



Facilities of the Future
SAAPI Conference
May 2019



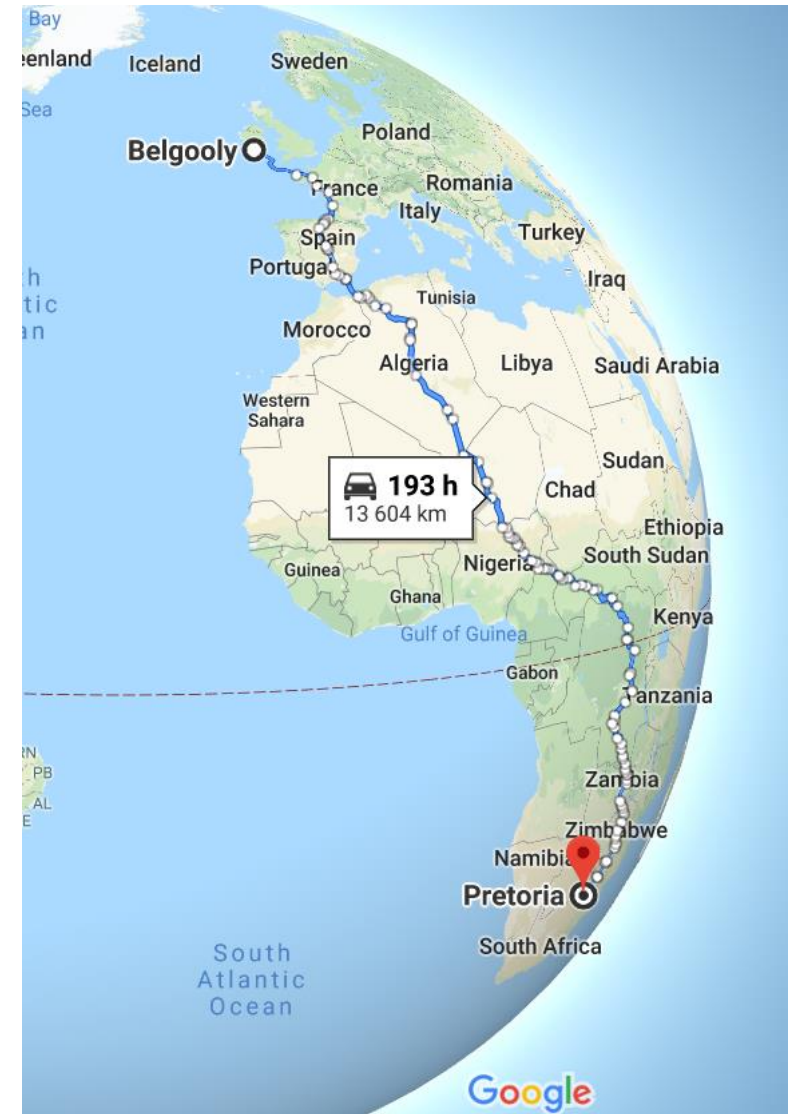
WHEN YOU NEED TO MEET A HIGHER STANDARD

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Global Director, Quality,
Compliance and Regulatory.



WHEN YOU NEED TO MEET A HIGHER STANDARD

AGENDA

- Why Change?
- What's holding the Industry Back?
- Flexible Factories
- Smart Factories/IIOT
- Big Data/Analytics
- Artificial Intelligence
- Continuous Processing
- Advanced Therapeutic Medicinal Products
- Combination Products
- Robotics
- 3D Printing
- Virtual Training



WHY CHANGE?

- New Technologies
- Niche Markets
- Flexible Batch sizes
- Patient Experience
- New Products
- Cost
- Efficiency
- Speed to Market
- Quality



WHAT'S HOLDING US BACK?

- The Regulators?
 - Philosophy of Modern Regulation
 - Innovation Offices
 - Fast Track
- Fear of the unknown?
- Managing Post Approval Changes?

