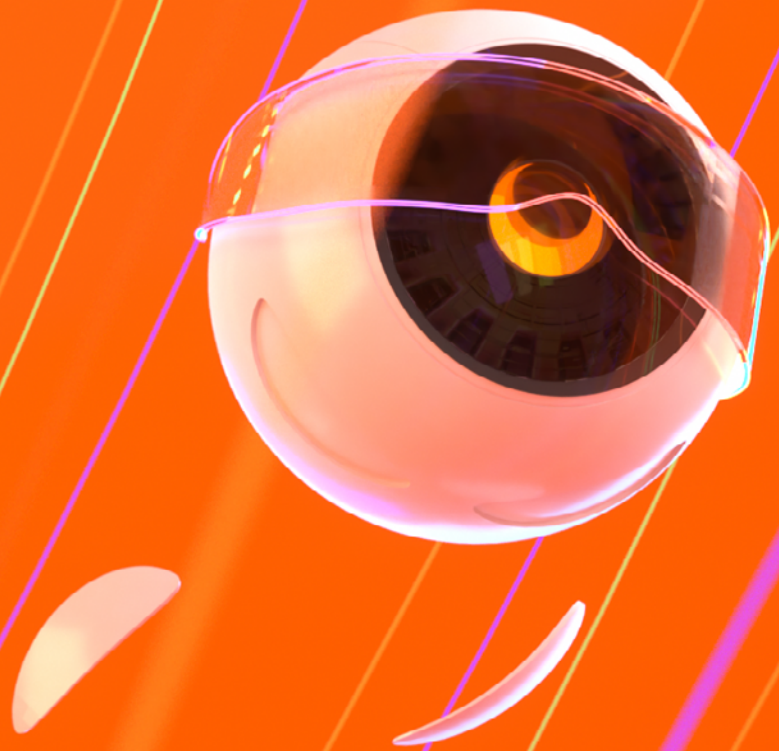
Investment Recipes

by AtonRā Partners



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On the Menu

RISE OF THE COBOTS

Cobots Thrive In A Post-Pandemic World

Cobots are a new form of industrial robots

Cobots (Collaborative Robots) embody a new form of industrial automation that leverages advances in robotics, sensing, and machine intelligence.

- Cobots work alongside and with human workers. They are simpler and cheaper to implement than traditional robots and poised to be widely adopted.
- The global economy is desperate for growth engines, and cobots deliver added value in manufacturing and beyond.

Co-robotics improves multiple pockets of productivity

Cobots serve the need for humble and practical automation, being easy to deploy, teach and operate. The global pandemic demonstrated the need and benefits of co-robotics, marking an inflection point for the industry.

- Teradyne, the cobot global leader, is guiding for record shipments in 2021.
- The cobot ecosystem and interoperability will drive further adoption, as more and more use-cases demonstrate a quick return on investment.

Demand for cobots is booming

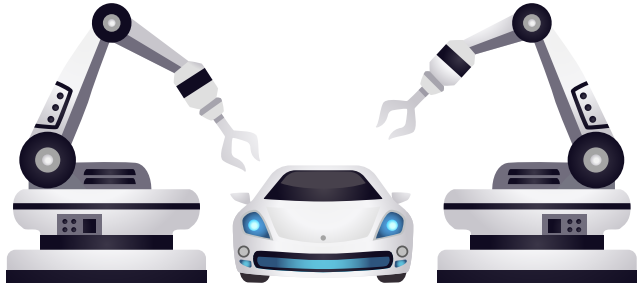
As more players join the fray, innovation and market adoption will accelerate, making cobots the fastest-growing industrial robotics segment.

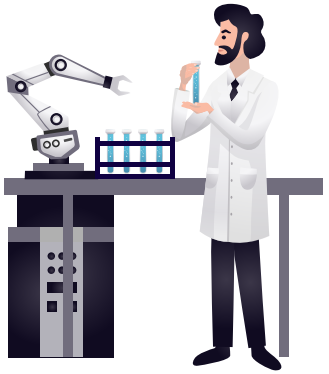
- China and the U.S. are accelerating manufacturing and automation investments, driving healthy growth of the industrial robot market.
- Cobots will grow from 1% to 20% of the industrial robotics market between 2015 and 2025 – an $8bn industry.

First commercial Cobots (Universal Robots, Kuka)	**2008**
Collaborative robots remain rare, with fewer than 2 000 units deployed	**2011**
Teradyne acquired Universal Robots Quanta spun-off Techman Robots	**2015**
~100'000 cobots installed Teradyne (US) #1 Techman Robots (TW) #2	**2020**

SOURCE:
U.S. National Association of Manufacturers, International Trade Organization, ABI Research

Cobots Are Industrial Robots Teaming With Humans





Traditional industrial robots are large articulated arms installed in reserved factory spaces.They can handle heavy payloads, work in hazardous environments and operate at fast speeds. Such robots require long-term investments and reliable factory layout and process.

Industrial robots initially addressed the automotive industry, yet their adoption has pervaded all sectors and is significantly accelerating as China massively invests in manufacturing.

Collaborative robots (Cobots) are smaller robots that work alongside humans.They embed multiple sensors, actuators, and software which make them safe and efficient at interacting with humans. They are more flexible and cheaper than traditional robots.

The ability to work with humans significantly increases the value proposition and productivity of collaborative robots, opening a new era in industrial automation.

Economies Rely On Labor Productivity

Covid-19 disrupted global manufacturing

The global pandemic highlighted the supply chain's fragility and the stringent needs of the on-demand economy, boosting the adoption of new manufacturing models.

- Industry 4.0 is expected to deliver up to $3.7tn productivity gains by 2025.
- Covid-19 disruptions forced the adoption of automation, with two-thirds of the companies saying they accelerated their investments in AI and Robotics.

Strong manufacturing makes strong economies

The U.S. - China tensions explicit the direct relationship between manufacturing and technology leadership. The U.S. administration is pushed by industries to up the ante and counter the "Made in China 2025" investment plan.

- Manufacturing makes ~15% of the global GDP or $14tn in added value (and ~25% of China's GDP).
- The sector has the highest multiplier of any economic sector. For the U.S., each $1 spent in manufacturing adds $2.7 to the economy.

Robotic automation enables strong manufacturing

Industrial robots aggregate technologies that reduce human labor participation in the production process, resulting in a significant productivity increase.

- An increase in robot density (number of industrial robots per 10'000 employees) of 1% results in an increase in productivity of 1% to 5% (the less automated the industry, the more leverage), adding an average of 0.4% to annual GDP growth.
- The global market for industrial robots is expected to surpass $40bn by 2025.

SOURCE:
McKinsey, World Bank, U.S. National Association of Manufacturers, International Trade Organization, ABI Research

Productivity Trends Have Stalled

Labor productivity trends are way behind historical trends

Since the global financial crisis in 2007–2009, productivity growth has slowed down globally to such levels only experienced in war contexts.

- Working-age population is growing slower and educational attainment plateaued in developed countries, limiting the growth of a skilled workforce.
- Offshoring to Asia drove a decline in capital intensity per worker, and the decrease in machines' investment significantly hampered productivity growth.

Closing the productivity gap requires massive investments in automation

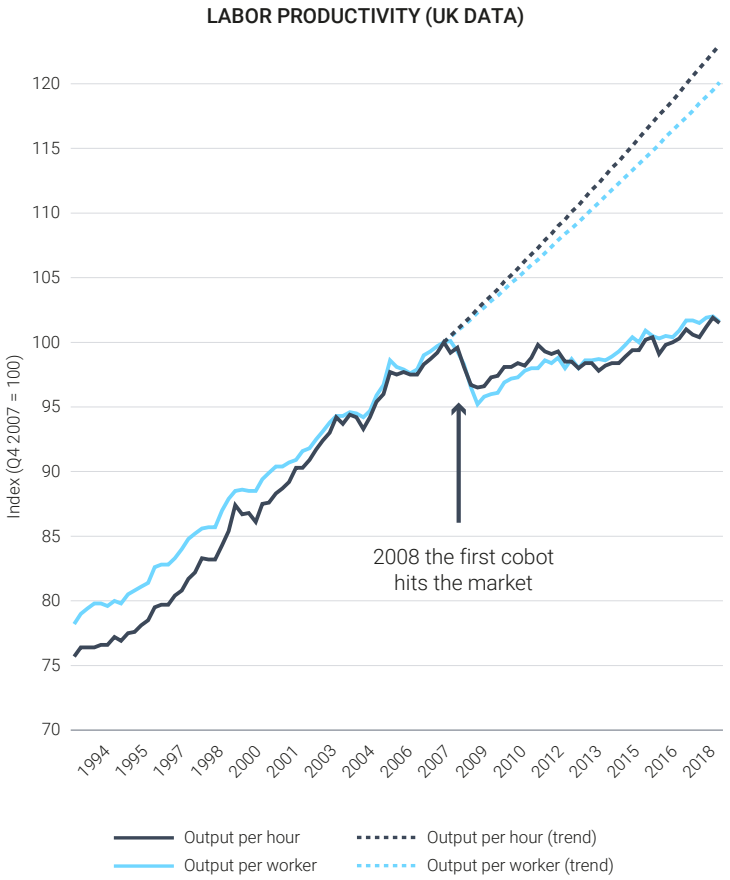
As the global population is aging, companies struggle to replace their experienced employees, who retire taking with them expertise and know-how. Collaborative robots and machine learning are paving the way towards a sustained production.

- U. S. manufacturing labor shortage could be up to 2mn over the next decade.
- In February this year, no less than 17 U.S. national industrial associations urged the U.S. president to act and reinvigorate manufacturing across the nation.

Collaborative robots in factories and warehouses a solution

The global supply chain model is undergoing a significant redefinition due to Covid-19 and geopolitical tensions, driving onshoring (esp. in the U.S.).

- Collaborative robots both extend human physical capabilities and enable up to 85% reduction in human non-productive time (e.g., fetching or positioning materials).
- Translating knowledge into automated processes and teaching robots to replicate helps with maintaining in-house knowledge.



SOURCE:
World Bank, DELOITTE, McKinsey, MIT, UK's ONS, "COLLABORATIVE ROBOTS AND KNOWLEDGE MANAGEMENT – A SHORT REVIEW" – 10.1515/aucts-2017–0018

Small Robots Disrupt Productivity

Catching up with the market demand calls for plug-and-play automation

Logistics and warehousing businesses experienced explosive demand in 2020. The long delays of adding typical large robots would have resulted in a dip in productivity before an acceleration, so they turned to collaborative robots.

- MIT research shows that cobots' nimble and immediate automation redefine the "economy of scale" and drive a manufacturing revolution.
- Industry players get organized to enable interoperability of their products, so that cobots can complement machine tools (an ~$80bn market in 2020).

