FRISCHEDATEN

Tender for an

OPEN INNOVATION CHALLENGE

as part of the FriDa project

"Optimized decision-making along the fruit, vegetable and fish supply chain using an open data and service framework"

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1 Introduction

The German retail sector alone loses food worth more than €450 million worth every year due to breakage and spoilage. The research project "FriDa – Fresh Data", funded by the Federal Ministry of Agriculture and Food, aims at reducing this food waste. For this purpose, the FriDa consortium, consisting of 5 partners from industry and research, develops two complementary solutions. On the one hand, the intelligent fruit and vegetable trays ("Smart Trays") developed by Euro Pool System are able to independently determine position and temperature data and transmit them wirelessly. In this way, a complete (temperature) monitoring of the supply chain is possible. On the other hand, tsenso, in cooperation with Fraunhofer and the University of Bonn, develops predictive models for precise real-time determination of the quality and shelf life of the transported products. Information is brought together along the supply chain through a data exchange platform developed by ATB and can be used by software applications. The combination of innovative solutions has great potential to reduce food waste by leading to greater transparency and optimized food quality up to the point of sale.

<u>Consortium</u>

- ATB Institut für angewandte Systemtechnik Bremen GmbH
- Euro Pool System International (Deutschland) GmbH
- Fraunhofer Institute of Optronics, System Technologies and Image Exploitation
- Rheinische Friedrich-Wilhelms-Universität Bonn, AG Cold Chain Management
- tsenso GmbH

As part of the FriDa project, an Open Innovation Challenge is launched with the aim of giving external solution providers the opportunity to integrate additional components into the FriDa solution landscape. In the following chapter, key challenges are formulated that serve as a starting point for this Open call.

2 Key Challenges

Three key challenges were defined for which innovative solutions are sought.

2.1 Challenge 1: Transfer of sensor values (technically oriented)

A technical solution is sought to ensure that all sensor values of the Smart Trays are transmitted to the FriDa platform without gaps (i.e. all data measured at the specified intervals). Currently, the Sigfox network is used for data transmission. However, for various reasons (e.g. shielding in cold stores), there are always gaps in the transmission and thus a lack of (temperature) data.

For this purpose, the existing sensors could be supplemented with solutions or, if necessary, another sensor solution could be evaluated. The following requirements must also be considered, which in turn are covered by the current solution:

- Autonomous operation of the sensors in reusable crates without local infrastructure and changing users along the transport chain
- Battery life of at least 2 months
- Installation of the sensors within the reusable crates
- Reuse of sensors based on the service life of a returnable platform

New solutions could be, for example:

- Data caching and asynchronous delivery
- Complementary/different system for data transmission
- On-demand signal amplification

2.2 Challenge 2: Monetization and added value of collected data (opinion research)

As part of the FriDa project, a wide variety of data is collected. These include temperature data, spectral data, location data. Both the raw data and statements based on it can provide quality-relevant information and decision-making aids in various applications.

Open questions are:

- Who needs which data, information and decision-making aids?
- What added value does this data offer for which actors (e.g. retail or end consumers)?
- How to quantify and validate the added value?
- What is the willingness-to-pay? Which business models are suitable for which target group?

Thus, applicants are sought who carry out a survey on the topic "willingness to pay for supplementary food and quality data". For this purpose, surveys among consumers, as well as in wholesale and retail, can be solution-leading approaches.

2.3 Challenge 3: Food models (research oriented)

During transport, fresh food is influenced by various quality-relevant parameters, such as temperature or humidity. Mathematical shelf life models are developed in order to predict which impact this has on the freshness and shelf life of the products.

For application in practice, the most accurate real-time information possible is required, such as the ambient temperature, humidity, sugar content, etc. This data can be recorded, for example, via sensors or food scanners.

Open questions are:

- What data is needed to create, evaluate and validate models for calculating the freshness or quality of food? How can this data be incorporated into a "quality formula" for fresh food?
- Which other calculation models relevant for the fruit and vegetable sector are available and how could they be integrated into existing solutions?

We are looking for applicants who develop practice-relevant solutions to the questions described above. These can also focus on one fruit or vegetable product for demonstration purposes.

3 Tender

3.1 Schedule

The following schedule is proposed. May be subject to change.

Publication of the call	From October 2022
Deadline for submission of proposals	31.01.2023

Selection of offers	28.02.2023
Payment of the 1st half of the agreed budget	March 2023
Working time	March-June 2023
Evaluation of results	July-August 2023
Payment of the 2nd half of the budget	August 2023

3.2 Tender procedure

The call will be published in October 2022.

As part of the tender process, there will be an introductory and information event (web meeting) with representatives of the project consortium.

Applicants have the opportunity to apply in digital (pdf) or paper form. An applications must contain at least the following information:

- Information about the company or start-up
  - Company name with address
  - Contact persons and function
- Proposal
  - Max 10 pages, Arial 11pt, single spacing
  - Solution approach and planned procedure must be described
  - The concrete expected output of the work, such as demonstrator, module, or report, must be clearly understandable.
  - Cost estimate for travel, materials, development costs must be included

Proposals can be submitted to:

Euro Pool System International (Deutschland) GmbH
Ms. Anna Lamberty
Rosental 8
53332 Bornheim, Germany

Or digitally (pdf) by e-mail to: anna.lamberty@europoolsystem.com

The submission deadline is 31.01.2023 – 18:00 (CET).

