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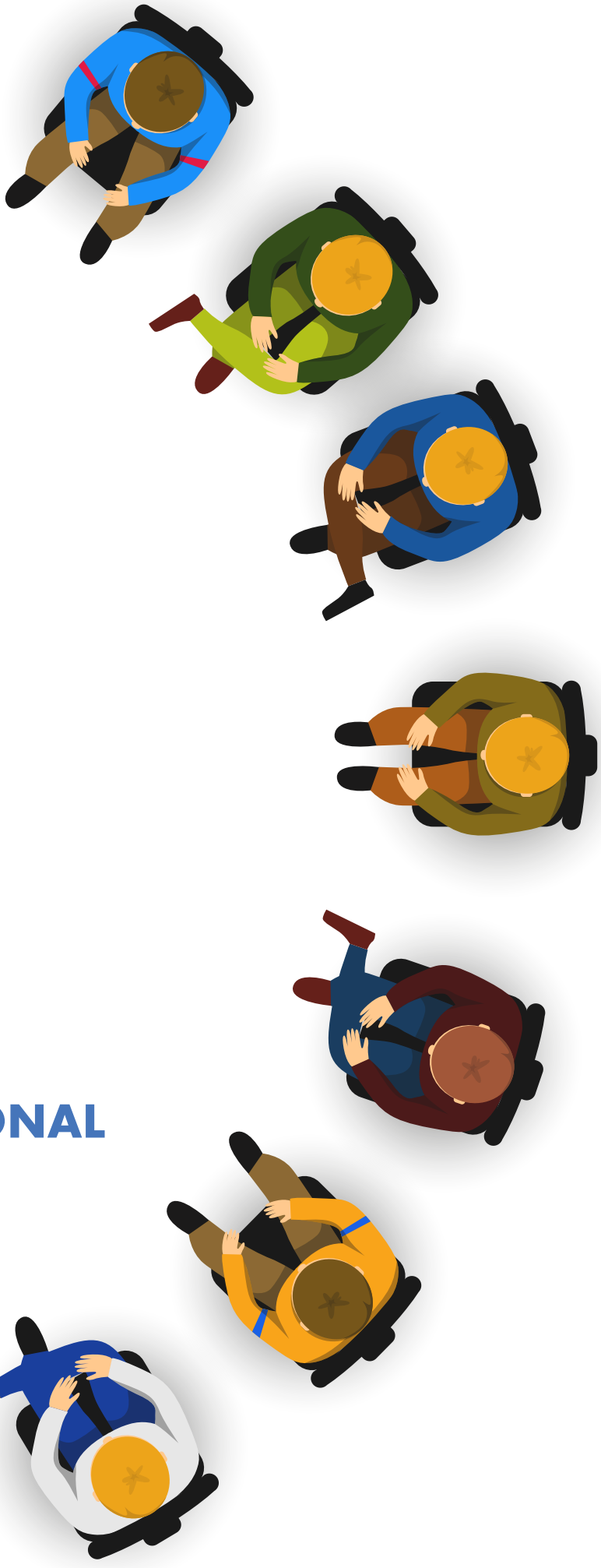
University of Antwerp



WHITE PAPER

THE FIRST INTERNATIONAL PHARMA LOGISTICS MASTERCLASS

2021

Pharma.Aero
Bedrijvenzone Machelen Cargo 706B, 1830 Machelen

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Preface

The pandemic that hit the world end of 2019 has pushed the world in several ways to its limits. It created severe problems worldwide, both from a healthcare perspective and from a social and economic perspective. But the disruption caused by the pandemic also created opportunities and enabled some trends and innovations to be implemented at "the speed of light" during the past two years.

Specifically, traditional boundaries and limits vanished both in the life sciences industry and in the logistics and supply chain industries, resulting in the implementation of several innovations. An example is the premiere of using the messenger RNA (mRNA) vaccines in a completely new designed logistical "direct-to-destination" flow using innovative packaging combined with dry ice engineered dosing systems on a global scale.

During a lunch meeting in the Summer of 2020, Wouter Dewulf, Roel Gevaers and Frank Van Gelder were chatting about how fast the pharma industry was picking up the development of vaccines for the Covid-19 pandemic. They observed that the logistics part (mainly public and scientific) was potentially lagging behind, as the complexity of the classical supply chain disabled many logistical companies' to develop innovative logistical distribution strategies overnight. It was potentially resulting in having vaccines available but not the logistical capacities to handle them.

The final result of that lunch was an open letter to raise awareness to the government and logistical companies to develop strategies for distributing the Covid-19 vaccines. Experts such as Prof. dr. Pierre Van Damme and Wim Tiest contributed to this effort.

General Eisenhower said: "You will not find it difficult to prove that battles, campaigns, and even wars have been won or lost primarily because of logistics". Within a few weeks, we received several stakeholders' reactions to this open letter. These reactions made it obvious that there were 3 factors identified:
1. Lack of alignment between industry and governments concerning the development of the vaccines;
2. Lack of alignment between industries and scientific research institutions;
3. Lack of alignment between pharmaceutical manufacturers and logistical service providers.

This analysis enabled the start of organising the first International Pharma Logistics Masterclass. We were aware that, in order to fulfill this ambition, we had to bring together, pharmaceutical manufacturers, business logistics stakeholders and the academic world. We were confident that this would lead to a melting pot of sharing knowledge and insights, through cross industrial networking. Doing this under the umbrellas of Pharma.Aero, the University of Antwerp and Metrans Longbeach, was the basis for getting started.

The result became clear in September 2021: the first edition of the Pharma Logistics Masterclass: "Where Business meets Academics"

We established an Organising Committee:

Scientific Committee

- Prof. dr. Roel Gevaers (chair)
- Prof. dr. Tom O'Brien (co-chair)
- Prof. dr. Pierre Van Damme (co-chair)
- Dr. Sven Buyle
- Prof. dr. Wouter Dewulf
- Prof. dr. Christa Sys
- Prof. dr. Thierry Vanelslander
- Prof. dr. Edwin Van Hassel

Business Committee

- Mr. Frank Van Gelder (co-chair)
- Mr. Nathan De Valck
- Dr. Omar Najim (external advisor)

We listed the primary learning objectives of the Masterclass:

- To gain in-depth knowledge about pharmaceuticals and vaccine production, storage, and handling conditions
- To get a deeper insight into pharma supply chains and related logistical costs
- To identify economic and operational challenges in air and maritime transport of pharmaceuticals and vaccines
- To obtain further knowledge about the last-mile pharmaceutical distribution
- To identify the specific challenges in European, American and Asian pharma logistics
- To share best practices and lessons learned from industry experience

The result was a 5-day interactive and exciting masterclass. An interesting blend of business, science, pharma and logistics formed a new community: The 'Pharma Logistics Masterclass community' and the 'Alumni of the Pharma Logistics Masterclass'.

The open letter led to several important recommendations to the government and was the source of several pharma-related projects across the globe. It became clear that cross-industrial collaboration was essential in handling the pandemic crisis.

Antwerp, November 2021

Frank Van Gelder
Co-Chair of the Committee
Pharma.Aero

Prof. Dr. Wouter Dewulf
Member of the Committee
UAntwerpen

Prof. Dr. Roel Gevaers
Chair of the Committee
UAntwerpen

The Organising Committee wishes to thank the Pharma Logistics Masterclass sponsors sincerely:

Organisers: PHARMA.AERO, University of Antwerp, METRANS Transportation Consortium

Platinum Sponsor: HOPE Consortium

Gold Sponsors: AIRBRIDGECARGO, AirCargoBelgium, brussels airport the heart of Europe

Silver Sponsors: Cold Jet the force of nature, H.ESSERS, DSV

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With the support of: gsk

Program Overview

Tuesday, 7 September – CITY CAMPUS, University of Antwerp

AIR STRATEGIES DAY

Topics to be addressed

- Where is air cargo heading the next decade?
- What can we learn from the industry stakeholders' recent experiences?
- Why industry and academic collaboration drive future strategies for air transport innovation?

PROGRAM

12.00 pm - 01.30 pm
Executive Masterclass pre-meeting
The University Club (by invitation only, kindly offered by Essers Pharma Logistics)

01.00 pm - 01.30 pm
Registration and Light lunch

01.30 pm - 02.30 pm
Welcome address by the Chairs and the Dean of the Faculty

02.00 pm - 03.30 pm
Setting the scene:
"Where is air cargo heading the next decade?"

- **The Data Jet Engine: the daily fuel to industry decision making?**
  (Dr. Sven Buyle, University of Antwerp)
- **A flight to the next generation of Pharma Logistics**
  (Mr. Frank Van Gelder, Co-Chair & Secretary General Pharma.aero)
- **Runways of strategy: the take-off checklist for a future air cargo industry**
  (Prof. dr. Wouter Dewulf, University of Antwerp)

03.30 pm - 04.00 pm
Coffee break

04.00 pm - 05.00 pm
What can we learn from the industry's stakeholders' recent experiences?

- **The airline perspective**
  (Ms. Yulia Celetaria, Healthcare Director Global at Volga-Dnepr Group)
- **The airport perspective**
  (Mr. Bruno Guella, Managing Director at MVD Free Airport)

05.00 pm - 05.45 pm
Panel debate
"Why industry and academic collaboration drive future strategies for air transport innovation?"

- Ms. Jaisey Yip
  (General Manager, Cargo & Logistics Development at Changi Airport Group)
- Dr. Sven Buyle
  (University of Antwerp)
- Mr. Jeroen Janssens
  (Sr. Manager Cold Chain Distribution at GlaxoSmithKline Vaccines)
- Mr. Fabrice Panza
  (Manager Global Cool Chain solutions)
- Moderator: Prof. dr. Wouter Dewulf
  (University of Antwerp)

06.00 pm - 07.00 pm
Bus transfer from University of Antwerp to Mechelen

07.00 pm - 09.30 pm
Workshop "Food for thought"
(Lieven Comeyne, Partner Supply Chain & Operations at Deloitte Belgium)

Dinner and workshop session takes place in a medieval chapel in the historic centre of Mechelen.