Such agility comes with massive return-on-investments

Cobots do not require safety guarding, so they come with minimal indirect costs. Yet, they handle the dangerous, repetitive, and dull parts of the workers' jobs.

- Besides the additional productivity, cobots participate in keeping the workforce safe, focused on added value tasks and provide opportunities to upskill.
- Cobots have a typical payback period <10 months. They are programmable, can be upskilled and redeployed, protecting the value of an investment.

A value proposition SMEs can hardly ignore

Cobots are cheaper and more comfortable to integrate than traditional robots, bringing investments within most companies' technical and economic reach.

- In the U.S. or China ~90% of manufacturing companies are Small and Mid-size Businesses (SMBs) and can benefit immediately (set-up time of a cobot is <1 day).
- The share of cobots in the industrial market has doubled in 2016-2019 and will grow 4x to ~20% in 2025, addressing large and small players.

SOURCE:
International Federation of Robotics, Universal Robots, Stanford University HAI, MIT Sloan, Grandview Research, How Long to Payback my Robot Investment?

Cobots Support Innovation

Cobots raise the bar of safe and precise operations

Cobots are the first robotic technology to work alongside human workers. This revolution happens thanks to sensors ensuring the complete safety of operations.

- Proximity detection and force sensing make cobots exceptionally efficient at precision assembly and actuation. For instance, cobots accompany medical staff from diagnostics to surgery (e.g., KUKA's LBR Med robot).
- Lidar and vision systems push the envelope of cobots capabilities, adding metrology, inspection, and sorting capabilities.

And they do not stop there, they learn and improve

Cobots are easy to program, and AI holds the promise of enabling these sensor-rich machines with cognitive functions such as planning and natural interactions.

- Workers can teach robots step-by-step, just by moving them, as cobots remember. So, they can learn from operators (Productive Robotics, Embodied Intelligence).
- AI adds additional layers of autonomy, improving cobots' adaptability to changing environments and novelty, just as a human would do (e.g., Covariant.ai).

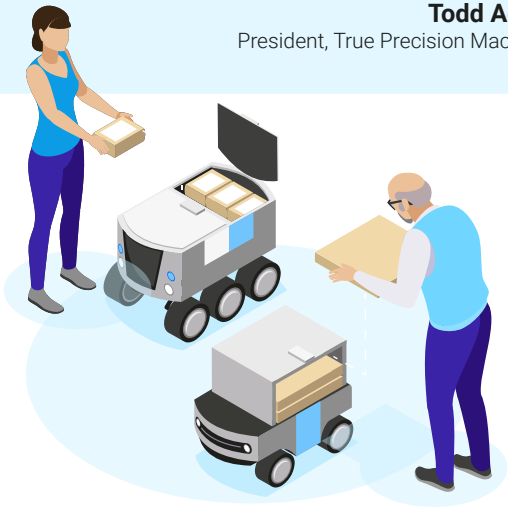
So they can interact nicely with and gently grasp their environment

Cobots favor dexterity over strength, embedding precise servo-motors and controls. Multiple tooling and robotic hands are under development.

- OnRobot embeds force/torque sensors and optical sensing technologies in the electrical gripper, which enable cobots to grasp fragile products such as food.
- Schunk released a bio-inspired gripper that mimics the gecko's paws, while Soft Robotics explores the use of fluids rather than mechanical parts for grasping.

People think that robots take away jobs, but it has actually helped grow our business, become more competitive and better utilize the talents of our team.

Todd Ackert
President, True Precision Machining



SOURCE:
Companies

Co-Robotics Is The Future Of Manufacturing

Cobots revolutionize Industrial Robotics

Thanks to lower prices, ease of integration, myriad use-cases, and learning capabilities, cobots are an inevitable component of the Industry 4.0 revolution.

- Collaborative robotics' market is growing much faster than Industrial Robotics, at a CAGR >40% (vs. ~+12%) for the next five years, towards a ~$8bn industry.
- By 2027, collaborative robots could account for ~30% of the industrial market.

A leader has emerged, trailblazing the cobot path

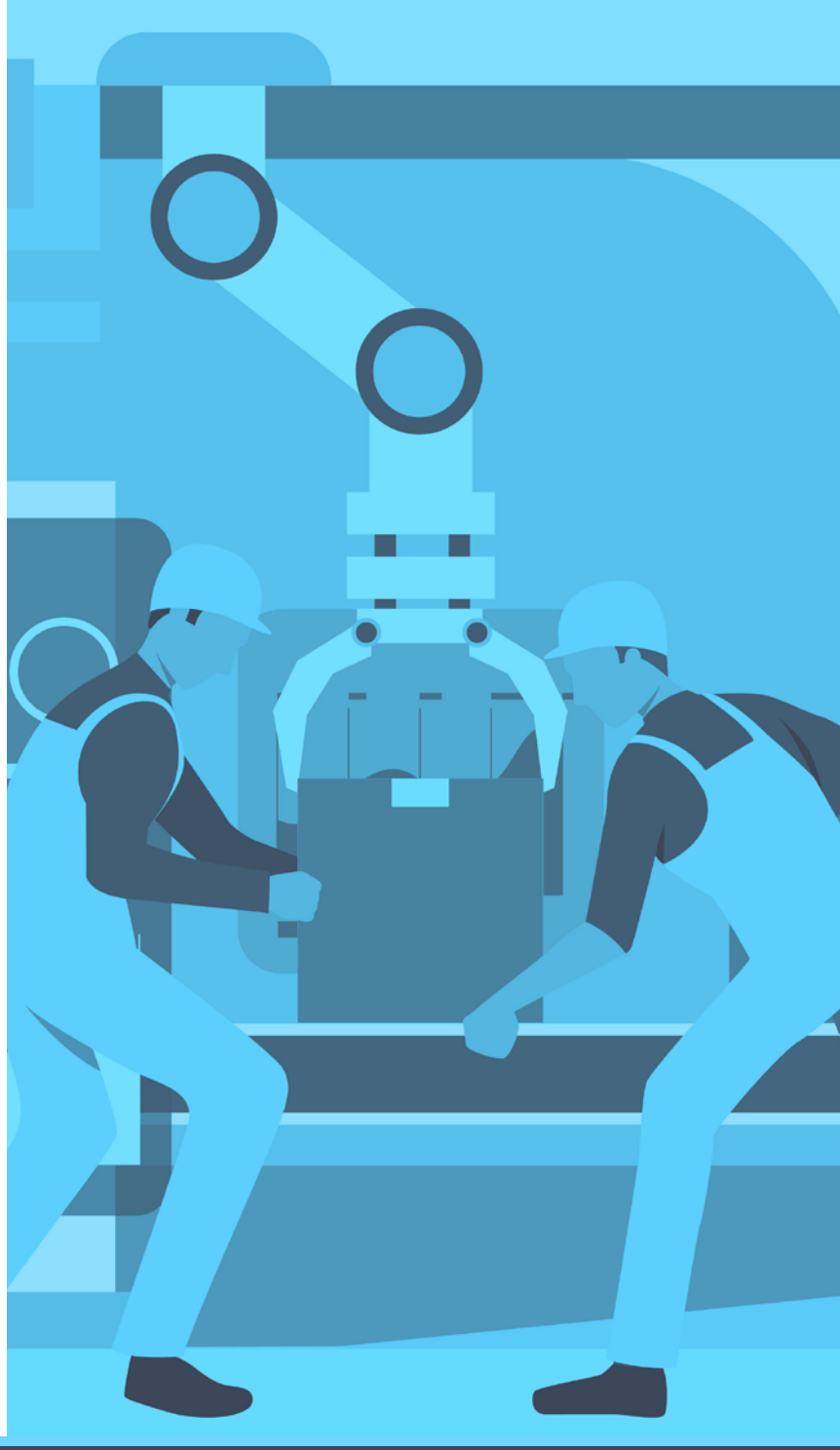
Teradyne built a superb portfolio of technologies acquiring the cobot pioneer Universal Robots first in 2015 and then Energid's motion control software in 2018.

- Teradyne shipped its 50'000th robot in late 2020 (more than the sum of all cobots ever sold by its competitors) and has a commanding ~50% market share.
- The company guided a conservative 20% to 35% CAGR for its collaborative and autonomous mobile robots – towards 20% of the company revenues.

Many are now joining the party, amplifying the market opportunity

Industrial robotics leaders now offer cobots, recognizing the market risk and opportunity and reinforcing the market traction. Fanuc, ABB, Hahn Group, and Yaskawa, the global industrial robot leaders, are late entrants in the cobot market and have so far only captured single-digit market shares.

- ~70% of all robots are expected to be sold in the Asia-Pacific region (2025).
- China cannot afford, socially and politically, a scenario where robots would replace human workers, strongly favoring collaborative production models – driving an explosive cobot market (CAGR >100% in the last five years).



SOURCE:
Loup Venture, CB Insights, ABI Research, Interact Analysis

Catalysts

- **Covid-19 pandemic urges automation.** 85% of businesses said the pandemic changed the game and demand increased investments in robotics. SMEs are a vast majority of them and are very likely to introduce /grow their use of cobots.
- **China competition pushes the U.S. to invest.** Facing the pressure of multiple industries and the many COVID-19 related failures in the supply chain, the U.S. administration will support on-shoring.
- **Public recovery plans support collaborative automation.** As the world slowly exits the pandemic, countries will use public money to support Co-robotics automation as it helps both job creation and the economy.

Risks

- **Economic hiccups defer investments.** As illustrated in early 2020, capital expenditure is hard to maintain in uncertain contexts, especially for the smaller businesses that drive cobot's adoption.
- **How safe are cobots?** As cobots swarm into warehouses and fabs, the risk of accident and tighter regulation constraints will grow.
- **Competition tends to drive down prices.** For now, Cobot players are competing on features, and China has yet to find its collaborative robot champion. Pressure on prices could impair the market dynamics yet would open new market opportunities for wide adoption.

Bottom Line

- Cobots are the fastest-growing segment in industrial robotics, driven by productivity needs in manufacturing and renewed spending in infrastructures. The spectacular return-on-investment of cobots is likely to direct capital expenditures in the cobot market (esp. in the U.S. and China), driving a >40% annual growth for the next five years, growing the adoption of cobots towards 20% of the industrial robots shipped in 2025.
- The industrial robotics leaders have recognized the opportunity, strengthening cobots' adoption and growing the ecosystem. We believe that trailblazer companies will benefit from increased exposure and interoperability between players. We reiterate our strong conviction on Teradyne, the market leader, and expect new players to go public in the mid-term (such as TechMan and Aubo Robotics).