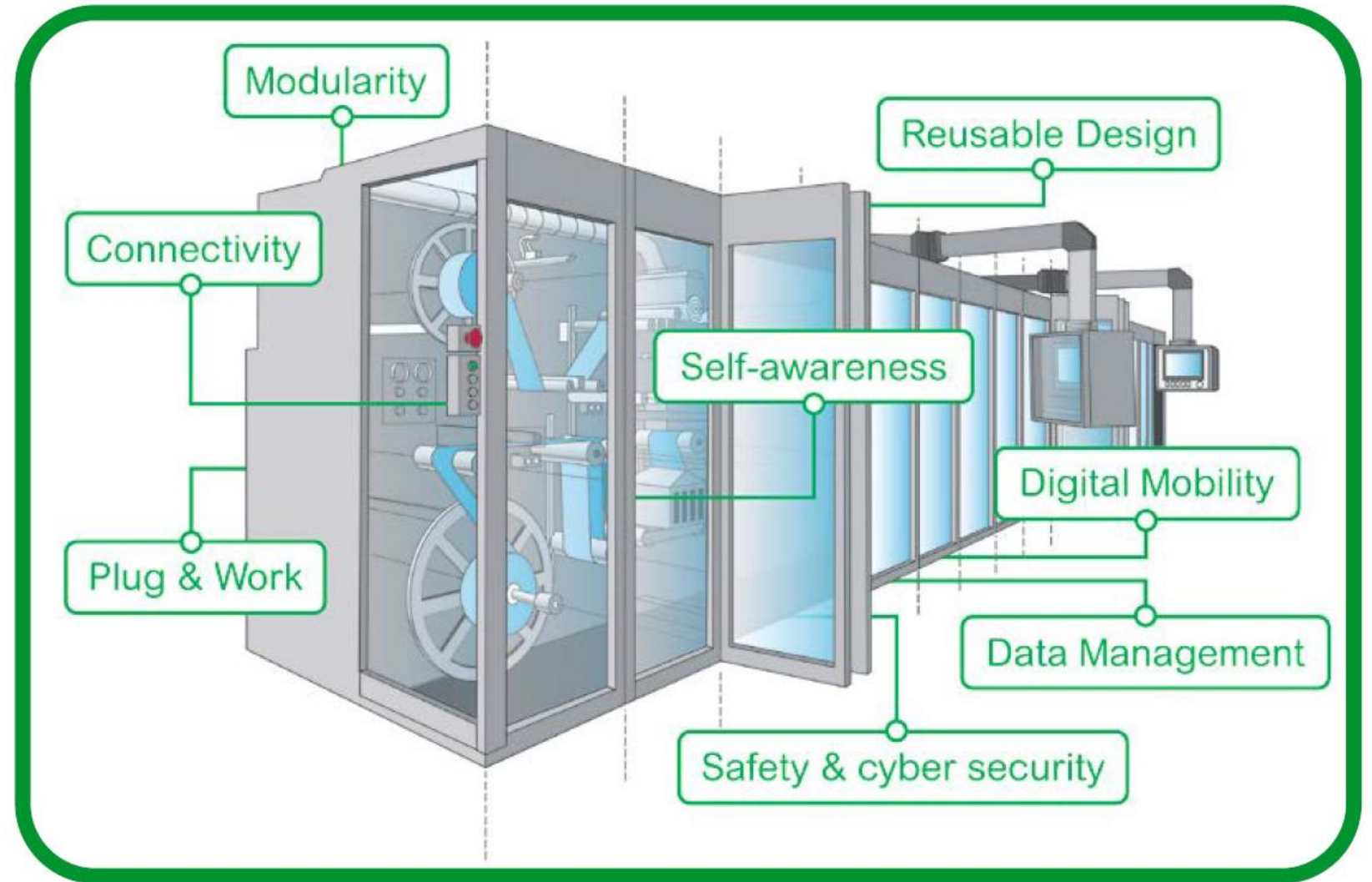


FLEXIBLE FACTORIES



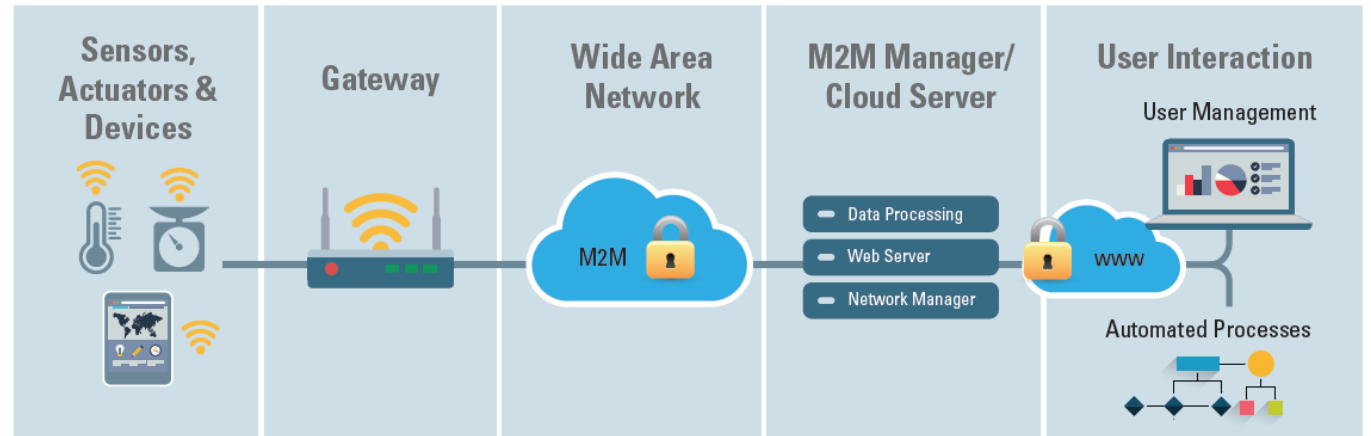
- Multi Purpose Facility
- Modular Design
- Rapid and Compliant Set up
- Replicate design elements
- Highly Automated

