DICE Network+ Case Study

The **DICE Network+** is a three-year UKRI EPSRC-funded programme that seeks to leverage the power of the digital revolution to drive a circular economy across sectors and value chains. Led by the University of Exeter, our expert academic team comprises eleven investigators from nine UK universities. We are creating an inclusive, connected community harnessing interdisciplinary collaboration and research to guide industry partners, government bodies and policy makers towards a digitally enabled sustainable and circular economy.

Our work is focused on two key challenge areas:

- EMBED: Embedding sustainability and circularity within the design and development of digital and communication technologies.
- ENABLE: Realising the potential of the digital revolution to enable a circular economy across sectors.

By adopting a network of networks approach, harnessing interdisciplinary collaboration, research, and technological innovation, our network will be a beacon for change, inspiring and guiding industries, policymakers, and communities towards a digitally enabled sustainable and circular economy.

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For and behalf of the **DICE Network+**

Advanced Clothing Solutions: Digital Technology Enabling Circular Fashion at Scale

Transforming Fashion's Reverse Logistics Through Digital Innovation

1. Introduction & Case Summary

Advanced Clothing Solutions (ACS) has transformed from a traditional highland-wear rental shop into **Europe's largest circular fashion hub by strategically deploying digital technologies throughout its operations**. Operating from a 200,000 square-foot facility, ACS processes 400,000+ garment orders annually[1] using an integrated digital ecosystem that includes RFID tracking, automated warehouse management systems, API-driven e-commerce integrations, and proprietary resale platforms[2]. This case study examines how ACS's digital infrastructure enables brands like H&M, The North Face, and Belstaff to **deliver rental, resale, and repair services at scale**, demonstrating that circular fashion models can be both environmentally sustainable and commercially viable when powered by the right technology stack.

2. The Challenge

The fashion industry faces a fundamental operational challenge in implementing circular business models: **the complexity of reverse logistics for single-SKU inventory**

[1] With the UK market alone expected to reach 4.3 billion pieces by 2029, this is just one in 10,000 pieces being recirculated by ACS. Yet, ACS has capacity to process 6 million garments annually and 3 million in storage.
https://www.springfair.com/news/uk-fashion-industry-recap-2024-statistics-trends

[2] Dürkopp Fördertechnik, "ACS Clothing - Rental and Resale fashion fulfilment," https://www.duerkopp.com/en/stories/asc/

management. Unlike traditional linear fashion retail, which optimises for forward-moving supply chains, circular models require sophisticated systems to track, process, clean, repair, photograph, price, and redistribute individual garments through multiple use cycles[3].

When ACS expanded beyond formal menswear rental in the mid-2010s, four main challenges emerged:

1. **Operational Complexity:** Circular business models require managing thousands of unique garments with different histories and condition states. Manual tracking couldn't scale from hundreds to hundreds of thousands of items annually.
2. **Data Visibility:** Brand partners needed real-time inventory visibility across the entire lifecycle: from warehouse through rental, return, cleaning, repair, and back to availability.
3. **Integration Barriers:** Brands wanted rental and resale through existing e-commerce platforms, requiring seamless API integrations that most Third-Party Logistics (3PL) providers couldn't deliver[4].
4. **Quality Control:** Maintaining "like new" quality through multiple cycles required tracking each item's cleaning frequency, repair history, and wear patterns – impossible with manual systems.

The goal: Create **a digital backbone achieving 99.99% tracking accuracy**, seamless platform integration, real-time visibility, and support for multiple partners and business models.

[3] Business of Fashion, "DHL Launches Branded Resale," https://www.businessoffashion.com/articles/retail/dhl-launches-resale-program/ (2024)
[4] WWD, "ACS Partners With Archive to Pioneer Resale Channels," https://wwd.com/business-news/technology/acs-partners-with-archive-on-resale-channels-for-the-north-face-and-pangaia-1236160529/ (2024)

3. The Approach

ACS's approach centred on building a comprehensive digital technology stack that integrated **hardware automation, software platforms, and API-driven integrations** to create what they term a "**circular fashion operating system**".

3.1 RFID Technology for Single-Item Tracking

ACS's digital infrastructure is built on **Radio Frequency Identification (RFID) technology for instantaneous, contactless garment tracking**. RFID tags sewn into each garment contain unique identifiers linked to the item's digital record in the *Warehouse Management System (WMS)*[5].

The infrastructure includes bulk scanning, allowing multiple garments simultaneously, checkpoint readers automatically logging movements, and automated sorting integration, routing garments to appropriate stations without manual intervention.

Impact: 99.99% inventory accuracy, collective scanning of entire rental returns, processing **45,000 garments weekly**, and tracking up to **6 million items at capacity**[6].

