**COVID-19 VACCINE SUPPLY CHAIN RESEARCH 2021**

1. **RESEARCH AGENDA**

**Introduction LCB**

At the instigation of the Province of Noord-Brabant, Breda University of Applied Sciences (BUas) has developed a partnership with Eindhoven University of Technology (TU/e), Nederlandse Defensie Academie (NLDA) and Tilburg University (TiU) to stimulate innovation in the industry by joining forces in research and education. The Logistics Community Brabant (LCB) was established for this purpose. At the request of and with financial support from the Province of Noord-Brabant and the municipality of Breda, the partnership was formed in April 2018, LCB, out of the four, previously mentioned, universities that offer logistics degree programmes. LCB cooperates with regional partners like REWIN, Midpoint Brabant, Vijfsterren Logistiek and Supply Chain Platform Zuidoost-Brabant.

The assignment of LCB is to promote and accelerate innovation in the logistics sector (especially SMEs) in the province of Noord-Brabant. By combining the strengths of universities, companies and governments (triple helex) LCB fosters innovative developments. This province-wide partnership in logistics aims to expand and innovate Noord-Brabant as an international top logistics region. LCB is located at BUas.

**Agenda**

LCB has the following themes on their innovation (and research) agenda:

* Liveable city
* Data driven logistics
* Smart industry
* Multimodal transport
* Health care logistics
* Event logistics

LCB has proclaimed *Healthcare Logistics* as one of their themes in which supply chain innovation plays a key role. Within this area[[1]](#footnote-1) LCB, in close cooperation with BUas research, also focusses on research about the organisation and ramp up of the Covid-19 vaccine supply chains. This *research topic* is part of the BUas expertise area of supply chain visibility[[2]](#footnote-2).

The mass production and distribution of Covid-19 vaccines on a global scale, with its special requirements on temperature control and speed, will be in many ways unique in history. Vaccinating enough people to bring the pandemic to an end (as soon as possible) is the key focus for setting up supply chains that facilitate this ambition. The supply chain planning and ramp up of activities focusses on avoiding shortages, delays and expirations of the vaccines.

It is intended to write a scientific article on this subject matter. This will be conducted by Albert Mandemakers[[3]](#footnote-3) under the supervision of Prof. Dr. Henk Akkermans (TiU). This scientific article is expected to be submitted for publication in 2022. In line with this, a PhD track has been set up in 2021.

Furthermore, it is intended to involve students into this research agenda. Students can contribute by executing LCB-assignments on this topic that fit with university requirements of master and bachelor thesis projects and minor programmes or learning communities.

**Goal of Covid-19 research agenda**

The goal is to contribute to both science and society by having a deepened understanding of the ramp up and planning of these vaccine supply chains. The research agenda focusses on global distribution of vaccine supply chains and how they are coordinated by supply chain actors. In retrospective it will give us a better understanding on how we can deal with these challenges in the future as we face the next pandemic or other major unplanned events.

In extension of this goal, it is obtained to disseminate this knowledge to the industry concerned, to the scientific world and to the public. Secondly, it is important to valorise knowledge at universities from where future research can be conducted and for educational purposes, by valorising the knowledge as a part of the curricula and as an input for future assignments.

1. **STUDENT PARTICIPATION**

**Student participation**

LCB seeks students who would like to contribute to this research agenda. This is carried out as a part of their curriculum. The student products relate most likely to a bachelor or master thesis or to a minor report.

**Knowledge dissemination**

It is the intention to share the knowledge you acquire with the network that LCB has with the logistics work field and healthcare or possibly beyond. LCB organises this knowledge dissemination in consultation with the students. This takes place (afterwards) by recording a knowledge clip about your student thesis. Furthermore, it is also possible that LCB requests to do a presentation at their periodically organised theme meetings and/or at external meetings.

On your own request, it is also possible to write an article of your own. If you would like to write an article (a scientific or popular article) then this will need consultation between you and LCB.You can add it as an additional product to the thesis or minor report in collaboration with your supervisor from LCB and possibly with other students. After all, it could also be the case that a seminar is organised in which you will be asked to develop new knowledge and/or disseminate knowledge.

**Focal areas and demarcation**

Potential focal areas within this research area are as follows:

Geographically:

* Global distribution networks of covid-19 vaccines (first mile and linehaul of this supply chain)
* National distribution networks of covid-19 vaccines (last mile of this supply chain) including comparative country analysis
* Connection between the global and national networks

Subjects Covid-19 vaccine supply chains:

* Matching supply and demand while taking into account potential demand disruptions (show up rate of people for the vaccines, production disturbances, shortages in different countries, etc.)
* Cold chain challenges of these supply chains and lead time requirements
* Behavioural aspects of supply chain actors and the impact on supply chain coordination, decision-making and collaboration
* Data sharing and information management around the organisation and planning
* ICT-challenges: data-driven decision-making, digital technology and supply chain visibility

Theory/Literature:

