major competitor." He called out their nascent, much-hyped antibody discovery business as a flop: "no basis to say they are taking market share from us."

***Twist hasn't had "much of an impact" on the market and key competitors like Genscript; don't see them as threat anymore or as a "major competitor"***

***"To be brutally honest, they really didn't have much impact as we thought they would [when they launched]…they really didn't have much impact on us, and our business continued to grow****, like 20% to 30% every year, which is beating the market in general on average, and we are still a market leader. So,* ***we haven't really seen them as a big threat as we thought they would be…we haven't seen much of an impact, and we don't see them as a major threat for business anymore.*** *I think it's quite analogous to this company called AbCellera, which is based in Vancouver, Canada. They also had big hype when they came to market. But the stock prices keep dropping, and people had too much of an expectation…it's not like these companies will be a gamechanger or anything in the market…In gene synthesis,* ***I really don't see them as a major competitor to us.*** *–Executive at Genscript, key Twist competitor*

***Twist is offering legacy products Asian competitors have long provided; cheaper and faster to order from Asia***

*"All of those services we already have at GenScript, and* ***we have been doing it for over 20 years now****. We are still the market leader and big in the space. Unless they bring something to the market that is cheaper because this is the thing about non-GMP services,* ***you don't have to use a company that's based in the U.S. because people can find a lot more affordable and quicker solutions outside of the country.****" –Executive at Genscript, key Twist competitor*

***Twist isn't taking market share from their key, low-priced Asian competitor***

*Q: "When you say they haven't made an impact in the market, you're talking about their antibody discovery effort?"*

*A: "Yes, usually antibody discovery, but even in gene synthesis,* ***just looking at our numbers, it has been going up steadily, and then there's no basis for us to say that Twist is taking a lot of our clients*** *because many of them return to us and maybe they are taking up customers that have not been working with us previously but the customers that we had been working with came back, but there is* ***no basis for me to say that they are taking market share from us."*** *–Executive at Genscript, key Twist competitor*

Source: Scorpion Capital consultation calls with experts

**We found the Genscript executive's color regarding Twist's face-plant in antibody discovery particularly interesting, given that Twist has hyped it as a key growth driver. He stated that he's recently met with 4-5 antibody discovery customers who worked with Twist, only to now return to Genscript, and that these customers painted Twist as overpromising and underdelivering – that they couldn't come up with antibody leads nor honor timelines, taking 7-8 months before failing. We encountered widespread derision of Twist's antibody hype – from ex-employees and other experts – such as a longtime executive in the space who called their hopes "naïve" as it's utterly unrealistic "to switch over from a tool company to a drug discovery company and make antibodies."**

***Customers returning to Genscript after trying Twist suggest its antibody offering is a disaster***

*Q "You said you were aware of 4-5 antibody discovery customers that have switched this year?"*

*A: "**Yeah, at least 4-5 antibody discovery customers switched to us** because that's the part of the business that I'm in, and for the other part, the gene synthesis part, you may want to talk to the other two people that I told you about."*

*Q: "What did they say about Twist antibody discovery offerings?"*

*A: "They pretty much told me the same thing that I described. They told them they had a plethora of antibodies in their library and that they could deliver a certain number of leads based on the screening. But the result that they got **didn't present them with that many leads from the screening. And the timeline that they promised was not kept. It usually takes about 4-5 months, but I think they went well over 7-8 months for many of them. And that actually wasn't a bad case. For a GMP manufacturing part, it's like one year**." –Executive at Genscript, key Twist competitor*

***Twists antibody ambitions are "naïve" given tools heritage and "gigantic legacy manufacturing and overhead"***

*""**To switch over from a tool company to a drug company and make antibodies and things like that**, it's easy to do a couple of deals. It's hard to actually turn the whole thing around and actually make it into anything…because it's so different. I've been in both worlds. **It's a completely different world. So, I think it's a bit naïve** to think that Twist can hire in Aaron Sato, who's an antibody expert who did some great things at Sutro and think that they're going to do that with all those **gigantic legacy manufacturing and overhead**." –Longtime executive in Twist's space*

Source: Scorpion Capital consultation calls with experts

**A third source of competitive and market share color, a regional sales manager who recently left IDT, Twist's key US competitor, stated that Twist initially took "substantial" share – "especially in NGS" – given their "insane prices," but that IDT is now "having a substantial amount of success at winning back the customers they had lost several years before," due to various frustrations with Twist's lead times and quality.**

***IDT initially lost customers to Twist but now having "substantial success at winning" them back, due to Twist's quality/consistency problems and its inability to make sufficient lot sizes***

*Q: "How much share did you guys lose to them, and what kind of customers? It sounds like it was the price-sensitive, less quality-sensitive customers. What was the impact on IDT's business at the time?"*

*A: **"Actually, early on, it was substantial, especially for NGS. They made a really big splash, and I think that their low prices compelled a heck of a lot of even tightly regulated clinical labs to switch over to them**. But, of course, you don't necessarily recognize low consistency in the short term. You recognize that after multiple years. At least **at the time that I left IDT, the team was having a substantial amount of success at winning back the customers that they had lost several years before."***

*Q: "And what did those customers say?"*

*A: **"That they need consistency. They need fewer lot numbers**. They need data that is going to be as close to perfectly replicated patient after patient after patient. And **because of the need for Twist to both amplify their panels and potentially introduce mutations and the inability to make very large lot sizes, that impedes their ability to make a consistent product**. To put it in perspective, a company like an IDT could make one lot to last a clinic one to two years. Whereas Twist could make one lot to last them a matter of weeks. There are massive cost savings from the intake quality control standpoint. The quality control team of the clinics doesn't have to be running experiments all the time."*

*Q: "And you're referring to NGS here?"*

*A: "Yes, I'm referring to NGS here, yes." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

## We note that this IDT research source competed head-to-head against Twist for years, and was forthright in acknowledging IDT's initial share loss to Twist as it entered the market with "shocking" discount of 75%. However, he now observes that "there's definitely a change in customer attitude happening" away from Twist – despite is radically lower prices.

***Twist used "shocking" discounts of 75% to lure customers aways from Danaher/IDT; "change in attitude" among customers toward Twist as they now return to Thermo, which allegedly used the phrase "Ponzi scheme" in internal discussions to describe Twist***

*A: "I think there's **definitely a change in customer attitude happening. How quickly that happens, I don't want to get wildly excited about it, but I think it's happening."***

*Q: "How much lower were they on price to steal all of that business like NGS? What was the magnitude of the price disruption they caused?"*

*A: "I had customers that left me for prices at 25% of what I was charging them."*

*Q: "So, they were offering a 75% discount?"*

*A: **"Seventy-five percent discount. That is correct. It was shocking."***

*Q: **"It sounds similar to a Ponzi scheme**. It's like you're basically giving away product. You're buying market share. You burn money hand over fist to show growth. Then, the only way you can show more growth is by raising more money to give away more money to customers with these obscene prices."*

*A: "**Yeah, I think that was the exact phrase that was used in internal discussions, yeah."***

*Q: "You guys used the phrase "Ponzi scheme," or somebody mentioned it?"*

*A: "Yeah…**it was a word that was used. There was a remarkable amount of skepticism, which is why the response was patience. Let's see how this plays out."***

*Q: "Did you hear that word more than once, just out of curiosity?"*

*A: "Yeah, absolutely."*

*Q: "How is this sustainable?"*

*A: "I don't know. I didn't buy Twist stock when they went public." –IDT ex-regional sales manager, left recently*

Source: Scorpion Capital consultation calls with experts

**He added that IDT is Twist's "biggest threat" in NGS, and that the large players have all "released new chemistry" that eliminated Twist's momentary advantage within their little niche in NGS. He continued that he's "not bullish about their NGS products" and described a race to the bottom in pricing – "it's a much more competitive space."**

***IDT is Twist's "biggest threat"; large players have "released new chemistry" that eliminated Twist's momentary advantage within their niche in NGS***

*Q: "You're saying they're trying to pick off the price-sensitive customers from Roche and others? That's their game?"*

*A: "Price and actually it is the performance of their probes because of the way that they manufacture probes, they have edged out what was aging technology from Agilent and aging technology from Roche.* ***IDT was the biggest threat when I was at Twist, and one of the reasons why I saw a lot of value in [redacted] was I didn't want to work for a company that didn't perform as well. Since joining, Agilent has released new chemistry, and so has Roche. So, they've all caught up to that, and it's no longer a big advantage."*** *–Former employee now at a key competitor*

***"Not bullish" on their NGS offering; race to the bottom in pricing; competitors' NGS chemistries have caught up***

*A: "****I'm not bullish about their NGS products****. They had a dominant position in hybrid capture when chemistries weren't caught, and performance wasn't caught up in their ability to sell the unique relationship. I think the business models have changed at their competitors to catch up. So, it's a much more competitive space. "*

*Q: "****Is it a race to the bottom in pricing?"***

*A:* ***"Usually, sequencing comes first, and that's what's happening****. Everyone's going to focus on the race to the bottom for sample prep next. I think if sequencing costs less than sample prep, then the market has to adapt." –Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

**A recurring theme during our research interviews was Twist's difficulty in competing against large players that own the market – which is why it had no way to break in except via its insane discounting and customer subsidy scheme. Our research suggests that these players are now actively using their fly swatter, and Twist is starting to struggle. For example, Novartis stated that it plans to reduce its spend with Twist in favor of larger vendors that are "dominating more and more of the market": "Twist is not a big vendor, and they cannot offer many different things. They have their market, which is laboratories in universities and smaller startups…."**

***Twist's chip can only make smaller oligos, which are a small niche; limited growth opportunity; larger vendors will continue to dominate; Twist may "go bankrupt" or "collapse"; Novartis plans to reduce spending with Twist***

*Q: "You're saying these guys have a niche in very early-stage research with a very short oligos product.*

*A: "Exactly. For that product, yes.* ***It's a very dedicated niche…I don't think the stock will suddenly in two years or in five years that everybody will buy from Twist."***

*Q: "Why is that?"*

*A: "Because I think the* ***big ones are getting bigger and bigger and dominating more and more of the market, and big pharma is consolidating with a smaller number of vendors that have a better offering****. And Twist is not a big vendor, and they cannot offer many different things. I think they have their market, which is laboratories in universities, smaller startups, and some part of pharma, but* ***they will not suddenly grow like crazy…what could happen in the future is that they go bankrupt or they collapse because at some point, if they are selling everything at a lower price, I don't know how they are going to compensate for that."***

*Q: "Do you plan to spend less or more with them or about the same per year?"*

*A: "Probably every year,* ***it will decrease because we will invest more into the Thermo's and the Sigma's because they will dominate more and more."*** *- Novartis, a large Twist customer, scientist in a leadership role*

Source: Scorpion Capital consultation calls with experts

**Ex-employees and other experts indicated that Twist's total addressable market is tiny, particularly in NGS – perhaps a few hundred million dollars. NGS comprises half of Twist's revenue and has been its key driver of recent growth. Despite its hype and lofty aspirations, Twist's financials show that it remains for all intents and purposes nothing more than a commodity NGS play – and the small TAM helps to explain why Twist is fast approaching saturation. The NGS market is composed of two segments: hybrid-capture and amplicon sequencing. Hybrid-capture is the smaller of the two, with one former employee saying it's "hundreds of millions…probably less than $500 million" with Twist attempting to compete for a small pie against Agilent, Roche, and IDT.**

***Two primary methods in NGS, and Twist only plays in the niche one***

***"An NGS is what you mentioned where you make a probe****, and you put a piece of biotin on it, and that sequence, it's specific to a sequence that the customer defines, and I'll use an example like BRCA 1, BRCA 2. You want to sequence only that.* ***You have two ways of doing it. One, you can order a primer, and you can get a primer set to amplify it and then sequence it. Or you order a hybrid capture probe*** *that has the sequence of BRCA defined in it. Build the library up and pull it out, and then put it on a sequencer and sequence only what you pulled out using the probes." –Former employee now at a key competitor*

***Twist's TAM in NGS is less than $500MM and is dominated by divisions of large players like Roche, Agilent, and Danaher***

*"Specifically, hybrid capture, it's* ***hundreds of millions. I would say probably less than 500 million, and it's dominated by four key players*** *in the market: IDT, Twist, Roche, and Agilent." –Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

# Twist is locked out of most of the NGS total addressable market because its technology can't make enough mass for primers – "this is well known" – thereby dooming them to a little niche with only a "fixed amount of space": "they don't have the core competency"; space is "owned by their competition like Roche."

