BIDWELLS

LIFE SCIENCES 2030

The implications for real estate

SUMMARY

The coming decade will see major steps forward in the evolution of life sciences. These advances will present opportunities for a real estate industry that has developed an appetite for the sector. The goal of our Life Sciences 2030 research programme is to better understand evolutionary trajectories to help direct investment and development for an industry on the precipice of significant change.

Life sciences are a central plank of the UK government economic strategy for the coming decade. While the sector was on a growth trajectory prior to the arrival of Covid-19, the pandemic experience highlighted the opportunity presented for the investment community, including real estate.

With a growing volume of life science real estate development and repurposing underway, this report identifies five areas from which some of the greatest life science advances are likely to emerge. Our Ones to Watch are based on a balance of current innovation and their realistic chance of being commercialised by 2030.

An understanding of how these sectors will develop will enable greater pinpointing of specific property requirements and locational parameters for the future. To capitalise on the opportunity, business space will need to evolve in tandem with science.

Our R&D Business Survey (2021) undertaken with YouGov, finds advances in life sciences will drive demand for both wet and dry laboratories in the short to medium term. Looking further ahead, requirements for specialist facilities will accelerate to enable the evolving role of areas such as AI, robotics and specialist manufacturing.

We are indebted to life science specialist Anil Vaidya at Ten93 for working with us on this report. We are equally grateful to our clients and the leading life sciences businesses which have contributed to this work.

Life sciences 2030 Ones to Watch

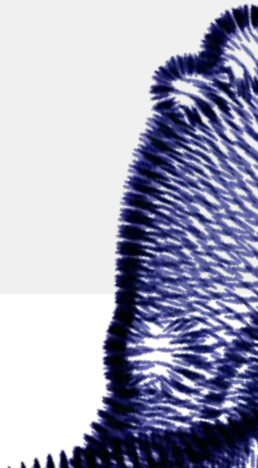
1. **BIOPHARMA**
   The biopharma sector has seen rapid development in the areas of AI drug discovery, and cell and gene therapy, with further advances expected over the next decade. This innovation is often driven by start-ups stemming from academia, although traditional pharma companies are building expertise.

2. **DIAGNOSTICS**
   Covid-19 has brought diagnostics to the fore with investors and the public, highlighting the need for reliability, accuracy and speed in the diagnosis and monitoring of conditions. We focus on laboratory based diagnostics, direct to consumer technology and digital imaging.

3. **MEDICAL DEVICES**
   The pandemic has also driven investors to rethink opportunities in the medical device arena, particularly with advances in robotics and 3D printing. Medical implicants, surgical devices and assistive technologies are expected to see strong growth as a result.

4 **DIGITAL HEALTH**
   There is significant public recognition of digital health applications due to user engagement on mobile or other platforms. The convergence of technologies and interoperable systems is facilitating applications encompassing telehealth, disease management and digital therapeutics.

5. **BIOPROCESSING**
   The biotech industry forced the development of new tools and instruments to manipulate living things. This is driving growth in the bioprocessing sector, where cells, enzymes and proteins can be used to create a range of new products and services, including the potential for industrial applications beyond life sciences.



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The life sciences opportunity

Life Sciences are a fundamental pillar of the UK's burgeoning knowledge economy. The Covid-19 pandemic has not only underlined the societal value of the sector but also illustrated the range of economic activities ranging from R&D to engineering and manufacturing.

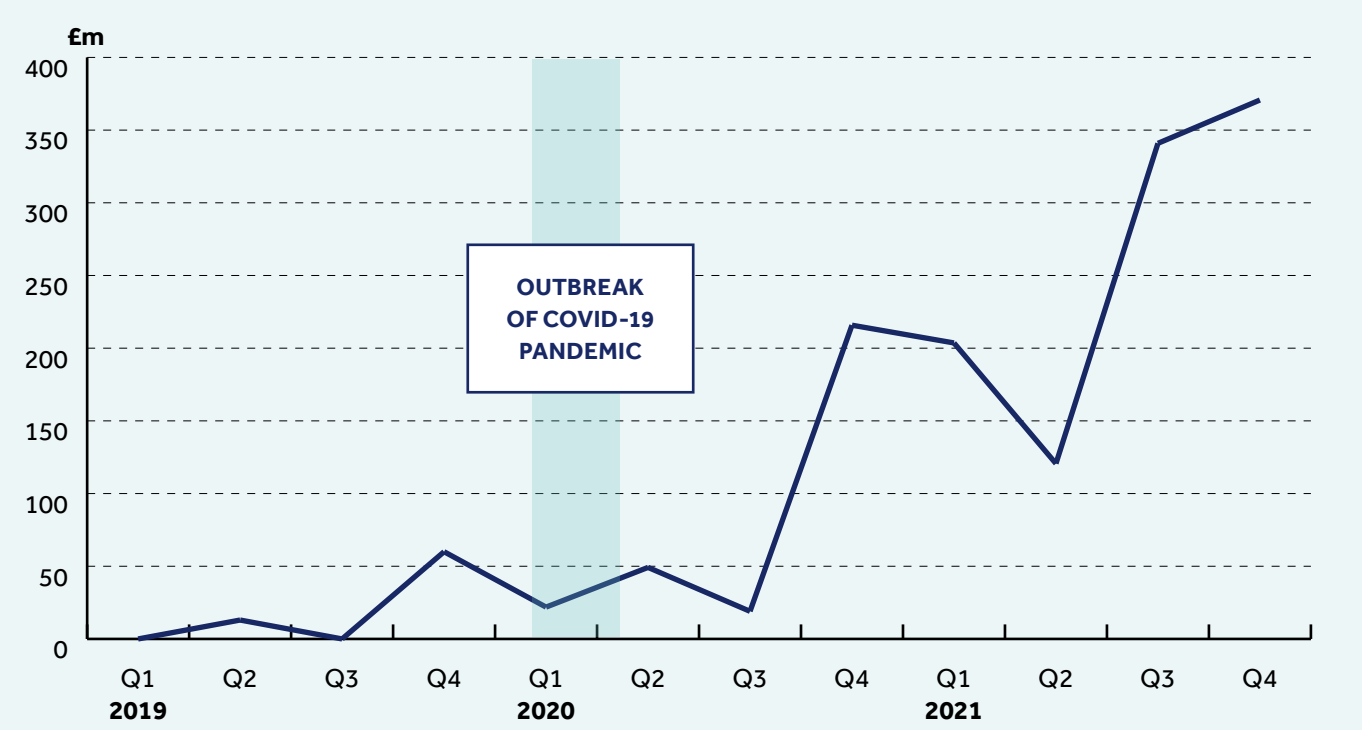
Life sciences contributed £88.9bn to the UK economy in 2021 by the biopharma and medtech sectors, which accounted for 71% of the sector's total. A further indirect contribution of £26.2bn came from service and supply chain elements. The sector is responsible for 268,000 jobs, 52% of which are in the medtech sector, with the remainder in the biopharma industry[1].

£89bn
GDP Contribution

268k
Jobs

Source: Office for Life Sciences 'Bioscience and health technology sector statistics 2020, updated Feb 2022

Laboratory real estate investment across the Oxford - Cambridge Arc



Source: Property Data, Bidwells

Government vision

The economic[2,3] potential is a fundamental driver of the UK Life Sciences Vision[4], launched in July 2021. This was the first sectoral publication to build on the government's post pandemic Plan for Growth[5] and links with the UK Innovation strategy, also published in 2021[6]. The Vision sets out a 10-year strategy for the sector to "build on successes of [the] COVID-19 response and accelerate delivery of innovations to patients". The plan includes additional finance through the Life Sciences Investment Programme, bringing total potential funding to £1 billion.

The plans sets out seven critical healthcare missions on which government, industry, the NHS, academia and medical research charities will work together at an accelerated pace. The missions are:

- Accelerating the pace of studies into novel dementia treatment
- Enabling early diagnosis and treatments, including immune therapies such as cancer vaccines
- Sustaining the UK's position in vaccine discovery, development and manufacturing
- Treatment and prevention of cardiovascular diseases and its major risk factors, including obesity
- Reducing mortality and morbidity from respiratory disease in the UK and globally

The missions focus on preventing, diagnosing, monitoring and treating disease early, through the adoption of "innovative clinical trials to develop breakthrough products and treatments quickly to help save lives, and accelerating the development and adoption of new drugs, diagnostics, medical technology and digital tools".

The real estate opportunity

The life sciences industry has been concentrated on locations of research excellence and other areas of specialism across the UK. The geography of activity is broad, but inevitably there is an R&D focus around leading academic institutions.

Much of the initial real estate capital has been focused on these centres of R&D excellence. The impact has been evident across the Oxford - Cambridge Arc which has seen a sharp increase in investment since the pandemic as, largely international, investors, sought exposure to prime opportunities in the UK.

What are life sciences?

Life sciences is the study of living things. Historically, life sciences referred to the study and manipulation of living systems principally in biology and chemistry but that definition has broadened as wider areas of technology have impacted human health.

Health life sciences refers to the application of biology and technology to health improvement through specialisations such as biopharmaceuticals, medical technology, diagnostics and digital health.

Many companies operating in traditional industries such as drinks, chemicals, arms, agricultural, tobacco and technologies transitioned into the life sciences sector, because of the technological cross-overs.

Drivers of sector growth

The life sciences sector has experienced tremendous growth during the last decade, but a particular acceleration over the last five years. This has been driven by a series of separate but converging factors.