Program Overview

Wednesday, 8 September – CAMPUS DRIE EIKEN

THE PHARMA PRODUCTS & ADMINISTERING DAY

Topics to be addressed

- Pharmaceuticals & Vaccines: How are they made? The cooking recipes, the storage and handling conditions. How and why?
- How is the University of Antwerp preparing for the Pharma and vaccine future? A visit to the labs and Vaccinopolis'construction site.
- How is the largest vaccine center of Flanders working? Some insights behind the scenes mainly focussing the storage and handling conditions.

PROGRAM

09.30 am - 10.00 am
Coffee

10.00 am - 11.20 am
Pharmaceuticals & Vaccines: How are they made? The cooking recipes, the storage and handling conditions. How and why? (part 1)
(Prof. dr. Pierre Van Damme)

11.20 am - 11.40 am
Coffee break

11.40 am - 1.00 pm
Pharmaceuticals & Vaccines: How are they made? The cooking recipes, the storage and handling conditions. How and why? (part 2)
(Prof. dr. Pierre Van Damme)

01.00 pm - 02.00 pm
Wrap-up and discussion with participants from Asia-Pacific
light lunch at foyer (Next to building R)

02.00 pm - 03.00 pm
Visit to Vaccinopolis (construction site) & labs
(Prof. dr. Pierre Van Damme)

03.00 pm - 03.20 pm
Coffee break

3.20 pm - 3.45 pm
Bus transfer to Park Spoor Oost

03.45 pm - 05.00 pm
Visit to vaccination Centre Park Spoor Oost
How can a cold chain be guaranteed in the largest vaccination centre of Flanders?
(Prof. dr. Pierre Van Damme)

05.00 pm - 05.30 pm
Bus transfer to Campus Drie Eiken

05.30 pm - 06.30 pm
Light dinner

Program Overview

Thursday, 9 September – CITY CAMPUS

MARITIME FLOWS & HINTERLAND POLICIES DAY

Topics to be addressed

- Pharma and air are clearly linked with each other, but the highest market share for pharma transport by volume is via maritime flows. How does this work?
- Is it mainly inbound or outbound?
- What can we say about the value versus the volume? Is value for air and volume for sea?
- What factors should be taken into account when analyzing the full inbound chain from a cost perspective?
- What can we learn from local hinterland governmental policies? Can someone prepare an urgent pharma or vaccine hinterland network? How to deal with local comunities and how can these be prepared?
- Are areas near coasts or large hubs better suited for quick and agile pharma actions? Learnings from Long Beach

PROGRAM

01.00 pm - 02.00 pm
Light lunch next to Room C003

01.00 pm - 02.00 pm
Wrap-up and discussion with participants from Asia-Pacific

02.00 pm - 03.45 pm
The maritime sector and Pharmaceuticals?

- **Maritime transport and pharmaceuticals: Are a reduced cost and an improved cold chain shipping drivers of sending pharmaceuticals, in the broad sense, via maritime transport?**
  (Prof. dr. Christa Sys, University of Antwerp)
- **Pharmaceuticals on the waves**
  (Mr. Marc Rooms & Mr. Lennert Bosman, Kuehne+Nagel)

03.45 pm - 04.15 pm
Coffee break

04.15 pm - 06.00 pm
Workshop
Logistical costs in supply chains, including pharma.
How to get a full overview of the cost structures of a pharma value chain?
(Prof. dr. Edwin Van Hassel, University of Antwerp)

06.00 pm - 07.00 pm
Light dinner

Dinner and workshop session takes place in a medieval chapel in the historic centre of Mechelen.

07.00 pm - 09.00 pm
Interactive case and panel

- **How are ports and hinterland connected with each other concerning pharma and vaccines?**
- **What can we learn from local hinterland governmental policies? Can someone prepare an urgent pharma or vaccine hinterland network? How to deal with local communities and how can these be prepared?**
- **Are areas near coasts or large hubs better suited for quick and agile pharma actions? Learnings from Long Beach**
- **Vaccines at the beach: The case study of a Covid-19 distribution rollout. How the yearly test against an antrax terrorist attack prepared the Long Beach area for a quick and effective vaccine campaign. A logistics perspective**

Panel:
- *Ms. Gabriela Hurtado (Medical countermeasures coordinator Long Beach)*
- *Mr. Alan Hendrickson (Emergency planner at California Department of Public Health)*
- *Mr. Matthew Franco (Logistics Specialist of City of Long Beach)*
- *Ms. Elisabeth Callens (CEE Reefer Manager DSV)*

Moderation by Prof. dr. Tom O'Brien and Prof. dr. Thierry Vanelslander
- *Moderator: Prof. dr. Wouter Dewulf (University of Antwerp)*

Program Overview

Friday, 10 September – VISITS DAY

Topics to be addressed

- How does a production facility of pharma products and vaccines look like? How important is research?
- How is digitization helping pharma flows?
- What are the dos and don'ts on tarmac concerning pharma products?
- What should be known about the air-site procedures?

PROGRAM

12.30 pm - 13.45 pm
Lunch and networking

01.00 pm - 01.30 pm
Virtual tour GSK and insights in global supply chain strategies
(Ms. Elisabeth Van Damme, Director External Communications, GSK and Jeroen Janssens Senior Manager, Vaccine Distribution & Cold Chain GSK Vaccines)

01.30 pm - 02.00 pm
The Covid-19 distribution and digitalization case at Air Cargo Belgium: project BRUcure Samuel Speltdoorn
Business Development Manager Cargo
Brussels Airport Company

(Nathan De Valck, Head of Cargo Product & Network Development, Brussels Airport Company)

02.00 pm - 04.00 pm
Alternated visits to AirSide Apron 9 Pharma Transporters, Landside Swissport Pharma Hub and Second lane Landside Medexi Pharma Warehouse and distribution

Program Overview

Saturday, 11 September – CITY CAMPUS

LAST MILE & DISTRIBUTION DAY

Topics to be addressed

- How important is the last mile in pharma logistics?
- Is there a difference between rural areas and urban areas related to pharma logistics?
- Some examples of mathematical models to distribute volumes over a pharma network
- What can we say about insourcing versus outsourcing and contract logistics in pharma flows?
- What about privatizing these flows completely? Or should these be organised by governments? Can we learn something from the different vaccine approaches in the USA versus Europe?
- Should the pharma products be brought to the people, or should people come – to a certain extent – to the products? A discussion that is ongoing in the USA
- Are we heading toward fully integrated chains: direct to place of administration, cutting out several pharma intermediaries?
- Wrap up of the full Masterclass

PROGRAM

01.00 pm - 02.00 pm
Wrap-up and discussion with participants from Asia-Pacific

02.00 pm - 02.20 pm
Is the last-mile in pharma logistics also the efficiency and effectivity killer of the whole supply chain? Some thoughts using the vaccination campaigns as a reference point
(Prof. dr. Roel Gevaers, University of Antwerp)

02.20 pm - 02.40 pm
The importance of last mile packaging in pharma logistics.
How to deal with ambient, cooled and frozen pharma products
(Ester Van den Bossche, UPS Healthcare)

02.40 pm - 02.55 pm
Pharmaceutical distribution in urban area: an integrated analysis
(Dr. Alexis Nsamzinshuti, ULB)

02.55 pm - 03.10 pm
Coffee break

03.10 pm - 03.25 pm
How linear programming and advanced analytics can help optimizing pharma and vaccine distribution flows
A best practice example by the Moov Model
(Dr. Annelies De Meyer, VITO)

03.25 pm - 03.40 pm
Insource or outsource? A Framework for the Collaborative Evaluation of Service Outsourcing Contracts in Pharmaceutical Logistics
(Dr. Elena Pessot, Italian National Research Council)

03.40 pm - 04.00 pm
How to distribute high value pharma products and vaccines via the road in Europe?
Some Best Practices
(Mr. Jef Molenaers, Essers)

04.00 pm - 04.15 pm
Coffee break

04.15 pm - 05.30 pm
Interactive panel:
Challenges for pharmaceutical distribution in Europe and the USA: Balancing markets and equity – Mobility versus Logistics

- Prof. dr. Neeraj (Vice dean for Sood, Faculty Affairs and Research at USC Sol Price School of Public Policy)
- Dr. Abigail Cochran (Postdoctoral Research Associate at University of North Carolina at Chapel Hill)
- Moderation by Prof. dr. Tom O'Brien and Prof. dr. Roel Gevaers

05.30 pm - 06.30 pm
Light dinner

06.30 pm - 07.30 pm
Panel discussion and Masterclass wrap-up by chair

- Panel discussion
- Keynote
- Masterclass wrap-up by Chair

07.30 pm
Network reception

Air Strategies Day
Main Takeaways

Learning Objectives

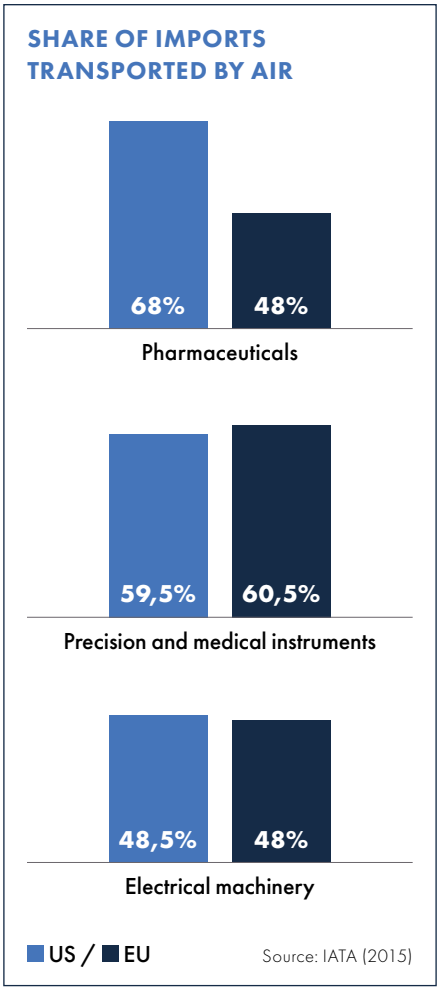
1. Where is air cargo heading in the next decade?
2. What can we learn from the industry stakeholders' recent experiences?

