



WHITE PAPER

...Not Worth a Thousand Words

Why Traditional Temperature Loggers and Imaging Technologies are Inadequate to Determine Freshness and Reduce Waste

Getting the Complete Picture

When is a picture not worth a thousand words? When it only tells a part of the story. Why? Because in many cases, what's important is knowing the entire story that includes all the details that are important in order to make a decision about what's going on and what the result will be.

For example, imagine two trucks are driving from Chicago to Dallas and you take a photo of each one. Can you tell from the photo which truck will get to Dallas first? The white one? The gray one?



You can't tell from the photos because you don't know how fast the trucks are going or what speed they'll maintain for the rest of the trip. A photo can only tell you about the conditions at that moment in time. Trying to determine the remaining freshness or shelf-life of produce or other perishable foods from a photo, trailer temperature logger or temperature pulsing is the same. Here's why.

It Starts in the Field

When it comes to knowing the remaining freshness of perishable produce you need to know what happened to the produce from moment it is harvested. Why? Because everything that happens from that point, in terms of time, temperature and handling, impacts the product's freshness capacity and remaining shelf life and therefore its value to the retailer and consumer. The product is harvested at peak quality and, at that point has an optimal shelf life but...

Was the product immediately transported to the pack house or did it sit in the field for an hour? For four hours?

What was the temperature in the field at harvest? 60 degrees? Or 90 degrees?

Was it immediately pre-cooled when it arrived at the pack house or did it sit on a loading dock or in a warehouse? If so, for how long and at what temperature?

What about the pallet next to it? It looks identical, but do you know its history?

You get the point. Every pallet can be – and most likely is – different. Ultimately, each pallet has its own unique freshness capacity, that is, the maximum amount of remaining shelf life which is impacted by time and temperature from the moment of harvest. And that remaining shelf life is dynamic, constantly changing throughout the supply chain based on time and conditions. Two pallets harvested from the same field on the same day could have shelf lives that vary by as much as five days or more and one could be aging much faster and the other much more slowly – based on its history.

If you don't know what the remaining freshness of each pallet is, you can't know which pallet to precool first or how to prioritize processing or which one to ship to a nearer or more distant location. Without this information, chances are good that more than a third of the produce received by the retailer has inadequate shelf life to ensure freshness in the display case or with the consumer.

So, back to the picture analogy. Imagine if you pulp the product temperature at shipping and again at receiving. It might tell you the current temperature or perhaps even some of the temperature history. But can it tell you remaining shelf life? Will it ensure there is sufficient shelf life or freshness for the store and consumer?



No.

Or, what if you actually took a picture of the product or used hyperspectral imaging and photo analytics? That may tell you the current condition of the product but, again, it can't tell you the previous history, rate of aging or remaining shelf life. Further, this approach is labor intensive and difficult and impractical – if not impossible – to apply to field packed produce, which accounts for the majority of highly perishable produce in the market today. Strawberries, blueberries, broccoli or lettuce are put into packages that don't work with imaging systems. Plus, color management is essential but difficult to maintain across different devices and locations, producing inconsistent data that leads to unreliable results.

You Need More Than a Snapshot

To determine the freshness and remaining shelf life, you need to know the freshness capacity of the product (that is, the total possible shelf life determined at harvest and dynamically updated based on actual handling and conditions since harvest), and the current rate of change of aging for the specific pallet of product.

Pulp temperature measurements and hyperspectral imaging cannot provide this knowledge. Nor can trailer temperature loggers as they gather trailer temperature, which is both incomplete relative to the full product history, as well as not an accurate indication of product temperature (pallet-to-pallet temperature varies by as much as 35% in a single trailer).

You can try testing by visual inspection, temperature pulsing, taking pictures or images or looking at trailer temperature logs but these tests and processes do NOT reduce waste, as they are not predictive and therefore cannot help in routing or inventory management decisions. These tests are merely a snapshot of the current state of the product, and it does not provide data about its remaining shelf life or freshness. Some tests are better than others at screening for more criteria, but *none of them* tell how long the product will remain fresh – which is what is needed to avoid waste and ensure delivered quality and freshness.