Demands of an ageing population

According to the World Health Organisation (WHO), average global life expectancy has increased by more than six years between 2000 and 2019 – from 66.8 years in 2000 to 73.4 years in 2019, the fastest increase since the 1960s[7]. This has been driven by greater prosperity and the increased effectiveness of pharmaceuticals and medical care.

However, WHO data also finds the increase in the average healthy life expectancy of 5.4 years between 2000 and 2019, has not kept pace with the increase in life expectancy of 6.6 years. In many cases, an increase in age means an increase in the number and complexity of illnesses, some of which may also be chronic.

For businesses operating across the life sciences sector, this can bring both challenges and opportunities. Overburdened health care systems are increasingly focused on reducing costs in societies with an ageing population, but there is also a market for products and services.

Advances in preventative medicine and age related frailty, are combining with the delivery of age specific solutions such as regenerative treatments, testing to support homecare and assistive technology. Opportunities in these areas are supported by growing affluence amongst older people who are forming a rising share of the global population.

Covid-19 impact

Advances in life sciences were accelerating prior to the pandemic, supported by both public/third sector funding and expanding private equity funding. The arrival of Covid-19 undoubtedly raised awareness of the sector and its future potential.

The crisis highlighted UK's scientific strength, served by research from the country's globally established universities, supported by structures stemming from the 2017 life science strategy[8]. This was exemplified by the collaboration of the University of Oxford and AstraZeneca to deliver the first approved Covid-19 vaccine. However, understanding of the disease and potential treatments were also advanced as a result of the county's long-established research strengths.

The pandemic has impacted on supply chains, which longer term will boost domestic manufacturing as specialist facilities and skills are established. This will form the basis of a further report in this series.

Equity funding underpinning growth

Life sciences have seen increasing investment funding both in absolute terms, but also the amount of money raised in each series has increased. The amount of venture capital funding available to European BioTech firms has more than doubled in less than a decade.

The appeal of the sector reflects a wider investment redirection towards knowledge industries. An increased focus on the opportunity presented by innovative and technologically advanced processes was evident in the wake of the 2008 financial crisis, when the US in particular saw an acceleration in the pace of new life science company formations.

The pandemic provided another spur. Between 2018 and 2020, 22 biotech companies were founded in the UK, double the number in France or Switzerland, with UK funding well in excess of the typical offer available in other European countries[9]. UK companies account for 29% of the total funding raised in Europe. This pace of investment continued in 2021, when a record level of venture capital was raised in the UK, totalling £4.25 billion in 2021, up from £2.8 billion in 2020[10].

This acceleration in investment reflects the perceived opportunity of the sector given the pace of advancement in the underlying science, when compared with other knowledge industries. The challenge the sector faces is ensuring investors fully understand the risks involved in developing new medicines and healthcare technologies, the lengthy development pathways, the regulatory challenges and the payment model.

"Big tech advancement outpacing our own R&D is a concern."

Response to the YouGov/Bidwells R&D Business Survey

Respondent base: R&D director or equivalent of large global R&D businesses with a base in the UK. Fieldwork undertaken in Q4 2021.

Advances in scientific discovery and techniques

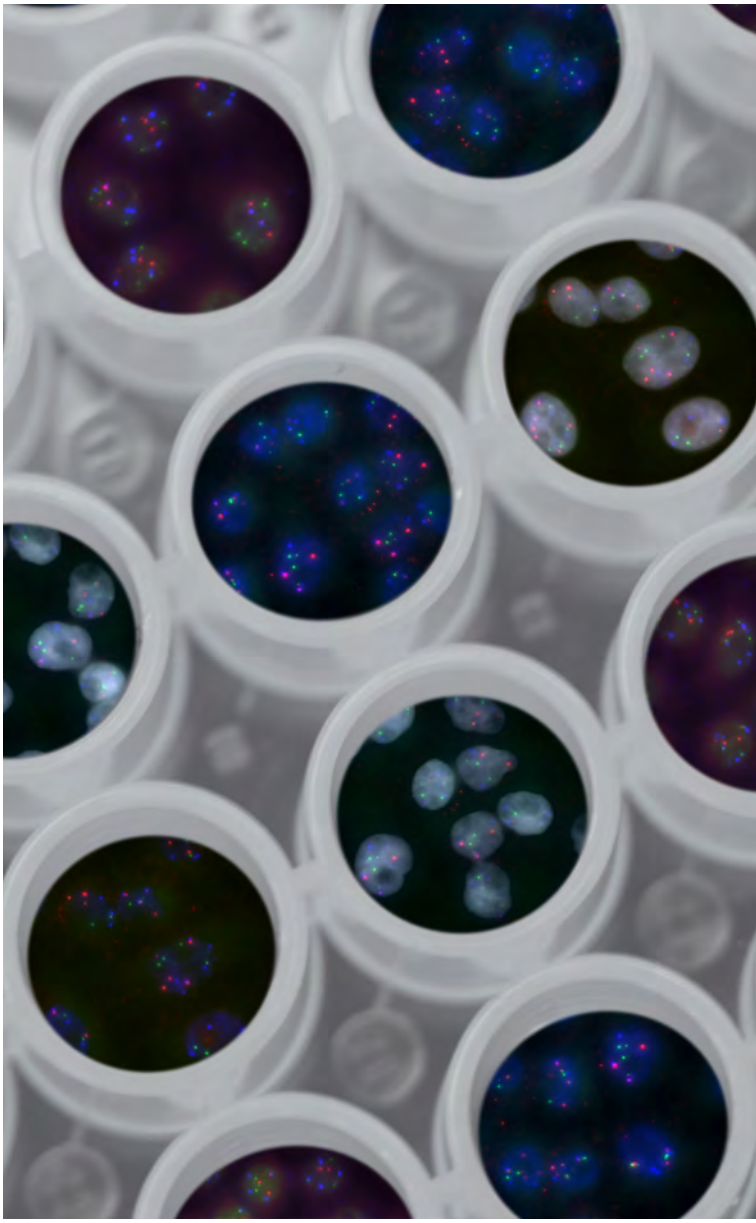
The pace of advancement in scientific understanding and, in parallel, the development of new techniques to advance the application of the sector have accelerated over the last five years.

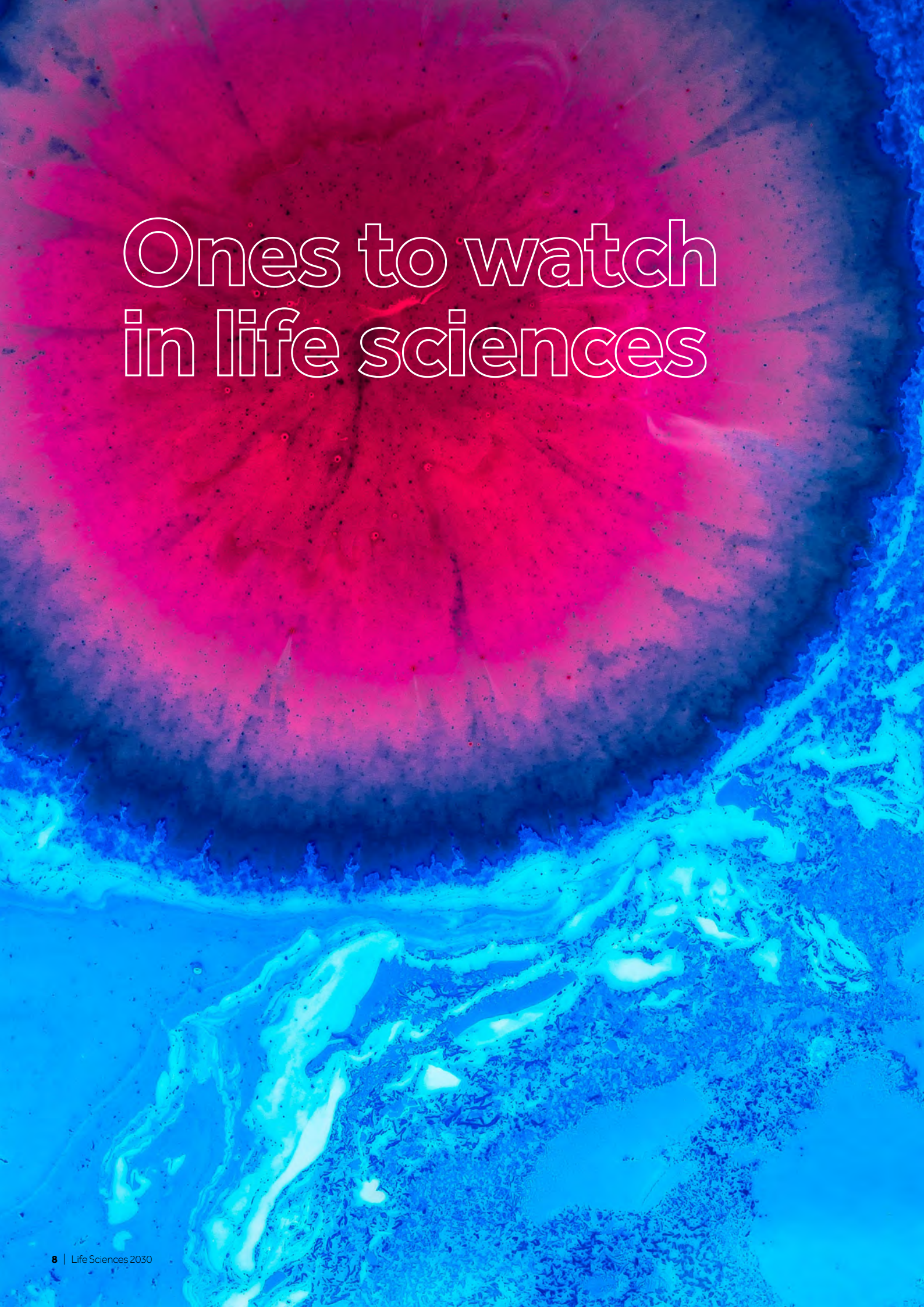
Research discoveries in areas such as gene and cell therapy, genetic engineering, immunotherapy, and precision medicine have raised the potential for cures for diseases which were, until recently, considered untreatable. Such advances have been assisted by the improved commercialisation of academic research and greater collaboration between institutions and the private sector.