SMART MACHINE DESIGN

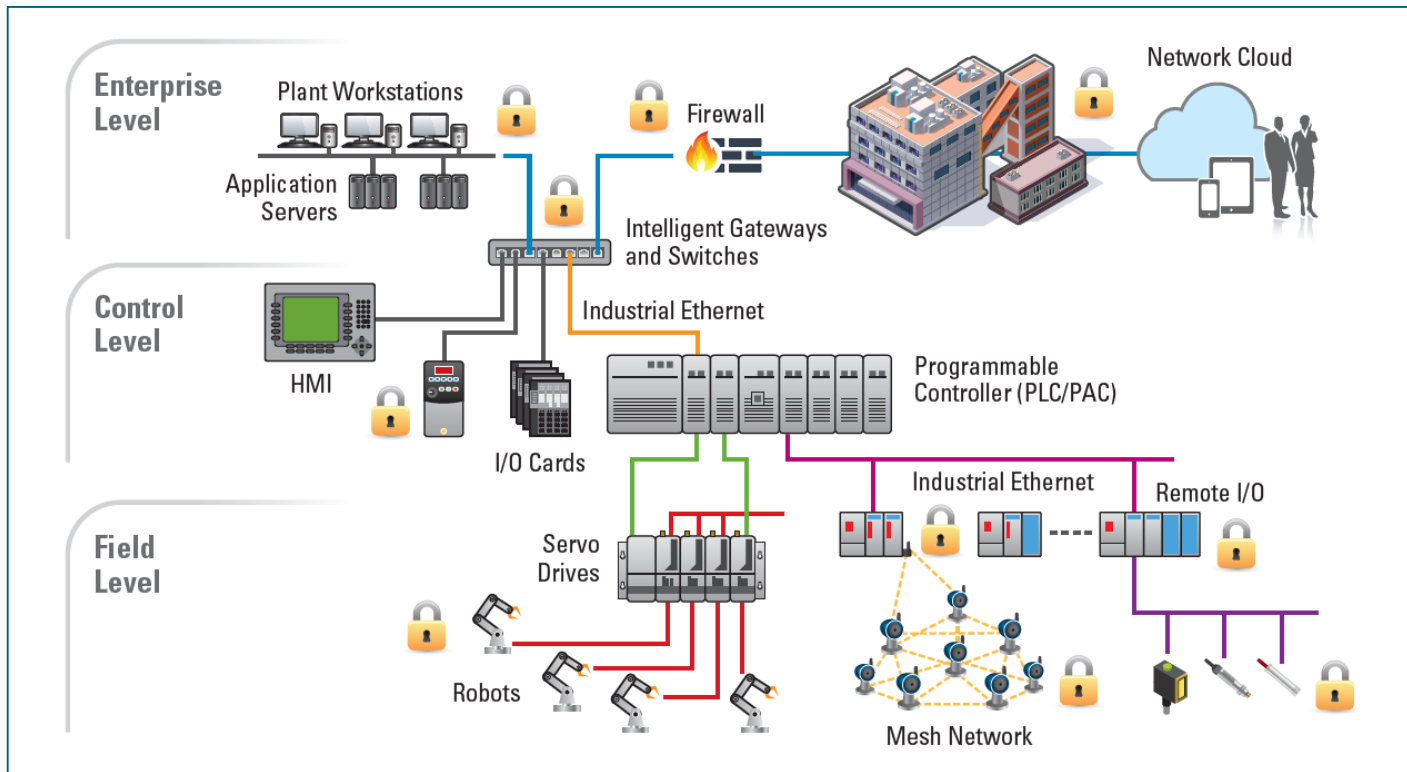


SMART FACTORIES/IIOT

- Smart devices with varying level of intelligent functionality
- M2M
- M2P
- P2M
- Open & Standard Internet and Cloud based technologies