Companies mentioned in this article:

ABB (ABB CH), Aubo Robotics (not listed) Fanuc (6954 JP), Hahn Group (not listed), Kuka (KU2G DE), OnRobot (not listed) , Schunk (not listed), Soft Robotics (not listed), TechMan Robots (not listed), Teradyne (TER US), Yaskawa (6506 JP)

PROTEINS' RESEARCH MUSCLES UP

The Genomes' Little Brother Is Emancipating

Proteins' knowledge needs to catch up

Both the genome, our set of genes, and the proteome, our set of proteins, are inter-linked, but the discrepancy in their discovery speed is widening. Boosted by low sequencing prices, the genomic knowledge is leading to an increase in applications (e.g., medical diagnostic), whereas expensive technical costs and lack of skilled technicians for proteomic data access still limits its application.

- Genomic Market ($19bn) and Proteomic market ($20bn) were on par in 2019, but expectations for 2027 are respectively for $82bn and $49bn.

Unlocking proteins advantages requires new techniques

Proteins are among the best biomarkers due to functional relevancy, but the lack of innovation in protein detection techniques slows down biomedical research. Genomic research relied on being able to amplify genetic material in a sample, allowing to pick up on low abundant traces of DNA or RNA. A luxury that proteomic technics and research do not have, limiting protein-based biomarker diagnostics.

- Even the latest innovation in genomic sequencing relies on the decades-old "PCR" DNA amplification technique.

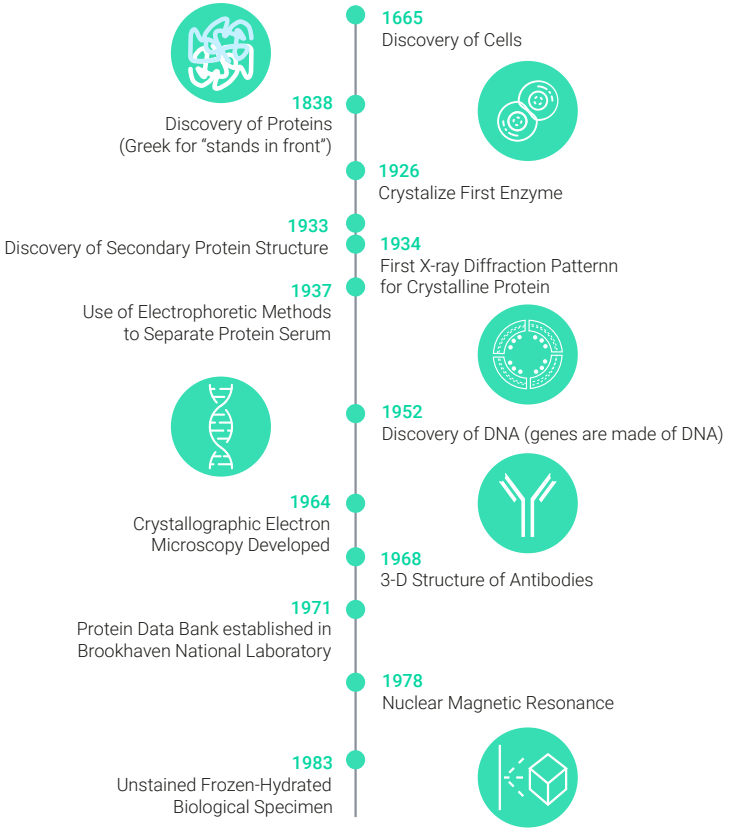
Newcomers aim at closing the gap

If proteins cannot be copied as DNA can, two new approaches are appearing: sample enrichment, looking to enhance the detection range for current techniques, and new sequencing techniques development. Both approaches could vastly increase proteomic knowledge output.

- Seer/Olink and Nautilus/Oxford Nanopores are promising companies developing within these approaches.

A BRIEF INTRO INTO PROTEIN HISTORY

Protein is an essential part of organism and is studied in the life sciences and biotechnology fields. It has led to multiple medical breakthroughs.



SOURCE:
NuSep, Grandviewresearch, Nautilus, Seer, OlinK, Oxford Nanopores,nature

The Folding Stones Rocking Life From Its Core

Proteins are involved in all life processes

Proteins are sequences of amino-acids (AA) and are involved in all processes supporting life, from duplicating our genetic material to storing fat. Yet their intricate synthesis and chemistry make studying them a very complex matter.

- Protein synthesis is carried on within our cells through a complex system able to read mRNA, which are gene copies, and convert it into an AA sequence.
- Among the most famous class of proteins, we find enzymes, hormones, and antibodies.

Genes instruct, but proteins do; information vs. function

Even if the genetic material holds the information to build a protein, reading a protein-coding gene sequence does not easily translate into knowing the resulting protein sequence. Our massive capacity to read DNA bases is thus decoupled from our ability to test its main functional product, the proteins.

- <2% of the human genome codes for protein but numerous gene-independent events modify the protein during its multi-stage synthesis.

3D shape add an extra layer of complexity

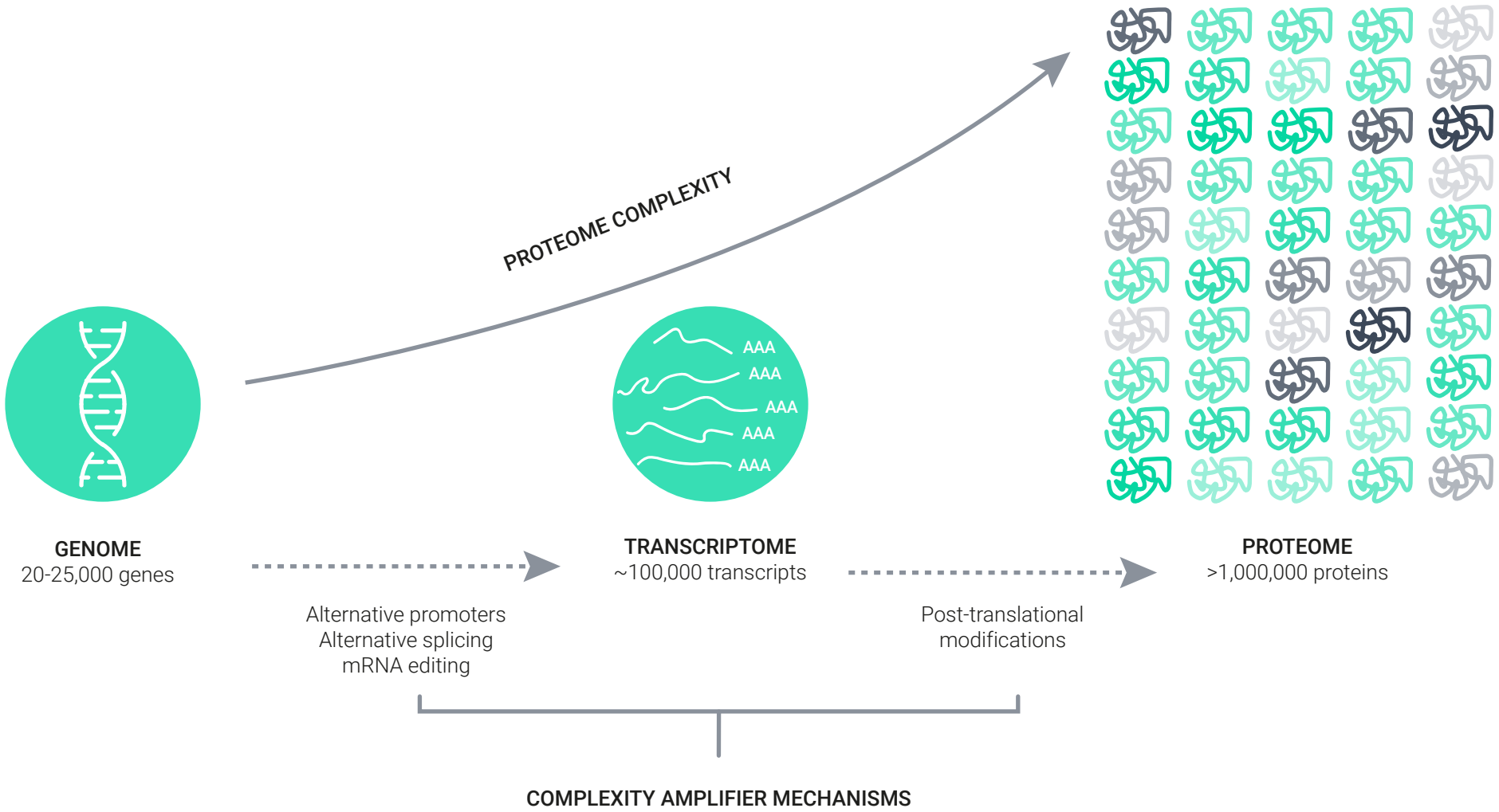
Not only is the relation from DNA to protein not straightforward, but proteins must fold in specific ways to acquire their function. A complex process, whose understanding is currently being tackled by using AI and massive databases.

- Google via its Alphafold2 AI has been able to correctly fold proteins in silico.
- Failure to correctly fold protein leads to major diseases such as Alzheimer, Parkinson, Huntington and Creutzfeldt-Jakob disease.

PROTEINS PROVIDE MANY ESSENTIAL FUNCTIONS IN THE BODY

SOURCE:
NATURE, GOOGLE

The "Not-So-Straight" Path From DNA To Proteins



SOURCE:
SWISSPROT

Playing The Hard-To-Discover Game

A 20-ingredients recipe for proteins

Even digging into AA chemistry is more complex than DNA chemistry. There are more AA than nucleotides (20 vs. 4), classified in more families based on chemical properties (5 vs. 2), increasing the complexity of resulting proteins.

- It took >200 years from discovery of the first AA until being able to read protein sequences, while it took half that time for nucleotides and gene sequencing.

Sample analysis: Discovery versus Targeted methods

Currently two approaches are available to analyze proteins in a biological sample: discovery methods, trying to reveal what sort of proteins are in the sample, and targeted methods, often leveraging antibodies' specificity to fish for a known target that may be in the sample.

- Discovery methods rely heavily on the protein's physicochemical properties but the tools to decipher them are extremely complex and difficult to use.
- Targeted methods rely heavily on the engineering of specific antibodies, which are long and costly to produce.

Detection range is too narrow for both methods

Unlike genomic studies, which can give a full snapshot of a cell genome, proteomic studies do not furnish the entire range of detectable proteins.

- Over the last 20 years, 25mn genes have been discovered against only 170k proteins across all organisms.
- Discovery methods are still unable to read the whole proteome at once.
- The library of antibodies for targeted proteomics is still incomplete.

Slow Data Collection Limits Applications In Health

Proteomic data is more relevant than genomic data in clinical settings

Since proteins are responsible for the function of the cells, after completion of genome sequencing, most of the biological questions remain unanswered.

- Proteomic analysis can provide comprehensive assessment of cellular activities in the clinical research of different diseases.