Crucially, the advances are not just in the scientific arena. Life sciences research and application has seen a technological transformation over recent years. The majority (83%) of the life sciences community is now using some level of automation across their R&D processes.

This has innovated the drug development process and clinical trials but is extending well beyond these areas. Cloud-connected medical devices, artificial intelligence, machine learning, and gene sequencing and editing are evolving rapidly and will deliver new products and transform processes. This will present challenges to companies across the sector to keep pace with the evolution underway. This point was identified in our latest YouGov/Bidwells R&D Business Survey[11].

These scientific and technological advances are the focus of our Life Sciences 2030 programme. The research identifies the key areas of growth across the life sciences sector, each of which are discussed below.



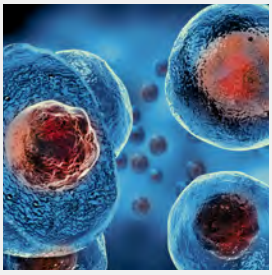


Ones to watch in life sciences

The coming decade will see large steps forward in the evolution of the life sciences sector driven by an acceleration in technological and scientific advances. We have identified the specialisations from which the greatest advances are likely to emerge.

The developments highlighted in this report have been chosen on the basis of a balancing of current innovation and their realistic chance of coming to the marketplace. Looking further ahead, other technologies such as optogenetics (light technologies) or biological computer chips, are likely to emerge. However, these have not been explored in this report because of the lack of maturity of the technology and longer timeframe to market.

We have focused on five high growth areas



1. Biopharma

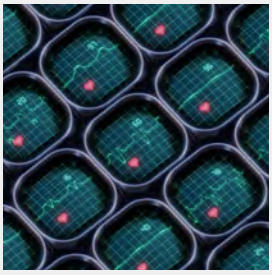
Key areas of growth: AI Drug Discovery, Cell Therapy and Gene Therapy

2. Diagnostics

Key areas of growth: Laboratory Diagnosis, Direct to Consumer Diagnostics and Digital Imaging

3. Medical devices

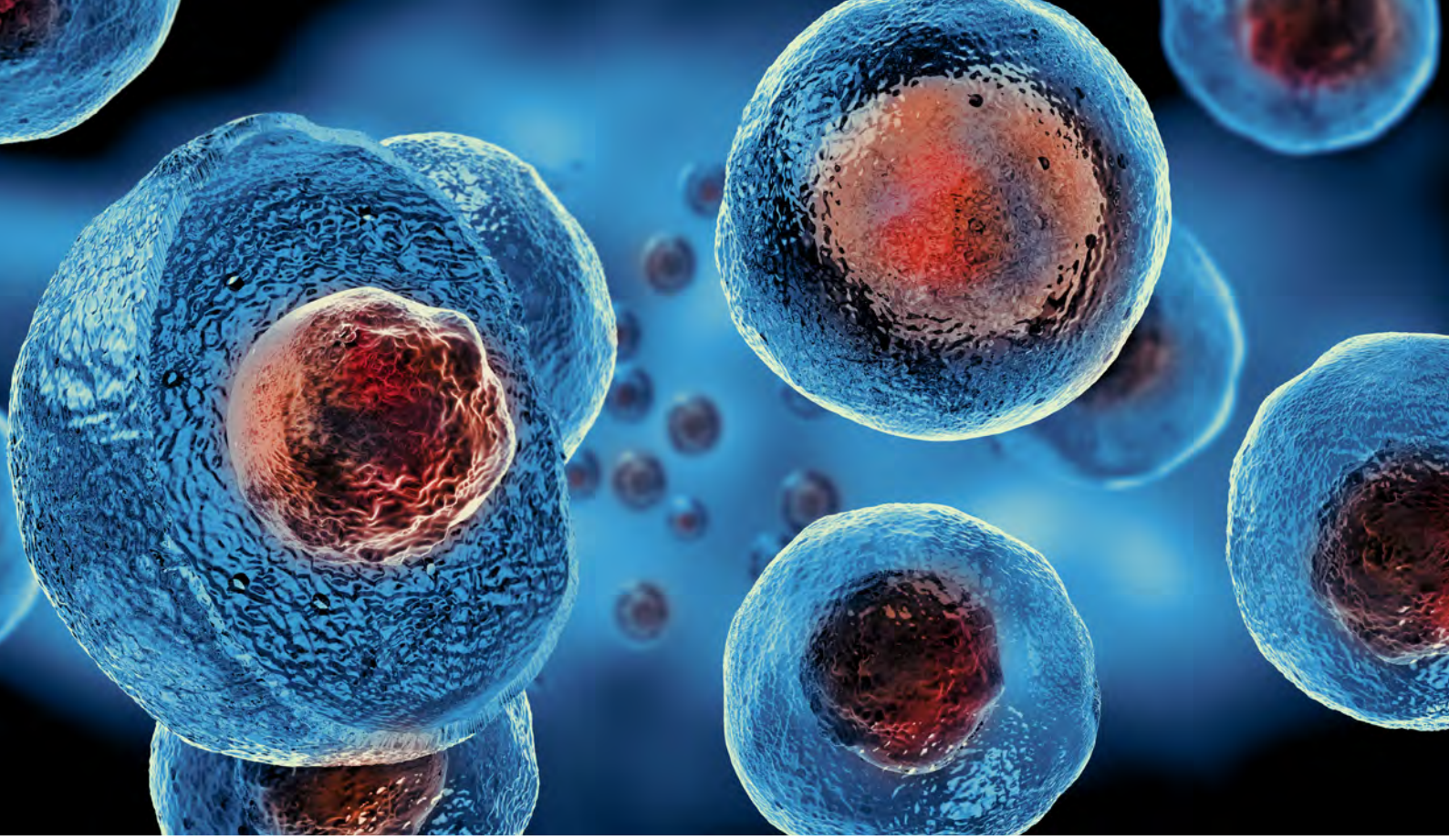
Key areas of growth: Medical Implants, Surgical Devices and Assistive Technologies



4. Digital Health

5. Bioprocessing

These specialisms are summarised in the following section, with a brief comment on the real estate drivers in each case. The property implications will be considered in more detail in a series of forthcoming Bidwells Life Sciences 2030 reports.



1. BIOPHARMA

Start up biotech companies have tended to come out of academia, working on innovative solutions and, because of their size, can respond faster to market and technological changes than traditional pharmaceutical companies.

More recently, traditional pharma has either invested in developing their own biological pharmaceuticals or acquired start up biotech companies. These companies are sometimes described as biopharma - a term coined from the combination of biotech and pharma.

The term biotech itself has transitioned to include companies working in a range of biological technologies such as cell manipulation, genetic engineering, and protein engineering, rather than just focusing on the manufacturing process.

We have identified three areas of particular growth over the next decade: Artificial Intelligence Drug Discovery, Cell Therapy and Gene Therapy.

What is the difference between biotechnology and pharmaceuticals?
Historically biotechnology and pharmaceuticals were defined by the respective manufacturing processes. Traditionally pharmaceutical companies manufactured products based on synthetic chemistry and biotechnology companies manufactured using biological processes. These days the differences are less clear and the term biopharma has emerged to cover the industry more broadly.

"One of the greatest challenges for our R&D over the coming years will be working out how to make the most of AI"

Response to the YouGov/Bidwells R&D Business

Respondent base: large global R&D businesses with a base in the UK. Fieldwork undertake in Q4 2021.

PROJECTED MARKET VALUE

$380m – $12bn

Between 2019 and 2026

Source: Globalnewswire

AI DRUG DISCOVERY

Artificial intelligence (AI) is an umbrella term that refers to machines problem solving and making human types of decisions.

Within AI there are two broad technical approaches to solve problems; Machine Learning or Deep Learning.

The machine learning approach requires the programmer/user to 'train' the system to understand the data set whereas with Deep Learning the machine trains itself.

The applications for AI are wide ranging from image recognition to speech analysis.

The process of identifying new chemicals that could be used as a medicine is known in the industry as Drug Discovery.

There are a range of approaches that the industry has taken to identify such chemicals, the most common approach being to analyse large chemical libraries.

The current approach to drug discovery is not very efficient or successful. This is a contributor to the failure rate of over 96%[12] of new drugs, and part of the reason for the high cost of bringing a new drug to market.

AI is considered to be a promising approach to support the drug discovery process, where the machine learns from previous successes and failures in molecular choice and combination. This convergence of technology with pharma, is referred to as pharma-tech.

Direction of travel

The projected growth for using AI in drug discovery is significant because pharmaceutical companies are investigating methodologies to best exploit their data and understand the biology.

AI in drug discovery has three applications:

(1) Identifying new compounds

(2) Drug optimisation

(3) Repurposing

Within these areas there are specific therapeutic applications in such fields as oncology, infectious diseases etc.

A key challenge for AI drug discovery is the quality of the data being used to train the models as well as the algorithms being used to interrogate the data.

The use of computer modelling in drug discovery is not new. Companies that operated in this space in the past, using traditional modelling approaches, have generally failed to deliver on promises. However, there is hope that new applications using AI may deliver better results.