Summary of the presentations

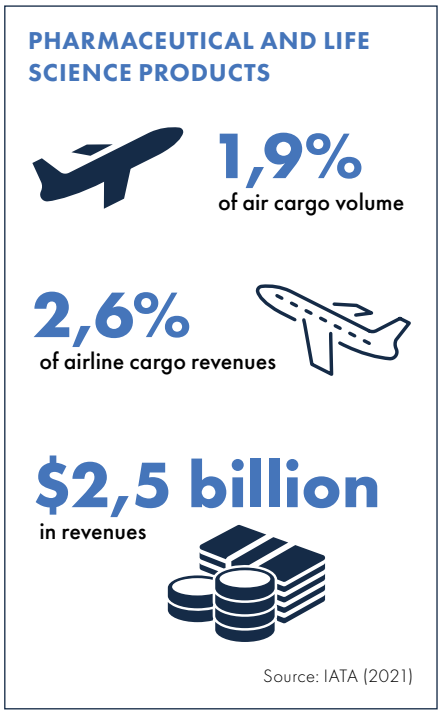
1. Setting the scene: Where is air cargo heading the next decade?

Most world trade volumes are transported via maritime transport, while only about 1% is transported by air (Boeing, 2021). However, when looking at the value of the goods, a different picture shows up. In value, air transport accounted for 25,6% of the EU's exports and 21,1% of its imports in 2020, compared with a share of 0,6% and 0,3% of the exported and imported volumes (Eurostat, 2021). Air transport plays a vital role in terms of the transport of pharmaceuticals and life science products. About 35% of all pharmaceuticals imported by the EU and 65% of those imported by the USA are transported by air (IATA, 2015). Those products account for 1,9% of all air cargo volumes, contributing a 2,5 billion USD in revenues for airlines which represents 2,6% of airline cargo revenues (IATA, 2021).

The primary air cargo flows happen in the Northern hemisphere. 27% of the air cargo ton kilometres produced in 2020 were realised between Asia and North America, 21% between Asia and Europe and 12% between Europe and North America. The traffic flows between other regions in the world are much smaller. (IATA, 2021) Also, most of the pharmaceutical products produced worldwide in 2019 were sold in the Northern hemisphere (49% in North America and 23% in Europe) (EFPIA, 2020).



Like all transport sectors, the air cargo sector was primarily impacted by the lockdowns following the Covid-19 pandemic. The lockdowns led to unprecedented growth in e-commerce and next-day deliveries. At the same time, there was a high demand coming from the pharmaceutical industry to deliver time-sensitive medical supplies. The demand, measured in cargo ton-kilometers, showed a fast V-shaped recovery as fast and reliable transport was much needed.



However, on the supply side, the available cargo ton-kilometers are still below the pre-crisis levels. (IATA, 2021) This phenomenon can be explained as a large part of the cargo volumes are transported in the belly of long-haul passenger aircraft. The demand for (intercontinental) passenger traffic did not recover at the same speed as the demand for air cargo. Consequently, air cargo rates and revenues skyrocketed (IATA, 2021). Where full freighter operations were considered a niche before the pandemic, those operations boomed. Air cargo became a lifeline for many airlines and airports. More airports and airlines will start to understand the strategic value of air cargo resulting in more symbiosis between home carriers and their hub airport's cargo strategy. Digitalisation will help to make the industry more efficient and transparent, while horizontal and vertical integration will be on everyone's agendas. Many new business opportunities are waiting for airlines and airports to levy on their available data to increase their revenues from air cargo. Academics can assist the

HOPE Consortium

PLATINUM SPONSOR

Collaboration to get vaccine to the right place, at the right time and in the right condition

— the Hope Consortium case study

From the outset, Covid-19 global pandemic has presented many challenges that many people, system and communities have not faced before in its lifetime. This global pandemic has gone beyond being just a healthcare challenge to become an economic, financial, political and societal one. It has been described and will continue to be one of the biggest events that affected people's lives in our life time. One of the challenges that presented itself early in the pandemic, and while scientists globally have been working on developing the various vaccines and therapeutics that the world successfully produced within a record time, is the increased demand it put on the global supply chain in terms of capacity needed, new ways of working as well as new technologies requirement to deliver these vaccines, therapeutics and PPE to the right places around the world, at the right time and most importantly in the right specialised condition in a high reliability fashion.

In the second half of 2021 and as the world is seeing the effect of vaccination efforts happening globally and the green short of economic activities recovery, it is becoming evident that global supply chain capacity is coming under pressure. This is also compounded by the traditional ways the supply chain has been designed, where business specialisation and boundaries exist along the different steps involved in the supply chain to deliver in a high reliable way, especially when vaccines (which is one of most in demand goods today that need highly specialised processes, equipment and need to be handled in the most specialised way) is now needing an added new technologies to get the vaccines to where it's in demand in the most remote areas and across the world.

Abu Dhabi Department of health, through its role as the guardian of health for the population it serves, realised that a robust and high reliable supply chain will be needed to deliver vaccine procured to the smallest clinics and mobile clinic where vaccination campaign are being undertaken. Through its early engagement with vaccine developers within a few months of the start of the pandemic, an added challenge was presented which is the new temperature bands that the new vaccine platform require, being -80, -20 and the traditional 2-8. A team was set to establish an end-to-end supply chain that enable an effective vaccination programme once this happen. Abu Dhabi Department of Health spearheaded the creation of the global "HOPE Consortium", with the main aim of providing one stop shop to provide the best-in-class solutions globally to transport, store and deliver vaccines irrespective of temp and location needs around the world.

The partners that signed to be funders of the HOPE Consortium included Etihad Cargo, Rafed, Skycell, Maqta Gateway and AD Ports.

Etihad Cargo is the first IATA CEIV Pharma Certified airline in the Middle East. Etihad Cargo plays a major role of providing worldwide connectivity and crucial airlift to facilitate the distribution of vaccines. They currently operate across more than 1,100 IATA CEIV Pharma/ GDP certified trade lanes across their global network which ensure the integrity of products during transportation. Etihad Cargo also has leveraged pharma interline agreements to further expand its network across the African continent to reach regional destinations to support rural communities in the fight against COVID-19. Finally, Etihad Cargo secured approval to expand dry ice carrying capabilities, which further supports their capacity to carry vaccines with deep frozen temperature requirements

Rafed, the biggest GPO (Group Purchasing organisation) in UAE with experience spanning over 20 years in the region; providing procurement know how, Pharma industry relationship holders. Rafed provides economy of scale cold storage solution and cutting-edge inventory system that are significantly beneficial to the healthcare sector. By centralizing healthcare procurement services, applying industry best practice and harnessing technology, Rafed's unique operating model, in addition to the state-of-the-art facility with cold storage solutions, has delivered economies of scale, efficiency and more competitive pricing in addition to the delivery of vaccines, pharmaceuticals and medical equipment.

Skycell, the swiss based cold and ultra-cold packaging and container solution that provide the lowest temp failure rate and the longest passive temp range, supported by IoT monitoring.

Abu Dhabi Ports and Airports that have a local and global reach and one of the largest all-temp-bands storage facilities regionally and one of the largest globally.

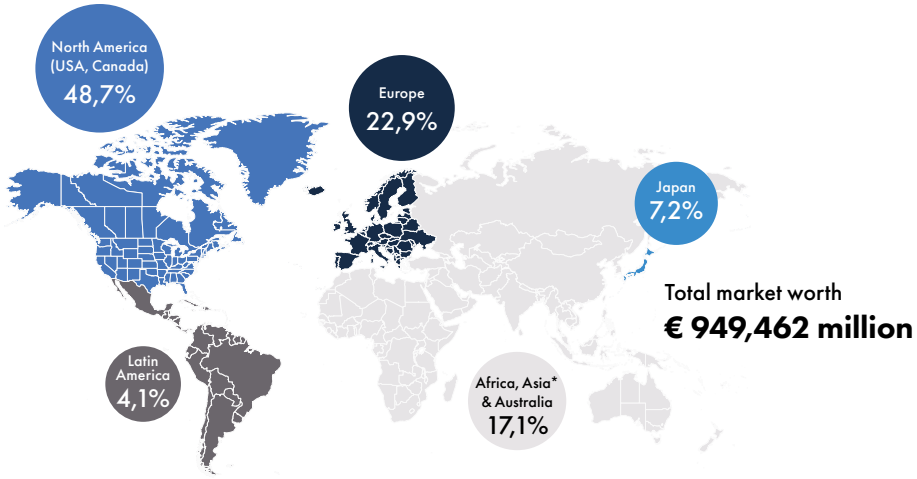
All supported by Maqta Gateway, who deployed and customised a vaccine tracking solution called "mUnity", the new solution is enabling all stakeholder to have liver information of the location of any vaccine consignment, its temperature and size using IoT and Blockchain technology.

Through working collaboratively and in onboarding another 14 partners to date from multinational freight forwarder like DHL, Agility-DSV, UPS, Aramex, Kuehne-Nagel to vaccination programme service provide like Via medical; Hope Consortium has been able and within 18 months of its inception to deliver over 180 million vaccine doses to over 65 destination around the world. At the writing of this, the HOPE Consortium have the annual capacity to transport, store and distribute over 9 billion doses of vaccine across all main three temperature ranges required. Plans area ready in place to multiply this capacity by three times by end of next year, to serve the Abu Dhabi vision of becoming a life science logistical and manufacturing hub regionally.