* Supply chain strategies (in crisis situations)
* Cold chain and pharmaceutical supply chains
* Data-driven decision-making and supply chain visibility
* Disruption management and supply chain uncertainties
* Behavioural operations & supply chain management

Research approach, possibilities:

* Literature (scientific articles and books)
* Desk research (collecting and analysing existing data, to be used for triangulation of findings from field research)
* Field research (interviews (most likely)/ surveys)
* Modelling (as of 2022, depending on data availability)

In case of conducting interviews, the following needs to be taken into account: The interviews will be held under the guidance of your LCB-supervisor. The interviews will be conducted in the mother tongue of the interviewee or in English. The questions and topics will be sent in advance to the persons to be interviewed. Based on the transcripts of the interviews, by using data-analytical techniques, a codebook is constructed of common denominators and patterns that are derived. An analysis will be made of these findings. The interviewee will be listed as one of the sources with whom the interviews were conducted. Interviewees are pseudonymised as references in publications. If we include a specific part of the summary of the interview in the thesis, report and/or article and if it is agreed upon, then we will make a reference to the interview. A voice recording of the online interview will take place with permission of the interviewee. This recording is used for making the transcripts. All data is protected and therefore not public and needs to be treated in a confidential manner and will be used as longitudinal input for focal group meetings, follow up interviews, etc., to synthesise findings and to develop new insights.

**Choosing a focal area for the student product**

These research areas need to be discussed and choices need to be made to specify the focal area for every student research that contributes to this research agenda. The choices for these focal areas are coordinated by LCB (Albert Mandemakers) after consultation with the student about his/her preferences. A match needs to be made with the specific requirements of the student products of the master thesis, bachelor thesis, minor product or learning community, as expressed by their university. For this research agenda it is mandatory that you write your report in English.

**Supervision**

Your proposal will be discussed with LCB (Albert Mandemakers) and of course the proposal needs to be approved by your University. During your research you will get guidance and leads from LCB (Albert Mandemakers) and LCB will provide her network that you can use in consultation with your supervisor.

**Student products, so far (February 2021 – June 2021):**

* Three master thesis Supply Chain Management of TiU:
	+ Last mile and supply chain service (vaccination process) research for Covid-19 vaccines applied to the Dutch situation. The research involved enhancement of the logistical process and its effectiveness in matching supply and demand.
	+ Research on waste of vaccines within the distribution chain focussing on first mile, long haul and last mile including supply chain service.
	+ Research on matching of supply and demand in pharmaceutical supply chains with the focus on production of covid-19 vaccines.
* Learning community white paper of BUas master Supply Chain Management: In this white paper a group of students focussed on an international comparison of the last mile and supply chain service (vaccination process) research for Covid-19 vaccines. The research involved enhancement of the logistical process and its effectiveness in matching supply and demand. The document included recommendations for follow up research.

**Student products (September 2021 – January 2022):**

In the covid-19 vaccine dossier new (more or less expected) supply challenges will emerge e.g., how to integrate Covid-19 supply chains in standard supply chain business when these vaccines turn into an annual flu shot, how to roll out the vaccine distribution to the low and middle-income countries, or what we learned from this crisis on how to ramp up these supply chains in the future. Special attention is put on the role of logistics service providers (LSPs). LSPs have built up years of experience in pharma logistics, combine different vaccines in their networks and are aware of local circumstances by operating via their regional distribution centres.

* New master thesis students (three) of Supply Chain Management (TiU) are invited to conduct research in the following fields:
	+ *Behavioural supply chain management and decision-making in a pharmaceutical context.* Covid-19 vaccine supply chains are ramped up and organised by supply chain actors in an environment characterised by uncertainties and disruptions. These actors interact and cooperate (in some form) with each other. This will lead to untransparent behaviour based on incomplete information. Keq questions will be how we can have a better understanding of this supply chain behaviour, how we can mitigate supply chain failures and how decision-making in ramped up Covid-19 vaccine supply chains can be enhanced. Focus will be on globalised supply chains with final mile in the Netherlands (compared with other Western countries).
	+ *Data driven decision-making, supply chain visibility and digital technology in pharmaceutical supply chains.* Covid-19 vaccine supply chains can be characterised as cold chain pharmaceutical supply chains. In these supply chains technology is used to monitor temperature and data-sharing is crucial. What can we learn from the current vaccine supply chain cases? What (technological) innovations have taken place and which (technological) innovations are needed for the future? How can supply chain coordination and collaboration be enhanced in these pharmaceutical supply chains through realising data driven decision-making and supply chain visibility?
	+ *Decision-making and organisation of ramping up Covid-19 supply chains focussing on the last mile in Low and Middle Income Countries (LMICs).* Key is decision-making of last mile in LMICs and the role of NGOs, governments, pharmaceutical companies and LSPs in coordinating these distribution networks (with emphasis on the role of LSPs). Attention is required for behavioural and technological aspects (digital developments, data-exchangeability, supply chain visibility, etc.). How are these distribution networks organized and planned in LMICs? What is the role of COVAX-programme and is it working effectively? What are the challenges for LMICs, how do they cope with disruptions in organising the final mile and how can supply chain failures be mitigated?
* Minor Supply Chain Management (Bachelor programs of BUas): *Organisation of ramps up of Covid #19-vaccine Supply Chains.* This assignment focusses on the ramp up(s) of the Covid-19 supply chain from the manufacturer plants to the destination warehouses or dosing locations. Focus will be on the role of the logistics service providers. Further demarcation of the assignment will be discussed. This assignment includes the information flow and data sharing between the supply chain actors. It also entails the use of data for tracking & tracing of vaccines and for coordinating the supply chain (data driven logistics and supply chain visibility). The problem thesis for this assignment relates to supply and demand uncertainty. What is/was the impact of sudden supply and demand disruptions of vaccines on the planning of the distribution of vaccines? How can supply and demand uncertainty be incorporated into a robust and/or resilient supply chain strategy? Is an end-to-end supply chain strategy required? What are the lessons learned of the recent ramp up(s) of the vaccine supply chains? What should be changed for the future or in the planned ramp ups in the third world? How to transform current vaccine supply chains into more long term fluent organised supply chains? Is an integrative dashboard feasible and desirable and are there any best practices?