As collecting the full handling history for each pallet can seem overwhelming, what's needed is a solution that autonomously collects the necessary product data at the pallet level, from the time it is harvested to the present time – and do it automatically without manual intervention – which then can provide the data that drives prescriptive recommendations for better decision making.

The ZIPR Code™

The Zest Intelligent Pallet Routing Code (ZIPR Code) is the industry's first and only freshness metric and is a component of the Zest Fresh™ solution. The ZIPR Code is essentially a dynamic date code that empowers workers and systems to better manage product based on actual freshness, rather than on the false assumption that the date label represents remaining freshness. Zest Fresh includes autonomous product condition data capture for each pallet of produce from harvest to retail. Wireless IoT temperature sensors, inserted into the pallets at harvest, monitor the product's condition and, combined with cloud-based artificial intelligence, machine learning and predictive analytics, dynamically calculates the ZIPR Code providing growers, shippers and retailers with a freshness metric that improve inventory and distribution management.

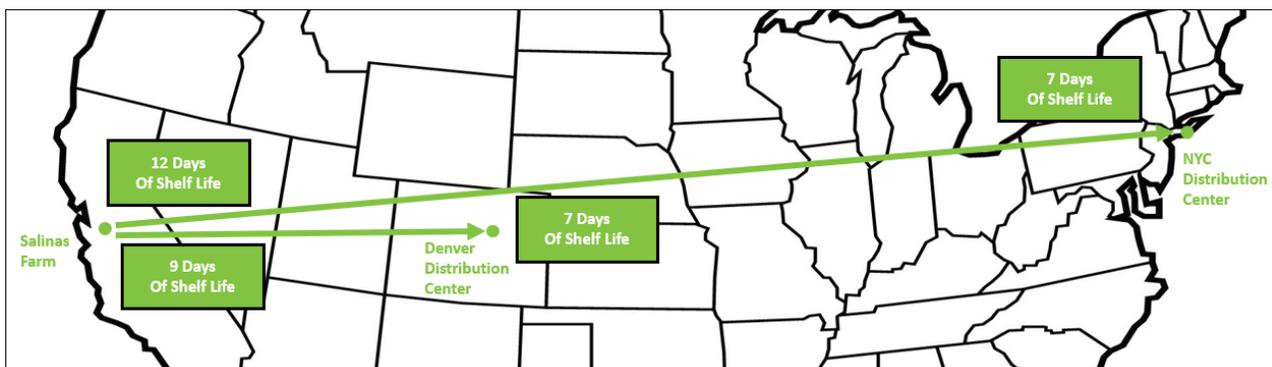


The ZIPR Code is dynamically calculated and provides you with the current freshness of each pallet to help you intelligently manage product throughout the fresh food supply chain. Using the ZIPR Code, growers, shippers and retailers always know the remaining days of shelf life for each pallet of produce to enable intelligent decision making that reduces waste and ultimately improves profitability.

The ZIPR Code is:

- A real-time calculation of the days of remaining freshness or shelf life.
- Continuously updated for each pallet, as quality and freshness can vary by pallet, even within a single day's harvest.
- A goal-oriented metric for freshness requirements.
- Normalized to easily implement across product categories.
- Specifically calculated for every product, from strawberries to lettuce to broccoli, etc., based on variety, harvest location and product specific profile.

The ZIPR Code product profile is based on actual product samples to reflect product specific data, such as harvest quality, and product aging rates that are unique to the variety, field conditions and micro-climate. The product profile defines the freshness capacity and the rate of aging which are both used to evaluate pallet-level condition data, driving dynamic updates of the ZIPR Code for each pallet. Zest Fresh then uses the ZIPR Code to best match available pallets with customer requirements and



transit times. That is, if you know one pallet has seven days of remaining shelf life and another has twelve, they can be intelligently prioritized to locations that match the freshness with the transit time.

