Capgemini invent

CXO INSIGHTS

CXO TECH BRIEF FOR LIFE SCIENCES

1. SECTORAL EXEC SUMMARY

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Inevitably, new technologies will profoundly change every component of the value chain and transform the user experience in the healthcare world.
This transformation has already started with the widespread use of mature technologies such as AI or IoT and will now accelerate exponentially with new technologies such as 5G or in the longer term quantum computing.

Healthcare players must now rely on these new technologies to develop their market share while integrating the challenges of cybersecurity and GDPR.

1. SECTORAL EXEC SUMMARY

SECTORAL OVERVIEW WITH A RETROSPECTIVE ON 2020 AND PROJECTIONS FOR 2021

The year 2020 with the global Covid-19 pandemic has strongly impacted the Healthcare and Life Sciences (LS) industry. From R&D to patient product delivery, all the layers of the industry have been re-designed to fight against the pandemic.

One major impact is that the R&D divisions had to re-assign part of their workforce and material production capabilities to develop vaccines against Covid-19 to the detriment of their other research. The same impact has been seen on clinical trials for other treatments which have been delayed due to congested hospitals. On the patient side, an indirect side effect of the pandemic has been an increase in the number of patients stopping treatment due to Covid-19 restrictions, leading to an overstock of drugs for pharmaceutical labs.

Unfortunately, these consequences might continue over the next two years. All these impacts reinforce the need for pharmaceutical companies to be more agile.

One of the main stakes for 2021 will be to effectively communicate the importance of the new Covid-19 vaccine to a population that shows signs of mistrust. Another major stake will be to gather real world evidence to prove the efficacy of drugs to medical authorities.

MAJOR MOVES BY KEY SECTORAL STAKEHOLDERS VIS-À-VIS THE TECHNOLOGICAL IMPACTS ON THE VALUE CHAIN[2]

One of the largest technology ecosystems that has developed in recent years is with major tech companies such as Google, Microsoft, and AWS. For example, Google has worked with DeepMind to successfully solve the age-old problem of modeling protein folding with AI. There are also a vast array of tech companies that help pharmaceutical companies to reduce costs or accelerate their clinical trials. Some of the main players are Veeva, MediData and Oracle. The tech giants have also started to face the pharmaceutical companies head on, aiming to sell applications as treatments instead of drugs.

CONVICTIONS REGARDING THE SECTOR'S KEY TRENDS BASED ON TECH AND SECTOR MATURITY ANALYSIS

LS companies are being disrupted by a number of forces: Data science, Gene and Cell therapy, Digital Health, Virtual trials, Bionic Pharma, Patient Centricity and the COVID-19 crisis. All these forces have led to the transformation of the healthcare sector as we know it today, have accelerated the digital transformation of the pharma industry, and have turned long-term planning upside down.

In 2020, clinical research and life science research were primarily technology-driven. Big data and data analytics were employed to study the complex and high volume of data used for analysis.

The **AI market** will increase by a CAGR of 29.42% and is estimated to be worth USD 4,893.1 million by 2025 (1)

Moreover, digitalized diagnosis and treatment have gained market momentum since the past couple of years, among patients and healthcare professionals alike. However, the COVID-19 pandemic and the associated lockdowns and social distancing norms have boosted the demand for digitalized diagnosis and treatment several folds in 2020.

IoT, mobile apps and platforms are the primary drivers of this digital transformation, facilitating the use of Artificial Intelligence and advanced analytics to create value for end users and enhance the experience of patients and healthcare professionals.

The **Digital Health market** is expected to witness a 37.1% spike in growth in 2021 (2)

Some Pharma companies have launched initiatives to transform and digitize their manufacturing and supply chain, starting with 3D Printing, Robotics and shifting to Blockchain.