SMART FACTORIES/IIOT

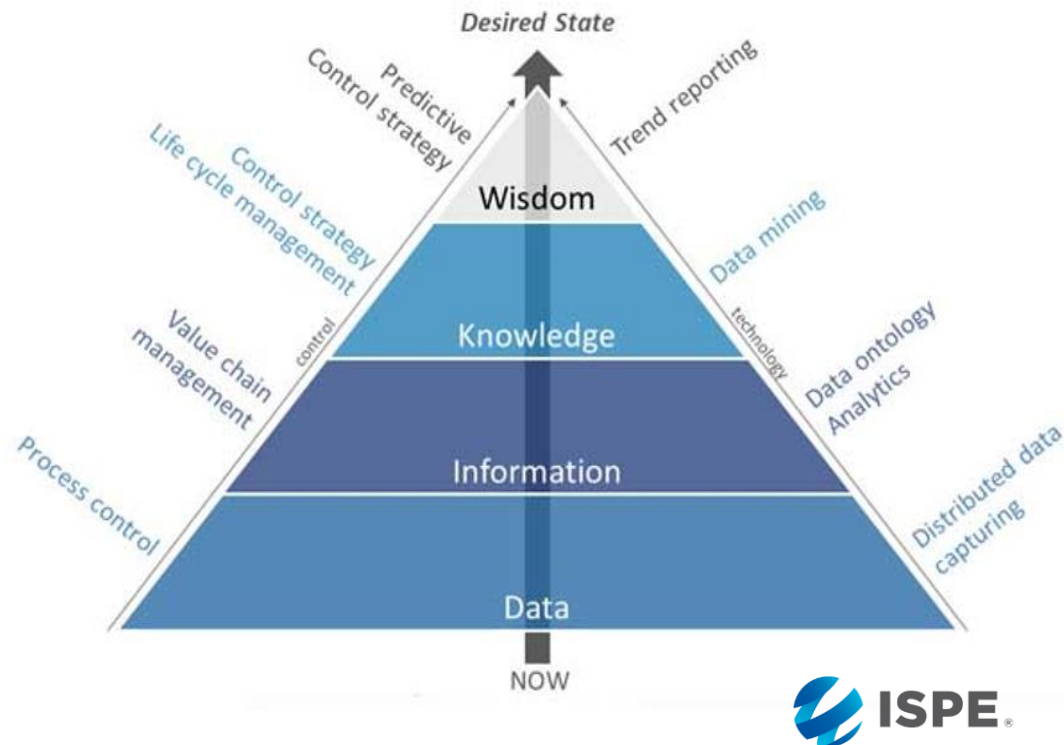


- Sensing And Activation
- Controlling
- Optimisation
- Autonomous Control

- Facilitate End user Monitoring & Control

- Biometrics
- Mobile/Wearable Technologies

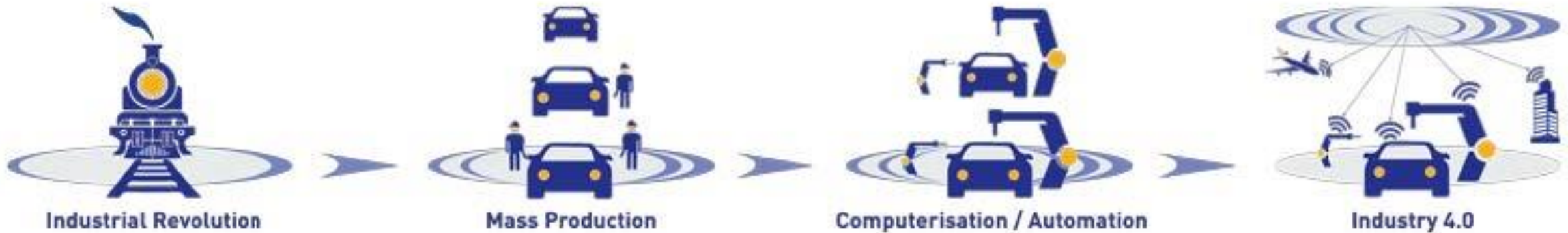
BIG DATA/ANALYTICS



- Culture
- Decision Chains
- Lifecycle Knowledge Development
- Augmented Reality

