

Unique Capability Launch

EPG's Routing Solution Greenplan Debuts Fair Cost Allocation for Logistics Operations

EPG (Ehrhardt Partner Group) is proud to launch a globally unique capability for its routing SaaS Greenplan: Fair Cost Allocation. This algorithm, co-developed with the University of Bonn, is the first in the world to accurately calculate the true costs—both financial and environmental—of delivering individual shipments in a network. Applying discrete mathematics to real-world logistics, Fair Cost Allocation equitably distributes costs and CO2 emissions across customers to enable smarter shipment assignments and smoother execution.

Fair Cost Allocation is powered by discrete mathematics and the research of Prof. Dr. Jens Vygen and his team at the University of Bonn. The solution adapts the "Nucleolus" concept from cooperative game theory to address the intricacies of delivery cost calculation, one of the biggest unsolved challenges in logistics. The result is an optimized algorithm – built upon the concept of the "Happy Nucleolus" – that allocates costs without burdening any one shipment, route, or network with an unfair share of the load.

A Fundamental Challenge in Logistics

Rivalling the complexity of route planning itself, Fair Cost Allocation empowers companies to calculate the cost of their operations with newfound precision. In traditional systems, calculating the cost of shipments across a delivery network involves rough estimates, leading to inaccuracies and inefficiency. The Fair Cost Allocation algorithm provides a data-driven method that analyzes factors such as time sensitivity, geographical distance, delivery density, and operational constraints for each shipment.

Consider a shipment with a tight delivery window of 30 minutes in a neighborhood with few other deliveries. This shipment is inherently more expensive to deliver due to the restricted time

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frame and inconvenient location, but it's important to determine how much of that cost is fair to assign to the shipment. Most companies serve multiple customers. The new algorithm evaluates the resources required for shipments on their own and then within a multi-customer network.

This information is valuable to the route planning process and can be used in combination with EPG's core routing algorithm Greenplan to further optimize dispatch. Using detailed logic, Fair Cost Allocation can distribute costs fairly among shipments and make informed assignment decisions. This intelligence can additionally be used to minimize penalties for dropped or delayed shipments by prioritizing orders in a way that causes least harm.

CO2 Allocation and Environmental Impact

In addition to financial cost calculation, the algorithm can tackle the growing need for sustainability in logistics by considering CO2 emissions. A shipment requiring express delivery to a distant location contributes more greenhouse gases than a local delivery with flexible timing. Fair Cost Allocation identifies the environmental impact of each shipment and then reconsiders the cost in a multi-customer situation, assigning each shipment a new fair share of the total emissions generated by a network. This is particularly valuable for companies that want to comply with CO2 caps, include sustainability metrics in their operations or inform customers of their individual environmental impact.

How the "Happy Nucleolus" Works

In the recently published paper "Cost Allocation for Set Covering: The Happy Nucleolus," Dr. Vygen et al. from the University of Bonn establish the rationale of fair cost sharing, a rationale which Greenplan then applies to the context of routing.

Every company has a certain number of customers requiring deliveries each day. The challenge that the "Happy Nucleolus" solves is assigning a fair cost to each customer so that any group of these customers is happy, benefiting from inclusion in the network. The algorithm considers the cost of service for each group if they acted alone and compares it to the assigned cost share of the group in a full network. If a group pays less in the assigned setup than they would on their own, they are considered "happy".

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By making all groups happy - starting with the least happy groups - the “Happy Nucleolus” ensures that no group is weighted by unfair costs and achieves a fair cost distribution across shipments. The foundations of the concept have existed in theory for years, but its high complexity, a so-called NP-hard problem, has prevented it from being calculated with good approximation on a large scale and applied – until now.

Beyond Single Networks

In a more complex use case, Fair Cost Allocation tackles the challenges faced by operations that split shipments between two or more delivery networks, each with distinct characteristics. For example, in the post and parcel sector, parcels can be transported in combination with mail or in a typically more flexible parcel-only network. The challenge is determining which deliveries should be assigned to which network in a way that maximizes efficiency and minimizes costs. Greenplan is the first solution capable of calculating the cost of assigning each delivery to a particular network and reducing overall efforts through strategic assignment. The rationale: The costliest parcels that could be carried by the less costly combined network should be transferred from parcel network.

Current Applications and Future Impact

Fair cost allocation provides powerful analytics for logistics operations - and Greenplan, alongside the University of Bonn, is the first to crack it.

The feature isn't limited to one industry or sector; it applies to any operation which seeks to calculate exact costs and improve shipment assignment. From 3PL and retail to post and parcel, the potential applications are broad and transformative. This marks a significant advancement in how businesses manage their networks, helping them optimize resources, reduce costs, and enhance sustainability efforts—and it's already in practice.

Fair cost allocation is active for Greenplan's customers, and the impact is clear—smarter, cleaner logistics drive sustainable success. In our coming release, we'll explore its

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implementation across key sectors, detailing the step-by-step process and tangible outcomes for businesses worldwide, especially those with multi-network operations.

Date: October 15, 2024

Length of text: 6,274 characters including spaces

EPG – Smarter Connected Logistics

EPG is a leading international provider for a comprehensive Supply Chain Execution Suite (EPG ONE™) and employs 1,000 people at 23 locations around the world. The company group provides its more than 1,600 customers with WMS, WCS, WFM, TMS and voice solutions to optimize logistics processes – from manual to fully automated logistics environments. EPG solutions cover the entire supply chain: From warehouse and road to ground and cargo handling solutions at airports. Logistics consulting, cloud services, managed services and logistics training courses at the company's own academy round out the comprehensive list of solutions from EPG.

Company Contact

EPG – Ehrhardt Partner Group

Dennis Kunz

Tel.: (+49) 67 42-87 27 0

E-Mail: presse@epg.com • Internet: www.epg.com

Press Contact

BFOUND GmbH

Thor Riemschneider

Tel.: (+49) 6742 8727-1209

E-Mail: Thor.Riemschneider@bfound.com • presse@epg.com • Internet: www.epg.com