Two of the key lessons learnt from this pandemic are; first that the world is big and small at the same time, in a sense we are small in terms of connectedness where it took a contagion to travel the majority of our world irrespective of borders and kilometres within 2 months, hence no-one will be able to say that they are safe, until everyone if safe. The second lessons, is that to achieve effective response to this pandemic and especially from a supply chain point of view, collaboration is key, collaboration needs to transcend public and private or national and international labels; processes need to be designed according to needs and not according to existing boundaries of specific steps ownership. This need to be done in the spirit that getting what is needed to where it is needed in the most reliable way is now literally becoming a life and death matter.

This is precisely why we decided to sign up and engage with the first Pharma Logistics Masterclass being held at the University of Antwerp in September 2021, so we can continuously learn and share best practices to be prepared for coming challenging years.

THE WORLD PHARMACEUTICAL MARKET (2019 SALES)



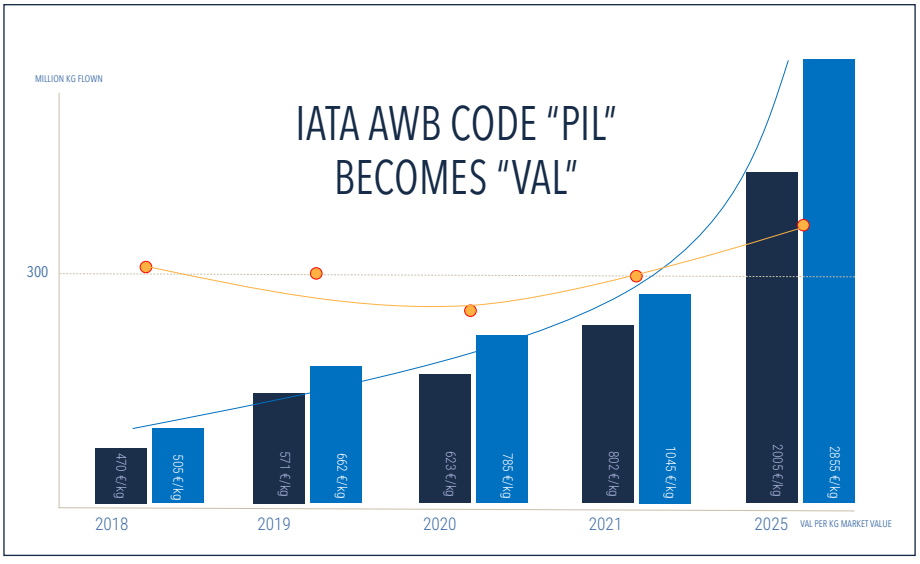
*Excluding Japan

Source: IATA (2021)

industry in assessing whether the pre-crisis parameters, hypotheses, and models will continue to hold in the post-corona era.

When looking at the trends in the Life Science industry, we can expect a breakthrough in individualised medicine in the coming years. The next generation of healthcare will be accessible for everyone and more patient-oriented, personalised, and heavily data-driven. By 2030, individualised medicine and gene therapy are expected to be the primar method of care for most major diseases such as cancer, diabetes, and heart diseases. Artificial intelligence-driven clinical research will become the new standard for research. Further optimisation of production processes and supply chains will become possible thanks to data availability and big data modelling.

The individualisation of medicine has significant consequences on pharma supply chains. While the EU, USA, Canada, and Asia Pacific are likely to remain responsible for 90% of all Research and Development activities, production will become much more decentralised. At the same time, the volumes transported will change from large bulk to smaller dedicated volumes. Supplier-to-customer end-to-end supply chains with optimised lead times will become the new standard. These changes will have a disruptive impact on the current airfreight industry.



During the current Covid-19 disruption, the airfreight industry demonstrated that it could stand disruption. Despite the global capacity paralysis, flexible and reliable transport solutions were developed in times of a global crisis. Due to increased collaboration over the air transport value chain, the airfreight industry could adapt to the new normal.

The corona pandemic, in a way, proved to be a rehearsal for what is coming. The future airfreight industry should match the ambition of the future health care industry. The new airfreight company should focus on mapping, analysis, and sharing of different operational data, physical internet and Artificial Intelligence technologies, operational analytics training with highly qualified IT & data scientists, and developing a data mindset within all layers of the company. Collaboration over the supply chain will become even more critical in the future. Pharmaceuticals are the only product where air cargo players can add value.

The IATA code for pharmaceuticals (PIL) might transform symbolically into the code for valuables (VAL). Being able to offer a sustainable, reliable, and fully traceable service will be essential embedding the future life science industry's vision.

2. What can we learn from the industry stakeholders' recent experiences?

While the past months have been a rehearsal for what has to come, the existing bottlenecks which might cause additional hurdles have also become visible. Crew availability for a stable operation seemed to be a challenge in a world of travel restrictions. Also, the availability of dedicated equipment, materials, and resources needed for pharma logistics has formed a bottleneck during the heat of the pandemic.

The airports close to the demand for specialised pharmaceuticals are sometimes located in very remote areas and often poorly equipped to handle pharmaceuticals. There is also a lack of experienced specialists available over the value chain.

STRATEGY THINKING IN THE AIR CARGO INDUSTRY

Pre-Corona	Post-Corona
1. Air cargo growth < PAX growth	Valid
2. Overcapacity is looming on most trade lanes	5 years
3. Freighters might become a niche in an ocean of belly capacity	3 years
4. Forwarders are the kingmakers	Not valid
5. Large pax airports are 'cargo friendly'	Not valid
6. Airport communities, digitization and transparency are key	Valid
7. Pharma, perishables and E-commerce are the products to focus on	Valid
8. Hardly any vertical or horizontal integration in the market structure	3 years

2020 had brought the concept of collaboration to a new level when all the stakeholders stepped away from 'words' to actual actions.

TYPOLOGY OF AIRLINE CARGO STRATEGIES — PRE-COVID-19

Wide Body operators	Premium Cargo Operators	Strong Regionals	Basic Cargo Operators	Cargo Stars	US Giants	Carpet Sellers	Mega hub Carrier
Aeroflot	Air Canada	Asiana Airlines	Air China	China Eastern	American Airlines	Aegean Airlines	Emirates
Etihad Airways	ANA	Cargolux	Cathay Pacific	China Southern	Delta Airlines	Aerolineas Argentinas	
Hainan Airlines	British Airways	China Airlines	Korean Air	Lufthansa	United Airlines	Aeromexico	
Iberia	Japan Airlines		Qatar Airways			Air Europa	
AF-KLM			Turkish Airlines			Air New Zealand	
Qantas Airways						Austrian Airlines	
Singapore Airlines						Avianca	
Thai Airways						Brussels Airlines	
Virgin Atlantic						Copa Airlines	
						Croatian Airlines	

FOUR STRATEGIC TAKEAWAYS

1 More airports and airlines will understand the strategic value of air cargo

- More symbiosis between home carrier and hub airport's cargo strategy
- New players got the taste of air cargo and will be accommodated by airports

2 Belly space capacity will most likely take-over again in 3 to 5 years

- Pricing goes back to 'normal' in 2 to 3 years, and decrease further beyond

3 Digitization will help to make the industry more efficient and transparent

- Forwarder's power got a hit
- Horizontal and vertical integration will be on the board's agendas

4 Pharmaceuticals are the only product where air cargo players can add value

- PIL becomes VAL
- A sustainable, reliable, fully traceable product will be key

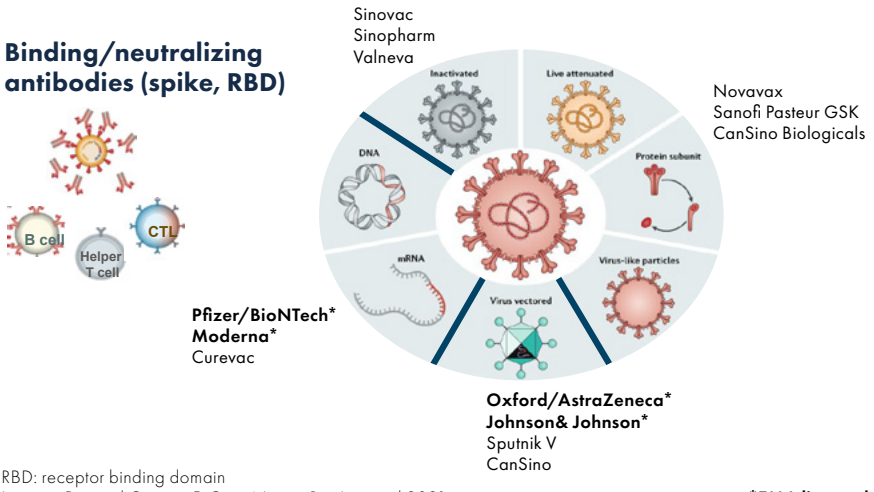
Pharma Products & Administering

Main Takeaways

Learning Objectives

1. Pharmaceuticals & Vaccines: How are they made? The cooking recipes, the storage and handling conditions. How and why?
2. How is the University of Antwerp preparing for the pharma and vaccine future: a visit to the labs and vaccinopolis (under construction)
3. How is the largest vaccine centre of Flanders working? Some insights behind the scenes mainly focusing on the storage and handling conditions
4. How is the US Supply Chain organised?