Real estate considerations

- Lab and office space required, depending on company's AI focus and extent to which functions may be outsourced. Robotic solutions may need to be accommodated, again subject to focus.
- Ideally the space is located near hospitals for access to clinicians. There will be IT infrastructure considerations and access to talent is important.

PROJECTED MARKET VALUE

$7.8bn – $48.1bn

Between 2019 and 2027

Source: Globalnewswire

CELL THERAPY

A cell is the basic building block of all living things. The human body contains trillions of cells and over 200 specialized cells for making skin, bones, muscle etc. Cell therapy's aim is to replace the patient's diseased or damaged cells by transplanting them with healthy cells.

Cell therapy[13] has actually been available for many years and used in blood transfusions and bone marrow transplants. The technology relies on understanding the cell type, from where they can be sourced, how they can be modified and how they can be transplanted into the body.

There are broadly two sources of cells that can be transplanted into a patient: the patient's own cells (autologous cells) or a donor's cell (allogenic). Other cells such as stem cells can self-renew and are classified in a variety of ways depending on their source and ability to transform into a specific type of cell.

The ambition for the sector is to grow any cell type from a range of different type of stem cells and successfully transplant them into the patient. However, the sector needs to overcome ethical, risk and technology challenges.

CAR-T (Chimeric Antigen Receptor T-cell) is an advanced form of cell therapy, that is specifically developed for individual patients and involves reprogramming the patient's own immune system cells which are then used to target the patient's cancer. It is an extremely expensive, complex and potentially risky treatment but it has been shown in trials to cure some patients, even those with quite advanced cancers and where other available treatments have failed.

Direction of travel

The approach offers significant potential but also comes at significant cost and risk to patient.

Drugs such as cell and gene therapy are classified as Advance Therapy Medicinal Products (ATMP) and attract a very high regulatory hurdle.

This regulatory hurdle, length of time to get to market and manufacturing challenges add to the cost of the products and in some instances the withdrawal of products due to economic viability[14].

Despite the challenges for this technology, the potential for replacing, repairing, restoring, or regenerating damaged tissues, and organs is significant[15].

Real estate considerations

- Laboratory space with clean room requirements with air handling systems capable of meeting ISO 14644-1 (class 5-7) air cleanliness levels. There is a need for flexible internal configuration. Co-located with the R&D space, there is a need for warehousing (raw materials, cryostorage, etc), and office space. HVAC Systems and UPS Systems will need to be accommodated.
- At present the academic research is normally associated with hospitals so proximity is important although this may broaden as larger pharmaceutical companies have an increased presence. The location needs to allow for patient proximity for tissue collection and dispensing. A location providing access to talent is essential.

PROJECTED MARKET VALUE

$3.6bn – $35.7bn

Between 2019 and 2027

Source: Globalnewswire

GENE THERAPY

Gene therapy is the introduction, removal, or change in a person's genetic code with the goal of treating or curing a disease. The technique, often referred to as Precision Medicine, can be used to reduce levels of a disease causing protein, increase production of disease-fighting proteins or produce new or modified proteins.

Gene therapy[16],[17] transfers genetic material, usually using a carrier (sometime known as a vector) into the appropriate cells of the body with the intention that these genes will be able to modify the progress/development of a disease.

There are a number of different engineering approaches in gene therapy, from modifying a gene using a viral vector (AAV), gene editing (CRISPR/cas9, TALEN, ZFN), gene silencing (mRNA), reprogramming and cell elimination. Some approaches utilise both a combination of gene therapy and cell therapy.

Gene therapy is considered at an inflection point, 'where the rate of technological innovation of gene and cell therapy is significantly outpacing the ability to safely and expeditiously move promising candidates forward in order to benefit patients.'

Direction of travel

Gene therapy[18], [19], [20] has been in development for decades, with the first clinical trial on a young girl in 1990 for a rare genetic disease. Following treatment, the girl went on to live a healthy life. However, in late 1990s, after a person died from being on a clinical trial, the regulators started to take a more rigorous interest.

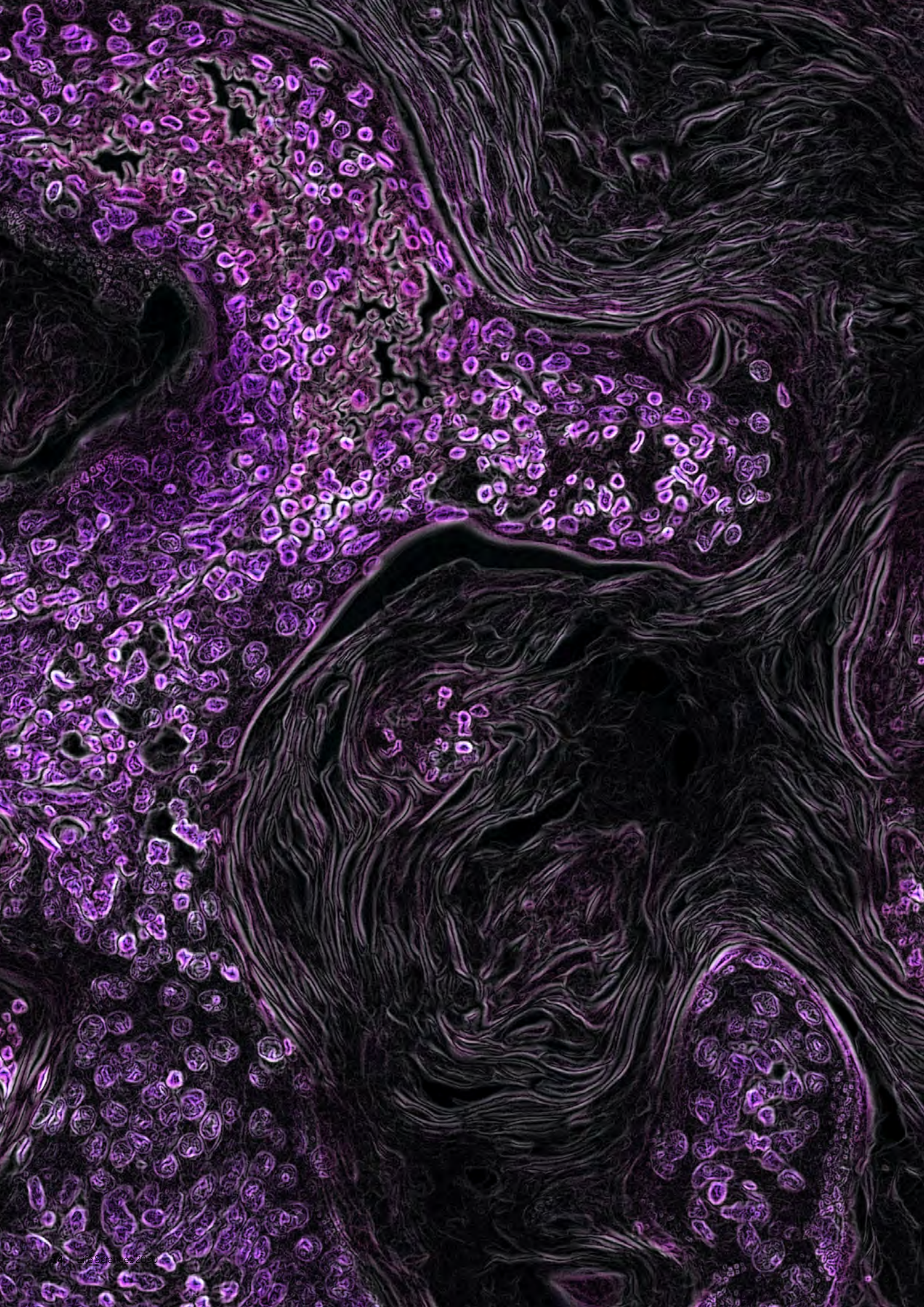
To date, there are numerous approaches to gene therapy and the stock market is bullish about its potential success with a number of treatments expected to be approved by 2025 in the USA and Europe.

The R&D Pipeline illustrates the percentage of gene and cell therapy therapeutics in development. It is believed it will open up new medicines over the next decade.

There are reasons for caution however given safety concerns, regulator scrutiny, patent conflicts and in some instances, unrealistic expectations in stock market valuations.

Real estate considerations

- Property requirements are similar to those for cell therapy. Operations require laboratory space with clean room requirements with air handling systems capable of meeting ISO 14644-1 (class 5-7) air cleanliness levels. Again there is a need for flexible internal configuration and the on site provision of storage (raw materials, cryostorage, etc), and office space. HVAC Systems and UPS Systems will need to be accommodated.
- As in the gene therapy arena, academic research is generally associated with hospitals so proximity important, but again this may broaden as large pharmaceutical companies take a greater role. The location needs to allow for patient proximity for tissue collection and dispensing. Gene therapy is a specialist area and access to talent is essential.



Given academic expertise in CGT technology in Oxford and Cambridge Universities, as well as proximity to centres of excellence at UCL, Imperial and research institutes such as the Wellcome Sanger Institute, both clusters have seen a rapid expansion of the sector.

Across Cambridge 72% of 2021 laboratory floorspace lettings were by CGT companies. Notably the sector comprised nearly 5% of office lettings. Across Oxford, 69% of lab floorspace was let by CGT businesses in the same year.

2. DIAGNOSTICS

Diagnostics has often been considered the 'poor relation' in the life sciences space, for a range of reasons from market valuations, product commoditisation and payee pressures. However, Covid-19 has brought diagnostics to the fore with investors and the public understanding the importance of the sector and the need for reliability, accuracy and speed in making a diagnosis.