Goals/Deliverables:

* + End-to-end supply chain concept design including innovative aspects.
	+ Proposal for an innovated dashboard design to monitor and to coordinate Covid-19 supply chains.
	+ Research report with a compelling storyline about the subject.
	+ Recommendations for stakeholders involved.
* Learning community white paper (final document) of BUas master Supply Chain Management: A group of students continued with one of the recommendations of the first white paper of the previous group. This research focusses on how the pandemic has impacted the efficacy and efficiency of supply chains including the relevance of strategies to strive for supply chain visibility, resilience and robustness. A survey will be conducted with companies including follow up case-study research including in-depth interviews.

**Student products (February 2022 – June 2022):**

In 2022, this research agenda will take a closer look at the learning effects and how these supply chains can be transformed into less ad hoc and more fluid supply chains. There will also be in-depth research in the relationships between pharmaceutical manufacturers and LSPs and their impact on the coordination of these supply chains.

* New master thesis students (three) of Supply Chain Management (TiU) are invited to conduct research in the following fields:
	+ *Learning effects vaccine supply chains.* Covid-19 vaccine supply chains are ramped up and organised by supply chain actors in an environment characterised by uncertainties and disruptions. What can we learn from decision-making and coordination in vaccine supply chains so far and how does that contribute to matching supply and demand that avoids shortages, delays and waste of vaccines in the near future? How we can mitigate supply chain failures and how can we organise more efficient and fluid Covid-19 vaccine supply chains in recurrent and/or newly ramped up vaccination rounds? Focus will be on globalised supply chains with final mile in the Netherlands (compared with other Western countries).
	+ *In depth research into the relation between pharmaceutical manufacturers and LSPs.* Covid-19 vaccine supply chains can be characterised as unpredictable, ad hoc and highly prioritised cold chain pharmaceutical supply chains. In these supply chains the relations between pharmaceutical manufacturers and LSPs are crucial for coordination and decision-making. What can we learn from these supply chain actors and their mutual trust? How can supply chain coordination be enhanced in these pharmaceutical supply chains through realising effective data-sharing and collaboration? Focus will be on globalised supply chains with final mile in the Netherlands (compared with other Western countries).
	+ *Decision-making and organisation of feasible Covid-19 supply chains focussing on the last mile in Low and Middle Income Countries (LMICs).* Key is decision-making of last mile in LMICs and the role of NGOs, governments, pharmaceutical companies and LSPs in coordinating these distribution networks. Attention is required for the feasibility of (extreme) cold chain vaccine supply chains in LMICs. The scope for this project will be derived from recommendations of previous master thesis research.

*These topics are not 100% fixed. Discussion is needed with students to find out what their preferences are, what the involved universities demand and what the LCB research agenda requires.*

**Motivation letter**

If you are interested to conduct a research that contributes to this research area, and if you want to apply for it, please send a brief motivation letter (maximum half A4) towards:

Karlijn Lips lips.k@lcb.nu cc: Albert Mandemakers Mandemakers.a@buas.nl

1. It is noted that this subject on the organisation and ramp up of the Covid-19 vaccine supply chains also links with the LCB-themes data driven logistics and event logistics. [↑](#footnote-ref-1)
2. BUas aims for research and knowledge development that contributes to supply chain visibility. Global supply chain management requires accessibility of information for different stakeholders from the production source to the destination (supply chain visibility). By acting based upon real time supply chain information (data driven logistics) the efficiency and effectiveness of supply chains can be enhanced (from a triple bottom line perspective) by for example improving matching of supply and demand, by improving inventory management and by increasing responsiveness towards customers. [↑](#footnote-ref-2)
3. Albert Mandemakers works as a researcher for both BUas and LCB and as the programme manager of BUas supply chain management master programme. [↑](#footnote-ref-3)