7 DIFFERENT STRATEGIES TO INDUCE SARS-CoV-2 SPECIFIC IMMUNITY



RBD: receptor binding domain
Lianpan Dai and George F. Gao. Nature Rev Immunol 2021

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Summary of the presentations

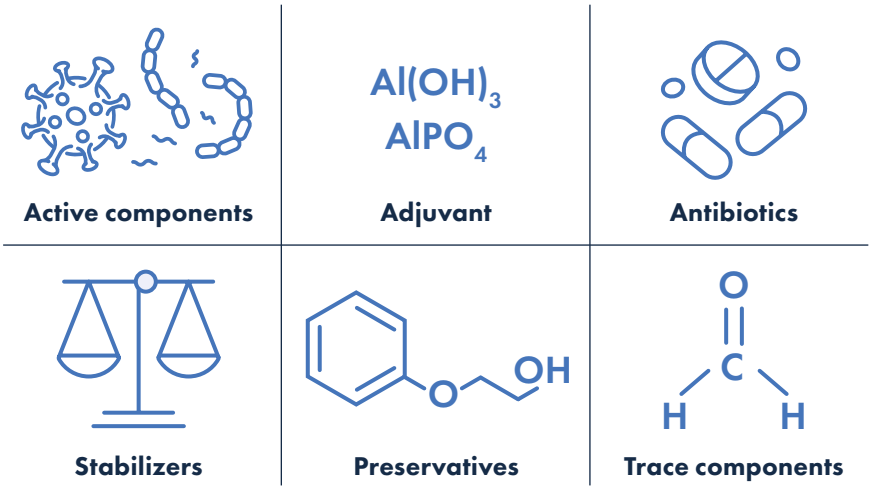
1. Vaccines: how are they made? Composition, production, storage and handling conditions

The vaccine manufacturing and handling process is presented from a chronological context by Professor Pierre Van Damme, from milestones in vaccinology to handling the complexity of vaccine production. Some reports refer to vaccination from the 7th century, where 'protection against' snake venom was sought by drinking the same venom. Later, from the 16th century, alternative forms of inoculation appeared to prevent diseases of the time such as "smallpox". At the same time that vaccination approaches appeared, there were also anti-vaccine movements, such as in France and the United Kingdom. The term vaccine/vaccination arises from the word vacca (cow) due to Jenner, MD in Berkeley's (1798) observations on the possibility of cow pox to protect the human constitution from smallpox infection.

Vaccination can be passive or active. In the first case, vaccination only offers antibodies without active intervention of human's immune system. The antibodies can be synthetic or of human or animal origin.

In the case of active vaccination, the patient's immune system is expected to respond by itself 'sometimes' with the help of adjuvants. Generally, the active component in vaccines is derived from the pathogen that causes the disease. The rest of the components are stabilisers, adjuvants and preservatives. As a result of the production process, it is possible to find residues such as trace of antibiotics.

COMMON COMPONENTS OF VACCINES



The vaccination process usually consists of 5 steps.

Step 1: Generation of the antigen, it can be viruses, bacteria or recombinant proteins

Step 2: Release and isolation of the antigen

Step 3: Purification of the antigen

Step 4: Formulation of the vaccine i.e. combining all components and uniformly mixing them

Step 5: packaging

The average duration of this process is between 4 and 7 years. In the case of the Covid-19 vaccine, the development time is between 12 and 18 months. On average, a vaccine can undergo up to 300 quality control tests during its manufacturing process, representing about 70% of the production time.

- Vaccines are complex for several reasons.
- A vaccine can be made up of multiple sub-components.
- Vaccines may contain separate components that require mixing and/or reconstitution prior to use.
- Vaccines require specific and highly controlled facilities.
- Vaccine storage is usually between 2 and 8 degrees Celsius.

If the cold chain breaks, the antigens and adjuvants could be disconnected or produce changes in the three-dimensional structure of the antigen.

TRADITIONAL VACCINE MANUFACTURING PROCESS

Step 1
Generation of the antigen
- Viruses: on cell cultures
- Bacteria: in biofermentors
- Recombinant proteins: yeast, cell cultures, bacteria

Step 2
Release and isolation of the antigen

Step 3
Purification of the antigen

Step 4
Formulation of the vaccine
i.e. combining all components and uniformly mixing them

Step 5
Packaging

CHALLENGES FOR VACCINE DEVELOPMENT

Pathogens or diseases:
Malaria, HIV, tuberculosis, CMV, dengue, RSV, HCV, ...

Challenging populations:
Hard-to-reach individuals, infants, pregnant women, older adults, immunocompromised persons, ...

Challenging circumstances:
Emerging infections, epidemics, pandemics (MERS, Ebola, Lassa, avian influenza, coronavirus,..), therapeutic vaccination

Strategies to overcome these challenges

New antigens

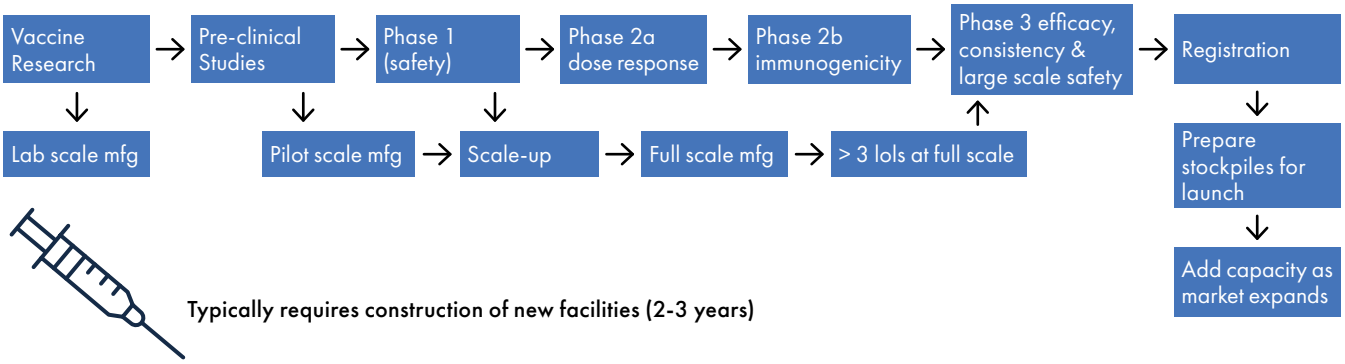
New antigen presentation
(e.g. DNA, mRNA)

New delivery strategies
(e.g. live vectors)

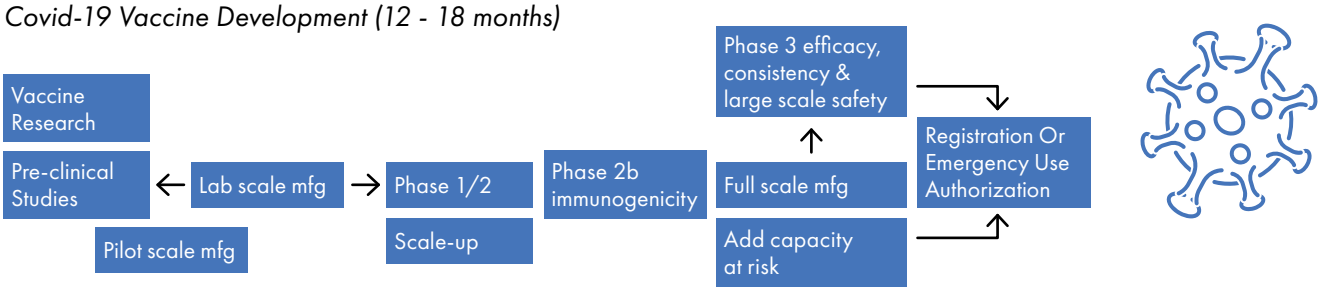
New adjuvants

COVID-19 MANUFACTURING IN FAST FORWARD

Typical Vaccine Development Process & Timing (4 - 7 years on average)



Covid-19 Vaccine Development (12 - 18 months)



Astral Aviation is a licensed cargo airline that acquired its Air Operators Certificate (AoC) and Air Service License (ASL) from the Kenya Civil Aviation Authority in 2001, and was subsequently designated as a cargo airline, by the Ministry of Transport of the Republic of Kenya in November 2006. Flying the blue skies of Africa for 22 years, Astral Aviation provides reliable and cost-effective airfreight solutions using a combination of schedule and charter flights within its Intra-African, Middle East, Asian and European Network.

CARGO SERVICE CENTER

Cargo Service Center, India is a premier Air Cargo handling company established in India offering customized Air Cargo Services to globally renowned international and domestic airlines. MCSC Cold Chain Solutions at Mumbai operates the Pharma Excellence Center, India's largest airport-based export pharma facility which is IATA CEIV and GDP certified and provides real-time capture of pharma cargo temperature to end-users.

2. Site visits

Vaccinopolis
A visit guided by prof. Van Damme to the construction site of the new vaccinopolis shows the potential for future vaccine assessment. Vaccinopolis is an initiative of the University of Antwerp, that is partly supported by the Belgian Federal Government. With an area of 6000 m^2, Vaccinopolis is a state-of-the-art clinical facility, with consultation rooms to perform out-patient clinical trials, BSL2 and BSL3 laboratories, and a 30-bed quarantine unit.

3. Site visits

Flanders vaccination village: Flanders' largest vaccination centre for Covid-19 vaccines is located in Antwerp Spoor Oost, and has a systematic vaccination process that lasts no more than 20 minutes. During the visit, the director of the vaccination centre dr. Jan Stroobants, presented the strategic design of the vaccination centre so that the flow of people is continuous and uninterrupted. One of the efficiency keys of the centre is the review of the requirements to be vaccinated in multiple stations throughout the process. The layout of the vaccination station is precise so that vaccinators do not have contact with the flow of patients, but rather have an internal corridor for their free movement. Storage is carried out in a controlled manner in an isolated area and with qualified personnel for handling, from dosing to preparing the kit for each vaccinator.

4. The state of the US Supply Chain's Impact on Pharma products and logistics

From a maritime point of view, the supply chain network in southern California is the principal gateway for about 40% of the United States trade, which means that challenges in this region are challenges for the whole country. The context before the Covid-19 pandemic was defined by the US and China trade war, with volatility in supply and demand and US exports heavily impacted. Additionally, global trade trends about larger vessels and shifting trade lanes impact how logistics and supply chains work. After supply shock in early 2020, China's shutdown and slow return to full production capacity caused US importers to panic and "front-load" their purchases on Chinese vendors. Also, bottlenecks show up at key points in the infrastructure like port terminals, drayage operations, freight corridors, and warehousing facilities.

The increase of e-commerce and online demand created a crisis for US logistics operations. Data from September 2021 about the entry/exit into the southern California port complex showed that all regular and contingency anchorages were full, occupied mainly for container ships. This situation affects transport prices and the availability of services to freight, especially regarding truck drivers shortages.