3.3 Selection of offers

From all applications submitted within the application deadline, a pre-selection of the most relevant offers will be made. The selection is made by the FriDa consortium on the basis of the following criteria:

- Completeness
- Plausibility of feasibility
- Relevance for problem solving
- Fulfillment of the framework conditions in financial and temporal terms
- Usability of the solution

The selected applicants will be invited to Bonn to present their offers. For this purpose, the selected and participating applicants will receive a one-time expense allowance of €2,000. After this presentation, the most relevant offer(s) for further cooperation within the framework of the challenge will be selected by the FriDa consortium.

All applicants receive written information about the evaluation of their offer. The evaluation results are not further explained or renegotiated.

After the selection of the offer(s) for cooperation, the teams are invited to an initial planning meeting, where details on implementation, cost planning, etc. are discussed. A corresponding contract including non-disclosure agreement and intellectual property regulation is signed by all parties involved.

4 Performance

During the working time, the winners will independently work on the challenge described in their offer. Before, during and after implementation, contact persons from the consortium will be available and interim meetings will be planned as required. Appropriate equipment, access to software solutions and expertise can be provided as required and by arrangement.

5 Payments

The maximum renumeration per applicant is €15,000. The specific remuneration amount per applicant is determined by the FriDa consortium and communicated to the applicant. The consortium decision will be guided by the submitted cost estimate. On this basis, a draft contract is provided. Immediately after conclusion of the contract between the winners and the consortium, 50% of the remuneration amount for implementation will be made available as an advance payment. The second half of the payout will take place after the end of the challenge. The payment will be made after receipt of the corresponding invoice (invoice amount corresponds to the remuneration amount) by the winner.

6 Appendix

As described in the introduction, the FriDa project deals with different approaches to counteract the problem of food waste. The current status of the project work is described in more detail below.

6.1 EPS & Smart Trays

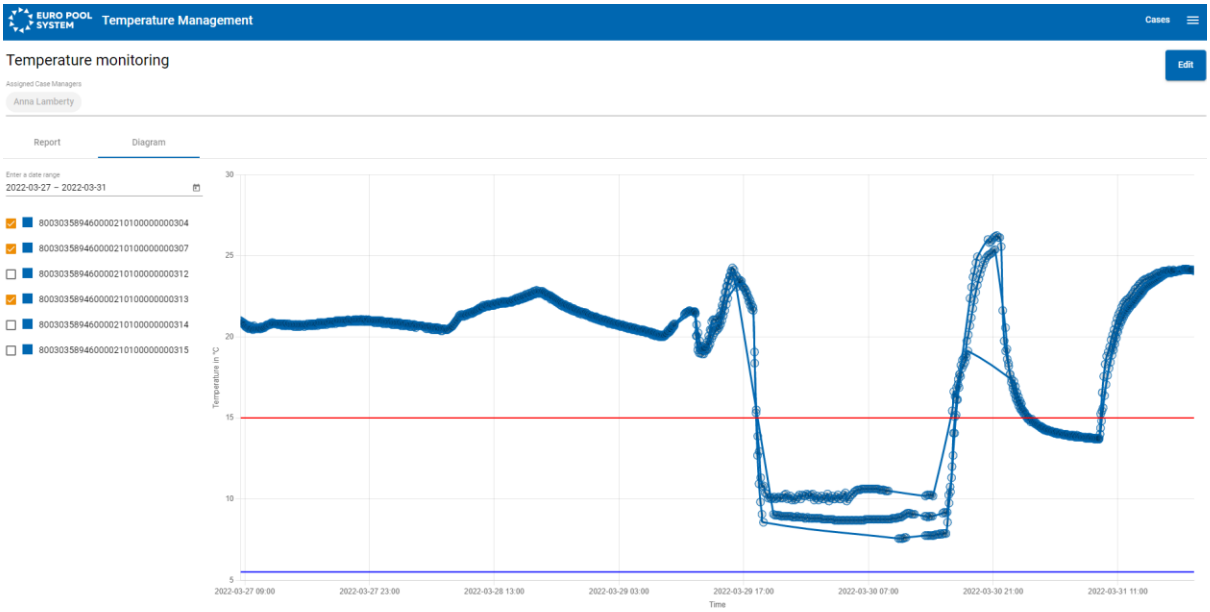
Euro Pool System is the leading logistics provider of returnable packaging in European fresh produce supply chains. Main activity is the pooling (= rental and return) of folding fruit and vegetable crates. The use of these reusable crates has numerous advantages over other packaging, such as more efficient logistics, better product protection and a lower CO_2 footprint.