The type of diagnostics is defined by where the test is being taken (lab, clinical, home), what type of technology is being used to make the diagnosis, and how the results are presented to the user. The market is continually being advanced with a range of new approaches from using AI to diagnose medical images to cancer detecting blood tests.

This report identifies Laboratory Liquid Biopsy, Direct to Consumer Diagnostics and Digital Imaging as particular areas of opportunity.

What is medical diagnostics?
Diagnostics is a diverse segment of the life sciences sector, where technology is not only used for diagnosing a medical condition but also monitoring the condition of a patient. Diagnostics can be split into a range of specialities:

- Laboratory diagnostics
- in vitro diagnostics (IVD)
- Point of care (POC) diagnostics
- Imaging diagnostics (X-Ray, Ultrasound, MRI)
- Tissue diagnosis (pathology)
- Genetic screening
- Companion diagnostics
- Direct to Consumer (DTC)

PROJECTED MARKET VALUE

$3.8bn – $19.6bn

Between 2020 and 2025

Source: Globalnewswire

LABORATORY LIQUID BIOSPOSY

Liquid biopsy is a laboratory based diagnostic that uses bodily fluids as an alternative to taking conventional and often painful tumour biopsies. The liquid (bodily fluid) referred to is usually; blood, urine, saliva - samples that can be collected with minimal invasion to the patient.

Liquid biopsy is a new diagnostic approach that captures biological markers (biomarkers) released by tumours into the bloodstream or other bodily fluid and typically uses Next Generation Sequencing (NGS) to analyse the markers.

The biomarkers are usually in the form of circulating tumour DNA (ctDNA) and intact circulating tumour cells (CTCs). These data markers are examined for RNA, protein expression, DNA and chromosomal abnormalities or mutations as an indicator of the disease type or presence.

Direction of travel

Liquid biopsy can be used for a range of different medical conditions; lung cancer, gastrointestinal cancer, prostate cancer, breast cancer, colorectal cancer, leukaemia and others[22].

The end user segmentation is more complex from hospitals, cancer institutes, academic centres and diagnostic centres (depending on the country of operation).

Liquid biopsy offers many advantages over the surgical alternative; however the gold standard remains surgical intervention. The challenge for the sector will be to provide an affordable product that provides the clinician with a sense of diagnostic confidence (accuracy, specificity, sensitivity).

The opportunities presented by the sector have attracted considerable investment. Grail one of the leading cancer screening starts ups, back by Jeff Bezos and Bill Gates had its $7.1billion acquisition backed by Illumina (a part owner) blocked in March 2021 because of concerns it might harm competition in this developing sector[23].

Real estate considerations

- Operations require laboratory space with internal configuration flexibility. Robotic lab systems and specialist instrumentation will need to be accommodated now and more so in the future. The space will need to facilitate a process layout from sample delivery, sample processing and delivery of results.
- The location of facilities is relatively flexible, but an accessible location on the road network is important for the transportation of samples and tests. Again, access to talent is important.

PROJECTED MARKET VALUE

$1.2bn–$2.7bn

Between 2020 and 2025

Source: Globalnewswire

DIRECT TO CONSUMER DIAGNOSTICS

Direct to consumers (DTC)[24] diagnostics is a sector where the consumer is able to order home based tests to undertake at their convenience. These range from genealogy screening for heritable disease and cancers, to fitness and wellness, to allergies. The tests actually fall into the IVD (In vitro-Diagnostics) segment of diagnostics but do not require a clinician's prescription or approval.

The range and type of DTC tests is significant, with the majority based on genetic testing through routine biomarker tests. Novel microbiome testing processes are also utilised.

The challenge for this area of healthcare is the variation in the regulatory position for gene testing in different markets.

Data and privacy security are also considered challenges. However, since the consumer is the buyer, the services on offer are not restricted to public health or insurance funding.

Direction of travel

The technology used to analyse these types of test typically utilise PCR, SNP genotyping arrays for sequencing. As the cost of these technologies fall, it is expected that the costs of the tests will also decrease. A number of the companies that use PCR testing, have also introduced Covid-19 testing kits.

Genetic testing[25] remains a controversial area. While it can provide a range of health information in terms of genomic and recessive scoring, there are limitations to how the clinical information is interpreted and it also depends on context. These tests can also lead to a number of false negatives.

The market is currently constrained by global variations in regulation. However, as clinical medicine moves more towards personalised medicine and the use of genetic data matures, it is expected that these tests will become more acceptable.

Real estate considerations

- As with liquid biopsy, Direct to consumer diagnostics operations require laboratory space with internal configuration flexibility. Similarly, robotic lab systems and specialist instrumentation will need to be accommodated now and more so in the future. The space will need to facilitate a process layout from sample delivery, sample processing and delivery of results.
- Again, the location of facilities is relatively flexible with affordability implications, although an accessible location on the road network is important for the transportation of samples and tests. Similarly, access to talent is important.

CAMBRIDGE

34% Proportion of life science sector office floorspace take-up by companies operating in the diagnostics sector in 2021, a sharp increase on 2020.

Source: Bidwells

DIGITAL IMAGING

There is no clear definition of digital diagnostics, because almost anything that has a digital component in a diagnostic device can be included in this field. For the purpose of this report, software based products such as AI radiological imaging systems to digital pathology are considered.

Digitalising existing diagnostic solutions such as x-rays, MRI, ultrasound and combined with AI solutions, opens the possibility of enhancing traditional radiological sciences.

Another imaging area that looks set to benefit includes imaging analysis for pathology, referred to as digital pathology, where machines enhance a pathologist's ability to detect diseases at a cell/tissue level.

Technologies being developed by companies operating in this area include digital pathology, remote diabetic retinopathy and AI radiology.

Direction of travel

Digitalisation of different types of diagnostic services is difficult to assess in terms of market size, without segmenting each diagnostic discipline. Additionally, the area of digital diagnosis also crosses over into the digital health space, causing further confusion in terms of market size and valuation.

Broadly, the move to digitalisation and the demand for virtual and remote analysis is expected to grow. The additional inclusion of artificial intelligence (AI) in analysing data is also set to increase[22]. Much of this activity is office based.

The challenge with using AI will be twofold: the quality of data to make an assessment and the regulatory position in different markets. Both challenges have the potential to lead to liability issues which is well understood by the regulatory agencies.

Real estate considerations

- Laboratory for sample preparation, which probably needs to be noise and vibration free. There will be IT infrastructure and systems integration considerations.
- Ideally the space is located near appropriate clinical facilities. The desk based pathologist role is central to operations and can be located on site or operate remotely which in some instances helps given the shortage of such skills.

3. MEDICAL DEVICES

The medical device sector has often had problems attracting the same type level of investment as the pharmaceutical/biotech sector. However, Covid-19 has forced investors to re-think the opportunities in this space.

The sector is incredibly broad, encompassing thousands of product categories. Areas of growth range from 3D printing of implants to robotics, the common theme being connectedness and data. This starts to blur into the boundaries of digital health as a separate discipline.

This report identifies Medical Implants, Surgical Devices and Assistive Devices as areas of particular growth.

What is a medical device?
The term medical device covers a multitude of products from sticking plasters and scalpels to pacemakers and MRI machines.

According to the UK regulator, the MHRA, the legal definition of a 'medical device' is any instrument, apparatus, appliance, software, implant, reagent, material or other article intended by the manufacturer to be used, alone or in combination, for human beings. Definitions will however vary across other country regulatory bodies.

PROJECTED MARKET VALUE

$85.4bn – $147.5bn

Between 2019 and 2027

Source: Globalnewswire

MEDICAL IMPLANTS

Medical implants[26] are devices that are either on a temporary or permanent basis placed into the human body. These types of devices attract the highest level of regulatory scrutiny.

The implant market can be segmented into: orthopaedics, cardiovascular, pacemakers, hearing, spinal, neurological, ophthalmic, dental, facial and breast.

The technology that is used to build these devices varies depending on the application but generally falls into materials sciences, mechanical systems, microelectronics and micro electromechanical systems.

Depending on the application the implant may be passive or active. Passive applications are usually structural supports such as stents, whilst active are those that interact with the body, such as neurological implants. There are however also cross over products such as stents that also elude certain types of drugs and therefore considered as active implants.

Direction of travel

Implants attract the highest level of regulatory scrutiny because of the risk associated with placing something into the body. These risks can include failing internally, needing to be removed or replaced and as well as associated surgical and infectious risks.

Two prominent 'dark' companies working in this space are Galvani Bioelectronic (GSK & Verily, previously Google Life Science) and Nuralink (Elon Musk company) both promising implants that can modify neurological signals.

The technology used to build these products is developing rapidly and there is a need for advanced engineering skills, data science skills, clinical science and an understanding of regulatory pathways[27].

Real estate considerations

- Early stage companies will need bench top laboratory /light industrial space but exact requirements are dependent on the device type. There will be manufacturing considerations as companies mature. This is likely to demand a cGMP clean room but the level will again be dependent on the device.
- For many in this sector the space would ideally be located near an appropriate clinical testing environment and a suitable talent pool.

PROJECTED MARKET VALUE

$5.9bn – $12.7bn

Between 2020 and 2025

Source: MarketsandMarkets

SURGICAL DEVICES

There are numerous types of surgical devices available. These may be categorised from common surgical instruments to specialist devices developed for specific medical procedures.

Future innovation in the surgical fields will be in robotics, imaging using VR/AR and autofocus systems such as pill like capsules.