Main Takeaways (reference to Learning Objectives)

1. There is a need for harmonisation of testing strategies, methods and specifications, and vaccine packs between EU and non-EU countries. Standard labeling on vaccine containers and paper leaflets should be replaced by e-leaflet or QR-codes. Better demand management is necessary for vaccine manufacturing, with dialogue between manufacturers and health authorities and adapted procurement practices.

2. Lessons learned about the management of vaccination processes are essential in planning collective health interventions and the development of capacities in terms of technologies and infrastructure for the study of vaccines and pharma products.

3. The collapse of logistics operations in other contexts is a call to strengthen capacities in terms of infrastructure for airports.

Maritime Flows & Hinterland Policies

Main Takeaways

Learning Objectives

1. Pharma and air are clearly linked, but the highest market share for pharma transport by volume is via maritime flows. How does this work?
2. Is it mainly inbound or outbound?
3. What can we say about the value versus the volume? Is value for air and volume for the sea?
4. What factors should be considered when analysing the full inbound chain from a cost perspective?
5. What can we learn from local hinterland governmental policies? Can someone prepare an urgent pharma or vaccine hinterland network? How to deal with local communities, and how can these be prepared?
6. Are areas near coasts or large hubs better suited for quick and agile pharma actions? Learnings from Long Beach
7. What is the link between pharma and maritime flows: Long Beach learnings versus Antwerp?

Summary of the presentations

1. Maritime Transport of Pharmaceuticals

Recognised companies such as AstraZeneca have proposed a change in international shipments from air to sea, with a goal of 70% in 2017 (qCaptain, 2015). The discussion on the transport shift between air and maritime focuses on certain essential elements: the control of the cargo temperature, the use of standard containers versus reefers, the transport capacity and the market. From a global perspective, maritime transport has considerably increased transport volume, doubling the amount in the last 20 years (UNCTAD, 2019).

The shipping is, mainly, composed of three segments:

- tramping with tankers and bulks, mainly dominated by China Cosco;
- liner shipping with containers and companies such as Maersk Line or MSC, and RoRo and OCC;
- PAX segments concentrated on cruises.

As an indicator of shipments, in the world, there are between 5,000 and 10,000 cellular containers ships (Sys & Vanelslander, 2020). There are currently nearly 55.000 merchant ships that sail worldwide, and this is also a gross tonnage indicator.

WHY IS THE OCEAN SHIPPING SHARE INCREASING?

Cost competiveness

- up to 80 percent less expensive than air transport

Container equipment

Control

Environmental

- ocean freight offers significant opportunities in reducing carbon footprint

Temperature excursions

According to the International Air Transport Association (IATA), air cargo share of global pharma transport declined from 17% in 2000 to 11% in 2013. In 2018, 0.5 million tonnes of pharmaceutical goods were flown while 3.5 million tonnes were shipped.

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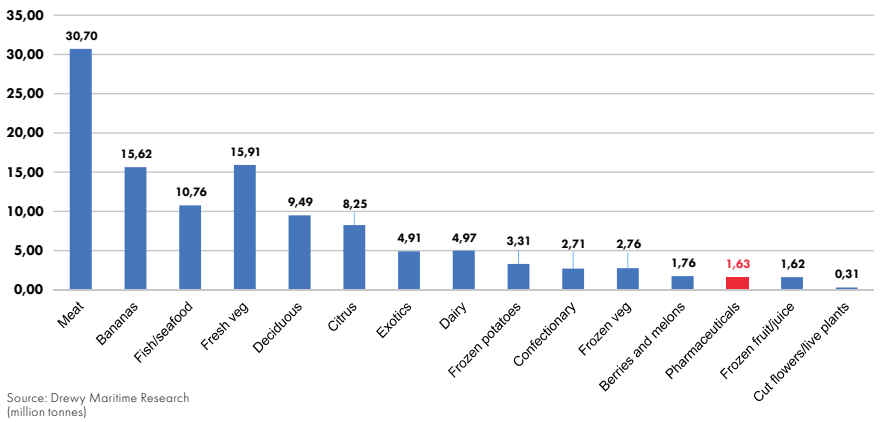
MARKET SIZE TEMPERATURE CONTROLLED



Source: Drewy Maritime Research (million tonnes)

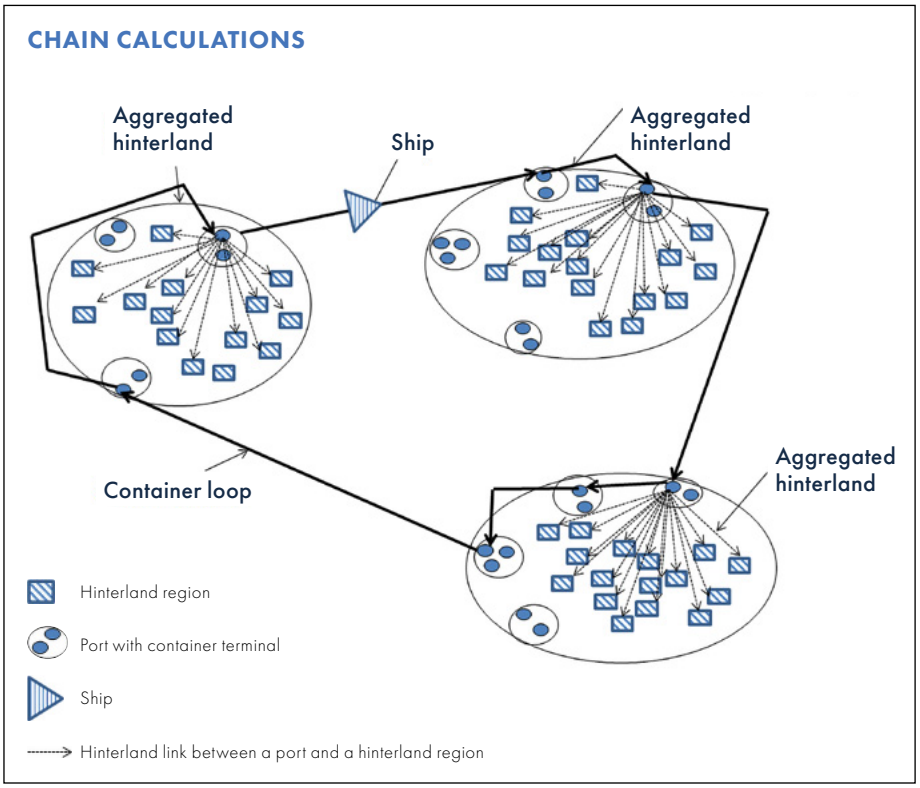
The competitive cost predominates among the reasons for transporting pharma products by sea instead of air. Maritime transport can be up to 80% less expensive than air transport. The equipment in the containers has improved, and together with the digitisation it is possible to monitor the cargo at all times. In addition, the reduction in the carbon footprint and the mitigation of incidents of temperature excursions.

The shipping of pharma products has advantages and disadvantages. First, cold chain management has progressively improved while increasing safety, low costs and better environmental results. The disadvantages are concentrated in the long periods and the size of the parcels. Finally, maritime transport has a series of operational needs for its good performance. A global network with local knowledge, standardised systems and processes, sub-collection evaluation with carriers, terminals and truckers, lane risk evaluation, risk mitigation, among others, is crucial

2. Logistics cost in supply chains: An overview. What about the cost in the Maritime Supply chain?

A model capable of representing the maritime supply chain allows it to determine the competitive power of a port (or set of ports) in a complete logistic chain. The model is also capable of designing and of analyzingof different network options of a container loop. In the network also the ports and hinterlands are included.

In order to calculate the total chain, three main "building blocks" are used in the model: a ship -model, a port sub model, and a hinterlandsub-model. A database of 25 different container ships has been constructed based on data from Significant ships (range 700 TEU until 20.000 TEU). The model receives inputs technical data like length, beam design speed; operational data like payload of the ship; and cost data about running, voyage, fixed costs and external costs.



With the described cost model, it is possible to calculate the generalised cost of different chains. A case study is presented from Sao Carlos Brazil to Duisburg in Germany. The selected container loop: CMA CGM for South America and Fr. North Eur. Plate Sling (11.000 TEU vessel). Results show that 33% of the total chain cost are born by the hinterland cost (26% are born in Europe and 7% in Brazil), and 5,5% of the total chain time is at the hinterland part of the chain (4,5% in Europe and 1% in Brazil). The hinterland transport is the cost breakdown of the supply chain. Tree modes are present for the hinterland segment: road (72.06%), rail (2.55%) and IWT (25.39).

Main Takeaways (reference to Learning Objectives)

1. The attention in the transport shift from air to sea is presented in the outbound flow, where temperature control challenges are accentuated. Maritime transport plays a vital role in the long term.
2. International collaboration and a resilient, multi-modal maritime andair ecosystem are needed.
3. Some crucial points to consider in transporting pharma products are market speed, equipment availability, temperature control and visibility.
4. Models show Showed an overview of the maritime supply chain with the main components. Application with multi-modal transport shows the difference between costs and prices and reveals the supply chain's crucial points.

Pharma Logistics Masterclass at Brussels Airport – 10th September 2021

Presenting GSK Facilities Wavre and Brussels Airport, the preferred pharmaceutical hub of Europe.

GlaxoSmithKline Wavre

GlaxoSmithKline, a world leading company in global vaccines production, started the day by sharing a virtual tour over the Belgian production facilities. Ms Elisabeth Van Damme (Director External Communications GSK) and Jeroen Janssens (Senior Manager Vaccince distribution and Cold Chain GSK), gave a detailed insight in the different aspects of producing vaccines. The day started with a great presentation from GSK at the Van der Valk hotel at Brussels Airport, followed by an introductory session on the pharma strategy of Brussels Airport itself. Due to the Covid-19 pandemic situation, the control tower and planning of their current supply chains were presented in a detailed overview. Looking at the future of vaccine airfreight supply chain, GSK will likely switch vast quantities of their current airfreight to seafreight over the next 3 years. It is interesting to see how certain pitfalls in their current airfreight supply chain quality in combination with a true sustainability change management drives an innovative company as GSK to new and different production processes increasing product viability and stability. Their so called "Lyophilized Vaccine Cakes" developed and supported by different research papers underlines the adaption of the basic manufacturing model to lyophilization of the vaccine with higher robustness toward temperature excursions and longer stability periods. It also directly impacts supply chain planning and potential waste.