Biomarker discovery growing despite proteomic data collection struggles

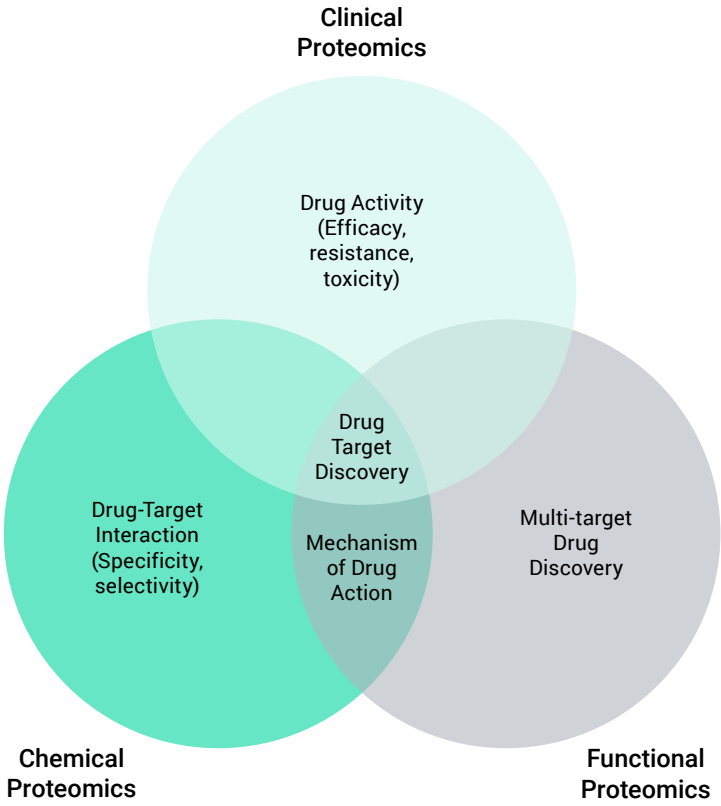
A biomarker refers to disease-related proteins or a biochemical indicator used in the clinic to diagnose or monitor the activity of diseases and to guide the molecular target treatment or evaluation of the therapeutic response. Finding better protein biomarkers is necessary for better diagnostics and personalized treatment.

- The biomarker discovery market is expected to reach $14 billion by 2026 growing at double digit CAGR.

More proteomic data would synergistically boost drug discovery too

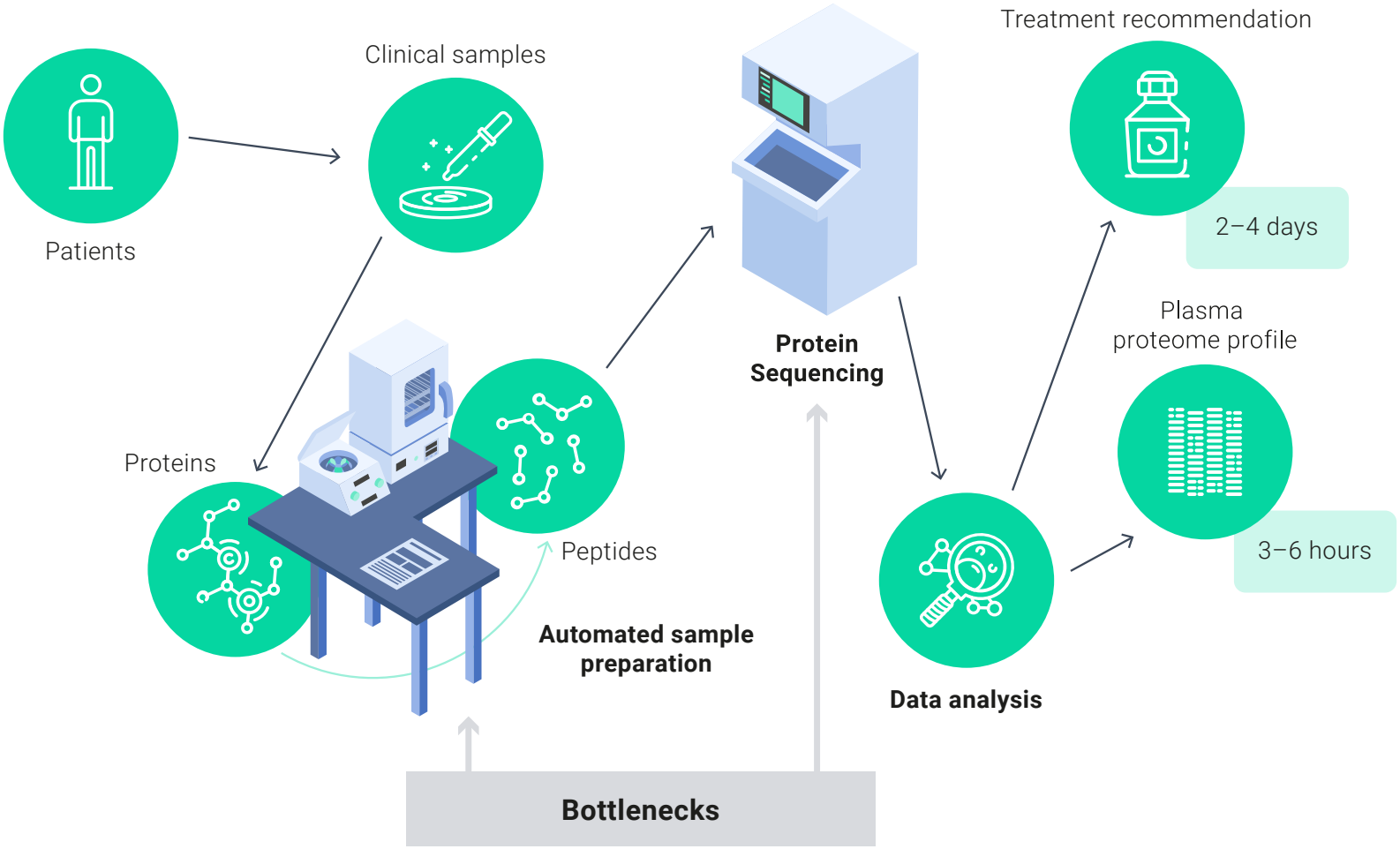
Target identification is the first step in drug discovery process and the identification and early validation of disease-modifying targets. Proteomics technology plays a prominent role as proteins are the main drug targets in disease conditions.

- The proteomic drug discovery market is expected to reach $13 billion by 2026 growing also at a double digit CAGR.
- By combining different proteomic data set (Clinical, Chemical and Functional), drug discovery speed and efficiency could be multiplied.



SOURCE:
BLOOMBERG, AtonRâ Research

The Bottlenecks Of The Dream Pipeline For Clinical Biomarkers



SOURCE:
EUROPEPMC

The Expensive Proteomic Data Quest

The good ol' expensive Mass Spectrometry is still running

Mass spectrometry is the gold standard method to readout the molecular signature of a sample. Particles in the sample are ionized then discriminated by their mass-to-charge ratio. The resulting "mass spectrum" is compared to an existing library of "molecular signatures" to know which particles are in the sample.

- Machine cost is high (>$500k) and running costs even more, so manufacturers like Thermofisher have "Affordability Programs" not to deter potential customers.
- Sampled particles without a known signature are much harder to sequence.

Variation of Mass Spectrometry protocols helped

A number of improvements, notably multiplexing techniques, lowered the data per $ invested ratio, at the expense of an increased method complexity, both in terms of longer time to result and need for even more skilled technicians.

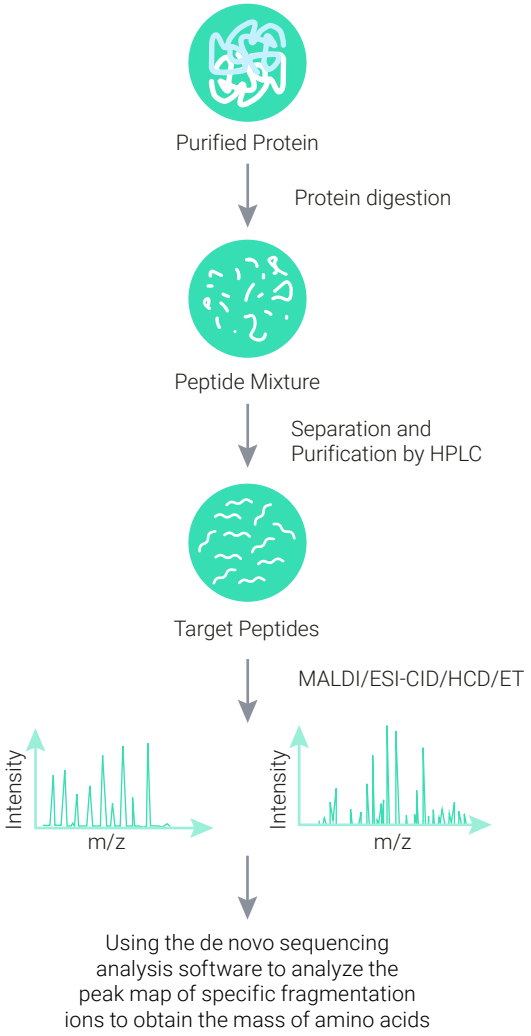
- Multiplexing allows to run several sample at the same time. This technology was introduced a decade ago with isobaric tags.
- Unfortunately, the samples to be measured must be simple enough to not overload the mass spectrometer.

The sample preparation slows the process

Independently of the protocol, sample complexity decreases output quality. Lengthy steps of sample preparation must be carried first, either to decrease complexity by chromatography, a method to separate molecules in a mixture, or by enriching a sample by depletion of the most abundant proteins.

- These additional steps can take up to half a day for a single sample and are very labor intensive.

DE NOVO SEQUENCING



SOURCE:
Thermofisher, AtonRâ Research

Protein "Fishing" Protein

Antibodies are the protein's fishermen main tool

Few tools can extract, or "fish", specific proteins from a complex biological sample. In truth, we have not yet manufactured anything better than what nature does: antibodies. Ironically, antibodies are proteins themselves, which means their discovery and manufacturing is very complex too.

- Antibody can detect the presence of proteins in a nanogram-per-milliliter range even in a complex sample like blood.
- Antibodies and reagents market for proteomic is expected to grow at a CAGR of 6% from 2019 to 2025 to reach ~$14bn.

