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Amazon - Reducing MSD Risk with Levitote cart

Musculoskeletal disorders (MSDs) are among the most persistent sources of workplace injury across global warehousing operations. MSDs account for 32% of all U.S. workplace injuries. Within Amazon's 2,000+ site network, employees traditionally used U-boat carts with low, fixed shelves. To reduce the risk of repetitive bending, Amazon developed Levitote.

Levitote replaces the fixed base with a spring-loaded shelf that self-adjusts to load weight, keeping totes in the ergonomic power zone throughout loading and unloading and reducing the number of back bends per employee per shift. Off-the-shelf spring-loaded carts were evaluated but couldn't meet Amazon's requirements. Their springs drift out of the power zone during typical loading, and their handles and casters fail Amazon's ergonomics guidelines. Amazon designed around each limitation: a spring mechanism calibrated to Amazon-specific tote weights, optimized handle clearance, a curved vertical handle accommodating any height, larger-diameter casters to reduce push force, and scanner and water-bottle holders added from employee feedback.

Deployed to 130+ sites across four continents with 19,000+ carts in service, Levitote reduces low-back MSD risk by up to 49%. Based on employee feedback, 84% prefer it over traditional U-carts.

Amazon Case Study

Project Levitote: A Self-Leveling Cart to Reduce Musculoskeletal Injury Risk at Global Scale

The Challenge

Musculoskeletal disorders (MSDs) are among the most persistent sources of workplace injury across global warehousing operations. According to Liberty Mutual's Annual Workplace Safety Index, overexertion involving outside sources has

ranked as the leading cause of workplace injury in the U.S. every year from 2001 to 2025. MSDs account for 32% of all U.S. workplace injuries

Within Amazon's operations network, which spans more than 2,000 sites worldwide, many processes rely on traditional U-boat material handling carts. Employees scan incoming inventory, place it into totes, load those totes onto U-boat carts, and manually push them to the next process. Because traditional U-boat carts hold items on low, fixed shelves, employees bend repeatedly throughout their shifts. At the scale of Amazon's global network, even a modest per-shift reduction in bending would affect tens of thousands of employees daily. That was the problem Levitote set out to solve.

The Solution

Levitote replaces the fixed base of a traditional U-boat cart with a spring-loaded shelf that self-adjusts to load weight. When the cart is empty, the shelf sits in the ergonomic power zone (between the knees and shoulders). As totes are added, the shelf gradually lowers, keeping totes in the power zone throughout loading and unloading.

Off-the-shelf spring-loaded carts were evaluated but could not meet Amazon's requirements. Their springs are calibrated to generic loads, so the shelf drifts out of the power zone during a typical loading sequence. Their handles and casters also fail to meet Amazon's ergonomics guidelines for grip diameter, positioning, and clearance. Amazon designed around each limitation: a spring mechanism calibrated to Amazon-specific tote weights, optimized handle clearance, a curved vertical handle that accommodates any height, larger-diameter casters to reduce push force, and scanner and water-bottle holders added directly from employee feedback.

Development & Global Scaling

Levitote began in France, where a task analysis and direct employee interviews identified the Stow process as the highest-priority area for improvement. Brainstorming sessions with stakeholders and employees produced the self-leveling U-boat concept, which was validated in a successful single-site pilot before expanding across Europe.

Expanding the design globally raised a core tension: the cart had to remain ergonomically consistent while adapting to regions where tote dimensions, safety regulations, and operator anthropometrics all differ. A 'one-size-fits-all' design was unworkable. Amazon resolved this with a two-layer model: a central cart design that fixes the core ergonomic principles, paired with a project-management framework

that guides regional teams in adapting to local needs such as local tote sizes, manufacturer availability, and cost. Partnering with regional manufacturers rather than a single global supplier accelerated delivery and reduced environmental impact. Region-specific variants have been successfully deployed across Europe, India, and North America.

Results

- Reduced injury risk: up to 33% lower low-back compression forces and up to a 49% reduction in low-back shear forces versus traditional U-boats.
- Employee preference: 84% of employees prefer Levitote carts over traditional U-boats.
- Scale of deployment: more than 19,000 carts deployed to 130+ sites globally, with 30,000+ employees trained.
- Lower maintenance: a reduction in maintenance driven by fewer spare parts and repairs, with two-to-five years of maintenance-free operation.
- Safety by design: a dual-sided central braking system, developed from EU employee feedback, that locks multiple wheels simultaneously from either side of the cart.
- External recognition: the 2026 Applied Ergonomics Conference Ergo Cup awarded Levitote the “Transferability/Scalability” Ergonomics Excellence Award.

Digital Human Modelling validated Levitote’s ergonomic performance, and continuous employee feedback drove design improvements at every phase of deployment.

Future Goals & Replicability

Amazon plans to deliver more than 23,000 additional Levitote carts to over 60 sites through 2026, expanding into regions not yet covered (including Australia, Mexico, and United Arab Emirates) and scaling within existing regions. WHS teams use a structured, data-informed process, supported by Amazon’s Global Ergonomics team, to identify and address MSD risks across material-handling equipment, starting with applying the self-leveling mechanism more broadly.

The program can be adapted rather than replicated exactly, and that distinction is the lesson for other organizations: hold core ergonomic principles constant while allowing regional customization. Amazon’s two-layer structure, a centralized design team that sets ergonomic and safety standards, and regional teams that tailor

features to local requirements through shared feedback loops, offers a replicable framework for scaling safety solutions across geographically diverse operations without compromising quality or slowing deployment.