***No ability to enter the broader NGS market; "don't have the core competency"; space is "owned by" Roche***

*Originally, they were a synthetic biology company, and the NGS market for targeted sequencing is a very specific one that is only what they are addressing.* ***Their ability to enter the broader NGS market is limited because of the fact that they make probes for hybridization capture*** *—targeted sequencing. The rest of the market is either of the two: one being old genome sequencing, that's just library prep. It doesn't involve an enrichment step. They can sell into that, but they* ***don't have the core competency to go after run rate business that is owned by their competition like Roche****." – Former employee now at a key competitor*

***Twist's technology is too limited to enable them to play in "a significant portion" of the NGS market***

***"The other part of the market that they can't address is making primers****, which is something that IDT does and tother companies.* ***Their technology doesn't really produce enough mass—and this is well-known—to make primers, which make up a significant portion of the targeted sequencing market****. From my perspective, you go and address the hybrid capture market. There's a fixed amount of space there. Then there's the rest of the NGS market, which you need tools to address. Their core competency from their original business was to make lower-costing synthetic biology products." –Former employee now at a key competitor*

***Inability to make primers – a key weakness of their technology –locks them out of most of the NGS market***

*"Taking a step back, there are really two different reasons someone would use NGS. One is to profile an inherited change in a genome or a portion of it. To sequence a portion of it, you need to use hybridization capture or—and I'll cite an example—or use primers.* ***Twist just can't make primers because their technology is limited in making the mass, the actual mass of primer that's required to run PCR****. So, you can search for inherited disease. You do that two ways. One, you can run an exome, which is what Twist offers, which is what IDT offers, and which is what Roche, Agilent, and others offer. Or you can sequence the whole genome, the entire thing. So, you don't need to use target enrichment to sequence that. You just need a library prep kit. Twist has a library prep kit but doesn't really market it very well to address whole genome sequencing because* ***they don't have other components that are needed to run a PCR-free workflow, which is what I think the whole genome sequencing community is migrating to****." –Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

**To make matters even worse for Twist, it's already trivial TAM within its corner of the NGS market is further limited by its inability to make key components of the NGS workflow, namely library prep kits and NGS reagents/enzymes, which drive "most of the revenue". In other words, two of the three components purchased in an NGS kit are prep kits and reagents, and Twist has to resort to purchasing these components and merely being a reseller. A former employee stated that of Twist's NGS hybrid capture TAM of only a "few hundred million," "most of that market, the number that I specified, most of that is library prep…they have purchase it elsewhere and resell it."**

***Even within Twist's niche in NGS, revenue is actually dependent on library prep kits, where Twist is a reseller***

*"**It's worth noting that most of the revenue associated with a hybrid capture workflow comes from library prep**. It doesn't actually come from hybrid capture. Those are the two components in that workflow. **So, most of that market, the number that I specified, most of that is library preop**. And another two players are added there: Illumina, who makes the machines, and NEG, and IDT just acquired a company that specializes in this. It's well-known that they don't manufacture their library prep kit. **They have to purchase it elsewhere and resell it**, so their margins are less on that." – Former employee now at a key competitor*

***Twist doesn't make the NGS reagents/enzymes either – the other key component of their NGS niche***

*"When you purchase a workflow that's targeted, you have to purchase basically three components, all that Twist and all other competitors offer. Number one is library prep. There are some library prep that specialize for certain sample types, for example, and there's other general bread and butter library prep, and that's **what Twist offers is a bread and butter library prep kit**. You have to purchase that. For larger deals, they'll discount it down, but generally, that list price is right around $25 to $30 per sample. The next component you have to purchase is the probes. For what Twist offers, it depends on how many probes you have, and the pricing is tiered based on whether you're purchasing 1000 probes or 50,000 probes. **The third component you're purchasing is the reagents that go with hybrid capture, all of which Twist offers. They don't make the enzyme**, which is true for other companies. There's only a handful of enzyme manufacturers in the world —it's a very small industry for enzyme manufacturing." –Former employee now at a key competitor*

Source: Scorpion Capital consultation calls with experts

**Even IDT, Twist's key competitor, remains a niche player given the tiny size of the market. An executive who has competed against both IDT and Twist stated that "IDT is the oldest and most reliable company" in the space, and just like Twist, they "tried to go longer [sequences] and go into genes, and they had the same problem." He stated that although IDT is a good company, they are "never going to be huge because they have a niche market…"**

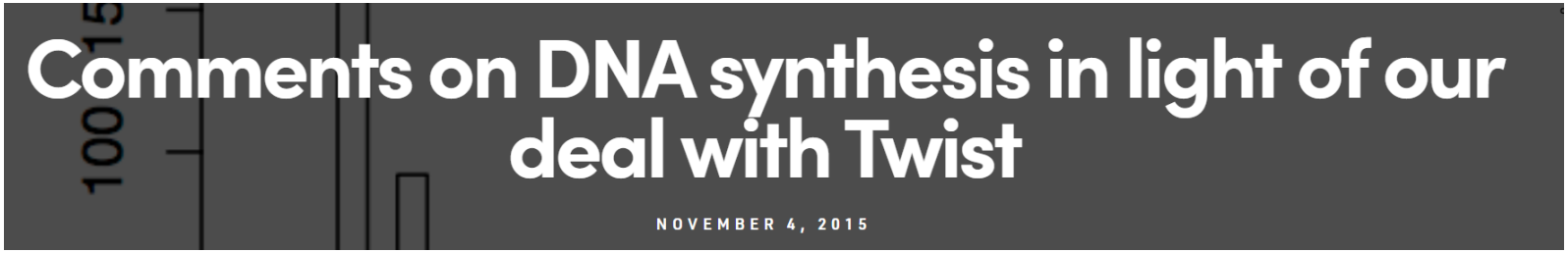
***Oligos space is dominated by IDT, which remains a niche player given the tiny size of the market; tried expanding like Twist but no way to make money***

***"IDT is the oldest and most reliable company in the oligos space. They are really good at oligos. They had tried to go longer and go into genes, and they had the same problem****. And they were really an efficient and effective company. We knew them very well and worked very closely with them. I went on a tour of their old facility twice, and it took three hours. We know the founders. It's a really good company, but they're* ***never going to be huge because they have a niche market that they're very good at, and they own it****." –Founding member of Gen9, an almost identical company to Twist*

Source: Scorpion Capital consultation calls with experts

**While Twist, like every "synthetic biology" company, promotes TAM figures in the tens of billions, investors are missing a key point – that Twist's insane pricing has already nuked its addressable market size. When Twist and Ginkgo announced their signature deal in 2016, a Ginkgo co-founder published a blog post discussing their "commitment to buy 100 million base pairs of DNA from Twist Bioscience." He stated that "by volume, this equals 10% of the global volume for gene synthesis in 2015." At a pricing of 10 cents per base pair, that pegged the TAM at a mere $100MM. Even if the market is now 10X the size, that's still only 10B base pairs – and given Twist discounts of >75% and pricing to Gingko we believe to be 1.5 cents, one can easily do the math. Twist's TAM is like a treadmill where one has to keep running faster to stay in the same place.**

***Blog post by Ginkgo Bioworks co-founder Barry Canton***




Source: https://www.ginkgobioworks.com/2015/11/04/comments-on-gene-synthesis-in-light-of-our-deal-with-twist/

**In a commodity market like synthetic DNA with a race-to-the-bottom in pricing - kicked off by Twist – the TAM simply keeps shriveling. The Ginkgo post noted that price per base pair was in 2005 was $1 per base pair and 30 cents per bp in 2014. Assuming Twist list pricing around 10 cents, then presumably further reduced to 1.5 cents in the Ginkgo deal, pricing has fallen 98.5%. Volumes have to increase exponentially for the TAM to stay flat – and comments by Ginkgo and Twist indicate that volumes are growing at a modest pace while prices have collapsed. Ginkgo and Twist announced a new deal in April 2022, in which Ginkgo CEO's stated that "over the past four years, we ordered approximately one billion base pairs of synthetic DNA from Twist" – a comical $15MM in 4 years from the "dominant" player, assuming 1.5 cents per base pair.**

***Twist and Ginkgo press release, Apr 5 2022***

"We love to make investments alongside incredible partners like Twist. Over the past four years, we ordered approximately one billion base pairs of synthetic DNA from Twist, allowing us to test hundreds of thousands of proteins across dozens of programs for our customers, resulting in many completed programs spanning vaccine manufacturing, food, flavor, fragrance and even cannabigerol (CBG)," said Jason Kelly, CEO of Ginkgo. "As we grow our capabilities to meet an increasing number and variety of customer needs, we are excited to continue partnering with leading companies in our ecosystem, which includes making sure we secure the high volumes of DNA that Twist is well positioned to supply."