In addition, the pooling system contributes to the circular economy. The figure below shows the flow of this system. In the first step, the crates are transported from the EPS depot to the producer (1). There, the fresh fruit and vegetables are packed into the crates directly after harvesting (2). In the next step, the goods are transported to the next actor in the supply chain (3). This can be, for example, a wholesaler or food retailer (LEH). In retail, the products are offered for sale directly in the crates (4). After the products have been sold, the empty crates are first collected and then transported bundled from the food retailer to the nearest EPS depot (5). There they are checked for function, repaired, washed and sorted if necessary and are then ready for the next round (6).

In previous innovation projects, Euro Pool System has developed a so-called "Smart Tray". These smart trays have an invisibly built-in temperature sensor that measures the temperature at regular intervals and transmits it wirelessly to the "FriDa platform", an Internet-based data exchange platform. A major advantage here is that the crates ideally accompany the product from harvest to sale, thus enabling seamless, cross-chain temperature monitoring.

6.2 Structure and architecture of the FriDa platform

As a first application example, the temperature data collected by the smart trays is transferred to the FriDa platform. In the exemplary application software "Tempman", this temperature data can then be displayed graphically as a temperature profile for the corresponding smart trays. Such a temperature profile can be used to retrospectively identify weak points in the cold chain and to optimize processes or operating procedures accordingly.



In addition, the complete temperature history of a product is an important prerequisite for modeling shelf life or other quality-related evaluations. These evaluations, in turn, could also be displayed graphically again with the corresponding applications. Of course, in addition to ambient temperature, there are many other parameters whose measurement is relevant and useful in the context of fruit and vegetable supply chains. It would be conceivable, for example, to measure the relative humidity, the sugar or acid content.

All measured parameters can be received by the FriDa platform and forwarded to one or more software applications (configurable N to M connectivity). To make this possible, an open data transmission standard is used (NGSI from ETSI). In this way, a large number of data sources and data subscribers can be easily connected to the platform. The use of the data (data subscription) is based on a "publish-subscribe mechanism" to provide data in real time.

The development of the FriDa platform is based on the use of open source software. Taken together, these components enable an automatic and scalable data flow between different data sources (e.g. smart trays – but also others) to data-based software applications (e.g. Tempman software).

6.3 Shelf life models

With the help of mathematical shelf life models, the quality and freshness status of food can be calculated. In order to implement such predictions for fresh fruit and vegetables in supply chains, product-specific models must be developed in advance. For this purpose, the quality and safety-relevant parameters for the respective product are examined and identified in laboratory studies. In storage tests, product samples are stored at different temperatures in order to distinguish the most important quality parameters and spoilage processes. The FriDa project focuses on the products raspberries and lamb's lettuce as examples. Particularly the texture, sensory changes and microbial spoilage are examined as quality and safety relevant parameters. The large number of parameters included helps to develop a shelf life model that is as accurate as possible. In addition, the microbiological hygiene status of the reusable crates used is examined. Samples of crates are taken at regular intervals before and after cleaning and examined for various microorganisms. This enables to estimate whether there is a risk of cross-contamination of the products due to the reusable crates.

The results of this hygiene monitoring are included in the risk assessment. Furthermore, the effectiveness of the cleaning and disinfection plans can be evaluated.

The results of the storage tests (loss of freshness under different temperature conditions) and the hygiene monitoring (microbiological load of the reusable crates before and after cleaning) are used to develop predictive shelf life models. Finally, validation takes place on a laboratory scale under realistic temperature conditions as they occur in the respective supply chains of the products. Other quality-relevant parameters, such as humidity, are also investigated in the laboratory studies. If these predictive shelf life models are now combined with the measurement data collected in real time along actual supply chains (using smart trays), predictions can be made about the shelf life and freshness of the respective product or batch. These forecasts can then be used for optimized decisions, e.g. regarding storage temperatures, transport conditions or distribution planning. In this way, the emergence of product rejects can be prevented.

6.4 Spectroscopy & Food Scanner

The model quality of the shelf life models described above can be further improved by using spectroscopic methods to measure product quality within a supply chain. Here, the electromagnetic spectrum reflected by a food is measured with a spectrometer. This is then interpreted using machine learning methods. In this way, information about the internal composition of the sampled food is obtained quickly and non-destructively. Since foods are mainly composed of water, carbohydrates, proteins and fats, near-infrared spectroscopy is particularly suitable for determining the ingredients. In addition to measuring the internal composition of a product, this method also makes it possible to make statements about quality and freshness.

There are already small and inexpensive spectrometers that offer many different applications. Within fruit and vegetable supply chains, this technology could be used in places that are not covered yet by conventional methods of quality control. It is also important to distinguish between point-measuring spectrometers and hyperspectral cameras. In the latter case, spatially resolved image acquisition is combined with optical spectroscopy, so that an extensive determination of the product quality can be carried out.

7 Our vision

In the FriDa project, we are developing several innovative solutions to realize "smart" supply chains using IoT, spectroscopy and predictive shelf life models. When these approaches come together in our FriDa platform, we can provide recommendations for action to reduce food waste, increase transparency within supply chains and enable optimized product qualities of fresh fruit and vegetables.