..things we know, ...known unknowns,
...unknown unknowns

INDUSTRY 4.0



BIG DATA/ANALYTICS

Table A: Digital Maturity Models

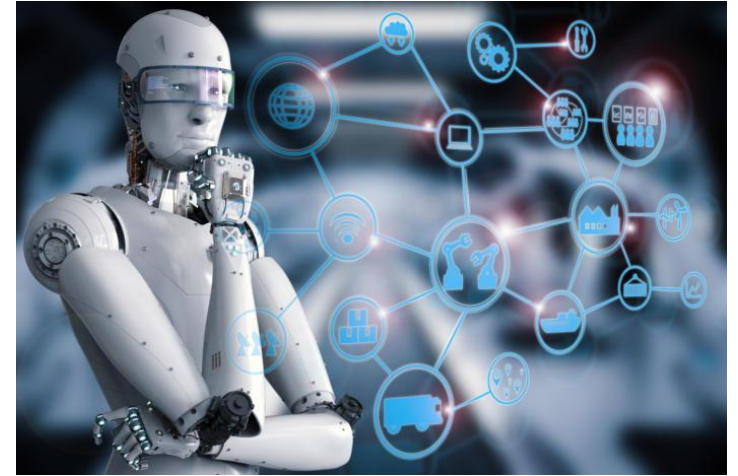
INDUSTRY	1.0	2.0	3.0	4.0
Information systems	Unit operation	Production process	Computerization	Transparency
Organization and processes	Craft shop	Taylorism*	Connectivity	Predictive
Culture	Internal focus, adaptive behavior	Internal focus, stabilizing behavior	External focus, stabilizing behavior	External focus, adaptive behavior

* A 19th-century management system that broke down steps in a manufacturing process into repetitive tasks.



ARTIFICIAL INTELLIGENCE

- **Aligns with Analytics**
 - Combines traditionally separate data sources
 - Continuous monitoring of all aspects of Process
 - Big Data
 - Single and Multivariate Analysis



- **Smart machines**
 - Fitted with multiple sensors
 - Self aware
 - Wear and tear
 - Predictive failure modes
 - Embedded intelligence

CONTINUOUS PROCESSING

- Challenges
 - Defining batch
 - Release Process
 - Analytics
 - Stats
 - Regulatory concerns
 - CQV/CPV/PAT
 - New Technologies
- Benefits
 - Less down/prep time
 - Less Cleaning/Steaming
 - Smaller footprint
 - Extend durations with closed systems
 - Realtime data and response
 - Flexibility
 - Reduced Energy inputs

<https://www.youtube.com/watch?v=zRhoJgKuNrc>

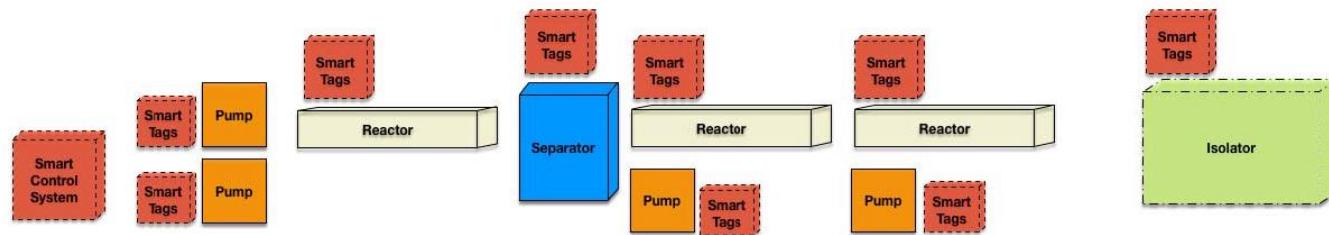




CONTINUOUS MANUFACTURING

Arrange Library Components to Execute Recipe.

Enable the Library Components to handshake with the Control Architecture.