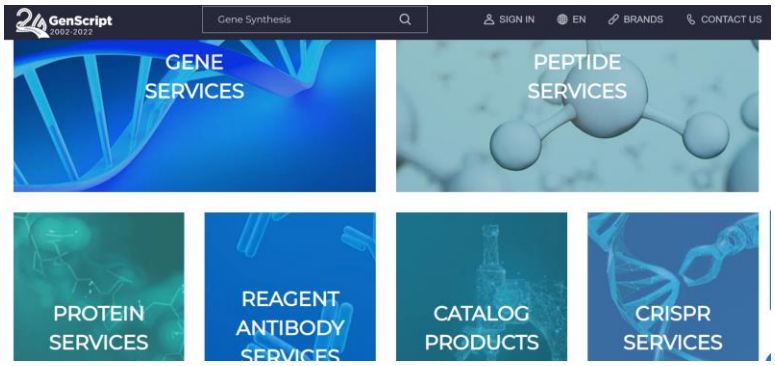
Sourcehttps://www.businesswire.com/news/home/20220405005337/en/Twist-Bioscience-and-Ginkgo-Bioworks-Sign-New-Collaboration

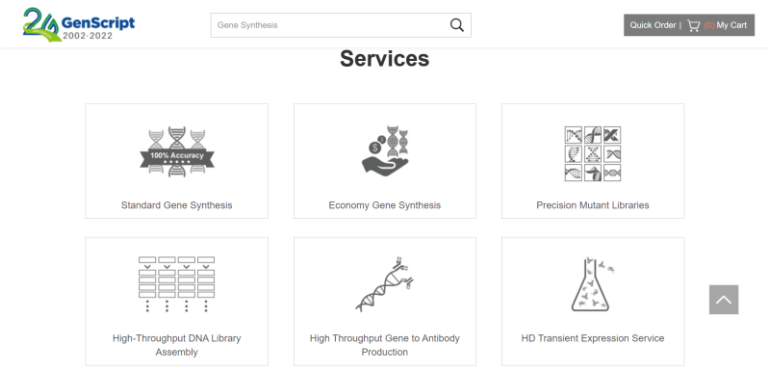
**Twist has one of the most horrific competitive positions we have seen – which helps to explain its mind-bending losses. One side, it competes with cheap Chinese players like Genscript and Genewiz. On the other, it competes against larger established players like Danaher/IDT, Roche, Agilent, and others. And we're ignoring the swarm of smaller, local players proliferating Google ads adverting the lowest price per base pair. Yet it gets worse: an impending flood of disruptive, venture-backed entrants with newer technologies and approaches that can produce longer sequences, at even lower prices, with better quality. An ex-employee stated that "our competitors mainly are Chinese companies" while Twist has to pay "Bay Area salary and so on." Genscript, for example, is $5.5B market cap and has 3X Twist's LTM revenues.**

***Twist's main competitors are low-cost Chinese players with cheap labor vs. Twist's Bay Area cost structure***

***"Our competitors mainly are Chinese companies**. You look at GENEWIZ and GenScript, and their founders are Chinese, and they have a lot of business in China. In that sense, they are very competitive in terms of pricing. Twist built a lab in the Bay area. **You have to pay the Bay area salary and so on. That's why the competition is very great**..." -Ex-Twist executive*

***Genscript website – same services as Twist***




Source: https://www.genscript.com/bioengineering.html

**About 6 months ago, Genscript – through it's Custom Array division - released a "silicon DNA chip" that trounces Twist's oligo synthesis capabilities, with the capacity to manufacture 8.4 million oligos simultaneously vs. Twist's claim of >1 million. A former Twist employee indicated that it "even surpasses Twist's ability to play in that space" and that Genscript's "manufacturing platform" is "extremely similar to Twist." Genscript is also a money-losing dumpster fire, so the announcement doesn't validate Twist's space, but merely highlights that Twist is not even the tallest midget in the room.**

***Dec 2017 press release***

GenScript Debuts Industry's Highest Throughput DNA Synthesis Platform for Commercial DNA Digital Data

***Each CMOS DNA chip carries 8.4 million unique oligos***

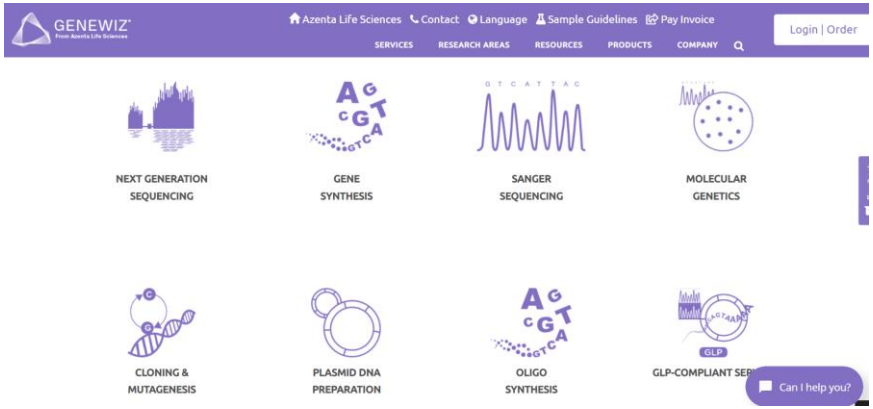
***Ex-Twist employee: GenScript chip "surpasses Twist's ability"; "extremely similar to Twist"***

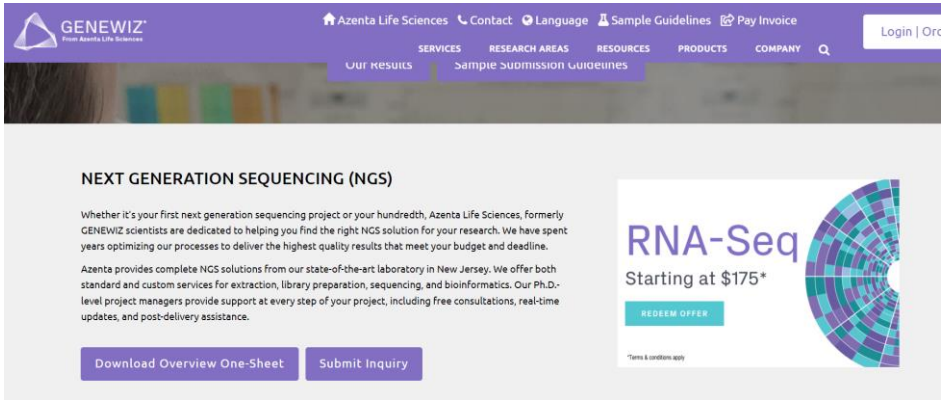
*"However, recently, I don't know if you caught* ***the announcement from GenScript with their new semiconductor synthesis platform and their ability to make, I think it's over 8 million unique oligos, which even surpasses Twist's ability to play in that space****. GeneScript is focusing on synthetic biology. I would argue that's Twist's core focus. If you look at all of their products, most of them are synthetic biology driven.* ***GenScript just came out with a semiconductor manufacturing platform that's extremely similar to Twist****, so I wonder about the future uniqueness of their ability to play in both markets, NGS and synthetic biology, in the five-year stretch."" –Former employee now at a key competitor*

Source: https://www.prnewswire.com/news-releases/genscript-debuts-industrys-highest-throughput-dna-synthesis-platform-for-commercial-dna-digital-data-storage-301525131.html

# Two other Asia-based players – Genewiz and Biointron – offer exactly the same menu of services as Twist. Genscript. Biointron just raised $75MM of new funding.

***Genewiz website***




***Biointron website***



Source: https://www.biointron.com/; https://www.genewiz.com/

**We previously quoted an ex-Twist employee in a senior role, who was a Twist customer at his new employer but is "rarely using Twist now" after being "frustrated" with delays and quality problems. He indicated they have shifted their business to Biointron, and raved about their speed and service delivery vs. Twist, despite the fact that they're based in Asia.**

***Ex-senior manufacturing employee was a Twist customer at his new employer but now using Biointron***

*"There's a lot of competition. You probably realized we're shifting a lot of the business away from them, actually. We're rarely using Twist now. That's my current company's situation. So, a lot of gene synthesis, the majority of gene synthesis is called protein expression. It's a protein or an antibody**. We can actually use a different company in China called Biointron. They synthesize DNA from DNA synthesis to deliver protein in three weeks. That's three weeks. Twist can barely deliver DNA construct**. And the other company can deliver proteins."*

***"We pretty much stopped it all now because after we found out, there's a company Biointron that can make the protein in two weeks plus shipping, a total of three weeks**. If you use all the agents and protein, they can make the protein in three weeks, plus one-week shipping from China to here; it's four weeks for protein, and in that time, we can get a DNA construct. Essentially, it's **significantly faster**, so we completely shifted to Biointron for most of the services we need. For most of our DNA synthesis, we do the coupling ourselves, just order the gBlock from IDT, or we get the service from GENEWIZ. **It Twist takes two to three months to get protein from DNA synthesis. Two to three months. This is three or four weeks plus shipping."** – Former Twist employee, director-level*

Source: Scorpion Capital consultation calls with experts

**In addition, Twist faces an impending existential threat from a long list of emerging companies with newer DNA synthesis approaches. We note that Twist's customers appear to be well-aware of these new entrants and are following them closely. An early and key Twist customer stated that Twist basically has no intellectual property, and that there are "20 different companies developing different technologies which have proof of principle…or have the potential to compete quite dramatically with Twist." In particular, he mentioned Evonetix in Cambridge, MA, DNAScript, and a Bay Area company called Elegen Bio that states "they can produce oligos twice as long as Twist's…there are lots of new companies coming into the space."**

***"20 different companies developing different technologies" with "the potential to compete quite dramatically with Twist"; able to product oligos "twice as long as Twist's"; "lots of new companies coming into the space"***

*A: "Yeah. Their only real IP is in the miniaturized equipment that they use for printing, and there are other companies developing platforms that might have similar functionality."*

*Q: "Who are those? Who do you think the biggest threats are?"*

*A: "DNAScript.* ***There are a number of startups that - Evonetix in Cambridge, GenScript. One of the things that differentiated Twist for a while is the length of the oligos. A Bay area company called Elegen Bio says they can produce oligos twice as long as Twist's. There are lots of new companies coming into the space*** *developing new methods, many of whom have demonstrated proof of principle."*

*Q: "Elegen Bio - have you used their product, or you're just aware of them?"*

*A: "They're not selling stuff at the moment. I think the general principle holds that there is a whole raft of companies, maybe* ***20 different companies developing different technologies which have proof of principle or have some business operating that have the potential to compete quite dramatically with Twist****."– Major Twist customer, one of largest genomics centers in Europe,*

Source: Scorpion Capital consultation calls with experts

**A longtime executive in the space who founded a key Twist competitor and is an active investor highlighted DNA Script and Molecular Assemblies as particularly disruptive to Twist. DNA Script "has an enzymatic process they're making at benchtop…kind of like an Illumina sequencer." He indicated confidence that Molecular Assemblies' enzymatic synthesis process and their service model are going to work."**

***Disruptive competitors on the horizon like DNA Script and Molecular Assemblies***

*Q: "Any emerging competitors that they should be worried about?"*

*A: **"DNA Script, number one, and Molecular Assemblies, I think, are probably two of the frontrunners I'd watch for** on the DNA synthesis and gene synthesis side."*