Surgical devices are often associated with common steel based instruments such as scalpels, needles, forceps. However, certain types of surgical procedures require specialist instrumentation and, in many cases, are often designed by the surgeon.

The goal for all types of surgery is to minimise the length of time for the procedure, minimise the level of surgical intervention and improve patient recovery time. Devices that can support any of these goals, presents a significant opportunity for the surgeon.

Direction of travel

The growth drivers in this market[28] are the advantages offered by robotic-assisted surgery. These include highly advanced visualisation capabilities providing surgeons with a superior view of the operating area, greater dexterity than the human hand is capable - ability to rotate 360 degrees, and superior manoeuvrability allowing surgeons to reach hard to access areas.

The high cost of robotic systems is however a key limiting factor for the uptake of these systems. The da Vinci system, one of the most commonly used robotic systems, costs between $1.5 million and $2.5 million, while the CyberKnife radiosurgery robotic system costs around $4-7 million per unit. The user also needs to pay an annual maintenance charge which is close to $125,000.

Real estate considerations

- Early stage companies will need bench top laboratory /light industrial space for R&D activities although the exact requirements will be dependent on the device type. Ideally this space would be located near a hospital or appropriate medical facilities for testing.
- Once established, there is likely to be more locational flexibility for manufacturing operations which are likely located in light industrial/ flexible tech space. Depending on the robot type, these may require a cGMP clean room, although probably only for the manufacture of part of the device. A location with suitable talent pool is as always important.

PROJECTED MARKET VALUE

$23bn – $35.6bn

Between 2018 and 2026

Source: Globalnewswire

ASSISTIVE TECHNOLOGIES

Assistive technology is an umbrella term that includes assistive, adaptive, and rehabilitative devices for the elderly and those with disabilities. These products are designed to support independent active daily living (ADLs).

The assistive device market covers a broad range of products that support a variety of conditions from sensory deprivation to mobility. As such these products range from simple food utensils to sophisticated robotic assistants to eco-skeletons to support walking.

These products are either classified as consumer devices or medical devices depending on the application, level of human intervention and claims made about the product.

Access to assistive devices is dependent on the country as well as the level of health and social welfare coverage.

Direction of travel

The elderly and disabled assistive devices constitute devices that provide improved accessibility for people with cognitive difficulties, impairments, and disabilities.

The market is expected to grow due to the improvement in healthcare for the elderly, a growing elderly population and greater disposable income[29]. Efforts to enable people to remain in their own home is also creating a demand for solutions to help these individuals[30].

The assistive device market is however highly fragmented and does not necessarily attract the same type of investment that is attracted by the more 'traditional' health products/devices. A move to incorporate universal design offers the possibility that some of these products may have a greater user/market appeal.

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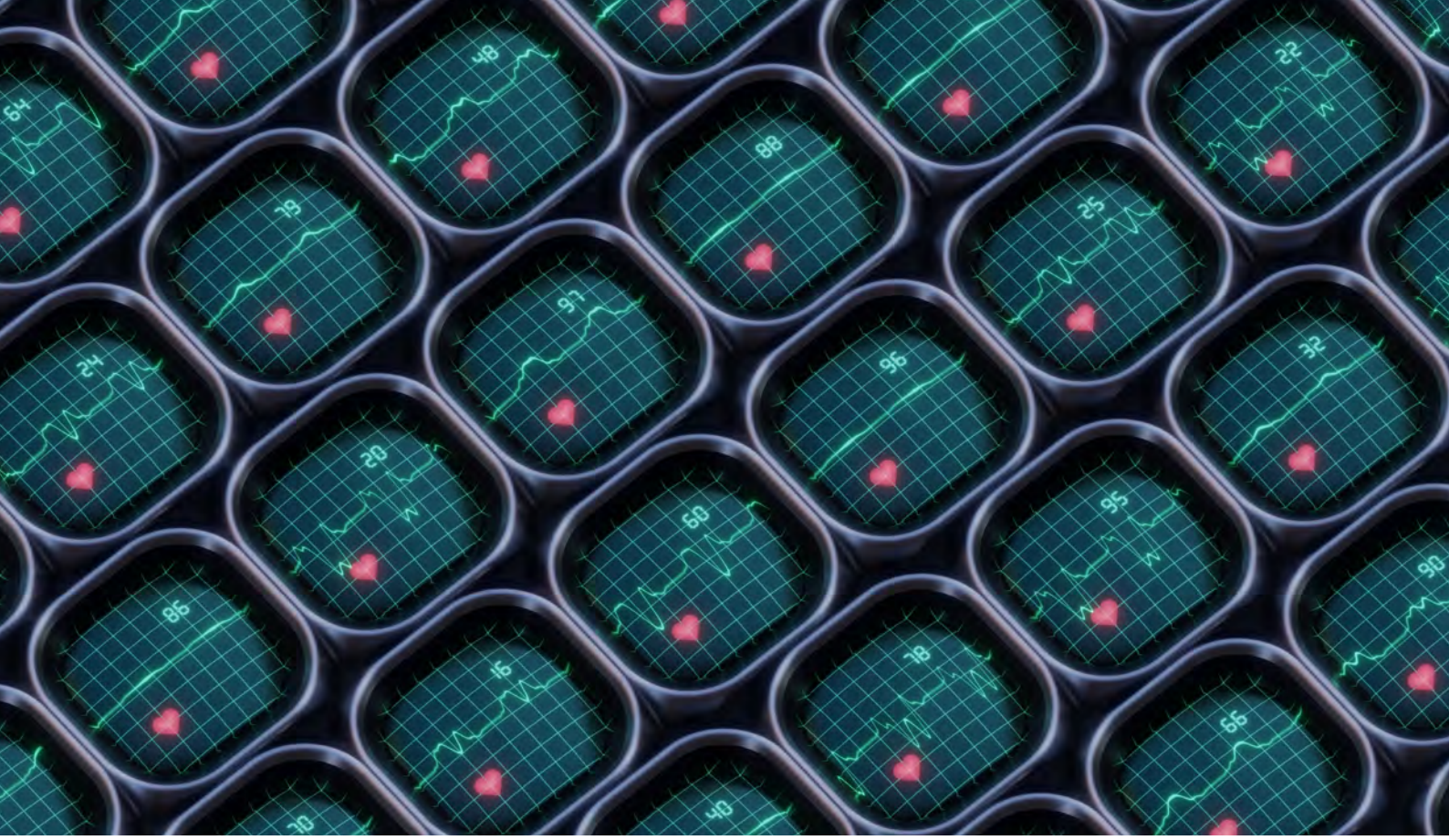
Real estate considerations

- As with surgical devices, early stage companies will need bench top laboratory /light industrial space for R&D activities although the exact requirements will be dependent on the device type. Ideally this space would be located near an appropriate hospital/rehab/medical facility for testing. However, there are many assistive technologies that are not medical in nature, but still require an appropriate testing environment.
- Once established, there is likely to be more locational flexibility for manufacturing operations which are likely located in light industrial/ flexible tech space. Talent requirements are potentially broader but may require specific specialist skills.



4. DIGITAL HEALTH

Digital health is probably the one area of life sciences that has significant public recognition because of user engagement on mobile, tablet or computer platforms. Reflecting the convergence of technologies and interoperable systems, the sector is viewed as a modern solution that supports health, wellbeing and continuous monitoring.

The broader life sciences industry would argue that areas such as AI drug discovery or digital imaging also falls into this category, causing confusion. However, in this report we focus on digital health applications which are single platform based (mobile), ranging from telehealth, disease management and digital therapeutics.

What is digital health?

The definition for digital health is extremely broad, varied and lacks consistency across the industry and different markets[31].

The US regulatory the FDA defines digital health as: "technologies [that] use computing platforms, connectivity, software, and sensors for health care and related uses. These technologies span a wide range of uses, from applications in general wellness to applications as a medical device. They include technologies intended for use as a medical product, in a medical product, as companion diagnostics, or as an adjunct to other medical products (devices, drugs, and biologics)." However, the 2020 FDA definition,[32] is not fully adopted making a definitive market size is difficult to measure.

PROJECTED MARKET VALUE

$184bn – $483bn

Between 2020 and 2025

Source: Businesswire Note: source closest to definition adopted

DIGITAL HEALTH

Direction of travel

The uptake and interest in digital technologies for health and wellness apps allowing the public to support their own wellbeing is being closely monitored by all health authorities.

Within the UK, public and institutional acceptance is illustrated by the uptake of telemedicine services such as Babylon Health and the NHS digital health library apps that can be 'prescribed' by physicians. As technology continues to develop in the areas of Internet of Things (IoT) and the wider introduction of 5G services, this sector of the life sciences industry will continue to grow[33].

The challenges faced by the sector focus mainly in the regulatory space, where numerous apps fail to comply with the more traditional rigour of medical devices or the pharmaceutical industry. The regulatory guidelines have transitioned over the years making it more expensive to develop such apps.

Real estate considerations

- Office space requirement with access to 5G test beds.
- Generally, companies are flexible with their location but talent is of course important.

5. BIOPROCESSING

The 20th century industrial revolution was built on the ability to convert fossil fuels into synthetic materials using chemical manufacturing processes. This has allowed all industrial sectors from agriculture to human health to have benefited from this form synthetic chemistry. The next 10 years will see the science of biology replacing traditional 'dirty' chemical manufacturing with less polluting biological processes, described as the bio-revolution.

The use of living things to manufacturer products has long existed, from fermentation processes used to produce beer and wine to culturing yeasts for bread and cheese making. The 1980s built on this understanding to create the pharma biotechnology industry, manufacturing drugs using biological systems. The biotech industry forced the development of new tools and instruments to manipulate living things which is helping unlock the bio-revolution where cells, enzymes, proteins can be used to create a range of new products and services. Two examples are discussed: animal feed and synthetic leather.