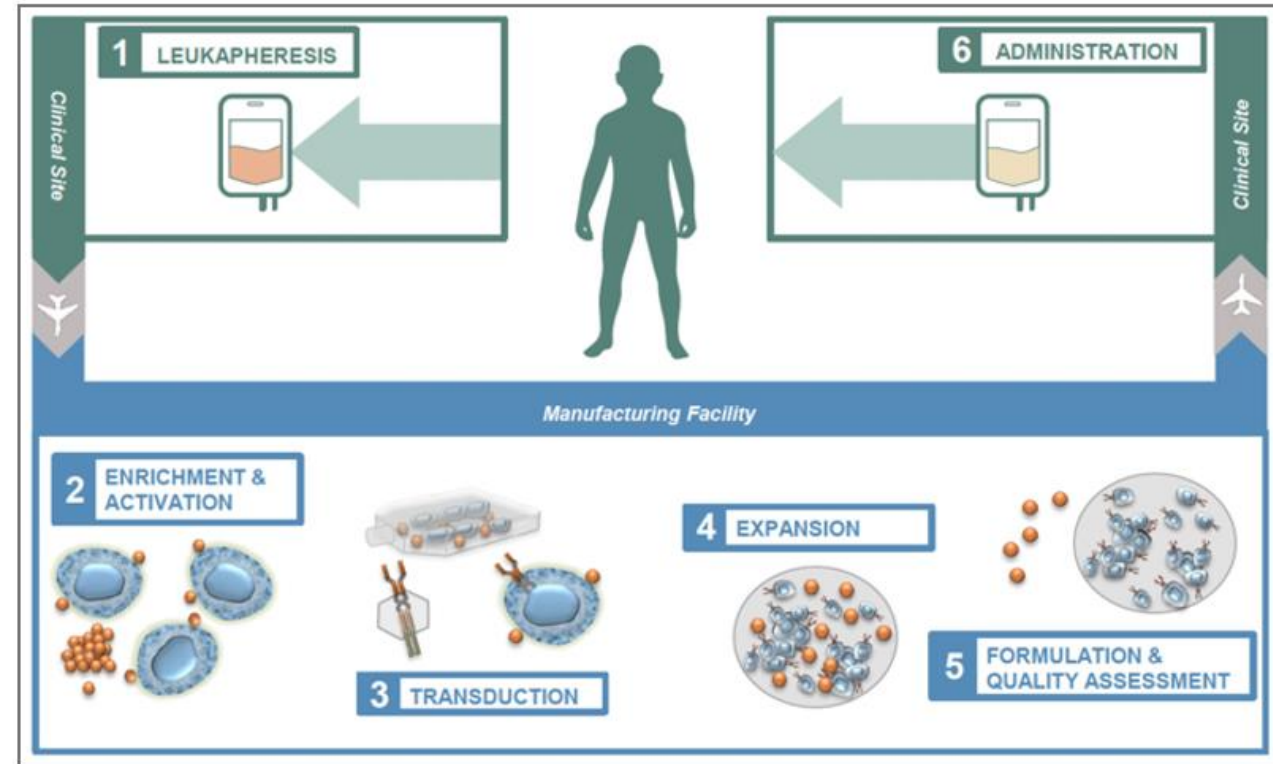


WHEN YOU NEED TO MEET A HIGHER STANDARD

ATMPs

- Gene Therapy Medicines
- Cell Therapy
- Tissue Engineered Products

- New Manufacturing Platforms
- Personalised Medications



ATMPs

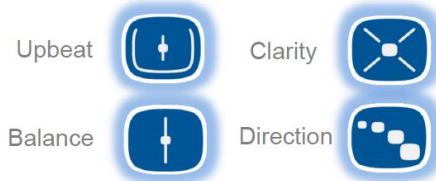
- Manufacturing in a Clinical Environment
- GMP in Hospitals?
- Release before testing?

- Lab scale Equipment
- Scale out not up



COMBINATION PRODUCTS

Common Brand Language



- Biologics often require Device Delivery
- Patient Experience
- Smart Technologies



WHEN YOU NEED TO MEET A HIGHER STANDARD

ROBOTICS

- Freeing people for more challenging jobs
- Consider other industries
- Efficient
- Cost