*Q: "How are they going to disrupt the space or disrupt Twist?*

*A: **"DNA Script has an enzymatic process that they're making at benchtop, so it'll be kind of like an Illumina sequencer** model, you know, multiple different sizes but one for every lab from the individual researcher to the group to the core lab to the genome center. That's DNA Script. They're making a product instead of a service. **Molecular Assemblies—I know a little bit about them, actually a lot about them. Their enzymatic synthesis process and their service model are going to work**. They've got a really good R&D team. They've got a really good CEO, Mike Kamdar, and they've got a hell of a commercial team that's chomping at the bit to get out there when the product's ready. Those would be the two that I would watch for." –Longtime executive in Twist's space; ex-founder of a key competitor*

Source: Scorpion Capital consultation calls with experts

**This executive, whose knowledge of the competitive landscape struck us as detailed and insightful, outlined how Twist is flanked by large incumbents like IDT and Genscript on one side – in business far longer - and new entrants on the other. He stated that Twist's offering is "no different from about 45 other companies," and that newer "enzymatic DNA methods will replace the oligo pools produced" by Twist as "it's going to be super cheap." He also pointed out the existential threat from whole genome sequencing – as costs plummet to sequence an entire genome, there's no need to buy a Twist NGS panel to sequence part of it.**

***Twist has challenges from entrenched incumbent competitors as well as low-cost Asian ones***

*"From a competitive situation, **IDT has still got a great business. GenScript still has a great business. You see multiple new competitors start in this space. I think there are going to be some challenges coming up in the future**. GenScript has been around since before Twist, and they've done fairly well in growing. There are some **new ones springing up**," –Longtime executive in Twist's space; ex-founder of a key competitor*

***Twist should be "worried" about being disrupted by enzymatic DNA methods and whole genome sequencing***

*"**I would personally be more worried if I were Twist about the companies that are coming online** with the desktop gene printers as well as some of the new enzymatic DNA methods. **I think the enzymatic DNA methods will replace the oligo pools produced otherwise because it's going to be super cheap**. But then whole genome sequencing is getting so cheap. Why would you do pools anymore if you get the whole genome for $100? There's **no use buying something to do a panel, which will cost you $20 when the whole genome is $100**. So, I'd be worried about enzymatic DNA synthesis. I'd be worried about the desktop synthesis. And I'd be real worried about the price of whole genome sequencing." –Longtime executive in Twist's space; ex-founder of a key competitor*

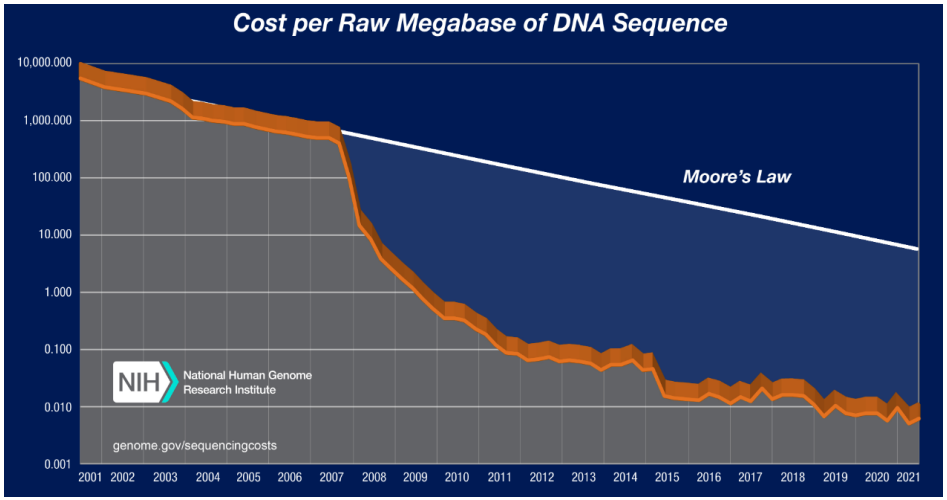
***Twist's antibody business is "no different " than "45 other companies"; "really big challenge in the marketplace"***

*"The antibody business that they've embarked on,..what they're doing is **no different from about 45 other companies**. Distributed Bio, which is now part of Charles River—both of those companies are younger, and both of those are making much more money and far more profitable than Twist. And you've got to ask the question, why is that? They're focused, they have a better product, and they have a higher quality discovery system. **Twist is going to have a really big challenge in the marketplace**." –Longtime executive in Twist's space; ex-founder of a key competitor*

Source: Scorpion Capital consultation calls with experts

**The cost of whole genome sequencing has fallen much faster than Moore's law, with players already targeting a cost <$100 vs. $10K and $1K ten and five years ago, respectively. The only point of Twist's NGS offering is to sequence a small part of the genome given the cost of the entire genome. As the previous expert indicated: "Why would you do pools anymore if you get the whole genome for $100? There's no use buying something to do a panel, which will cost you $20 when the whole genome is $100. So, I'd be worried about enzymatic DNA synthesis. I'd be worried about the desktop synthesis. And I'd be real worried about the price of whole genome sequencing."**

***Plummeting costs over time, and 2022 articles on cost approaching $100***




**A $100 genome? New DNA sequencers could be a 'game changer' for biology, medicine**

"This is the year of the big shake-up."

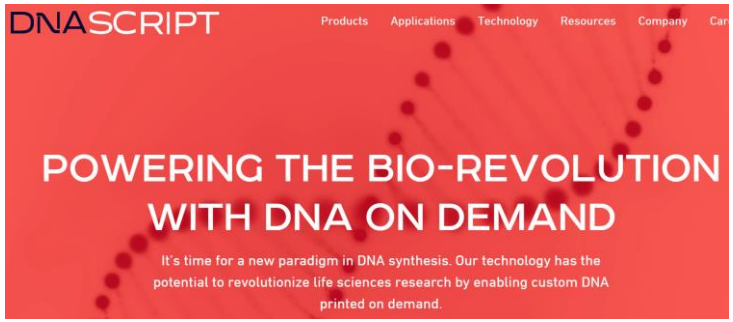
**Ultima Genomics Claims the $100 Genome and Raises $600M to Go Even Lower**

Sourcehttps://www.science.org/content/article/100-genome-new-dna-sequencers-could-be-game-changer-biology-medicine; https://singularityhub.com/2022/06/05/ultima-genomics-claims-the-100-genome-and-raises-600m-to-go-even-lower/; https://www.genome.gov/about-genomics/fact-sheets/DNA-Sequencing-Costs-Data

**Anyone researching these companies would be struck by the imminent disruption coming Twist's way, and how old and passe Twist's oligo manufacturing process is versus emerging players already backed with significant capital.**

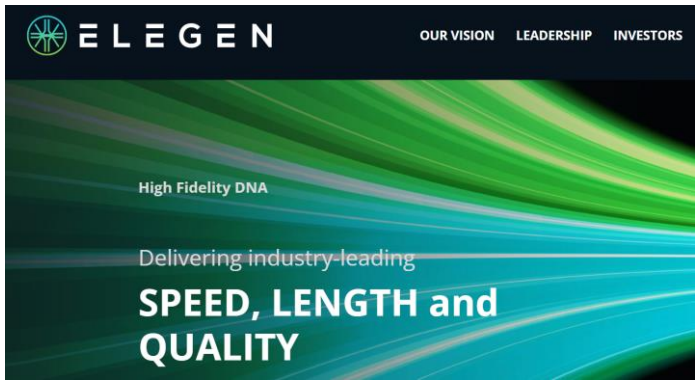
***Ultima Genomics***


***DNA Script***

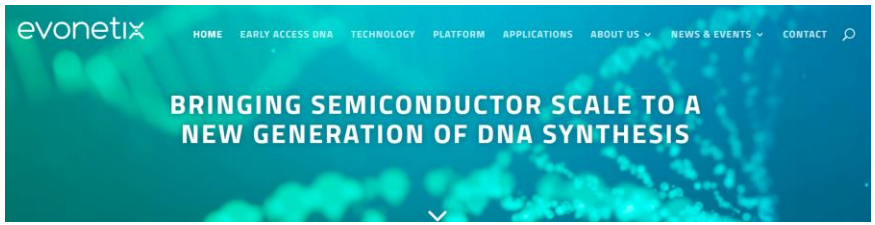



***Molecular Assemblies***


***Elegen Bio***




***Evonetix***

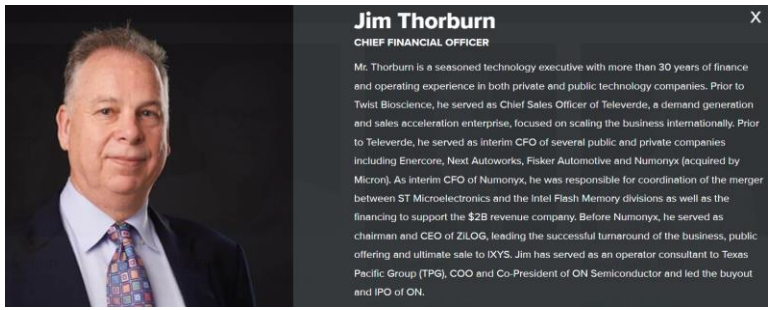



Source: https://www.ultimagenomics.com/; https://www.dnascript.com/; https://molecularassemblies.com/; https://www.elegenbio.com/; https://www.evonetix.com/

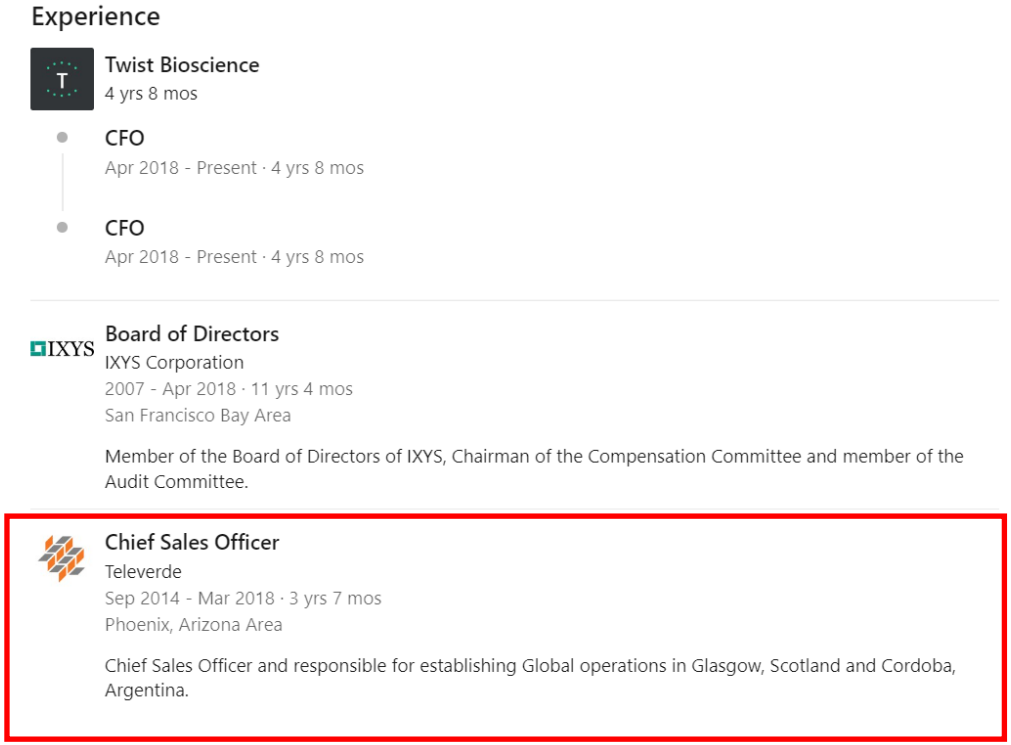
**Part VII: Twist's management exhibits striking red flags, with suspicious transactions with opaque, offshore Chinese entities, and its largest holders at IPO appear to be a cesspool of bad actors.**