Antibodies are expensive…

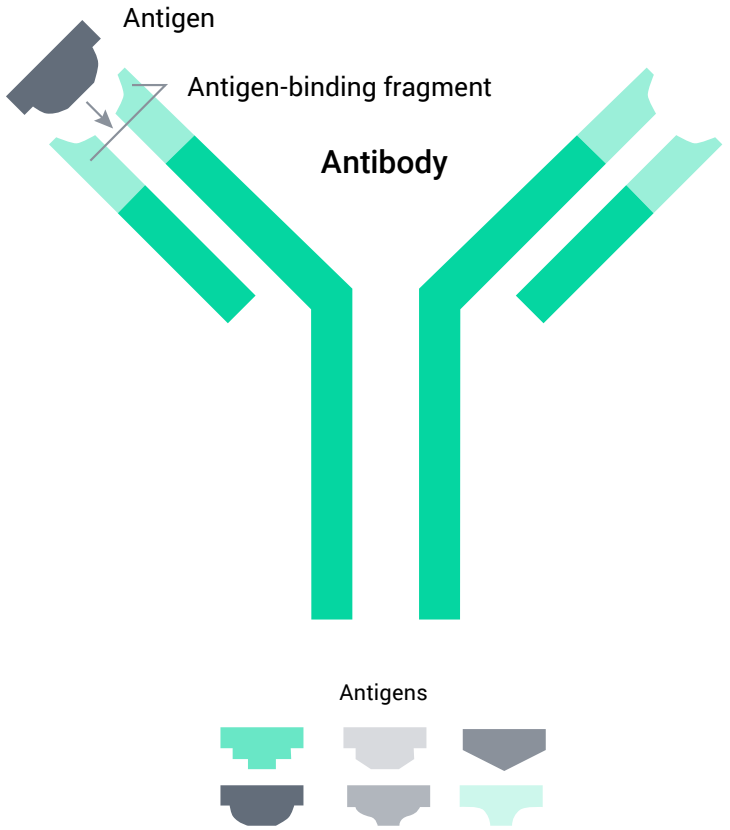
The main hurdle is the production of antibodies, which often requires animal experiment and long selection processes. Consequently, methods for targeted proteomic are trying to move away from using antibodies, even if their high sensitivity and specificity makes them the gold standard.

- A specific antibody selection and production can take 2 to 6 months and cost ~$20k.

… and can only be used in specific experiments

Antibodies technically recognize a pattern in the range from 4 to 7 AA. Unfortunately, antibodies recognize only a specific 3D conformation of this pattern. A nightmare for gathering data on one protein.

- For example, experiments must often use different antibodies for detecting presence (based on folded protein) and measuring length (based on unfolded protein) of the same target protein.



SOURCE:
Thermofisher, CELL, AtonRâ Research

The Blatant Proteomic Market Conundrum

Academia lacks money, slowing knowledge accumulation

Price of mass spectrometers, antibodies, reagents and maintenance limit the number of laboratories having direct access to proteomic techniques, slowing down the accumulation of knowledge.

- It also means that the capacity of proteomics facilities is a bottleneck for research institutions serving university laboratories.
- Even at the low internal price for running samples, the cost is around $2–3k. Including a minimum of 3 replicates, each experiment costs ~$10k.

Clinical research lacks knowledge, slowing technology implementation

Proteomic methods require highly trained scientists, including physicists and data scientists, most often found in academic settings. Lack of skilled scientists and academic research limits the potential for clinical application.

- Liquid biopsy is a good example of a lucrative segment working on the back of an "-omic" method. Genomic is the first "-omic" used and skyrocketed to a $1.1bn market. The addition of proteomic data could triple the size of the market.

Equipment Suppliers lack the clients due to high prices

Academic labs already spend most of their budget for their proteomic platform, thus are not a main target for equipment suppliers. BioPharma are potential clients with regards to drug discovery and the high sensitivity of the method to characterize proteins, but clinicians cannot use it as a routine test unless the cost is compressed.

- There is a factor of 10 in price for genetic testing compared to proteomic testing. As long as this gap is not reduced, service providers and equipment suppliers are missing out on a massive market.

SOURCE:
BLOOMBERG, AtonRâ Research

An Overview Of The Resulting Market

A market skewed towards tools and reagents

Proteomic methods, as stated, rely on the detection of physicochemical properties of proteins, either through sophisticated machines or using antibody. Applications such as biomarker and drug discovery are lagging, thus, most of the market is skewed toward tools and reagents.

- Tools and reagents represent 90% of todays' $20bn proteomic market.

Only big players can thrive

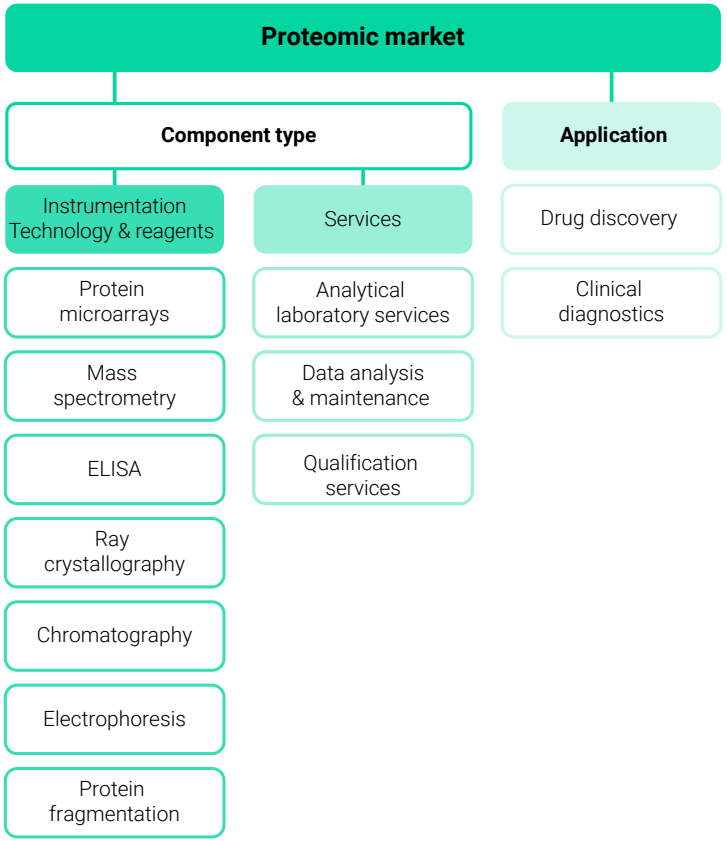
Due to the complexity of the methods and high price tag, the proteomic market has been restricted to deep pocketed and all-round players.

- Unsurprisingly top players include: Thermo Fisher Scientific, Bruker Corporation Inc., Agilent Technologies Inc., Waters Corporation, and PerkinElmer, Inc.
- For most, the proteomic-related activities represents <10% of their revenues, a proportion bound to change as the market expands e.g Bruker aims at 40%.

Newcomers need to bring a paradigm shifting tech

Innovation in that space requires to completely bypass the current technologies, especially mass spectrometry or antibody.

- Replacing antibodies during sample purification steps could be done with engineered nanoparticles or aptamer, as described in the following section .
- Bypassing the mass spectrometry could be done by using nanopore sequencing or fluorescent protein fingerprinting, as described in the following section.



SOURCE:
GRANDVIEWRESEARCH

Proteomic Boost: Simplifying Sample Preparation

Biological sample are very complex by nature

Biological samples always contain a mix of cells, tissues and liquid. Not only the sample preparation need to separate the sources, but also to remove the most prevalent molecules to not overshadow the low concentrated ones.

- Current techniques can detect around 3–5k proteins in a sample compared to expected ~6mn human proteins including all variations after synthesis.
- To detect these low abundant proteins which are often the best biomarkers, companies are trying to use Aptamers and Nanoparticles.

Aptamer technology could replace antibodies

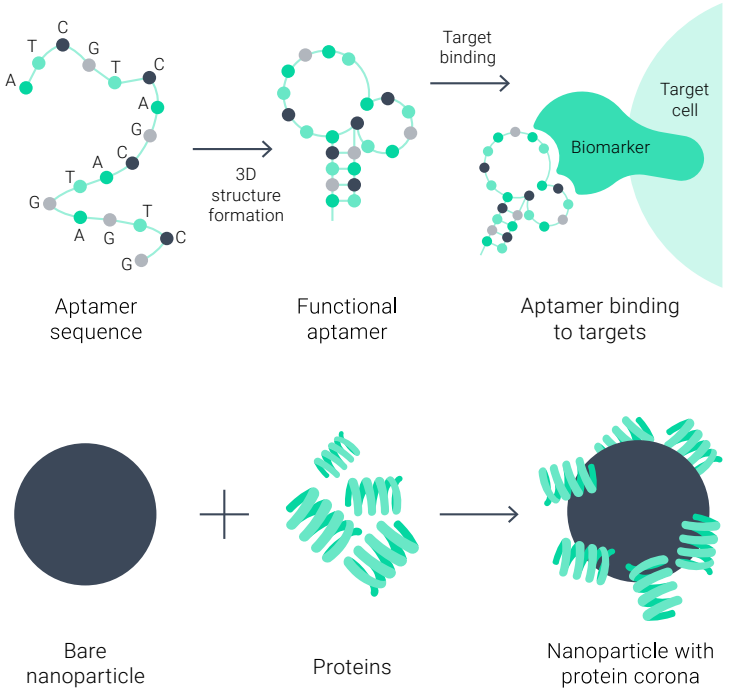
Aptamers are short sequences of nucleotide with antibody-like binding properties. They represent a fantastic opportunity to fish out of the sample the proteins of interest without the complexity of antibodies.

- Aptamer are easily produced, very cheap, and do not require animal experiment.
- Olink is currently one of the main player in the domain.

Nanoparticles can capture a range of proteins

One may not only be looking for specific proteins, but proteins which share a common chemical feature: charge, mass, hydrophilic, hydrophobic, etc. Nanoparticles can be customized to capture a specific set of proteins.

- Nanoparticle's customization possibilities are endless, and cheap too.
- Seer is currently the leader in this domain.



SOURCE:
Seer, Olink, Oxford Nanopores, Nautilus Biotechnology

Proteomic Boost: Alternative Sequencing Method

Sequencing is of paramount importance

Sequencing protein is the bottleneck to characterize drugs' target, which are virtually all proteins. As mentioned, the protein AA composition is not fully captured in the gene sequence coding for it and does not encompass post synthesis modifications carried by enzymes. Speed, accuracy and detection range for protein sequencing are the main factors able to improve the situation.

- To obtain protein composition with higher quality, speed and depth of analysis, companies are trying to use Nanopores and Microarrays.

Nanopores: the holes that say it all

Already applied to genomic, nanopores technology work under the same premise for protein: when a molecule diffuses through a nanopore, the current through the pore changes. The current variation could tell us the AA composition of the protein as it does for the nucleotide composition of DNA

- A major advantage is the ability to produce ultra-long reads, >2mn base-pair read lengths for DNA, a 4000-fold increase compared to the current standard and potentially around 1k AA, a 300-fold increase compare to mass spectrometry.
- Oxford Nanopores is a leader in Nanopores technologies.