What is the Bioprocessing?

The focus of this report has been on human health and how life sciences will impact on this sector. However, the core science and manufacturing processes to develop new pharmaceuticals such as gene/cell technology are equally applicable to sectors beyond human health and include areas such as: foods, agriculture, aquaculture, chemicals, energy, materials and the environment.

The implication is that the infrastructure being developed for life sciences, may well be applicable to wider industrial sectors.

PROJECTED MARKET VALUE

$2-4tn

10-20 years

Source: Mckinsey

BIOPROCESSING

Animal Feed

An alternative approach to producing animal and vegetable protein which is typically carbon intensive, is to develop feed from alternative sources such as bacteria and yeast to create microbial proteins. The production process utilises bio-reactors similar to those used in fermentation processes. Bacterial protein feed is attractive because it uses abundant natural gases and the process has high production rates.

Synthetics leather

Leather production is a time consuming and dirty process. The cow skin needs to be stripped of hair and the fat removed. An alternative approach is to modify the enzymes in the yeast to produce a collagen material that can be turned in rawhide sheets.

Direction of travel

Bioprocessing has been described as the 21st century bio-revolution. McKinsey considers that up to 60% of 'physical inputs' (materials, food, etc) to the global economy could be produced biologically[34]. The potential has come to the fore in the wake of material supply shortages over the last two years.

The challenge for the sector focuses on the risk of biological manipulation, which could lead to environmental contamination or damaging impacts on human health. This is an evolving field that will need a both social and regulatory agreement about levels of risk acceptability.

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Real estate considerations

- The space needed will depend on the nature of the product, but may include laboratory, and/or pharma and bioprocessing facilities. Light industrial facilities will be needed for manufacturing, plus warehousing and storage for inputs and products.
- Generally, companies are flexible on their location but there may be sector specific requirements. Again, talent will be important, but with specific skills depending on the nature of the process.

Regulatory considerations

Life sciences is a highly regulated industry because of the potential risk to human health - all the technologies outlined in the report have the potential to lead to injury or death if inappropriately used. Furthermore, areas such as gene and cell therapy, AI and Bioprocessing present risks that regulators have yet to fully understand.

All countries have their own regulatory approval system before products may be sold or prescribed to the public. The main global regulators are the FDA in the USA, EMA in Europe and PMDA in Japan. Prior to the UK leaving the EU, the UK conformed to EMA guidelines. Post Brexit, the regulatory approvals process for all medical products in the UK is now managed by the Medicines & Healthcare Products Regulatory Agency (MHRA).

The government is currently considering diverging from the EU ruling on Genetically Modified Organisms (GMO) which are banned under EU law. Further departures are possible over time which has implications for businesses operating in one or both regulatory environments. The challenge faced by life science companies in the UK and overseas, is whether the country represents a large enough market to warrant the expensive and time consuming process to register new products in the UK alone.

Linked to this calculation is the role of the NHS. The financial constraints on the National Health Service potentially limit the viability of the additional costs for registering new products in the UK, particularly over the coming years as expensive personalised treatments come to the fore. However, the NHS also provides an integrated route to undertake trials within the R&D process which is highly attractive to companies operating across the life sciences spectrum.

The impact of regulation on real estate requirements is generally indirect. However, in the UK context there is still some uncertainty on how the new regulatory arrangements will impact on the decision-making over the coming decade around the location of R&D and production facilities. This was noted by a small number of respondents contributing to the latest YouGov/Bidwells R&D Business Survey.

"Staying compliant with government regulations will have the greatest impact on our real estate requirements over the coming years"

Response to the YouGov/Bidwells R&D Business Survey

Respondent base: R&D director or equivalent of large global R&D businesses with a base in the UK. Fieldwork undertake in Q4 2021.

Implications for real estate

The next decade is evidently going to see significant advances in the science and technologies underpinning the life sciences sector. All of the drivers noted above will present real estate opportunities. However, advances in scientific understanding and the development of new techniques to progress the application of the sector will inevitably impact on the nature of future space requirements.

While the direction of travel is clear in some aspects, there is inevitably some uncertainty over the future. This presents a challenge for real estate provision; providing for the needs of the spectrum of life science companies now while building in the flexibility to future proof for the advances we will see over the coming decade.

Short to medium term life science business space demand

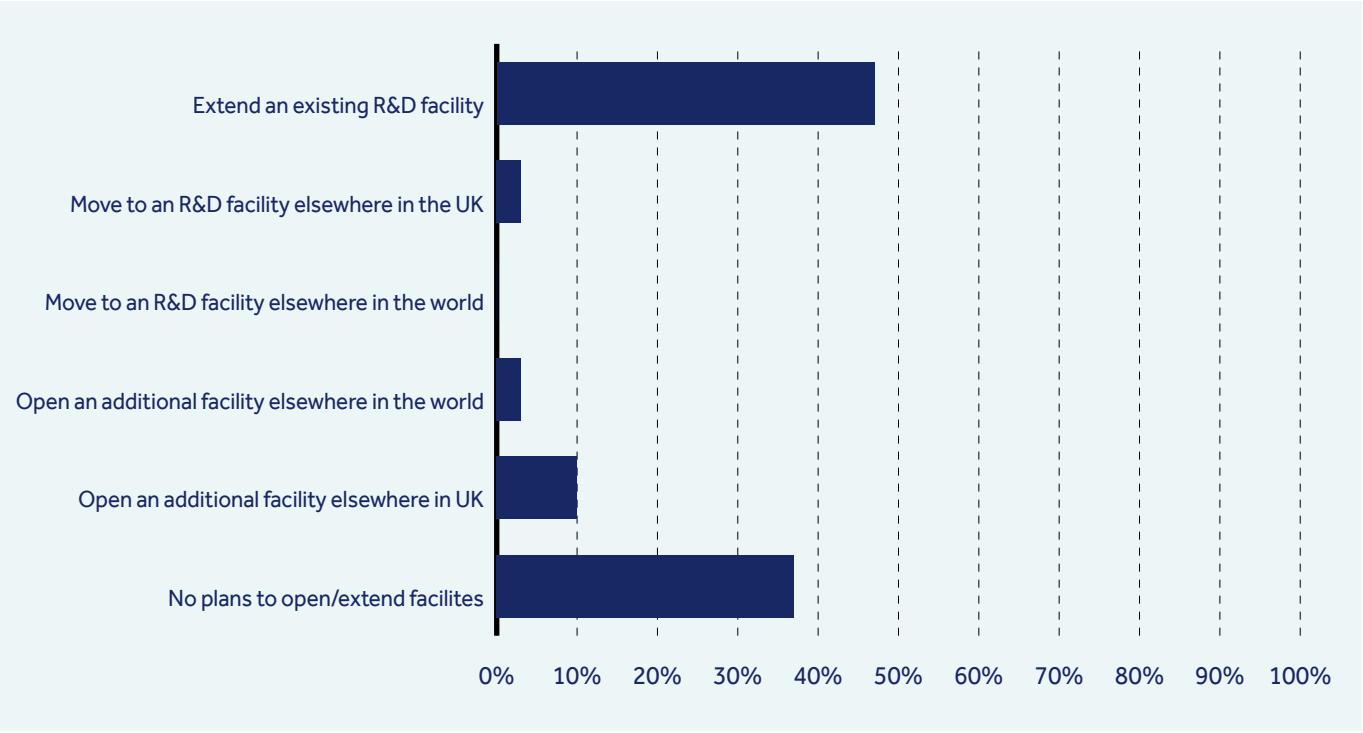
The challenge is articulated by R&D directors of global life science companies. Nearly a quarter of companies participating in the latest YouGov/Bidwells R&D Business Survey identify a need for more wet lab space over the short to medium term. They also report they will need for more dry lab facilities and specialist R&D floorspace. This is consistent with a further finding from the study, that 47% of life science companies plan to extend their facilities over the next five years.

Proportion of R&D businesses stating they will need specific space over the coming decade

	Over the next 2-5 years	Longer term as a result of advances in field
More wet lab space	24%	6%
More dry lab space	20%	17%
Need for other specialist space	20%	30%

Source: YouGov/Bidwells R&D Business Survey, 2021.
Note: The laboratory space requirements reflect the balance of respondents stating they will need more or less floorspace over the respective time periods.