**We are troubled by the background of Twist's CFO Jim Thorburn, who immediately prior to Twist was the Chief Sales Officer of Televerde, a controversial company whose business practices we shall detail. His LinkedIn Bio states he was at Televerde for ~3.5 years, and helped establish its "global operations in Glasgow, Scotland and Cordoba, Argentina." We note that the bio doesn't state what Televerde does or what these "operations" are.**

***CFO profile on Twist's website***




***CFO's LinkedIn profile***




Source: https://www.twistbioscience.com/company/team; https://www.linkedin.com/in/jim-t-5bb87a6/

**When we asked an ex-Twist executive about related-party transactions, he stated that "two people in the finance organization…still had some minority stake," referring to Televerde. He described Televerde as an "outsourcing company" that provided "second and third-level sales support" for Twist, and described the size of the relationship as "a couple of million bucks a year at most." We do not know whether the ex-executive's statements are accurate, and have not verified whether Televerde provided any services to Twist.**

***Ex-executive indicated that Twist has a related-party relationship with Televerde***

*Q: "Did they have any relationships with related parties when you were there?"*

*A: "I'm only aware of one, and they were disclosed, and* ***a couple of people in the finance organization had shares in a company that provided calls to customers****. That's the only one that I'm aware of. It was a company that provided second and third-level sales support. So, it was an outsourcing company. But that's the only one that I'm aware of. I believe it's disclosed as well."*

*Q: "Who owned it?"*

*A: "I'm not too sure of the entire ownership structure.* ***There were two people in the finance organization that had worked there and still had some minority stake."***

*Q: "And what did the company do for Twist?"*

*A: "They provided sales support. So, second, third-tier types of customers calling out, reaching out, and trying to generate business and support. That's what they did in the outsourcing provider market."*

*Q: "How large was that relationship?"*

*A:* ***"A couple of million bucks a year at most****, at least when I was there. Not big."*

*Q: "What is the name of that entity/business?"*

*A: "It may come back to me as we talk but right now, it's not coming to mind. Televerde."*

*Q: "Televerde: revenue and growth solutions for B2B companies?"*

*A: "You found it."*

*Q: "What was the relationship of these people with Twist?"*

*A: "There were* ***two senior individuals in the finance organization****…they had equity in that company as they were previously employed by that company prior to joining Twist." – Ex-Twist executive*

Source: Scorpion Capital consultation calls with experts

**We could not locate any mention of Televerde in the related-party transactions section of Twist's SEC's filings. However, the LinkedIn profile of an ex-Televerde employee mentions Twist and implies it is a client for call-center activities related to sales and marketing. If true, and if the CFO retains stock in Televerde, we would question why it's not disclosed in the related-party section of the filings.**

***LinkedIn profile of an ex-Televerde employee***

Televerde
Full-time · 2 yrs 6 mos

Campaign Manager / Project Coordinator
Feb 2020 - Aug 2021 · 1 yr 7 mos
United States

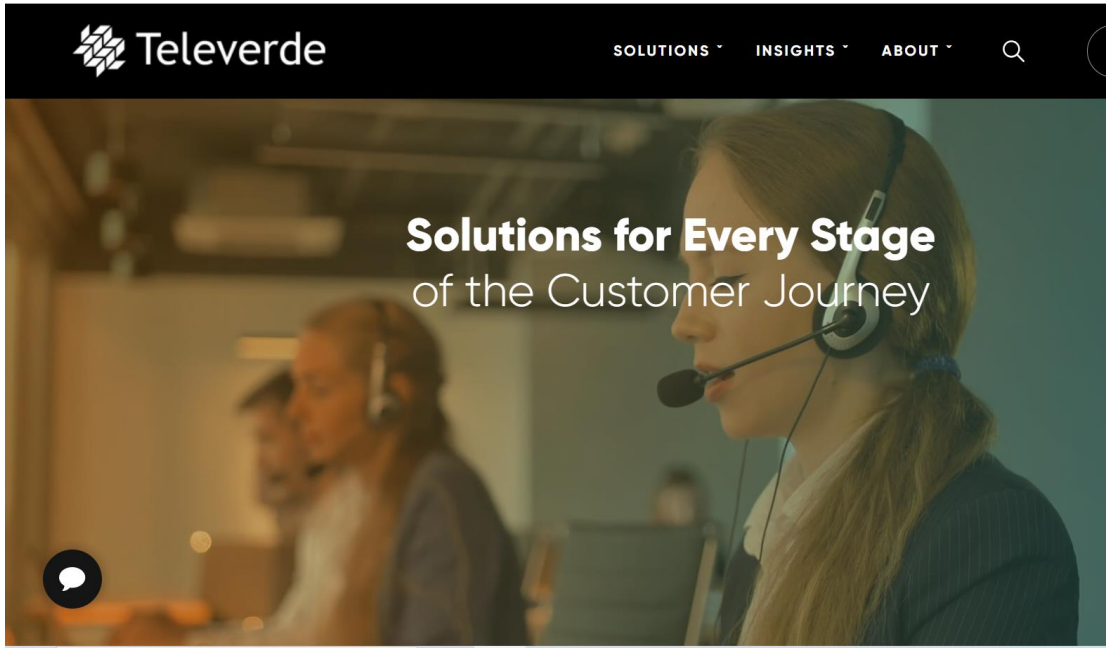
Clients I have worked with include VMware, Masco - Watkins Wellness, Xactly Corp, Ingram Micro, Cisco Partners, Adobe Magento, Twist Bioscience, Invoice Cloud, A10 Networks, iCIMS and New Relic.

Under general direction of Director of Client Success, the Campaign Specialist is the primary point of contact between the assigned client(s) and internal teams within Televerde. The Campaign Specialist is responsible for partnering with the Account Manager to design and develop effective marketing strategies and campaigns that will achieve client objectives. This role also has ultimate responsibility for the success of all client projects, including campaign performance, client satisfaction, profitability, and probability of account retention.

Source: https://www.linkedin.com/in/marialenava/

**Televerde's site describes itself as "Revenue Growth Solutions for B2B Companies." Its homepage opens with women dressed in normal work garb, and highlights its value proposition as say "no to high turnover" and "no to unnecessary overhead costs."**

***Televerde website - excerpts***




## Say 'Yes' to 'No'!

Say "Yes!" to:
No to high turnover
No to unnecessary overhead costs
No to costly hiring, training and extensive onboarding
No to the stress of figuring how to quickly ramp up or down

Source: https://televerde.com/

**While Televerde's site opens with women styled with makeup, coiffed hair, and office outfits, the company is in the "prisoner-leasing" industry, staffing its operations with incarcerated women – who appear to work in orange prison jumpsuits - exposing the grotesque irony of its tagline say "no to high turnover" – they can't go anywhere. Televerde is the subject of extensive, recent reporting, particularly by the Arizona Republic which conducted a 15-month investigation, as it's based in Arizona.**

***Arizona Republic article, July 20, 2022***

## Once seen as crass profiteering, Arizona prisons are all in on leasing prisoners to private companies

Televerde, an integrated sales and marketing technology organization, pays prisoners the state minimum wage. But after deductions, prisoners earn much less. *Illustration: Merry Eccles, USA TODAY Network; Photo: Arizona Correctional Industries*

***"Televerde, an integrated sales and marketing technology organization, pays prisoners the state minimum wage. But after deductions, prisoners earn much less."***

Sourcehttps://www.azcentral.com/story/news/local/arizona-investigations/2022/07/20/these-companies-arizona-use-prison-labor/10064188002/

**We find the allegations troubling, with one article stating that "many compare this to a kind of modern slavery," pointing out that it's legal in the US despite the "federal trade law [which] bans importing goods made by forced prison labor." Prisoners allegedly make 10-50 cents an hour, working for a "state-owned company called Arizona Correctional Industries" that "sells prisoners to private companies that want cheap or captive labor."**

***Article dated July 19, 2022***

## A woman's climb through Arizona's prison labor system shows entrenched racism and labor abuse

***Article dated July 18, 2022***

## She had it better than most Arizona prisoners but says she still faced racism and labor abuse. 'I don't think I'll ever forgive them'

Lola N'sangou landed a prison job with Televerde, a sought-after telemarketing firm, but she says the experience left her feeling exploited.

***Article dated July 18, 2022***

## Arizona changed how it sells prisoners to companies. The state raked in millions, but workers were neglected

Inmates work for far less than minimum wage, sometimes at dangerous jobs that leave them injured. The state says it follows all federal laws.

Source: https://fronterasdesk.org/content/1796008/womans-climb-through-arizonas-prison-labor-system-shows-entrenched-racism-and-labor; https://www.azcentral.com/in-depth/news/local/arizona-investigations/2022/07/18/arizona-prison-system-exploited-her-labor-she-kept-her-dignity/9636592002/; https://www.azcentral.com/in-depth/news/local/arizona-investigations/2022/07/18/arizona-rakes-in-millions-from-prison-labor/9724295002/

**The articles quote women alleging abuse, exploitation, and retaliation while "working" for Televerde, describing a disturbing hierarchy of "Televerde girls" and overt racism: "historically, women at Televerde have primarily been white" - 70% per state data in the article - while "Latina women made up only 15%" despite being "nearly 40% of the prison population." The article alleges other types of mistreatment: "curl your hair with contraband hair curlers"; 13 hour days; working in "trailers with no air conditioning…risked some women becoming sick from the heat."**

***Article dated July 18, 2022***

"Don't even try," one person told N'sangou, she said. "They don't hire Black girls."

Within her first few days of starting, she said a manager told her she should feel lucky to have her job.

"Why?" N'sangou asked.

Because, they answered, she didn't "sound Black."

She remembered one manager scolding another prisoner, saying: "If you can sell thousands in meth, you can sell this software."