Zest Fresh uses two independent ZIPR Codes – target and actual. The ZIPR Code represents the earliest date on which the product is forecast to spoil.

- **Target ZIPR Code:** This is based on the customer requirements, and sets a target for the earliest date on which the product may spoil. For instance, if a retailer requires 2 days for distribution (DC to store), plus 2 days for store sell through, and 5 days for the consumer use, that would be a minimum of nine (9) days of delivered shelf life. As the retailer may have DCs in very different locations, the transit time from the supplier to DC is added. A cross country trip of 5 days in addition to the 9 day requirement means the supplier must ship with a minimum of 14 days of shelf life. A local DC may only require 10 days of shelf life. Zest Fresh understands these requirements and translates them into a target ZIPR Code for each purchase order (and each item on the purchase order). This provides the supplier with a target for each pallet's actual ZIPR Code to meet to ship to be approved to ship to that location or purchase order.
- **Actual ZIPR Code:** Each pallet tracked in Zest Fresh will have a ZIPR tag, which captures the handling condition data for that pallet. The ZIPR tag also includes a unique ID, which Zest Fresh uses to track the pallet and its associated actual ZIPR Code. This actual ZIPR Code is based on the freshness capacity (total ideal shelf life) for the specific product, which is then modified by the actual processing and handling condition data, referenced against the product profile, to determine the pallet's actual ZIPR Code. The result is that the pallet's actual ZIPR Code is much like a dynamic data label. For example:
 - The retailer sets 1 day for the grocery distribution center, 2 days store sell-through, and 4 days for consumer = 7 day destination requirement.
 - Transit time added to destination requirement results in target ZIPR Code for a specific shipment. (i.e. 5 days + 7 days) = 12 days.
 - Zest Fresh screens available pallets by selecting pallets with actual ZIPR Codes that meet or exceed the target ZIPR Code. That is, if the retailer's requirement is that the product must remain fresh until 12 days from the current date, Zest Fresh identifies only those pallets that have a ZIPR Code of that date or later. Pallets with a lower ZIPR Code reflecting an earlier date, would be allocated to retailers with shorter shelf life requirements, or possibly to restaurant use.

The supplier loads the trailer with pallets that have compliant actual ZIPR Codes. There's no action required from retailer – Zest Fresh, using the ZIPR Code, provides automatic compliance checking. If exceptions are needed, Zest Fresh can escalate the request to retailer for permission. The target ZIPR Code may be modified for each purchase order, accommodating some variance in requirements due to seasonality.

Zest Fresh uses real-time analytics to empower suppliers to maintain consistent processes and handling, improving the freshness consistency of its products. Real-time corrective action notifications empower the supplier's workers to correct for product not being handled or processed properly. This same data provides the supplier with guidance to maintain optimum operating efficiency, saving money and increasing throughput.

Zest Fresh uses machine learning to improve the actual ZIPR Code forecasting based on real world results. The changing of pre-harvest and harvest field and weather conditions can vary the impact of post-harvest handling, so Zest Fresh tracks these trends and adjusts the forecasting to match actual

results. The combination of product profiling based on actual samples and the machine learning from actual results provides a dynamic forecasting model that accommodates the variations in nature.

Benefits of a More Intelligent Supply Chain

Using Zest Fresh and the ZIPR Code, growers, shippers and retailers are armed with dynamic up-to-date knowledge about the produce as it moves through the supply chain, to store shelves and to the consumer. Zest Fresh provides a level of intelligence that cannot be provided by trailer temperature recorders, temperature pulping, photo analytics or visual inspection. In fact, it is those “tried and true” methods that have led to the massive amount of waste that eats away at product margins for retailers today. Only Zest Fresh provides retailers with the information they need to cut waste and deliver freshness.

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