Brussels Airport

With its prime location in Europe, surrounded by a large cluster of pharmaceutical R&D and manufacturing, Brussels Airport has been investing in its pharmaceutical infrastructure for the past decade. Currently, the airport features 35.000 m² of dedicated pharmaceutical temperature-controlled warehousing spread across 19 different pharma-hubs, all of them GDP or CEIV compliant. The airport is the birthplace of CEIV pharma and has the largest concentration of CEIV companies in the world. Digital processes are developed to improve the pharma supply chain at the airport, whilst directly working together with the pharmaceutical shippers to continue its innovative role in the industry.

Site tour of landside and airside pharma processes at Brussels Airport

To continue the day, two electric busses from Brussels Airport transported the audience in two groups to two different pharma stakeholders located at the dedicated cargo area of Brussels Airport. One being a global cargo handling company, the other an independent pharma logistics specialist.

VLAAMS-BRABANT

with the appreciated support of Provincie Vlaams Brabant

Landside – Swissport Pharma Center

With its 3.620 m² of temperature-controlled warehousing dedicated for pharmaceuticals, the Swissport Pharma Center is one of the 19 pharmahubs located at Brussels Airport, claiming roughly 10% of the total of 35.000 m² dedicated pharmaceutical temperature-controlled warehousing at Brussels Airport. The Pharma Center went into operation in 2019 and is CEIV Pharma certified. Swissport staff explained the audience the entire handling process from point of pharma acceptance to leaving the facility towards the aircraft.

Landside – Medexi

Whilst one group was visiting Swissport, the other group had the chance to visit Medexi, an independent pharma logistics specialist at Brussels Airport. Medexi specializes in advanced packaging such as Va-Q-Tec, dry ice solutions, phase changing material and other passive packaging solutions, pharma storage capacity, and operational support for pharma distribution.

Airside – Apron 9 and the Airside Pharma Transporters

Once a better understanding of the landside pharma processes at Brussels Airport was achieved, the visit continued to the dedicated cargo aprons of the airport. The group observed the loading of a vaccine flight towards Japan, carrying an entire lower deck of mRNA Covid-19 vaccines. To complement the showcase of the airside pharma processes, a visit to the fleet of Airside Pharma Transporters was made. These active units maintain the required PIL temperature during transport at airside.

Company Visits
Main Takeaways

Learning Objectives

1. How does a production facility of pharma products and vaccines look like? How important is research?
2. How is digitisation helping pharma flows?
3. What are the do's and don'ts on tarmac concerning pharma products?
4. What should be known about the air-side procedures?

Key Lessons Learned

1. Pharmaceutical companies continiously evaluate the supply chain and the risk of transport involved in it. We learned that production processes are evaluated and changed in order to provide a more robust and resilient supply chain with lower risk on instability of the product

2. Brussels Airport company is the European prefered gateway for pharmaceutical transport. They are a leading innvovative airport using digitalisation as an enabler for end-to-end visibility and transparency of the pharma supply chain. With the pharma dashboard and digital applications of the BruCloud, the airport plays a leading role in enabling digital solutions for pharma supply chains.

3. The tarmac transport from and to the warehouse and aircraft is the most critical element in the multi-stakeholder supply chain of pharmaceuticals. The airport community approach bringing all stakeholders together is important to map and identify critical aspects of the tarmac pharma logistics operations.

4. Communication, process mapping, CEIV certification, planning and supportive measures such as the pharma dollies and digital applications are important enabler to minimize any risk of delays and temperature excursions tarmac side.

SILVER SPONSORS

The Last-mile & Distribution

Main Takeaways

Learning Objectives

1. How important is the last-mile in pharma logistics?
2. Is there a difference between rural and urban areas related to pharma logistics?
3. Some examples of mathematical models to distribute volumes over a pharma network
4. What can we say about insourcing versus outsourcing and contract logistics in pharma flows?
5. What about privatising these flows completely? Or should these be organised by governments? Can we learn from the different vaccine approaches in the USA versus Europe?
6. Should the pharma products be brought to the people, or should people come – to a certain extent – to the products? This is an ongoing discussion in the USA
7. Are we heading toward fully integrated chains: direct to the place of administration, cutting out several pharma intermediaries?
8. Wrap up of the complete Masterclass

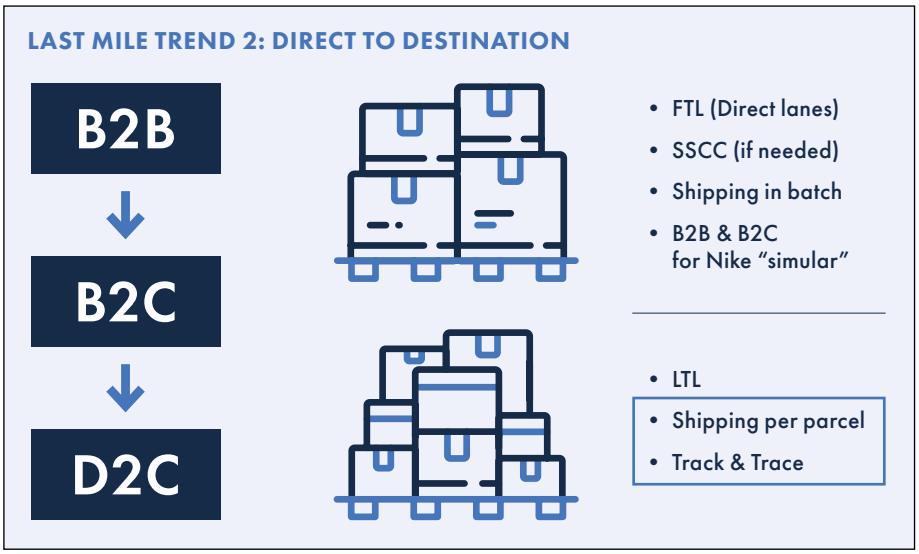
Summary of the presentations

As in several supply chain-related industries, the last-mile is one of the most critical and most complex parts. It lies after the primary hubs (on average well temperature-controlled air or maritime flows), where follow up, and tracking become more challenging (mainly in third world countries) and the efficiency losses in the last-mile. During the Last-mile & Distribution day, the academic and business presentations focused on general thoughts and innovations, temperature control and packaging in the last-mile, pharma distribution to pharmacists, and the competition between public and private pharma logistics. In the following paragraphs, the main conclusions will be summarised.

During the general overview, Prof. dr. Roel Gevaers stated that the last-mile of a pharma logistics supply chain could learn some practices from the eCommerce-driven last-mile chain. Pharma is a much higher profit generator overall, which makes the last-mile cost potentially less important than the last-mile in eCommerce driven last-mile chain. However, this also implies potentially less focus on efficiency and effectiveness. Prof. Gevaers also indicated that an increasing number of traditional (local) last-mile parcel players are investing and integrating more pharma last-mile business units into the existing (eCom) parcel business.

Next to that is another learning that in the eCommerce flows, a clear trend of direct to consumer flows has been visible for the last few years, by cutting out the middle man. For example, Nike Corporation ships its online ordered shoes (direct to consumer) straight from the Laakdal (Belgium) distribution to EMEA zone (Europe, Middle East and Africa), without any intermediary. This supply chain principle is also expected to be increasingly present in the pharma industries. A perfect example of this principle is the shipment strategy of Pfizer for the Pfizer-BioNtech vaccines: being shipped straight from the factory (with full track-and-trace) via transportation companies as Essers and integrators (Fedex, UPS, DHL) to the indicated location of the customer (in this case, country warehouses).

This brings us to the point of (cooled) packaging and tracking & tracing. Ester Van Den Bossche indicated that proper packaging is a key enabler for "direct to destination" shipments, as in pharma product quality is vital. The main temperature groups are indicated below. Each pharma product is placed into one of these temperature groups of zones.



Temperate	Controlled Room Temperature CRT	Cold	Frozen	Deep Frozen
+2°C to +25°C	+15°C to +25°C	+2°C to +8°C	-15°C to -25°C	Up to -79°C Dry Ice

Active cooling and passive cooling are the two methods to keep the pharma products safe between the temperature boundaries. While active cooling is traditionally used (via maritime for example by using reefer containers and actively cooled air containers), an increasing number of flows is being executed via passive cooling. Therefore, the use of dry ice is becoming more and more important, mainly to secure the frozen to deep frozen temperature boundaries.

1 BOX WITH 5 'PIZZABOXES'

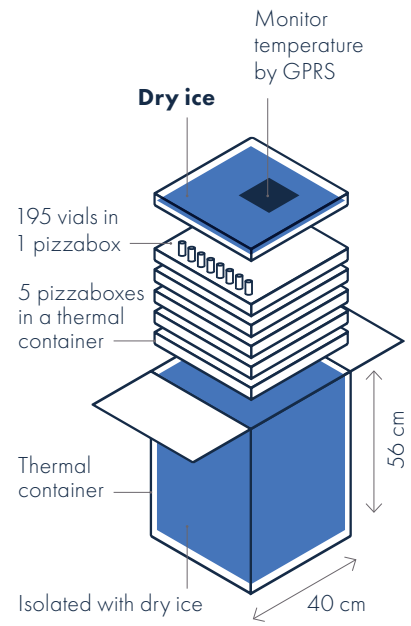


fig. 1

Essers showed how the last-mile trucking flows of the Pfizer BioNtech vaccines was combined with innovative packaging (including trackers, sensors and IoT devices) in combination with dry ice as a passive cooling solution, as can be seen in the figure 1.

Prof. Gevaers indicated that the industry should prepare and answer the question that using this kind of boxes (mainly via air), the main product shipped in weight is dry ice and not the pharma product itself.