Source: https://www.azcentral.com/in-depth/news/local/arizona-investigations/2022/07/18/arizona-prison-system-exploited-her-labor-she-kept-her-dignity/9636592002/

**Twist's CFO – in his LinkedIn profile – indicates his responsibilities at Televerde included "establishing global operations in Glasgow, Scotland and Cordoba, Argentina." We note a Televerde press release about its partnership with the UK Ministry of Justice regarding a "prison workforce" program for females at a particular prison – its "ninth prison-run center globally." The Wikipedia entry for that prison states it "was singled out as having one of the worst records for suicides in England and Wales." A BBC documentary about the prison - "Women On The Edge: The Truth About Styal Prison" - "reveals extraordinary levels of attempted suicide and self-harm at the prison and asks why so many women are driven to kill themselves when they end up inside."**

***Press release dated June 2020***

Televerde Partnership with UK Ministry of Justice & HMP Styal in England

***Documentary on Youtube***


Source: https://televerde.com/insights/press-releases/televerde-and-uk-ministry-of-justice-expand-prison-workforce-development-to-styal-england/; https://www.youtube.com/watch?v=H58pY4NLXB4

**A mysterious entity called Ever Alpha L.P. was listed in Twist's IPO prospectus as its largest holder pre-IPO, holding 14.9% of the shares. The prospectus indicated that Ever Alpha invested $70MM in Twist's Series D Preferred financing, making it the largest investor in the round.**

***Twist S-1 filing, Oct 3 2018***

| | Shares beneficially owned prior to the offering | | | | Shares beneficially owned after the offering | |
|---|---|---|---|---|---|---|
| Name of beneficial owner | Common stock | Options exercisable within 60 days | Aggregate number of shares beneficially owned | % | Aggregate number of shares beneficially owned | % |
| ***5% or more stockholders:*** | | | | | | |
| Ever Alpha Fund L.P.(1) | 32,623,385 | — | 32,623,385 | 14.9% | | |
| Entities affiliated with ARCH Venture Partners(2) | 32,540,315 | — | 32,540,315 | 14.8% | | |
| Illumina, Inc.(3) | 16,852,517 | — | 16,852,517 | 7.7% | | |
| Entities affiliated with Tao Capital Partners(4) | 12,957,396 | — | 12,957,396 | 5.9% | | |
| Entities affiliated with Fidelity Select Portfolios(5) | 12,430,596 | — | 12,430,596 | 5.7% | | |
| Entities affiliated with Paladin Capital Group(6) | 10,834,822 | — | 10,834,822 | 4.9% | | |
| ***Named executive officers and directors:*** | | | | | | |
| Emily M. Leproust(7) | 7,013,171 | 3,285,100 | 10,298,271 | 4.6% | | |
| James M. Thorburn(8) | — | 1,750,000 | 1,750,000 | * | | |
| Mark Daniels(9) | — | 1,246,817 | 1,246,817 | * | | |
| Robert Chess(10) | 691,315 | 70,340 | 761,655 | * | | |
| Frederick B. Craves(11) | 661,122 | — | 661,122 | * | | |
| Paul A. Conley(12) | — | — | — | * | | |
| Keith Crandell(1) | 32,540,315 | — | 32,540,315 | 14.8% | | |
| Xiaoying Mai(13) | — | — | — | * | | |
| Robert Ragusa(2) | 16,852,517 | — | 16,852,517 | 7.7% | | |
| All directors and executive officers as a group(14) (14 persons) | 72,324,659 | 13,185,134 | 85,509,793 | 36.7% | | |

| Name of stockholder* | Shares of series D convertible preferred stock | Total purchase price |
|---|---|---|
| Entities affiliated with ARCH Venture Partners(1) | 11,077,949 | $ 23,769,955.17 |
| Illumina, Inc.(2) | 1,556,590 | $ 3,339,975.16 |
| Entities affiliated with Paladin Capital Group(3) | 1,405,825 | $ 3,016,478.70 |
| Entities affiliated with Fidelity Select Portfolios(4) | 2,429,930 | $ 5,213,900.80 |
| Entities affiliated with Tao Capital Partners(5) | 2,086,725 | $ 4,477,485.83 |
| Ever Alpha Fund L.P.(6) | 32,623,385 | $ 69,999,997.21 |

Source: Twist S-1 filed Oct 3, 2018

**As we read the prospectus filed on Oct 29, 2018, we were struck by an opaque disclosure about a "Side Letter" with Ever Alpha and "certain other parties." Side letters are unusual, and we wondered why this side letter committed Twist to investing $25MM over three years into an entity in China. We further wondered who the "certain other parties" were, and why they were not disclosed. A transaction with a offshore Chinese entity that invests $70MM with $25MM round-tripped back raises obvious concerns relating to the Foreign Corrupt Practices Act.**

***Twist S-1 filing, Oct 29 2018***

***Side Letter with Ever Alpha Fund. L.P.***

*In March 2018, **in connection with Ever Alpha Fund L.P. and certain other investors' purchase of Series D convertible preferred stock, we entered into a side letter with Ever Alpha Fund L.P. and certain other parties pursuant to which, among other things, we have committed to using commercially reasonable efforts to invest up to $5.0 million, $10.0 million and $10.0 million over a three year period in connection with the incorporation, business and/or operations of a wholly owned foreign enterprise in the PRC,** subject to and contingent upon the approval of our board of directors and any applicable regulatory agencies in the PRC and U.S., and compliance with any applicable laws and regulations. The foreign enterprise will be exclusively owned and controlled by us through a subsidiary that we will wholly own, and Ever Alpha Fund L.P. will not have any direct economic, voting or other interests in this enterprise or any of our subsidiaries. Ever Alpha Fund L.P.'s interests in this enterprise are limited to its equity interest as a stockholder in the Company and its belief that expanding our manufacturing capacity and growing our sales organization in China will have a positive impact on our business and long-term value.*

Source: Twist S-1 filed Oct 29, 2018

**The SEC, in correspondence related to its review of the prospectus, asked Twist to include the side letter with Ever Alpha as an exhibit. We could locate no such exhibit, and it appears Twist didn't want investors to see it, and seems to have gotten away with "supplementally providing it" only to the SEC – presumably a busy staffer who didn't even notice the lack of an exhibit.**

***SEC letter to Twist, Sep 20, 2018***

Side Letter with Ever Alpha Fund L.P., page 153

3. Please revise to clarify the nature and extent of Ever Alpha's interest in the transaction described here. Please also file the side letter as an exhibit.

***Twist reply to SEC, Oct 2, 2018***

**Side Letter with Ever Alpha Fund L.P., page 153**

**3. Please revise to clarify the nature and extent of Ever Alpha's interest in the transaction described here. Please also file the side letter as an exhibit.**

Response:

The Company respectfully notes the Staff's comment. In response to the Staff's comment, the Company has revised page 153 of the prospectus to include the requested disclosure. On September 26, 2018, we supplementally provided a copy of the side letter.

Source: SEC correspondence https://www.sec.gov/Archives/edgar/data/1581280/000000000018029836/filename1.pdf; https://www.sec.gov/Archives/edgar/data/1581280/000119312518291190/filename1.htm

**Ever Alpha L.P. struck us as a bizarre entity, with no website or other details we could locate, except for an SEC filing stating it's domiciled in the Cayman Islands. The fine print in the S-1 contained a footnote, indicating that the entity was at the end of a daisy chain of other entities. The first step in the chain began with the general partner of Ever Alpha L.P., another Cayman entity called Ever Glory Limited. Other SEC filings led us to conclude that the entity at the top this chain is GF Securities, which the footnote appears to refer to as Guangfa Securities.**

***Twist S-1 filing, Oct 3 2018***

(1) Consists of 32,623,385 shares held of record by **Ever Alpha Fund L.P**. Ever Glory Limited is the general partner of Ever Alpha Fund L.P. **Ever Glory Limited** is a wholly owned subsidiary of **Guangfa Xinde Capital Management Limited**. Guangfa Xinde Capital Management Limited is a wholly owned subsidiary of **Guangfa Investment (Hong Kong) Company Limited**. Guangfa Investment (Hong Kong) Company Limited is a wholly owned subsidiary of **Guangfa Holding (Hong Kong) Corporation Limited**. Guangfa Holding (Hong Kong) Corporation Limited is the wholly owned subsidiary of **Guangfa Securities Co., Ltd**, a publicly listed company in Hong Kong. **Sun Shuming, Lin Zhihai, Qin Li, Sun Xiaoyan, Yang Xiong, Tang Xin. Chan Kalok, Shang Shuzhi, Li Xiulin, Li Yanxi and Liu Xuetao** serve on the Board of Directors of Guangfa Securities Co., Ltd and may be deemed to share voting and dispositive power over the shares held by Ever Alpha Fund L.P. The address of Ever Alpha Fund L.P. is Fl 16th, 183rd Tianhebei Rd, Guangzhou, PR China

Source: Twist S-1 filed Oct 3, 2018; https://sec.report/Document/0001104659-21-022549/ - states Ever Alpha is Cayman-domiciled

# The Cayman Islands corporate registry indicated that Ever Alpha Fund L.P. was a de novo entity that had only been formed about only two months prior to Twist's Series D. The entity appears to have been formed in late Jan 2018, and Twist's prospectus stated the Series D occurred in March and July 2018.

***Twist S-1 filing, Oct 29 2018***

***Preferred stock financings***

*As of June 30, 2018, we had raised $278.5 million in net proceeds from the sale of our equity securities, including the sale of 6,034,089 shares of our Series D convertible preferred stock from January 2016 through September 2017 at a purchase price of $21.24 per share for gross proceeds of $128.2 million.* ***On March 19, 2018 and May 29, 2018****, we issued 2,353,544 and 941,417 shares of Series D convertible preferred stock for an aggregate purchase price of approximately $50.0 million and $20.0 million, respectively.* ***On July 2, 2018 and July 3, 2018****, we issued 517,778 and 47,070 shares of Series D convertible preferred stock for an aggregate purchase price of $11.0 million and $1.0 million, respectively.*

***Cayman Islands registry report for Ever Alpha Fund L.P.***


**Search Report**

| | |
|---|---|
| **Entity Name :** | Ever Alpha Fund L.P. |
| **Jurisdiction :** | Cayman Islands |
| **Registration Number :** | 94466 |
| **Registration Date :** | 23rd January 2018 |
| **Entity Type :** | EXEMPTED LIMITED |
| **Registered Office :** | INTERTRUST CORPORATE SERVICES (CAYMAN) LIMITED<br>One Nexus Way,<br>Camana Bay,<br>Grand Cayman,<br>KY1-9005<br>Cayman Islands |

| | |
|---|---|
| **Status :** | ACTIVE |
| **Status Date :** | 23rd January 2018 |

Source: Twist S-1 filed Oct 29, 2018; https://my.egov.ky/web/myegov/home

**We questioned why Ever Alpha LP would invest $70MM in Twist, and Twist would recycle back $25MM via a side letter with Ever Alpha and "certain other parties." If meant to capitalize an entity in China, why didn't Ever Alpha just invest $25MM in the entity and $45MM into Twist – the net amount? Our suspicions were heightened when we looked into GF Securities – the entity at the top of the chain that controls Ever Alpha LP, Twist's largest holder at IPO. We immediately encountered articles discussing GF Securities involvement in a $12.7B fraud in China, centered on one of China's largest publicly traded pharmaceutical firms, Kangmei Pharmaceutical, which allegedly overstated its cash balance by $4.3 billion "using false documents."**