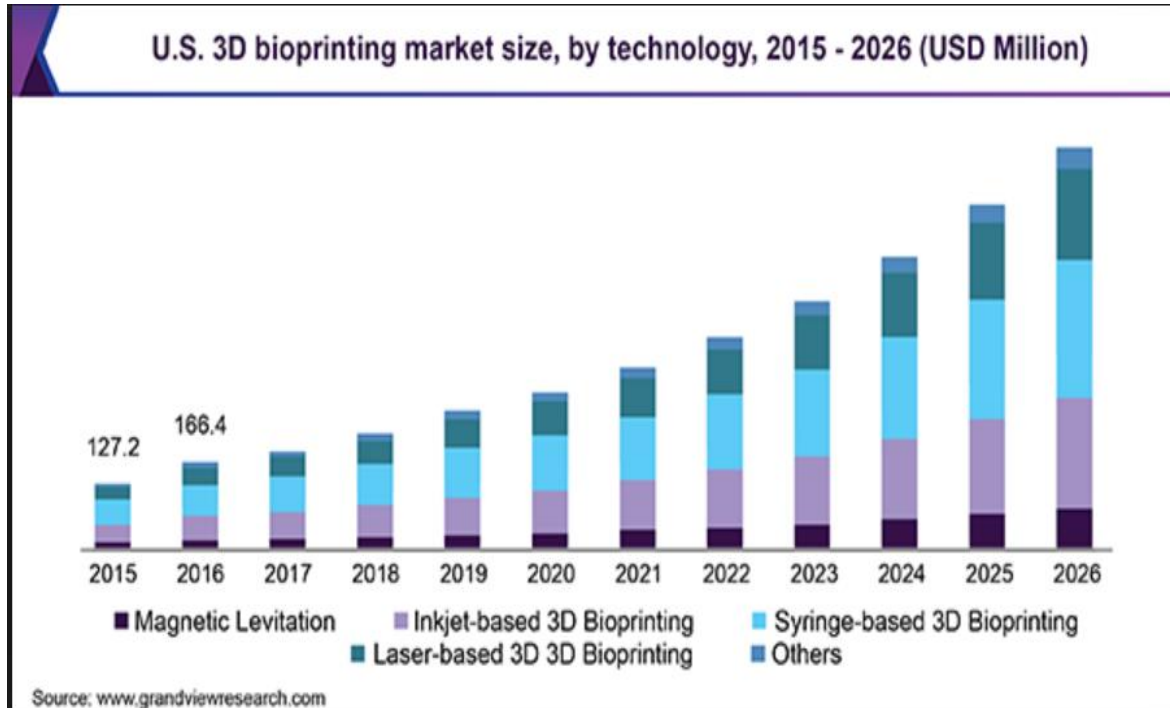


3D PRINTING



- **Prosthesis**
 - Cost
 - Skin tone
 - Personalisation
- **Bioprinting**
 - Printing of Tissue
 - How long till we can Print Organs?

3D BIOPRINTING



- Bioprinters
- Select Tissue Design
 - Scaffolding hydrogel material
 - Bio-ink
 - Layer by layer
 - 3D structure
 - Incubation
- Pharma testing
- Challenges – Vascularisation

VIRTUAL TRAINING

- People Key to Operations
- Training and Qualification
- Speed
- Cost
- Immediate feedback
- Product Impact

<https://pixogroup.com/what-is-virtual-reality-training/>



Virtual Reality Training by Novartis/Sandoz. Copyright: Innerspace (as seen on CleanZone)

PIXO
GROUP

What are the Regulators doing?

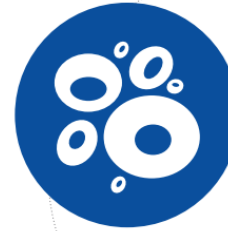


WHEN YOU NEED TO MEET A HIGHER STANDARD

EMA - HIGHLIGHTS

Medicines recommended for approval

Cancer



Alunbrig
Apealea
Braftovi
Carmustine Obvius
Erleada
Gefitinib Mylan
Imfinzi
Kanjinti
Kymriah ●●●
Lenalidomide Accord
Mektovi
Nerlynx
Ogivri
Pelgraz
Pemetrexed Krka
Poteligeo ●
Rubraca ●●
Trazimera
Udenyca
Verzenio
Vyxeos ●
Yescarta ●●●
Zirabev

Infections



Alpivab
Biktarvy
Delstrigo
Fulphila
Juluca
Pelmeg
Pifeltro
Tobramycin PARI
Vabomere
Xerava
Ziextenzo

Neurology



Aimovig
Buvidal
Dzuvéo
Emgality
Kigabeq
Namuscla ●●
Onpattro ●●
Rxulti
Slenyto
Tegsedi ●●

Haematology/ Haemostaseology



Besremi ●
Cablivi ●
Deferiprone Lipomed
Hemlibra ●●
Jivi ●
Lusutrombopag Shionogi
Mylotarg ●
Trecondi ●
Veyvondi ●