2.1 HOW IS THE VALUE CHAIN DISRUPTED BY TECH?

LIFE SCIENCES

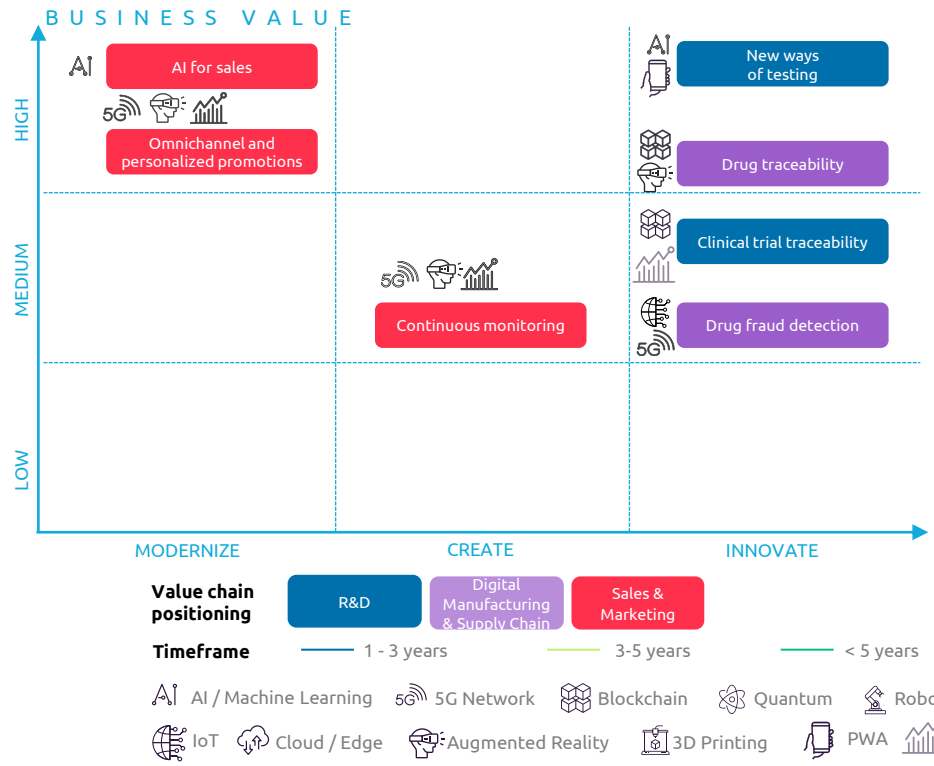
Research & Development | **Digital Manufacturing & Supply Chain** | **Sales & Marketing**

CHALLENGES

Research & Development	Digital Manufacturing & Supply Chain	Sales & Marketing
Deliver better products cheaper, faster and with less risk	Optimize end-to-end manufacturing and supply chain processes to reduce costs and increase visibility	Optimize the customer experience for physicians and patients to increase engagement
Clinical trial traceability	Drug traceability	Omnichannel model and personalized promotions
New ways of drug development	Fraud detection	AI for Sales
Remote monitoring		

2.2 FOCUS ON TECH DELIVERY MATURITY & BUSINESS VALUE

From the early phases of Research & Development to Marketing, Sales and Post-Marketing studies, every step of the Life Sciences industry value chain is impacted by digitization and technology. Just in 2019, the industry has seen a 123% growth in digital initiatives. Digital has become inevitable for all players in the life sciences and healthcare industry. IoT, mobile patient apps, AI, and big data are the leading digital initiatives and are expected to grow in the coming years. Technology allows all players to provide better evidence-based outcomes to patients quicker.



From a technology perspective, we identify 3 main groups:

- **Must-have technologies:** IOT, AI and data analytics specially to address **efficiency** and **predictability** stakes and to provide a customized patient experience.
- **Future must-have technologies:** Quantum computing to accelerate data exploitation and nanotech to improve **drug efficiency.**
- **Enabler technologies:** 5G to facilitate mass data transfers. Blockchain to improve traceability and network security.