***Asia Financial article, June 2020***

GF Securities under administration, activities frozen

***S&P Global article, July 2020***

Chinese regulator suspends GF Securities from sponsorship business

***Bloomberg article, May 2019***

**Chinese Firm Overstates Cash by $4.3 Billion Using False Documents**

Source: https://www.asiafinancial.com/gf-securities-under-administration-activities-frozen; https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/chinese-regulator-suspends-gf-securities-from-sponsorship-business-59400213; https://www.bloomberg.com/news/articles/2019-05-29/china-firm-overstates-cash-by-4-3-billion-using-false-documents#xj4y7vzkg

**The articles indicated that the fraud was "unprecedented in China" - with the ex-Chairman of Kangmei sentenced to 12 years in prison - and that GF Securities was forced to withdraw its IPO's "after the firm was accused of being involved in a serious fraud case," and that two individuals were "banned from bond underwriting business for 20 years." As we examined the individuals who were sanctioned and "publicly condemned by the Securities Bureau," we noted that two - Lin Zhihai and Qin Li - appear to be listed in Twist's prospectus as having "voting and dispositive power over the shares held by Ever Alpha Fund L.P."**

***Twist S-1 filing, Oct 3 2018***

*"Sun Shuming, **Lin Zhihai, Qin Li**, Sun Xiaoyan, Yang Xiong, Tang Xin. Chan Kalok, Shang Shuzhi, Li Xiulin, Li Yanxi and Liu Xuetao serve on the Board of Directors of Guangfa Securities Co., Ltd and **may be deemed to share voting and dispositive power over the shares held by Ever Alpha Fund L.P.** The address of Ever Alpha Fund L.P. is Fl 16th, 183rd Tianhebei Rd, Guangzhou, PR China."*

***Caixin Global article, Apr 2020***

## GF Securities General Manager Resigns Following Fraud Scandal

*"The general manager of Shenzhen- and **Hong Kong-listed GF Securities Co. Ltd.** has resigned following a major financial fraud by one of its clients and the failure of one of its hedge funds, triggering massive losses for the brokerage. The company said in a Tuesday filing that **Lin Zhihai, 56, the general manager and executive director**, resigned for health reasons. But several sources familiar with the matter told Caixin that **Lin resigned due to his accountability for issues related to a fraud by Kangmei Pharmaceutical Co. Ltd., a major GF client** and one of China's largest listed drugmakers."*

***Asia Financial article, June 2020***

*"Those facing punishment include the former deputy general managers Ouyang Xi and **Qin Li**, who were in charge of the relevant investment banking business…They were also **publicly condemned by the Securities Regulatory Bureau."***

Source: Twist S-1 filed Oct 3, 2018; https://www.asiafinancial.com/gf-securities-under-administration-activities-frozen; https://www.caixinglobal.com/2020-04-24/gf-securities-general-manager-resigns-following-fraud-scandal-101546881.html

**Given that Kangmei's ex-Chairman was sentenced to 12 years in prison and the company allegedly overstated its cash balance by $4.3B "using false documents," we were further stunned to see a 2017 press release from Twist stating that Kangmei Group was actually an investor in the company.**

***Twist press release, June 14, 2017***

# Twist Bioscience Raises Additional $27 Million

## -- Aggregate New Funding in 2017 Reaches $60 Million; Total of $191 Million Raised Since Inception --

Demonstrating strong support from institutional, cross over and strategic investors, the funding includes a key investment from Biomatics Capital as well as new investors Reinet Fund S.C.A., F.I.S., NFT Investment Limited, KANGMEI Group, Bay City Capital GF Xinde Life Science Investment Fund, 3W Partners Capital andDitch Plains Capital Management LP.

Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-raises-additional-27-million

**We could locate no subsequent disclosures from Twist stating whether $25MM of the Ever Alpha L.P. investment was recycled back - per the side letter – "in connection with the incorporation, business, and/or operation of a wholly owned foreign enterprise in the PRC." We were left to wonder if this purported enterprise was ever formed, and if $25MM was ever wired – and if so, to whom? The disclosure never states the reason for the $25MM, but at the end includes a vague statement about the "positive impact" of "manufacturing capacity" in China. We spoke with an ex-Twist employee involved with Twist's activities in China, who indicated that "an investment was made," but "production never really kicked off" and Twist bailed on manufacturing in China.**

***Twist allegedly invested in a production site in China but "production never really kicked off"***

*A: **"In China, there was a production site, an investment was made** on it, and then eventually, during my time there, it was retooled to be a distribution center, an R&D center to supplement the pharma business. But originally, it was intended for manufacturing."*

*Q: "When did they open a manufacturing site there?"*

*A: "They were getting ready to open it and then toward the end of the year, if I recall, the focus changed, and it became just a distribution center and a secondary R&D center for the pharma business. **So, production never really kicked off, although work and investment happened**." – Ex-Twist employee involved with Twist's activities in China*

***Ex-employee indicates that Twist decided to bail on China manufacturing***

*"The initial idea was to invest in the China market…**the idea in 2018 was to establish a manufacturing operation in China** to support China and, potentially later, China APAC business. That was the idea…the official Twist/China, everything is set up then. But we already signed the lease in Bio Island in Guangzhou and started to build that site. Fast-forward to the next year, **at the end of 2019, we decided, no, we're not going to do manufacturing for many, many reasons**." – Ex-Twist employee involved with Twist's activities in China*

Source: Scorpion Capital consultation calls with experts

## As we asked about the side letter and the $25MM, the ex-employee became instantly uncomfortable: "I didn't even know the letter was disclosed to the public. Even within Twist, we really downplayed that…I don't feel comfortable elaborating on that one, unfortunately."

***Ex-employee expressed discomfort when we asked about Twist's side letter with a Chinese investor***

*Q: "In the IPO prospectus, there's one thing I didn't understand. It said,* ***"side letter with Ever Alpha Fund LP."*** *It says "$25 million over a three-year period in connection with the incorporation, business, and operations of a wholly-owned foreign enterprise in the PRC."* ***Can you explain what that's referring to?"***

*A:* ***"Yeah, I don't think I can disclose more than that, unfortunately. It is highly confidential. I didn't even know the letter was disclosed to the public. Even within Twist, we really downplayed that...I don't feel comfortable elaborating on that one, unfortunately."*** *– Ex-Twist employee involved with Twist's activities in China*

Source: Scorpion Capital consultation calls with experts

**We asked if the side letter was a touchy topic because it reflected something improper, to which the ex-employee chuckled and said "I think you're a smart guy. You figure it out. I just really don't want to go on that topic, because even within Twist, [redacted] was not allowed to talk about it to other employees." We were unable to get further details on who Ever Alpha's actual beneficial owners are – typically the reason an entity would be domiciled in the Cayman Islands in the first place, instead of directly feeding into an entity in China – with the ex-employee stating that "their corporate structure is rather convoluted….in China, a lot of things are very convoluted."**

***Ex-employee expressed discomfort when we asked about Twist's side letter with a Chinese investor***

*Q: "Sometimes I encounter companies that have done things that are a little fishy, a little questionable, different types of transactions, accounting. It kind of looked a little bit suspicious when I read it. Sometimes companies do something that is a little bit in a gray area, particularly overseas.* ***Am I guessing properly here about why it's a touchy topic?"***

*A:* ***"[Chuckles] I think you're a smart guy. You figure it out. I just really don't want to go on that topic because even within Twist, [redacted] was not allowed to talk about it to other employees."***

*Q: "Can you talk about who Ever Alpha Fund is?"*

*A: "****They are government-backed. They invest in a lot of overseas companies****. I think they also have holdings in Hong Kong and all that. In terms of more details about that firm, I really just have a superficial understanding. My understanding is that they are the second-largest investor, they have a great interest, and they can help us to enter the China market."*

*Q: "If you had to guess, why do you think the CEO made it such a touchy topic?"*

*A: "I think just in general about China and also because they are government-backed. So, that is very sensitive."*

*Q: "You said Ever Alpha Fund is affiliated with a government entity? Is that the case?"*

*A: "I think their* ***corporate structure is rather convoluted****. There's some holding in Hong Kong and so forth. The core is government-backed. GF is government-backed…****In China, a lot of things are very convoluted.*** *As far as I know, they certainly pumped a lot of government-backed money. It really depends on which arm we're talking about. To be honest, I don't know the details of their corporate structure - t's very convoluted." – Ex-Twist employee involved with Twist's activities in China*

Source: Scorpion Capital consultation calls with experts

**We note that GF Securities – the entity that sits at the top of Ever Alpha and was sanctioned for its involvement with the Kangmei fraud – still sits on Twist's board of directors, via a 35-year old representative named Xiaoying Mai, who conveniently serves on the audit committee, and strikes us as the kind of puppet that's ideal for this sort of thing. When we asked the ex-Twist employee what she's doing there, the ex-employee stated that Emily – Twist's CEO – "wants to be the only channel to talk to her" and that others inside Twist were "instructed directly by the CEO, Emily, that "[redacted] should not disclose…details to her directly."**

***Twist's CEO allegedly instructed senior staff to not discuss operational details with a board member representing a key Chinese investor***

*Q: "I noticed when I was looking at Twist's prospectus that they have some pretty prominent Chinese investors. They have, I think it was GF Securities, Tao Capital, Ever Alpha Fund, which I think is affiliated with GF Securities. Who were the Chinese investors, and what was the role that they played in the company and this manufacturing hub?"*

*A: "GF was the second-largest investor at the time. They have a great interest in Twist's business. That's one of the reasons we chose Guangzhou because that's where they are, so they have a good connection there as well."*

*Q: "I noticed there's somebody named Xiaoying Mai, who's a member of the board. Who is she, and what is her role? She seemed awfully young."*

*A: "She is. For board appointments, because they were the second-largest investor, I think that's the rationale behind it.* ***In terms of her role, [redacted] was instructed directly by the CEO, Emily, that [redacted] should not disclose the operational business positions or details to her directly. She wants to be the only channel to talk to her on the business side."*** *– Ex-Twist employee involved with Twist's activities in China*

Source: Scorpion Capital consultation calls with experts

**As we examined other names in Twist's pre-IPO investor list, we noticed a plethora of opaque Chinese and other offshore entities. For example, 3W Partners Capital strikes us another front, given a superficial website with no team members shown on the relevant tab or any we could find on LinkedIn – nor any other information about its portfolio or activities. The "About Us" page sounds like made-up jibberish typical of a fake site.**

***Twist press release, June 14, 2017***

Twist Bioscience Raises Additional $27 Million

-- Aggregate New Funding in 2017 Reaches $60 Million; Total of $191 Million Raised Since Inception --

Demonstrating strong support from institutional, cross over and strategic investors, the funding includes a key investment from Biomatics Capital as well as new investors Reinet Fund S.C.A., F.I.S. NFT Investment Limited, KANGMEI Group, Bay City Capital GF Xinde Life Science Investment Fund, 3W Partners Capital andDitch Plains Capital Management LP.