Immunology/ Rheumatology/ Transplantation



Duzallo
Halimatoz
Hefiya
Hullo
Hyrimoz
Ilumetri
Zessly

Endocrinology



Lamzede ●●
Macimorelin Aeterna Zentaris
Mepsevii ●●
Myalepta ●●
Nityr
Semglee

Metabolism



Amglidia ●
Miglustat Dipharma
Segluromet
Steglatro
Steglujan

Pneumology/ Allergology



Bevespi Aerosphere
Riarify
Symkevi ●
Takhzyro ●●
Trydonis

Vaccines



Dengvaxia
Flucelvax Tetra
Shingrix

Cardiovascular



Prasugrel Mylan

Hepatology/ Gastroenterology



Rizmoic

Ophthalmology



Luxturna ●●

Reproductive medicine



Ulipristal Acetate Richter

Uro-nephrology



Silodosin Recordati

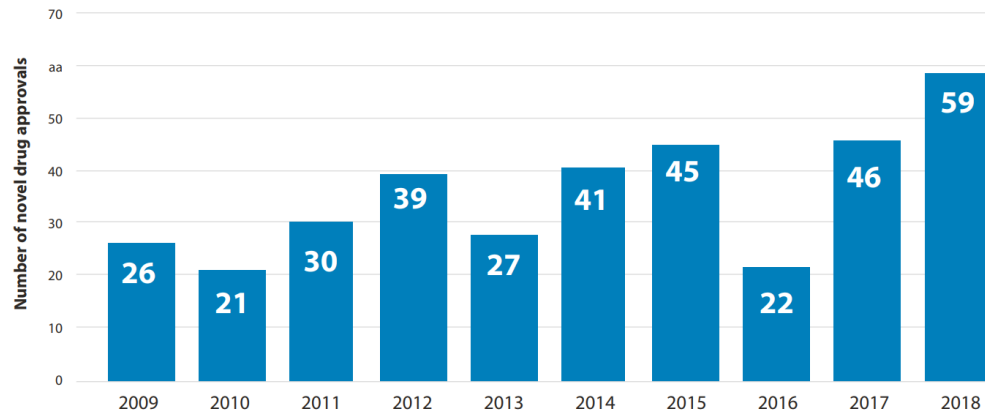
● Accelerated assessment ● Approval under exceptional circumstances ● ATMP ● Conditional marketing authorisation ● Orphan medicine ● PRIME

The medicines that contain a new active substance are highlighted in blue

FDA - HIGHLIGHTS

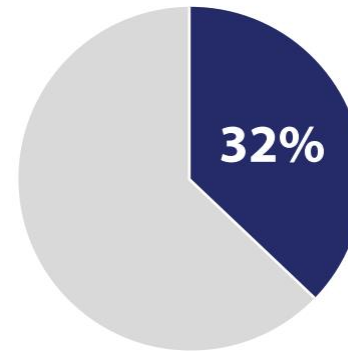
CDER's Annual Novel Drug Approvals: 2009 - 2018

In 2018, CDER approved 59 novel drugs. The 10-year graph below shows that from 2009 through 2017, CDER has averaged about 33 novel drug approvals per year.

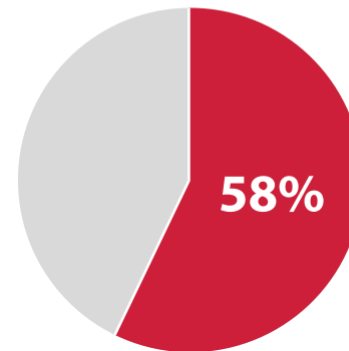


Novel Drug Approvals

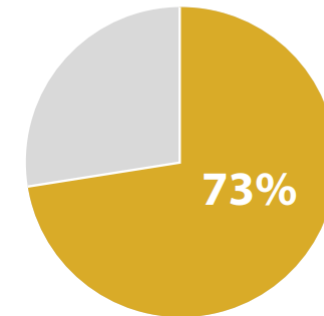
CDER identified **19 of the 59** novel drugs approved in 2018 (32%) as first-in-class.



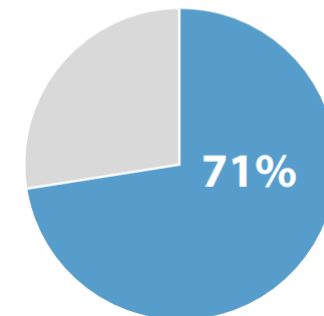
34 of CDER's 59 novel drugs (58%) were approved to treat rare or "orphan" diseases.



43 of the 59 novel drug approvals of 2018 (73%) were designated in one or more expedited categories of Fast Track, Breakthrough, Priority Review, and/or Accelerated Approval



42 of the 59 novel drugs approved in 2018 (71%) were approved in the United States before receiving approval in any other country



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GAO

Project | People | Process | Facility | Quality