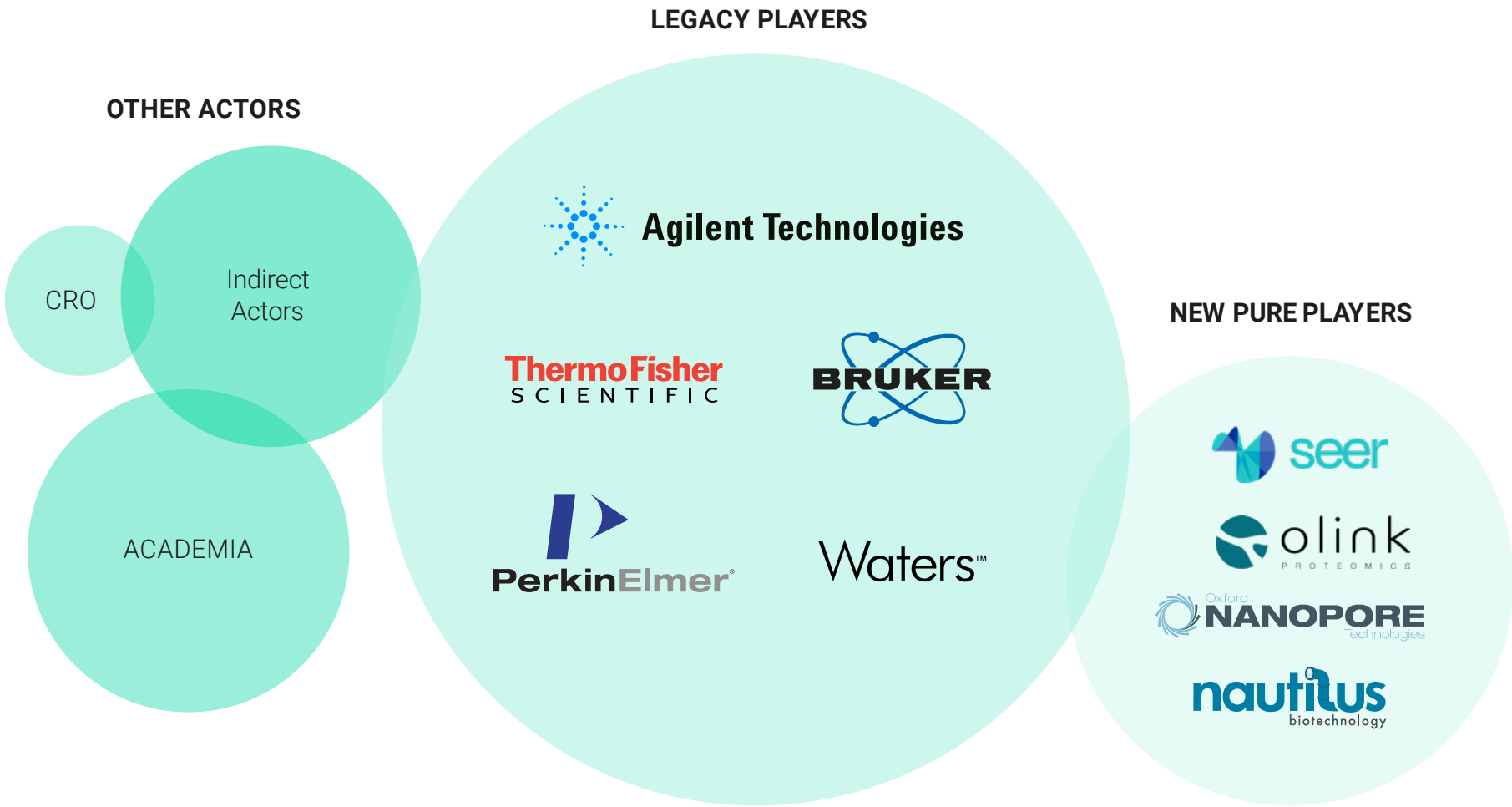
Imaging and Microarrays, the cheap chip deal

Proteins can be docked on chip for analysis. Technologies are being developed to label single proteins and read the sequence of the protein. This technology could detect a single protein in a mix and is much cheaper than mass spectrometry.

- It could sequence tens of billions of molecules a day while doing multiplexing to compare samples on the fly for the cost of one mass spectrometry experiment.
- Nautilus Biotechnology, a leader in the field, is going public in April for $900mn.

SOURCE:
Seer, Olink, Oxford Nanopores, Nautilus Biotechnology

The Playfield



SOURCE:
Companies Websites

Catalysts

- **Bypassing current tech.** Cumbersome or expensive current proteomic technics limit access to the market for smaller players.
- **Discovery of biomarkers.** Clinical research findings in the domain fuels the lucrative diagnostic industry.
- **Lowering cost of protein sequencing.** In the same fashion as in genome sequencing, where price drops lead to a genomic research boom, price for protein sequence should get lower to incentivize proteomic research.

Risks

- **Commercial failure.** Failure to bring commercially viable product on the market is bound to hurt proteomic research.
- **Technological hurdles.** Failure to overcome current technological limitation will slow-down protein-based medical diagnostics.
- **Big player innovation.** Thermofisher and the other big players are not staying idle. Although they would cannibalize part of their own business, proteomic innovation may come with increased margins.

Bottom Line

- Proteomic data is not as easily accessible as genomic data, despite being more clinically relevant. The slur of newcomers trying to address the subject from different angles may be the push the proteomic domain needs to catch up with the recent genomic progress. A boost that would hugely benefit Biomarker & Drug discovery.
- We have exposure to the sector through the big players and are monitoring closely the new disruptive pure players.

Companies mentioned in this article:

Agilent Technologies Inc. (A US), Bruker Corporation(BRKR US), Google (GOOGL US), Nautilus Biotechnology (NAUT US – IPO April 2021), Olink (Not listed), Oxford Nanopores (Not listed), PerkinElmer (PKI US), Seer (SEER US), Thermofisher (TMO US), Waters Corporation (WAT US)

FLY ME TO THE MOON

Space Tourism Prepping For Take-Off

A dream almost as old as spaceflight

Space tourism takes its roots as early as the 1970s, although it only materialized recently. With strong demand traction already despite supply constraints, the market appears more than promising.

- Space tourism includes 0G atmospheric flight, suborbital and orbital flights.
- Despite high prices, the market is expected to reach $3.4bn by 2028.

A dream that makes space companies think in all directions

While the concept of space travel is simple, and many players offer different ways of achieving it, the ultimate choice would depend on the customer. Would he rather launch to space comfortably in the familiar surroundings of an airplane with little training or vertically in the capsule on top of a 30-foot rocket after a bootcamp?

- Some space travel options last hours with only minutes in “true space”, while others allow tourists to remain in space for days.
- Numerous travel options compete on paper but are, in fact, complementary services. This allows customers to try different providers without cut-throat competition.

This is just the beginning

With talks already happening about transferring International Space Station (ISS) to private players and commercial space station projects flourishing, the next step appears obvious. Beyond-orbit flights are also a possibility but will remain a niche in the mid-term due to high costs and technological obstacles.

- SpaceX has a lunar flyby scheduled for 2023.
- Axiom Space is developing technologies to be used in a private space station.

SOURCE:
Axiom Space raises $130 million

It Is Not The Destination But The Journey

Different flavors of space tourism

Space tourism is theoretically an action of going to space for leisure. However, the ways to reach it differ depending on the space tourism ventures. Also, some of these only attempt to recreate specific aspects of the experience.

- "True" space tourism attempts to reach space during what can be classified as either a suborbital or an orbital flight.
- So-called 0G flights recreate zero-gravity conditions without even reaching space.

Where does space start?

One of the particularities to consider is that there is no universally accepted definition of where space starts. The Fédération Aéronautique Internationale sets the limit at the Kármán line (100km), but other definitions coexist, creating discrepancies among tourism ventures.

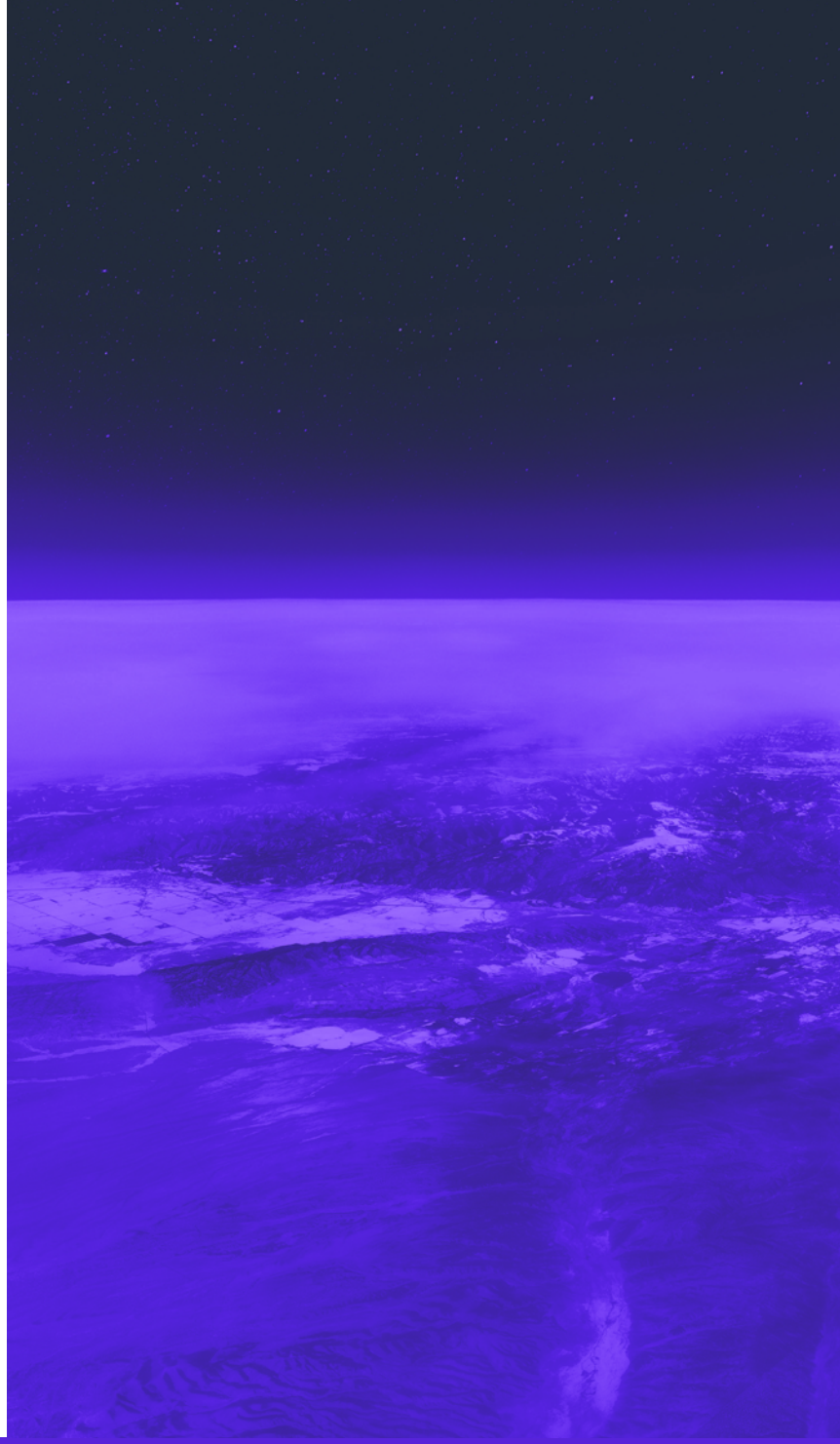
- The Kármán line can be defined as the physical limit until which an aerodynamical lift can sustain flight without reaching orbital velocity.
- The U.S. Air Force sets the limit at 80km to award astronaut wings.

