Final Report

WWTF supplementing measures: COV20

1. Project highlights (in German and English, max. half a page each)

This part addresses the general public and will be used by WWTF for its public relations work. Please describe the concrete COVID-19 Rapid Response project, highlights and outcomes briefly.

Die TU Wien und Fraunhofer Austria haben im Rahmen des Projekts *Preside* in Zusammenarbeit mit Partnern aus dem Lebensmittelhandel ein Tool entwickelt, mit welchem auf strategische Fragen zur Versorgungssicherheit durch wenige Klicks Antworten gefunden werden können.

Sollte ein Nachbarland von der Corona-Krise hart getroffen werden und die Grenze muss geschlossen werden, kann mit Hilfe des entwickelten Tools festgestellt werden, bei welchen Lebensmitteln es zu Lieferschwierigkeiten kommen kann. Darüber hinaus können die Konsequenzen beim Abriegeln einer bestimmten innerösterreichischen Region für die Verfügbarkeit der dort produzierten oder gelagerten Produkte visualisiert werden.

Basis der Visualisierung sind Handelsdaten verschiedener Unternehmen, die von Projektpartnern wie zum Beispiel dem Lebensmittelgroßhändler KASTNER bereitgestellt werden. Hierbei handelt es sich um Echtdaten aus der Lieferkette des Großhandels für selbstständige Kaufleute und die Daten des Bio-Fachhandels. Dank dieser Kooperation können in dem entwickelten Dashboard Warenströme visualisiert und unmittelbar gezeigt werden, welche Produktgruppen aus welchen Regionen geliefert werden.

Das Tool, stellt sicher, dass im Krisenfall jederzeit schnell regiert werden kann und Verwerfungen in der Lebensmittelwertschöpfungskette vermieden werden.

Within the framework of the Preside project, the Vienna University of Technology and Fraunhofer Austria, in cooperation with partners from the food trade, have developed a tool with which answers to strategic questions on supply chain security can be found with just a few clicks.

If a neighbouring country is hit hard by the Corona crisis and the border has to be closed, the developed tool can be used to determine which food products may experience supply difficulties. Furthermore, the consequences of closing a certain inner-Austrian region for the availability of the products produced or stored there can be visualised.

The visualisation is based on trade data of different companies, which are provided by project partners such as the food wholesaler KASTNER. These are real data from the supply chain of the wholesale trade for independent traders and the data of the organic specialised trade. Thanks to this cooperation, the developed dashboard can visualise the flow of goods and immediately show which product groups are delivered from which regions.

The tool, ensures that in the event of a crisis, it is possible to react quickly at any time and to avoid distortions in the food value chain.

2. Project revisited (in English, max. 2 pages)

Tell the story of where you started from and what you have achieved: How was the additional funding used? Why were the actions needed in response to the COVID-19 pandemic?

Which kind of data did you collect and analyse? Why was it necessary to collect the data right now?

With whom did you collaborate, why and how? With whom did you share the data and your results?

Which of the posed goals could be met and which were missed? What were the most positive experiences you made? What were the greatest challenges? Did the project require any changes in the allocation of resources (time, cost categories)? Please name reasons.

What is the Viennese context of your COV20 project?

After the lock-down was announced in mid-March 2020, people started stockpiling food and other products they might need for their everyday life during the corona crisis. As a result, empty shelfs in the supermarkets dominated the media and questions were rose, whether the food value chain could break down. This context was the starting point of our research: We aimed to identify potential weak points in the food value chain and provide a solid decision-making basis for policy makers.

For our research we used the distribution data of two major food wholesaler. In total we analysed about 160 million data records, containing all article movements from suppliers to central warehouses and from there to the respective stores between January 2019 and April 2020. Thereby, the focus was on the Eastern regions, namely Vienna, Lower Austria and Burgenland. Processing this huge amount of data was one of the challenges within the project. Especially, consolidating the article movements of the different wholesalers was difficult. Most of the products had to be categorized manually in order to be able to derive reliable results.

As stated before, the project started in the light of empty supermarket shelfs dominating the media. Therefore, our first task was to determine what products where effected by panic buying and whether their supply was guaranteed throughout the crises. We were able to retrace the increase in demand for most of the articles that were present in the media (e.g. flour, noodles or toilet paper had a significant increase in demand during this period). But we were also able to identify products that had a huge increase in demand but went less noticed by the public (e.g. ready-made sauces had an increase of 153% compared to the previous year, while the often-cited noodles only increased by 114%).

One of the reasons, why the strong increase for some products was unnoticed, was that these products did cause less problems in the supply chain. When having a look at the stock levels of the central warehouses, we were able to show that these products were never out of stock. This was, for instance, not true for flour: Out of 18 flour products, 9 products were at least for some time out of stock. As a conclusion of this analysis, we decided to have a deeper look at the supply side as well, as there were actually two problems conflicting in this crisis: On the one hand, the demand of food wholesalers increased significantly due to panic buying in the short term and closed restaurants in the long term, and on the other hand the supply may be limited due to the lockdown and the closed borders to neighbouring countries.