Five year plans of large R&D companies with a UK base



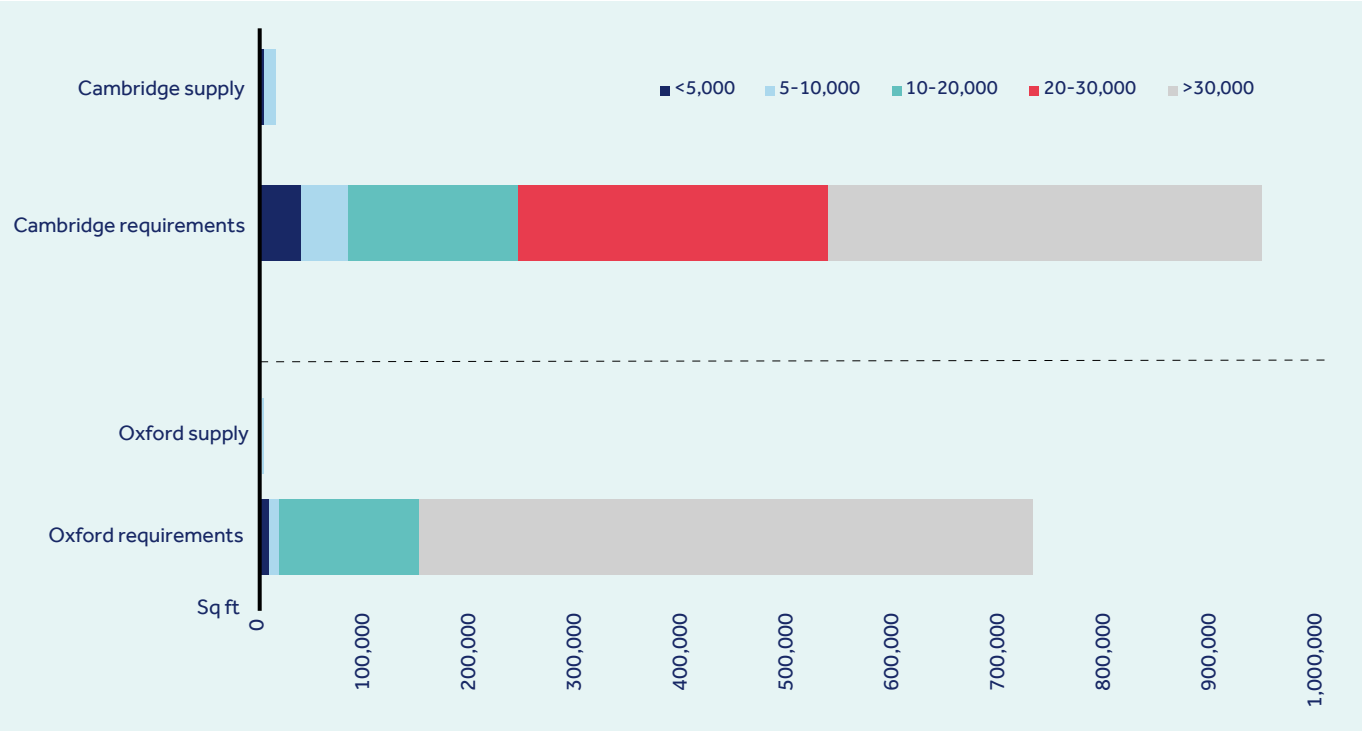
Source: YouGov/Bidwells R&D Business Survey, 2021.

As a forerunner for markets across the UK, these future requirements may be considered in the context of Cambridge, the longest established life science cluster in the UK.

Laboratory floor space across Cambridge almost doubled from 1.49m sq ft in 2011 to 2.90m sq ft over the decade to the end of 2021, including the space provided in the new AstraZeneca R&D global HQ facility which officially opened in 2022. This equates to growth of 95.4% or 6.9% per annum. Excluding the AstraZeneca space, the total addition of laboratory floor space over the last decade reflects growth of 59% or 4.7% per annum.

Given the fact that the cluster is home to nearly 630 life science companies[35], the expansion of 47% of these businesses, even at a small scale, would challenge the capacity of the existing and planned provision. This would largely come on top of existing business requirements for laboratory space in Cambridge, which totalled close to 1m sq ft at the end of 2021.

Laboratory requirements and supply in Oxford and Cambridge, Dec 2021



Source: Bidwells

Longer term implications of life science advances for space requirements

Looking beyond short to medium term requirements, companies were also asked about how advances in their field would impact on their space needs – the Life Sciences 2030 view. Taking this longer term perspective, the focus appears to shift to more flexible dry lab space and specialist facilities.

This may, in part, reflect uncertainty over the nature of space needed. Dry lab and lab enabled space is already in strong demand across the market. To an extent, such requirements are being delivered through new build space, flexible high tech units, as well a growing pace of office, industrial and retail repurposing, albeit at insufficient scale to meet demand.

The need for specialist space will include bespoke manufacturing facilities, for example for personalised medicine production, as well as space suitable for robotic facilitated R&D, and data space. While some of these facilities may be more flexible from a location perspective, power and connectivity specification for existing requirements and future proofing for scientific and technical advances will be crucial.

We expect to see increased prevalence of split sites with R&D focused in areas of research strength while manufacturing functions, often highly specialist in nature, may be located elsewhere in a company's home region or in another location in the UK. Certainly, our R&D Business Survey shows little appetite for offshoring either manufacturing or R&D functions. Concern over supply chains, regulation and quality control are all likely to contribute to this position.

The challenge for investors and developers providing the life science space for 2030 will be delivering all these aspects in a sustainable manner. We think it likely that innovation necessary to serve often competing requirements may well deliver sustainable by-product technologies which will benefit wider society.

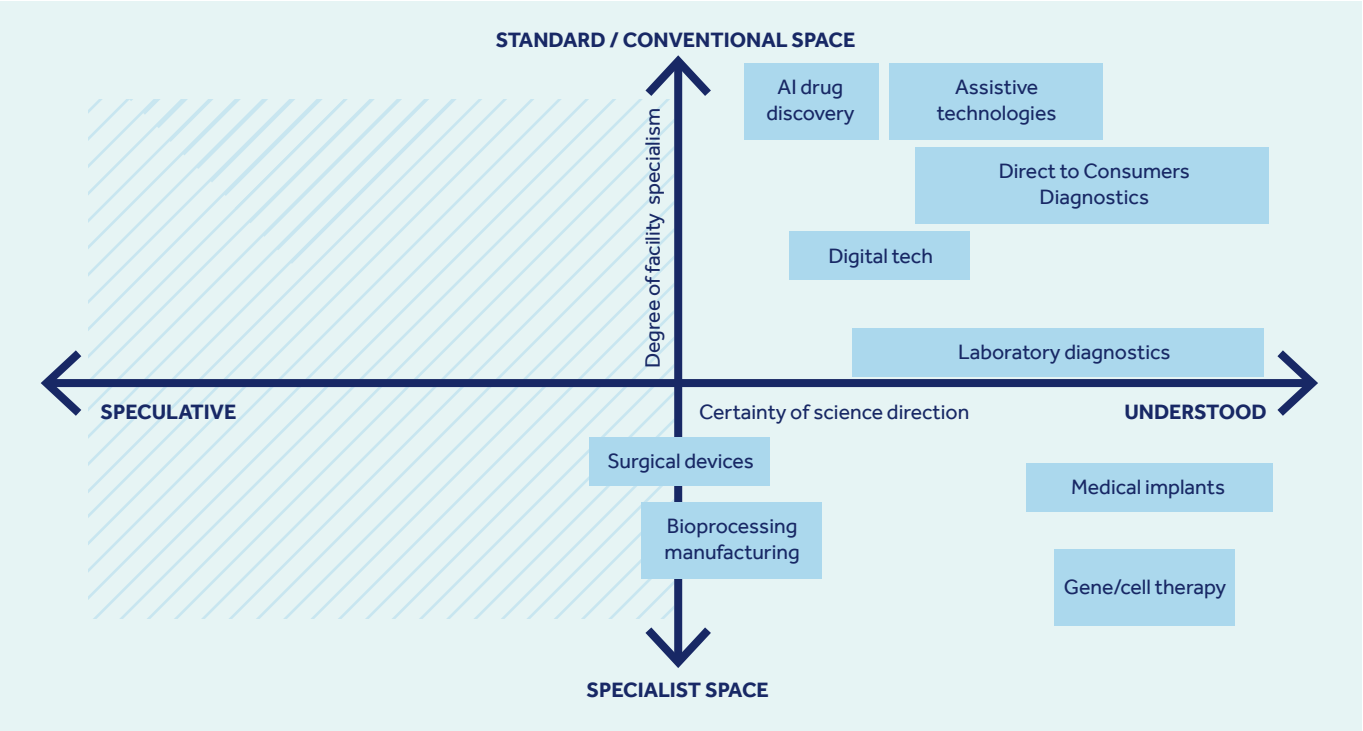
Life science space over the coming decade

We will be considering the real estate implications for growth across specific life sectors in forthcoming papers, but some general themes are evident.

It is clear that flexible space will be in high demand over the coming decade. For example, in the area of new generation sequencing, work stations may need to facilitate robotics and automation, rather than being designed around technicians. Meanwhile, larger robotic operations will have implications for loading and floor to ceiling heights. Similarly, changes in operational processes are likely to mean businesses will value space that facilitates the future-proofing of day-to-day activities, which could range from lift proportions and loading, to air replacement rates. Across the board, power capacity will be of increasing importance and data processing facilities will also expand in significance.

It is clear from our selection of Ones to Watch in the science arena that there is greater understanding of the opportunity presented by some segments than others. This not only relates to the science itself, but also the developments in technology that will facilitate the scientific advances, whether this be robotic technology, AI or big data. All these aspects will impact on the nature and scale of space requirements, which may be accommodated by a range of property types from office, lab or high tech industrial space.

Planning for the space requirements of life sciences growth areas over the next decade



Source: Bidwells

The chart seeks to segment future space needs by the level of specialist facilities needed, overlaid with the understanding of the opportunities to be derived in each area. In this research we have focused on the segments of life sciences which will be operational over the coming decade, i.e. the right hand segments of the chart.

As noted earlier in this report, there are many other exciting areas of science coming forward which would fall in the left hand segments of the chart, but their significant commercialisation is unlikely within the short to medium term. These areas will of course evolve and we will be monitoring the implications over the coming years.

Real estate development for a Life Sciences 2030 future is inherently uncertain. But, understanding this uncertainty and where flexibility is necessary for future advances plainly helps to mitigate financial risk, support viability and maximise the opportunities clearly presented by the life sciences sector over the next decade.

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