Traction is already substantial

Space appears as the ultimate frontier, therefore attracting pioneers and enthusiasts alike. This explains the fact that despite high price points, the demand is already substantial, and may only increase along with the development of more affordable solutions.

- There are 4.9bn mobile phone users in the world, of which 3.8bn use smartphones.
- In the U.S. alone, 20'000 branches could be closed over the next decade (vs. 4'500 branches closed since 2010, about 6% of total).

SOURCE:
Where, exactly, is the edge of space? It depends on who you ask,
Space Tourism: Humanity Leaving the Cradle?



An Historical Look

Early attempts in the 1970s

Although space was initially a governments' business, prospects of commercial flights appeared as soon as the 1970s, with the reusable Space Shuttle development. Yet those never materialized due to the 1986 Challenger accident.

- An early design included a 74-passenger module in the Shuttle's payload bay with enough support to spend three days in orbit.
- The first non-governmental astronaut was Charles Walker in 1984.

Limited success for the 1990s ventures

A new wave of ventures appeared in the late 1990s intending to enable commercial flights. However, the 2001 bubble, the 2008 financial crisis, and technological obstacles put an end to most of those before the first launch.

- Most of the players developing spacecrafts failed (e.g., Rocketplane) except Scaled Composite, whose design was perfected by Virgin Galactic.
- Space Adventures is one of the few survivors. It adopted a partnership-based business model with governments instead of developing its own vehicle.

First space tourists in the 2000s

Space tourism finally materialized with Denis Tito flying to ISS in 2001 on a Soyuz rocket. Still, the market never entirely took off due to the lack of available seats and high associated costs.

- Seven space tourists went to space over 2001–2011, with a pause between 2003 and 2005 due to the Columbia accident restricting Shuttle flights.
- Denis Tito reportedly paid $20mn for his flight, while other tourists paid >$40mn.
- In 2019 NASA announced it would again encourage space tourism in ISS.

SOURCE:
'What the hell happened?': The rise and fall of suborbital space tourism companies,
A Definitive History of Space Tourism & Human Spaceflight,
NASA Opens International Space Station to New Commercial Opportunities, Private Astronauts

Suborbital

Training for some, experience for others

Zero-G (or "vomit comet"), otherwise known as simulated weightless flights, started in the 1960s to train astronauts. Reduced-gravity aircrafts (modified seatless versions of classic models) simulate weightlessness by following a parabolic trajectory at the attitude of commercial aerospace around 10km.

- Each parabola lasts 60sec with 25s of "freefall", which feels like zero gravity.
- Since 2004, Zero Gravity Corp markets 0G flights of 15 parabolas simulating the gravity of Mars, the Moon, or its complete absence, for $5700.

That's one giant bill for a man, one small flight with a view

Virgin Galactic aims to establish the first commercial spaceline (U.S. Air Force's definition), therefore, lengthening the weightless experience at Mach 4 (4x speed of sound).

- Luxury SpaceShip will be launched from a carrier aircraft taking-off conventionally.
- Within its 2.5h flight, it will offer 6min of weightlessness by reaching altitudes of >80km, for a price of $250K.

A truly authentic astronaut experience

By 4Q 2022, Blue Origin plans to bring clients to the heights of 100km while staying true to the real astronaut experience by offering a seat in the capsule launching on a rocket and accelerating to beyond Mach 3.

- The New Shepard system is "vertical takeoff, vertical landing", providing 2.5min of acceleration and reaching the "space" in 10min for a price of ~$200K.
- The company is currently deep in the testing phase. The latest test launch in January reached an altitude of over 100km.

SOURCE:
ZERO-G, Virgin Galactic, Blue Origin

Orbital

Old but reliable space taxi

Since 1998, Space Adventures (also the owner of Zero-G) purchased seats from Russian Roscosmos on their Soyuz rocket for space travel. Since 2011, when the U.S. has retired its Space Shuttle and decreased U.S. astronaut launch capacity, all Soyuz seats were bought by NASA until they finally became available in 2020.

- The trip to space will require months of training and likely cost ~$50mn.
- The two tourists will be sent to ISS in 2023, and one of them will spacewalk.

Giving International Space Station a second life

Company Axiom Space is already organizing trips to the ISS and is planning to attach new modules to it, which will be used for space tourism upon the latter's retirement. The first of these modules is scheduled to be launched no later than 2024 and will contain sleeping “pods”.

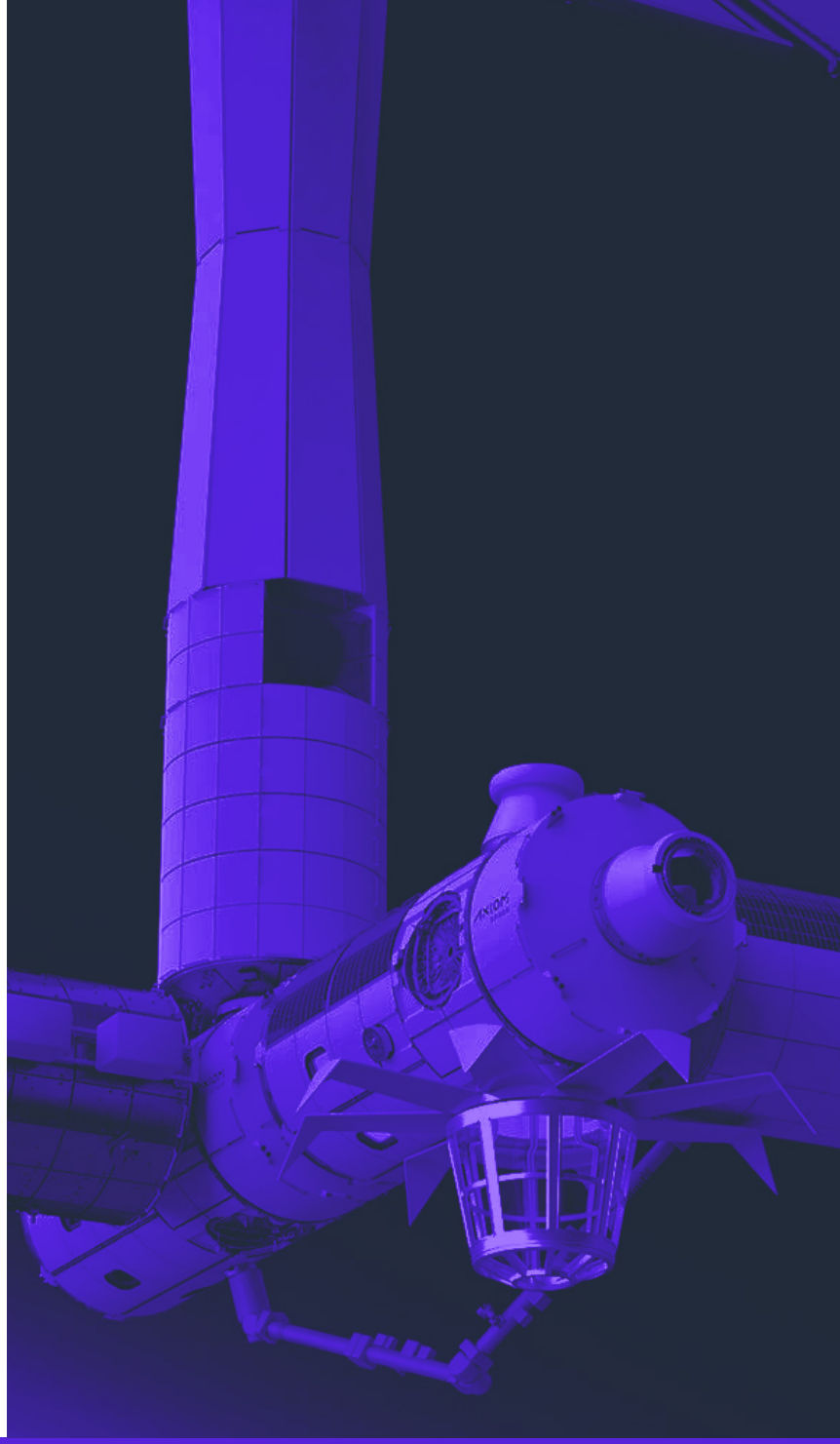
- The price for a mission or a 10-day stay on board is set at $55mn.
- The modules designed by architect and designer Philippe Starck will have a taste of French luxury. Tourists will visit a glass-wall cupola (picture on the right).

Highly customizable flights

SpaceX is developing a Starship spacecraft. In addition to true “space tourism”, it may offer long-distance flights, and carry people to Mars, Moon, and beyond.

- Space X Dragon may orbit the Earth every 90 minutes, allowing tourists to experience truly unique and custom space flights.
- In February, SpaceX has announced plans to launch a crew of only private astronauts into orbit later this year. The Dragon would carry four passengers who paid an undisclosed but “significant” sum for the trip.

SOURCE:
Roscosmos says it will send two tourists to the space station in 2023 — and one of them will spacewalk,
SpaceX and tech CEO's pitch: Donate $10 to charity, win a trip into orbit,
Russia, Space Adventures to fly 2 tourists to space station in 2023. (Spacewalk included!), Axiom Space



This Is Just The Beginning

ISS transferred to private players

Although additional funding was voted to maintain the station until at least 2030, NASA and Congress have been considering transferring the ISS to private interests, which would increase the number of space tourists.

- ISS absorbs $3bn per year from NASA, which in parallel needs funding to develop a costly lunar program.
- From a technical standpoint, the station has potential to last well beyond 2030.

Other stations

Now that technologies are maturing and launch costs are becoming relatively affordable, it is likely that the future of space stations belongs to the private sector, similarly to what happened in the launch sector. There are therefore substantial chances to witness some projects at least partially dedicated to space tourism.