To ensure this, a detailed analysis of the data of the incoming products was necessary, in contrast to the identification of the purchasing behaviour of the population with the data of the outgoing products. These data of the incoming products are essentially a conglomerate of incoming booking records to the respective central warehouse, article master data, data on transport tours and the supplier data (1st-tier).

In order to visualize the supply chain from the 1st-tier supplier via the central warehouse to the individual customers, these stakeholders had to be geocoded by extending the specific address with data on longitude and latitude and data on location, district, etc. This purely static network was extended to a dynamic network as a result of the linkage with the article quantities on single packaging unit of the period January 2019 to April 2020. Accordingly, it was now possible to determine the relevance of an individual supplier, depending on its relative quantity share and to identify a supplier as critical due to its potential location in a region heavily affected by Covid-19.

The linkage of the individual data records of the incoming and outgoing products from the warehouses was carried out with the software "Alteryx". In total, as already mentioned, about 150 single data files from almost 1.5 years of different food retailers were extracted, transformed and loaded into a target file according to the ETL process. The biggest challenge in this step was to consider the specific data characteristics in the data integration. The necessary data is taken from various ERP- (Enterprise-Resource-Planning) and WM-Systems (Warehouse-Management). Due to this almost every data structure looks different. Also, the food retailer-specific descriptions of article groups had to be consolidated on a meta-level to ensure an abstract description logic. The target file with about 160 million GB then served as an adjusted starting point for the visualization and development of the dashboard.

The dashboard for the visualization also consists of two areas and was created using the software "Tableau". In area 1 the material flows from the supplier to the customer are visualized. This visualization is possible on the one hand on country level, but also on district level, for example to select specific districts of the strongly affected region Lombardy in Italy and to analyse them on the supplier side. Area 2 reflects the cumulative stock level and the cumulative quantity of outgoing products over the period under investigation. It also shows the quantities growth, i.e. the percentage change in the output of a group of articles or a specific article from the time of the lockdown compared to the previous year. The stock range of the specific articles, i.e. the time of average security of supply in days that can be guaranteed without further goods receipts, completes the second area.

At this point, it should be mentioned that the performance of the dashboard in "Tableau", due to the previously performed calculation processes in "Alteryx", can be rated as very good, despite the huge amount of data. The user is able to make specific analysis on article group or article level by simple clicks of the individual filters and buttons. Furthermore, the ETL workflow in "Alteryx" was built up sustainably. New data can be imported with minimal effort and the dashboard is always kept up to date.

3. (Long-term) perspective (in English, max. 1 page)

Please name (possible) impacts of your activity on and benefits for society and/or additional economic benefits. What is the long-term perspective of your project, also regarding future lines of research? Will there be any changes based on the results / achievements you have experienced in the given project?

What is your contribution towards more open data / data sharing / evidence-oriented policies? Which other organisations or groups have been supportive in achieving these goals? Which ones will or should be supportive in the future? Have you found partners for future collaboration and why are these partners so attractive?

Please list any outputs of the project (e.g. cooperation, articles, book, media reports, patents, prototypes, memberships in committees, panels, etc,…).

The greatest benefit of the project is the demonstration of the strong dependencies and high complexity along the supply chains in the food wholesale industry. The mapping of the entire supply chain allows to identify critical points in the network even outside of the crisis and to make them redundant if necessary. The long-term aspect of the project would be to record and continuously update the entire network from the raw material supplier to the end consumer for the whole of Austria. This would require additional volumes of data from numerous different sources, updated at least on a daily basis. This would make the project even more complex. The prototype of the Preside Dashboard was handed over to the project partners who provided the data in the course of the project and will be used to analyse the own supply chains in detail.

One major success of the project was to present the data of two competing dealers together in one single dashboard. Since food wholesale is a highly competitive industry, data must not be passed on to the competition. Through a particularly work intensive data integration, in which the data sets of the individual project partners were sufficiently abstracted and aggregated on a suitable level (self-defined article groups), a framework was created in which the data sets could be combined from the point of view of the project partners. The companies Spar Österreichische Handelswaren AG and Kastner Handelsges.m.b.H. were particularly involved in the data integration phase. Both companies were willing to exchange data at a sufficiently high level of aggregation. Both companies were long-standing customers before the project and further cooperation with both companies is already planned after.

Positive results of the project included strengthening the relationship with the project partners, the exchange between two competing companies and the development of the Preside prototype. The dashboard was handed over to the individual project partners. The detailed visual preparation of the supply chains over time was particularly interesting for the purchasing department within the companies. In the course of further projects, the dashboard might be adapted individually to the company partners for operative use. For the ministries, which were supported by the Preside-Dashboard in the course of the project, the presentation of the complexity of the supply chains was particularly interesting. The dashboard was adapted to specific questions of the ministries (e.g. what happens if the borders to country XY are closed?). In the end, specific answers were provided in the form of a final presentation based on the dashboard. In the course of the support of the Federal Chancellery, numerous press articles and a television interview were produced. Furthermore, Fraunhofer Austria was accepted into the SKKM Coordination Staff of the Ministry of the Interior and the Covid Future Operations Clearing Board of the Federal Chancellery.