For example, with the Pfizer vaccines, more than three-quarters of the weight is related to the packaging and dry ice. This fact might become in the future a research topic, where scientific research compares traditional flows (consuming electricity, heavier containers, etc.) versus passively cooled solutions (packaging and dry ice for example). He also indicated that overall sustainability will soon play a vital role in pharma logistics.

As the middle man might become in the future less important in pharma supply chains, outsourcing and subcontracting logistics services will always be part of pharma logistics strategies.

Dr. Elena Pessot (Italian National Research Council) indicated in her presentation that all models to support pharma companies can analyse and procure transport and logistics contracts within pharma logistics.

Dr. Annelies De Meyer (VITO Research Institute) presented how lineair programming (including predictive data) can help pharma distribution models increase efficiency and effectiveness. The research institute VITO developed the Moov model for solving complex distribution flows.

Figure 2 indicates how a certain warehouse can be linked with many delivery points or patients, for example.

Dr. Alexis Nsamzinshuti (ULB) presented his research results about distribution models towards pharmacy shops in cities. He indicated that these pharma last-mile deliveries have to deal with typical urban-related issues like traffic jams, delays, etc. He suggested using more and more night deliveries, urban distribution centres, and potentially micro depots in larger cities. The issue might be that a night entrance (or lock) might need to be installed for the night deliveries. At the same time, urban consolidation centres imply an extra cross-dock activity, which might increase the costs and interfere with full temperature controlled track-and-trace. Nevertheless, these options might reduce the ecological footprint of pharma last-mile urban deliveries.

During the interactive panel discussion with experts from Long Beach and California, it became clear that a kind of competition exists between who is responsible for which part of the pharma last-mile in the US. Are public authorities responsible, or should private businesses be fully responsible? During this discussion, it became clear that it is not a black or white story. This depends highly on the type of pharma products and administering principles (for example a vaccine campaign) needed. A notable remark was that Pfizer selected its own Direct to destination supply chain, not participating

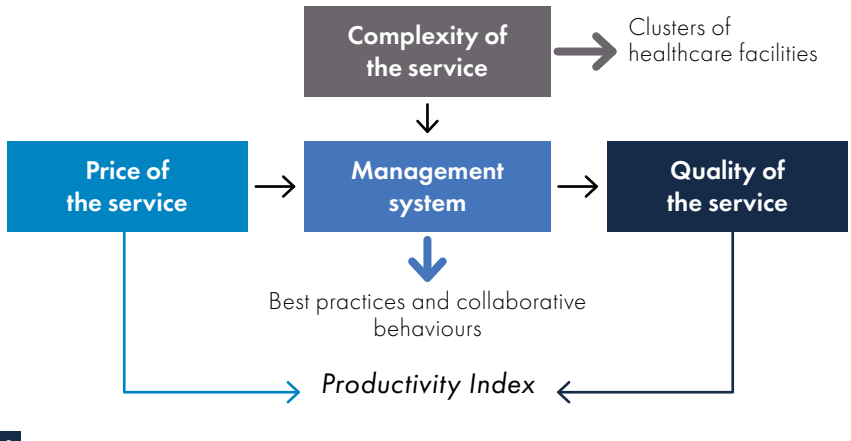
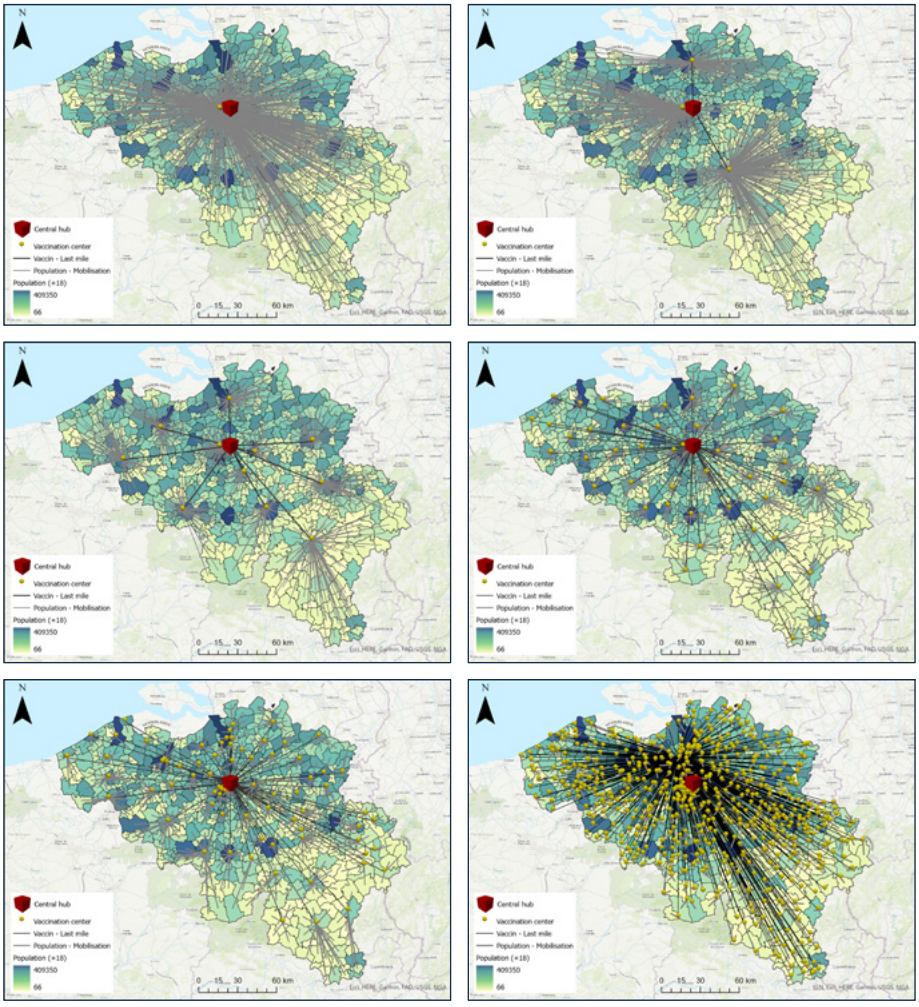


fig. 2

in the US Government launched Covid vaccines program Warp Speed. It indicated the competition between public and private again, even in a mainly public driven vaccination campaign.

Main Takeaways

The main conclusions are that the last-mile in pharma supply chains can learn from eCom distribution models, mainly for increasing effectivity (and partly efficiency). Next to that, we can conclude that a shift is happening to direct to destination (similar to direct to consumer in eCom) and that solutions like innovative packaging and passive colling (for example via dry ice) will become increasingly important.



Overall Takeaways

The Masterclass concluded with ten major strategic Takeaways gathered during the course:

1. The pharma logistics market will continue to grow at a swift pace. This growth is forecasted to be both horizontally ('the cake will grow') and vertically ('the cake will become more complex and more demanding').

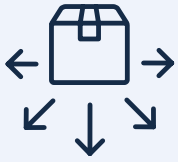
2. "PIL[1] becomes VAL[2]'! Pharmaceuticals become increasingly valuable and might need particular security handling protocols, in addition to full trace-and-track capabilities. The Covid-19 vaccines and an increasing number of high-value pharmaceuticals launched on the market demonstrate this statement.

3. The inbound and outbound supply chains for pharmaceuticals need to become more sustainable. The pharmaceutical industry increasingly focuses on more transparent and measurable, sustainable in- and outbound supply chains for both the raw materials and end products. The air and maritime industries in the middle-mile have to make more efforts to cater for this demand.

4. Maritime transport enters the pharmaceutical supply chain. While pharmaceuticals primarily use airlift, we observe that the maritime industry increasingly can offer reliable and sustainable solutions for pharmaceuticals. More know-how is needed to fulfil the demands of the pharmaceutical industry.

5. Effectiveness is often more important than efficiency. Supply chains often focus on cost efficiency. However, reliability, transparency, sustainability, security, safety and punctuality are critical parameters for the pharmaceutical industry.

[1] PIL - IATA code for 'Pharmaceutical cargo'
[2] VAL - IATA code for 'Valuable cargo'



6. Changes in business models (B2B to B2B2C) create last-mile challenges. Pharmaceutical distribution models change rapidly. Besides, pharmaceutical e-commerce distribution platforms make inroads into the classic distribution model. Pharma logistics companies need to adapt to this changing environment.

7. SARS-CoV2 is not the last world disrupting virus. The Covid-19 distribution challenges were an excellent dress rehearsal in working together and improving the pharmaceutical supply chain. The lessons learned should be integrated into the current supply chains. The pharma logistics industry needs to prepare for other major events in the following decades.

8. New technologies and big data will make significant inroads into Supply Chain Management. Artificial intelligence and advanced analytics may steer future decision making in a blink of an eye. As reaction speed means tackling a crisis fast and efficient, the applicability and integration of these newer technologies will gain more importance for the future.

9. Pharmaceutical supply chains become more fragmented and more complex. Different standard distribution models are currently at stake. The two main drivers for this phenomenon are sustainable solutions for the long term and more complex logistics models integrated into the value of the future pharmaceutical product.

10. Therefore, there is a need for increased coordination and collaboration between all players in the supply chain. The different transport modes, on one hand, and the different supply and quality management business units within pharmaceutical manufacturers, on the other hand, have proven, in this first edition of the Masterclass, that there is a need for enhanced collaboration and exchange of information to upgrade the future supply chain.

The First International Pharma Logistics Masterclass Class

7 - 11 September 2021
University of Antwerp
Belgium

Thank you!

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The Overall Takeaways of the International Pharma Logistics Masterclass 2021 demonstrated the need for enhanced knowledge and sharing of know-how between academics and the industry. Therefore, the Organising Committee has decided to hold a second edition in 2022. The key transversal themes of this second edition will be based on the central issues raised at the first Masterclass: Sustainability, Big Data, Crisis Management, Disruptive Technologies and Cool Chain.

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