***3W Partners website***

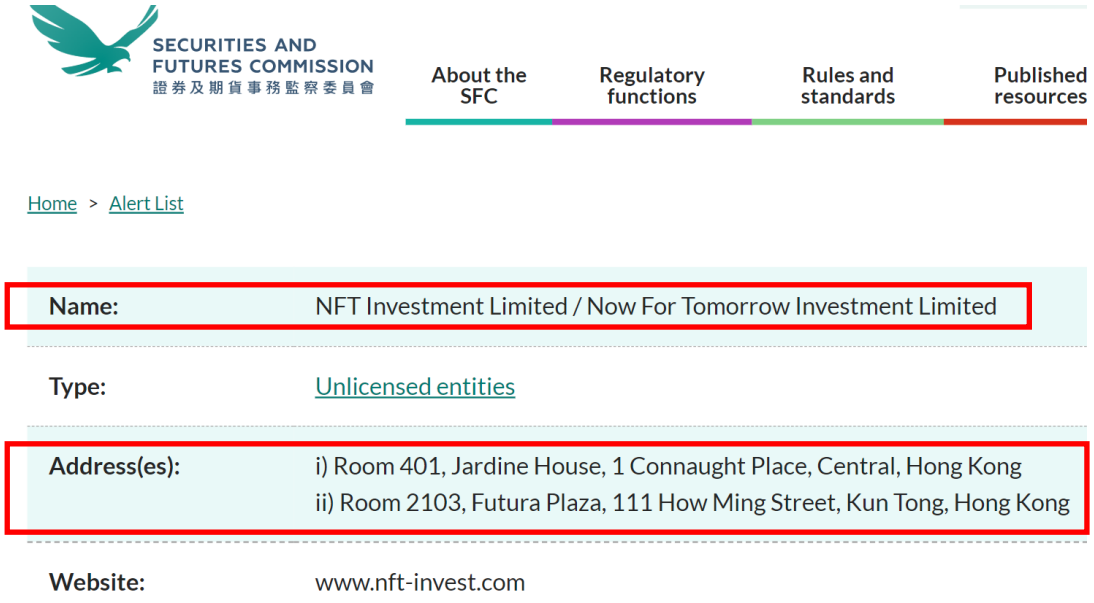
3W Partners is an investment firm focusing on Cross border Consolidation Growth in the 'new normal' development phase of the Chinese economy – slower growth, capacity rationalization, and globalized intense competition, leading to cross-border and localized opportunities. We believe a new generation of industry leaders will emerge which can pursue sustainable growth through Consolidation and Innovation.

Source: https://investors.twistbioscience.com/news-releases/news-release-details/twist-bioscience-raises-additional-27-million; https://www.3wpcap.com/about-us

**When we looked up another investor, NFT Investment Limited, the first hits are from the ICIJ Offshore Leaks Database concerning the Panama Papers database, which state it's based in British Anguilla. Another hit is from the Securities and Futures Commission of Hong Kong, which states it's based in Hong Kong. The website listed for it in the Hong Kong registry goes to a dead website parked at GoDaddy.com.**

***ICIJ Panama Papers page for the entity***


***Hong Kong registry page for the entity***




Sourcehttps://offshoreleaks.icij.org/nodes/10014391; https://www.sfc.hk/en/alert-list/1391

**We find it troubling that both 3W Partners and NFT Investment Limited appear to have the same address in Hong Kong, suggesting that they are linked – both at "Jardine House, 1 Connaught Place" in Hong Kong, but with different rooms listed.**

***ICIJ Panama Papers page for the entity***


***Hong Kong registry page for the entity***


Source: https://www.3wpcap.com/about-us; https://www.sfc.hk/en/alert-list/1391

**Ever Alpha Fund L.P. aka GF Securities and Kangmei Group are the not the only fish swimming in Twist's cesspool of investors. Another one of its largest holders at IPO was Paladin Capital, which quickly dumped its shares following the offering. We generally short frauds, and are always amazed at how such companies seem to be a magnet for investors, underwriters, and others with similar tendencies.**

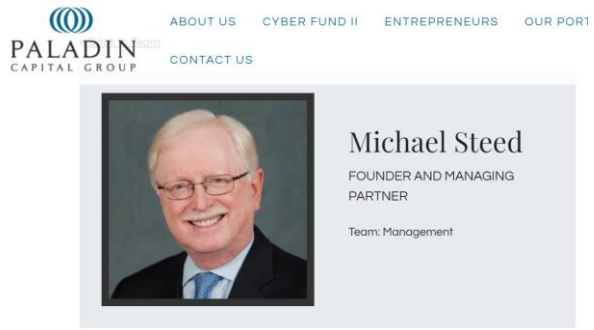
***Twist S-1 filing, Oct 3 2018***

| | Shares beneficially owned prior to the offering | | | | Shares beneficially owned after the offering | |
|---|---|---|---|---|---|---|
| Name of beneficial owner | Common stock | Options exercisable within 60 days | Aggregate number of shares beneficially owned | % | Aggregate number of shares beneficially owned | % |
| ***5% or more stockholders:*** | | | | | | |
| Ever Alpha Fund L.P.(1) | 32,623,385 | — | 32,623,385 | 14.9% | | |
| Entities affiliated with ARCH Venture Partners(2) | 32,540,315 | — | 32,540,315 | 14.8% | | |
| Illumina, Inc.(3) | 16,852,517 | — | 16,852,517 | 7.7% | | |
| Entities affiliated with Tao Capital Partners(4) | 12,957,396 | — | 12,957,396 | 5.9% | | |
| ~~Entities affiliated with Fidelity Select Portfolios(5)~~ | ~~12,430,596~~ | | ~~12,430,596~~ | ~~5.7%~~ | | |
| Entities affiliated with Paladin Capital Group(6) | 10,834,822 | — | 10,834,822 | 4.9% | | |
| ***Named executive officers and directors:*** | | | | | | |
| Emily M. Leproust(7) | 7,013,171 | 3,285,100 | 10,298,271 | 4.6% | | |
| James M. Thorburn(8) | — | 1,750,000 | 1,750,000 | * | | |
| Mark Daniels(9) | — | 1,246,817 | 1,246,817 | * | | |
| Robert Chess(10) | 691,315 | 70,340 | 761,655 | * | | |
| Frederick B. Craves(11) | 661,122 | — | 661,122 | * | | |
| Paul A. Conley(12) | — | — | — | * | | |
| Keith Crandell(1) | 32,540,315 | — | 32,540,315 | 14.8% | | |
| Xiaoying Mai(13) | — | — | — | * | | |
| Robert Ragusa(2) | 16,852,517 | — | 16,852,517 | 7.7% | | |
| All directors and executive officers as a group(14) (14 persons) | 72,324,659 | 13,185,134 | 85,509,793 | 36.7% | | |

Source: Twist SEC filings

**The Paladin Capital website states that its founder and managing partner is Michael Steed. His bio instantly piqued our interest, as it opens by saying that "prior to forming Paladin Capital, Mr. Steed served as Senior Vice President of Investments of a major financial services company based in Washington, D.C." When people worked for a major company, they say who it is, and when they don't it's for a reason.**

***Michael Steed bio, Paladin Capital website***

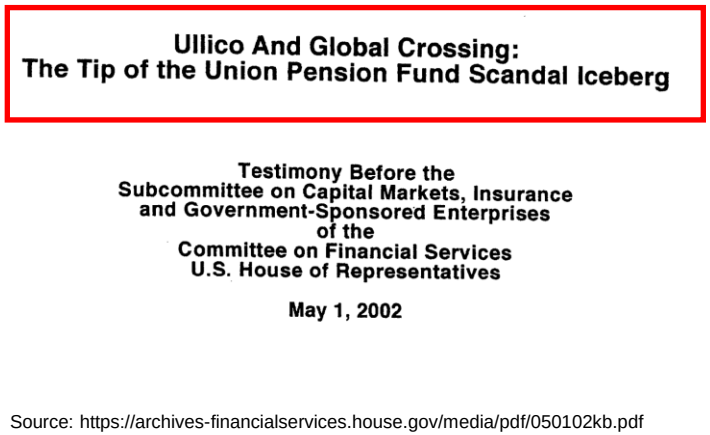



Michael Steed is the Founder and Managing Partner and serves as Chairman of the Paladin Cyber Fund, Paladin Cyber Fund II and Paladin III Investment Committees. Mr. Steed provides management oversight of the firm's operations and investments and is responsible for the strategic direction of Paladin's current and future activities. Prior to forming Paladin Capital, Mr. Steed served as Senior Vice President of Investments of a major financial services company based in Washington, DC, and served as President of its SEC registered investment advisory firm. From 1981 to 1985, Mr. Steed served as Special Counsel to the Chairman and as the National Director of the Democratic Party of the United States of America (DNC). Previously, Mr.

Source: https://www.paladincapgroup.com/people/michael-r-steed/

**Steed worked for Ullico, the captive insurance arm of various labor unions. Detailing the fraud at Ullico and Steed's role is beyond the scope of this report, but all one has to do is google terms like "Ullico" – the name Steed left off his bio – along with "Steed," "fraud," "organized crime," "insider trading," and "government hearings" to open a Pandora's Box of now-forgotten corruption.**

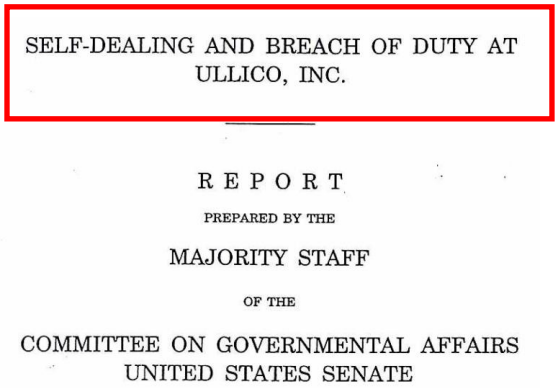
***Various Congressional hearings on the Ullico scandal***


Ullico And Global Crossing:
The Tip of the Union Pension Fund Scandal Iceberg

Testimony Before the
Subcommittee on Capital Markets, Insurance
and Government-Sponsored Enterprises
of the
Committee on Financial Services
U.S. House of Representatives

May 1, 2002

Source: https://archives-financialservices.house.gov/media/pdf/050102kb.pdf


SELF-DEALING AND BREACH OF DUTY AT
ULLICO, INC.

REPORT

PREPARED BY THE

MAJORITY STAFF

OF THE

COMMITTEE ON GOVERNMENTAL AFFAIRS
UNITED STATES SENATE

Source: https://www.hsgac.senate.gov//imo/media/doc/060204ullicomajorityreport.pdf?attempt=2

***Articles details scope of the abuses; one refers to alleged "connections with organized crime" by an Ullico director***


Ullico: The AFL-CIO's corporate scandal

Source: https://www.paladincapgroup.com/people/michael-r-steed/


Labor's Losses

A union-sponsored corporate rip-off.

Source: https://slate.com/business/2002/12/a-union-sponsored-corporate-rip-off.html