3. FOCUS ON VALUE CHAIN BLOCKS ALONG WITH USE CASES

Research & Development

USD 158.1 billion
Estimated market value of Healthcare IoT in 2022

Take advantage of digital technology to foster innovation and reduce overall costs

Access ready-to-use technologies

AI, Cloud/Edge, Data Analytics, Quantum, Nanotechnology

- **Stakes and why now:** Research and Development (R&D) is one of the most challenging functions to transform. In LS, there is intense pressure on R&D to deliver better products cheaper, faster, and with less risk. Due to the covid-19 pandemic, this phenomenon and challenge has increased dramatically.
- **How tech can help:** Digital technologies to ensure and reinforce high quality studies, optimize the completion time of studies, and reduce overall costs. Digital R&D requires various digital technologies such as Artificial Intelligence, Big Data, IoT, and Blockchain.
- **Examples of emerging use cases:** Predictive models and algorithms in healthcare and life sciences (HCLS) have emerged from the combination of patient data and advanced analytics. With machine learning and AI technologies becoming commoditized, scalable access to patient data now throttles the development of such predictive analytics solutions. As a digital marketplace for data, the AWS Data Exchange addresses this 'data bottleneck' by accelerating data exchange in a regulatory compliant, economically sustainable, and cloud-native manner.

Digital Manufacturing & Supply Chain

Cut manufacturing costs by up to 20% with digital technology

Upgrade operations facilities

Access ready-to-use technologies

AI, digital transformation, blockchain

- **Stakes and why now:** Pharmaceutical organizations, globally, are facing challenges meeting global quality standards, adhering to new healthcare reforms, and ensuring supply chain visibility. The pharmaceutical supply chain is facing one of its most critical tests from the ongoing COVID-19 pandemic, and many companies are struggling to succeed.
- **How tech can help:** A recent trend is a technology-based approach to optimize end-to-end manufacturing and supply chain processes, including procurement
- **Examples of emerging use cases:** Digital manufacturing and supply chain uses data integration to link different silos and processes of the manufacturing and distribution lifecycle. Connecting all members of a healthcare system and combining data helps better predict demand and can help cut costs while also improving the efficiency of Life Sciences logistics and supply chain operations.

Sales & Marketing

Yearly marketing budget of $30B for US pharma companies

Data-driven customer insights

Access ready-to-use technologies

AI, Mobile

- **Stakes and why now:** Pharma companies will have to drastically reinvent and shift their approach of personal and non-personal tactics to stay in touch with customers and prescribers
- **How tech can help:** Better manage post-approval activities and accelerate new business development through new digital ways to engage KOLs. Fully integrated digital CRM and CLM tools can drive engagement and help MSLs and Sales Reps to manage their objectives in a compliant way.
- **Examples of emerging use cases:** Remote events and congresses can be enhanced with virtual reality (VR). Use VR technology to explore a virtual trade show or give a comprehensive product demo with a full 360-degree experience. AI use cases have also emerged to help sales reps identify key talking points and machine learning to identify adverse events recorded during HCP conversations.

4. FOCUS ON USE CASES AND ASSOCIATED TECHNOLOGIES

CLINICAL TRIAL TRACEABILITY

RESEARCH & DEVELOPMENT

- In regulated clinical research, traceability is a requirement and stipulates that it should be possible to trace back the content of the clinical study to the original data source. Today's clinical research solutions have significant traceability limitations. Blockchain technology is trust-enabled by design: its decentralized nature, combined with a cryptographically encoded data chain, prevents its alteration by any third party while being available to all stakeholders at any time and may be considered as the "single source of truth".
- A blockchain network can be used as a storage space which is transparent and immutable, to allow data traceability for all clinical trials stages (enforcing controls and streamlining adherence)
    1. Consent management: For each stage of the clinical trials involving patients, the blockchain could store proof of consent at a given time
    2. Cooperation: A given pharmaceutical laboratory could share information to potential partners to ease the clinical trials process. Standardization of data and platform technologies will enable a broader range of collaboration leading to the development of new treatments that are researcher-led and enable research.
    3. Data trading: The blockchain could also be used as a trading platform for laboratories to purchase data from hospitals to ease clinical trials

MARKET TECHNO IMPACT

Market and techno rationale:

- Mediledger keeps an immutable record of transactions and data to demonstrate regulatory compliance and improve security while ensuring patient safety and drug supply security
- Reduced the incidence of epileptic seizures by 44% after its first year of use and 72% after 3 to 7 years

TECHNOLOGIES

Blockchain

Data Platform

Why now:

- Need for more transparency in clinical trials (some accidents happened in the past leading to disastrous consequences)
- Collaboration between different laboratories is difficult