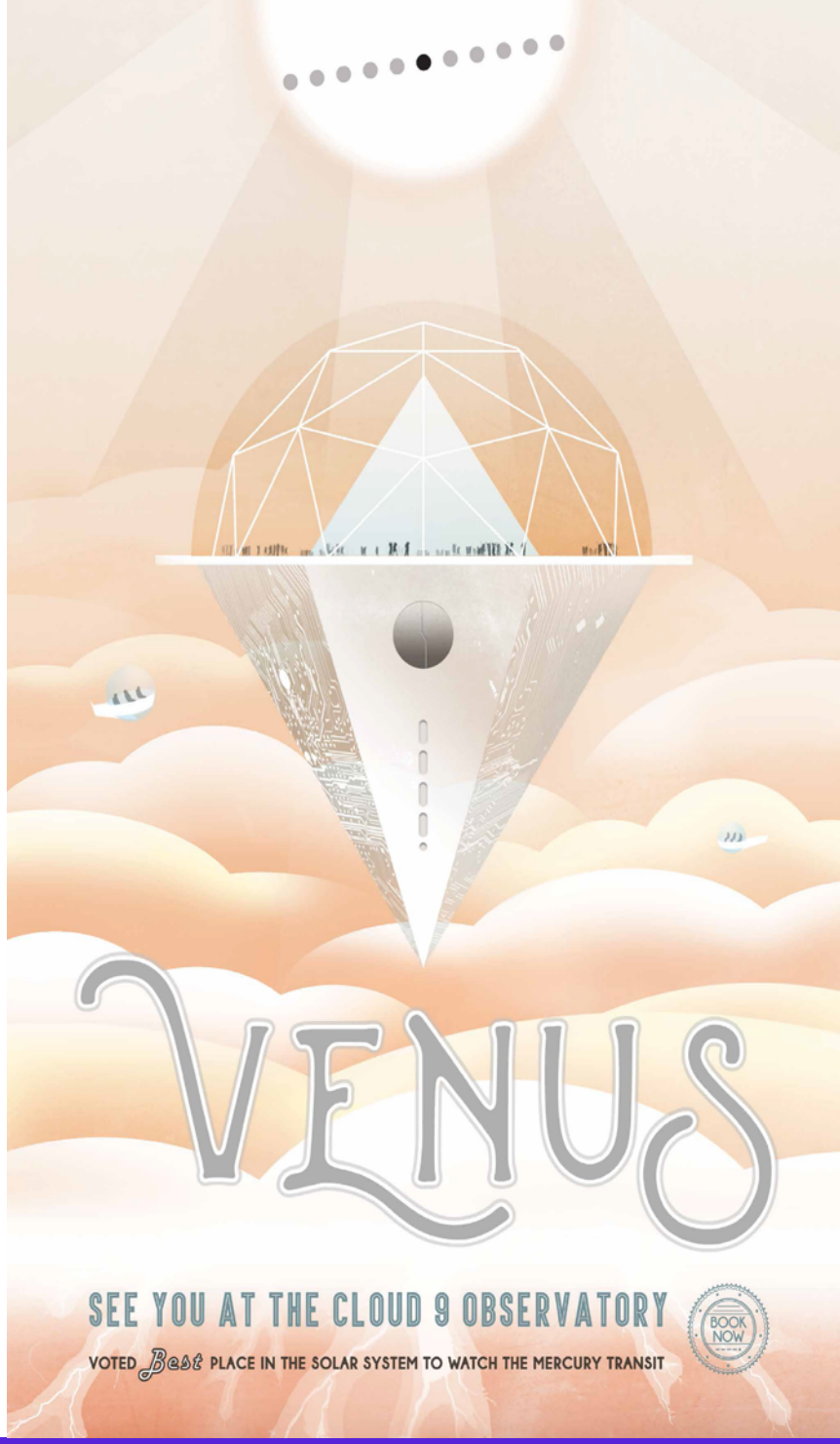
- Technologies such as inflated modules currently tested on the ISS by Bigelow would decrease the construction costs.
- Axiom Space raised $130mn in February to develop commercial space modules.

Beyond orbit

Although the projects of a permanent lunar base on the Moon opened to commercial crews appear unrealistic in the mid-term, there are already projects aiming at bringing commercial crews beyond Earth orbit materializing in the first half of the decade.

- SpaceX's "DearMoon" mission is scheduled to take a crew of 8 on a Starship spacecraft in a lunar flyby in 2023. This type of mission is likely to be infrequent due to the high costs and technical requirements to reach the Moon.

SOURCE:
Hearing – The ISS after 2024: Options and Impacts (EventID=105737),
The International Space Station can't stay up there forever. Will privately run, commercial replacements be ready in time?



Catalysts

- **Growing offering.** The market appears today to be supply-constrained, with long waiting lists for the current offerings. The rise of new players would allow for easing this constraint.
- **Improved accessibility.** Technological progress would lead to easier access to space, either through smoother experience or a faster turnaround and lower price, which would mechanically benefit demand.
- **New normality.** Plane flights seemed reserved to an elite when they first appeared but have since become part of everyday life. Democratizing space by dissipating this "pioneer" image would ultimately lead to significant growth.

Risks

- **Potential accidents.** Although reserved for well-informed individuals, risk acceptance remains limited. Accidents, especially ones resulting in casualties, would severely hamper the sector.
- **Unfavourable economics.** Current technologies and business models are at an early stage, especially for new suborbital players. Therefore, returns on investments might be more challenging than expected to generate, especially with unexpected technology-related issues.
- **Lack of funding.** Current suborbital ventures already require substantial capital. Future orbital stations will require even more. Any tightening of capital availability would hamper the sector's development.

Bottom Line

- Space tourism is the product of efforts dating back to the 1970s. Now made possible by technological development and affordable prices, the sector is experiencing a strong demand despite scarcely available solutions. Beyond suborbital and orbital flights, commercial stations appear the next logical step. However, they will require the next generation of launchers currently under development to reduce construction costs and make a more compelling business case. Virgin Galactic (in our portfolio) remains the most advanced player, with the first commercial flights expected within the next 12 months.
- The investible universe is continuously expanding, and we already have exposure in our portfolio to both the commercial players and their suppliers.

Companies mentioned in this article:

Axiom Space (not listed), Bigelow Aerospace (not listed), Blue Origin (not listed), Roscosmos (not listed), Space Adventures (not listed), SpaceX (not listed), Virgin Galactic (SPCE US), Zero Gravity Corporation (not listed)

CHARTS FOR THOUGHTS

Regional Cycles

Decades of outperformance

The charts show how over the past 40 years, each decade has been dominated by a regional equity market, whose outperformance spanned almost the full period.

- Japan, Europe and Emerging markets (EM) outperformed in the 80's, 90's and 00's, respectively. The U.S. has been outperforming over the past decade.

Drivers of equity market cycles

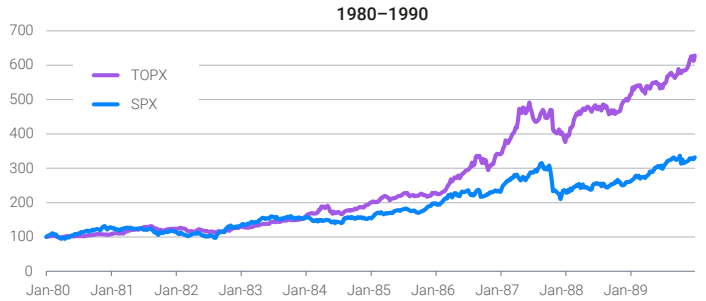
Demographics and easy Central Bank policies are necessary but not sufficient conditions. In relative terms, it can be argued that specific circumstances drive the actual outperformances.

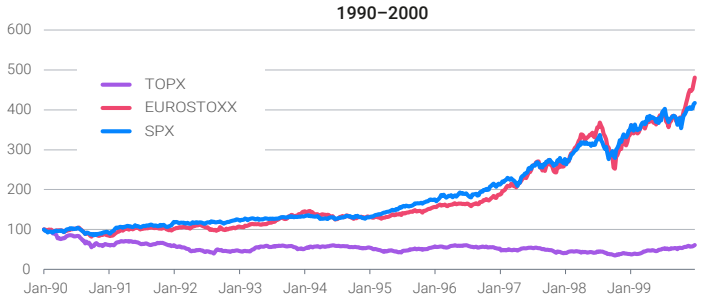
- Japan experienced financial liberalization, coupled with the Plaza Accord which unleashed a far too easy monetary policy and increasing internal demand.
- Europe benefited from the economic integration process that led to the Euro.
- Globalization and modernization drove massive investment flows into EM.
- The U.S. managed to come out of the great financial crisis with easier policies and took the global technological lead, propelling the growth of the past decade.

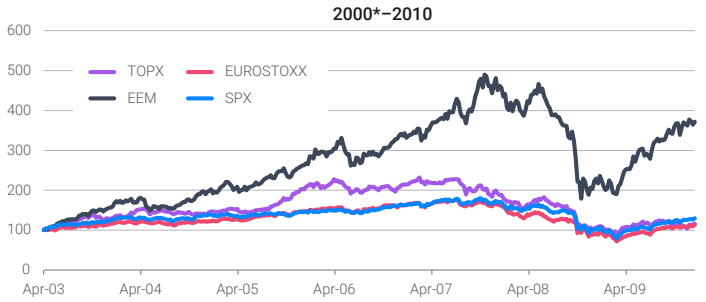
Who's next?

As we enter a new decade, it may be time for another regional rotation. But for this to happen, a catalyst for change and a driver boosting outperformance are needed.

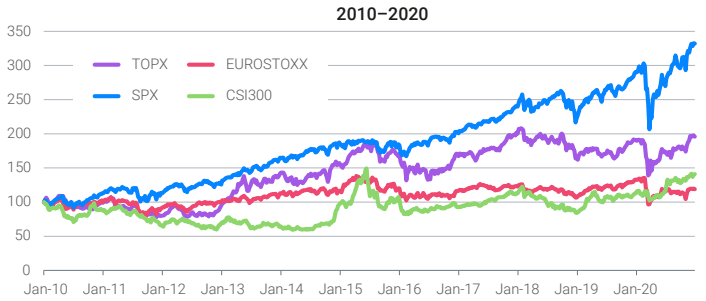
- Has the Covid-19 crisis potentially reshuffled the cards?
- Will it drive to a change in leadership? Who will benefit?







** EEM data available only since 2003*



SOURCE:
Eikon – Refinitiv, Atonra Partners

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AtonRâ Partners is a conviction-driven asset manager combining industrial and scientific research with financial analysis. AtonRâ Partners focuses on long-term trends powerful enough to be turned into thematic equity portfolios.

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