NEW WAYS OF DRUG DEVELOPMENT

RESEARCH & DEVELOPMENT

- To support the development of new medications and treatments, new technologies can be used to simulate human body activity and perform tests. As things stand today, animal tests are the standard, but they imply the loss of animals even though the latter cannot perfectly mimic human pathophysiology, which ultimately reduces the efficacy of those tests. In this regard, technologies support new ways of testing:
    - **Nanotechnologies** offer ways to model human diseases in vitro and therefore better verify the effectiveness of new treatments. Organs-on-chips are microfluidic cell culture chips that recapitulate the microarchitecture and functions of entire organs, both in terms of tissue interfaces and mechanical stimulation, to reflect the functioning of organs and can predict reactions to a lot of stimuli, including medication responses and environmental effects.
    - **Quantum computing** could open up better ways to simulate nature by using supercomputers to root out therapies from a database of molecular structures. Its deep convolutional neural network screens more than 100 million compounds each day making it possible to consequently shorten the process of developing a new drug candidate with the help of its smart algorithms.
    - **Artificial Intelligence** can be used to assist researchers in predicting the 3D protein structure of a drug in accordance with the chemical environment of the target protein site.

MARKET TECHNO IMPACT

Market and techno rationale:

- Emulate Inc., a startup launched and supported by Wyss Institute (Harvard), develops "living" platforms that emulate the functioning of a human body to perform tests and help achieve product innovation in drug development, among others
- Tissue Dynamics, Bi/ond and Hesperos are other startups providing organ-on-a-chip solutions
- Altis Biosystems and Netri also develop similar solutions, but focus on specific organs (intestinal epithelium and brain respectively)

TECHNOLOGIES

Nano-technologies

Quantum

AI/Machine learning

Why now:

- Not applicable – the desired technological maturity is yet to be reached

4. FOCUS ON USE CASES AND ASSOCIATED TECHNOLOGIES

DRUG TRACEABILITY

DIGITAL MANUFACTURING & SUPPLY CHAIN

Blockchain allows transparency and tracking of drug shipments throughout the supply chain

- Every player (pharmaceutical labs, transporters, wholesalers, pharmacies, etc.) within the supply chain is a node in the blockchain
- Every event is tracked and stored within the blockchain (e.g., shipment departure or arrival), including attributes related to the shipment (e.g., transportation conditions)
- Each deviation in the process (e.g., delivery rerouting) triggers an alert leading to the potential removal of the shipment from the market

There is always a risk of changes to environmental conditions which might harm the integrity of drugs, need regulating for the availability of stocks to avoid shortages, and making sure that the packaged drug has been received by the relevant customer. IoT is being employed to solve these age-old problems.

- IoT trackers to monitor location, temperature variations, humidity and shock on pharmaceutical shipments providing real-time insights to a connected application and sending alerts in case of deviations
- IoT enables manufacturers to shift from batch manufacturing to continuous manufacturing by interlinking testing and sampling steps in the manufacturing process using sensor technology and thereby ensuring data integrity

MARKET TECHNO IMPACT

Market and techno rationale:

- Keeps an immutable record of transactions and data to demonstrate regulatory compliance and improve security
- Enforces cross-industry business rules without ever revealing private data
- Provides patient safety and drug supply security

TECHNOLOGIES

Blockchain

IoT

5G

Why now:

- Counterfeiting of drugs is a major issue
- Potential mishandling of drugs (no accountability) throughout the supply chain

FRAUD DETECTION

DIGITAL MANUFACTURING & SUPPLY CHAIN

- Connect packages to reduce the risk of counterfeiting and to enforce compliance
  - Facilitate product identification
  - Be compliant with the serialization law
  - Ensure product quality and integrity for final customers
  - Reduce the size of the counterfeit market

MARKET TECHNO IMPACT

Market and techno rationale:

- DHL partnered with a lab which placed tags on its flagship products containing a microchip storing a unique serial code, allowing pharmacists and distributors to verify the authenticity of all products
- Results: Reduction of counterfeit products allowing the company to comply with the international serialization law

TECHNOLOGIES

IoT

5G

Why now:

- 50% of pharmaceutical products sold through rogue websites are fake and 30% sold in emerging markets are counterfeit
- IoT solutions can reduce the risk of counterfeiting

4. FOCUS ON USE CASES AND ASSOCIATED TECHNOLOGIES

OMNICHANNEL MODEL AND PERSONALIZED PROMOTIONS FOR MEDICAL CONTENT AND SERVICES

SALES & MARKETING

Delivering continuous and personalized promotions / medical content and services, with an omnichannel model.

1. A digital platform designed to bring people, expertise, and science together as a customized e-congress solution is the best fit for an end-to-end innovative and continuous learning experience. A customized digital experience with a mix of built-in features following 4 principles: on-going dialog, community-driven, expertise centric, and personalized experience
2. Augmented Reality (AR) and Virtual Reality (VR) to increase branding, engagement, and overall attendee/exhibitor experience. Use VR technology: explore a virtual trade show or give a comprehensive product demo with a full 360-degree experience. Use the information collected on the target audience/attendees and create an experience that speaks directly to their interests and needs.

MARKET TECHNO IMPACT

Market and techno rationale:

- **ON24**: The ON24 Digital Experience Platform enables businesses to convert customer engagement into revenue through interactive webinars, virtual events, and multimedia content experiences.
- Results: 76% physicians were influenced to change patient care

TECHNOLOGIES

Data analytics

AR/VR

Why now:

- Need for organizations to pivot to virtual events has skyrocketed
- To maintain the customer relationship
- Fewer costs and logistical issues
- Metrics available in real time

AI FOR SALES

SALES & MARKETING

- The impact of AI on pharmaceutical sales starts even before the sales rep meets a customer
- Machine learning can separate customers into highly specific segments, allowing sales teams to personalize their activities to a greater extent
- Sales reps can identify specific patient populations based on new factors such as interest in new drugs, location, and availability
- AI could recommend content and techniques to reps before their sales meetings based on past data
- Some major pharma companies have already used AI to tell sales reps what to say during meetings

MARKET TECHNO IMPACT

Market and techno rationale:

- There have been several partnerships between big tech companies and pharma to work on AI for sales (e.g., Google and Pfizer)
- One of the major players in the industry is Veeva with their AI CRM solution Andi

TECHNOLOGIES

Data analytics

AI/Machine learning

Why now:

- Pharma companies are sitting on a large pool of data that is ready to be used
- AI-driven approaches can help pharmaceutical reps to transform the physician and patient relationship without violating doctor-patient confidentiality

4. FOCUS ON USE CASES AND ASSOCIATED TECHNOLOGIES

CONNECTED MONITORING

CROSS-FUNCTIONAL USE CASE

- Connected clinical trial monitoring could be used to:
  - Improve the study ROI per patient by reducing the amount of time required for transcription assessment / reducing errors
  - Reduce the burden on clinical sites and achieve potential savings on site stipends
  - Increase patient compliance
  - Get access to real-time and cleaner data with fewer falsified data points
- Continuous monitoring could be used to:
  - Predict potential issues by seamlessly transferring data instantly from IoT devices (e.g., inhalers, pacemakers)
  - Collect information in real time
  - Reduce the incidence of adverse events
  - Empower patients with their own data

Real-time diagnostics are becoming more common. For instance, Capgemini is developing real-time diagnostics that enable surgeons to identify tissues during a procedure and improve the outcomes by providing actionable insights that allow the surgeon to act accordingly in real time.

MARKET TECHNO IMPACT

Market and techno rationale:

- Sending apps and devices to patients at home: Thermometer patch (Tucky), Spirometer (SmartOne), Oximeter (Oxitone)
- Results: Live tracking of patient metrics, an improved relationship between patients and medical staff
- NeuroPace has developed a surgically implanted device to prevent seizures. The implant autonomously monitors neuronal activity to identify and prevent seizures. Results: Incidence of epileptic seizures reduced by 44% after its first year of use and 72% after 3 to 7 years.

TECHNOLOGIES

IoT
5G
AI

Why now:

- 5G is expected to deliver seamless connectivity and guaranteed levels of performance including low latency, high throughput, and reliability, which will make all this possible in the following years

Capgemini invent

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