[5] RFID Journal, "RFID Thread Provides Discreet, Nonremovable Garment Tracking," https://www.rfidjournal.com/news/rfid-thread-provides-discreet-nonremovable-garment-tracking/201779/ (2024)
[6] Dürkopp Fördertechnik, "ACS Clothing RFID Integration," op. cit.

Furthermore, recognising that technological investment often comes at an environmental cost, **ACS prioritises procuring second-hand infrastructure whenever possible**. As well, they vet partners for green credentials and have established robust *recycling and donation programs* for their IT equipment.

3.2 Warehouse Automation: The Dürkopp Fördertechnik System

ACS partnered with **Dürkopp Fördertechnik (DFT)**, a German automation specialist, to install advanced garment-on-hanger (GOH) handling systems that transformed their warehouse operations[7]. Key components included:

- **Roll Adapter System:** DFT's proprietary hanging garment transportation system moves items through the facility via automated overhead conveyors through cleaning, steaming, repair, and storage areas without manual handling.
- **Eco Flow™ Technology:** Intelligently routes garments with capacity to process 1,400 jackets per hour through the steam tunnel alone.
- **Dynamic Buffer Storage:** Twelve high-capacity buffers, 5,000 items each, use RFID for selection and tracking, automatically releasing correct garments to fast sortation systems.
- **Three-Stage Automated Sorting:** High-speed sortation systems sequence garments into customer order fulfilment, handling up to 1,000 outfits per hour[8]
- **Vertical Storage Optimisation:** The automated system maximises vertical space utilisation in the 20K square meter facility, enabling high-density storage while maintaining rapid retrieval times.

The **DFT hardware communicates seamlessly with ACS's Warehouse Management System (WMS) through barcode data and RFID transponders**, providing real-time movement and stock information[9].

3.3 Platform Partnerships: Enabling Brand-Owned Circular Services

Furthermore, other platform integrations have enabled ACS to deliver their circular services:

- **CaaStle (Clothing-as-a-Service):** ACS served as UK operational partner for CaaStle's B2B rental platform. **CaaStle handled front-end customer**

[7] Dürkopp Fördertechnik, "GarmentFlow® Hanging conveyor system," https://www.duerkopp.com/en/products/garmentflow/ (2025)
[8] Warehouse & Logistics News, "Dürkopp Fördertechnik technology enables leading clothing hire group to pick 1000 outfits an hour," https://warehousenews.co.uk/2014/06/durkopp-fordertechnik-technology-enables-leading-clothing-hire-group-to-pick-1000-outfits-an-hour/ (2014)
[9] Warehouse & Logistics News, "Dürkopp implements hanging garment distribution centre for ASDA George," https://warehousenews.co.uk/2009/10/durkopp-implements-another-hanging-garment-distribution-centre-for-asda-george/ (2009)

experience while ACS managed backend operations through API connections synchronising inventory, orders, and fulfilment[10]. This enabled brands like LK Bennett to launch subscription rental in weeks[11]. Yet, in 2024 CaaStle collapsed, which highlighted partnership risks; despite flawless ACS execution, front-end technology failure cascaded to client relationships[12].

- **Reflaunt (Resale as a Service):** In 2022, **ACS partnered with Reflaunt to deliver a resale as a service model for global fashion brands**. ACS is notified when customer submitted items arrive for digitisation, and they use the Reflaunt platform to detail inspection, grading, and add photography. Reflaunt then lists across its network of 25+ marketplaces and 50 million customers[13][14]. For Reflaunt, ACS does not clean or refurbish items. Items are listed exactly as received, and ACS grades them against the condition declared by the customer. This partnership combines ACS's operational capacity with Reflaunt's marketplace reach to create significant scale.
- **Archive *(Branded Resale Marketplaces and Resale as a Service):*** *ACS's 2024 partnership with Archive represents the next stage in its resale infrastructure. Together,* ***ACS and Archive build fully branded resale marketplaces for fashion partners****, allowing brands to own the customer experience from start to finish. Archive provides the digital ecosystem, acting as the brains of the operation. This includes product data ingestion, automated item identification, pricing logic, and marketplace management. ACS provides the hands, delivering the operational engine that receives, processes, cleans, repairs, grades, photographs, and fulfils items. This partnership enables brands to launch high quality circular commerce channels supported by Archive's software intelligence and ACS's operational scale. It also incorporates a resale as a service model for brands that want a streamlined, operationally supported resale channel without building a full marketplace*[15].

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[10] TechCrunch, "Gwynnie Bee is bringing subscription clothing rental to traditional retailers with launch of 'CaaStle'," https://techcrunch.com/2018/03/22/gwynnie-bee-is-bringing-subscription-clothing-rental-to-traditional-retailers-with-launch-of-caastle/ (2018)

[11] PR Newswire, "CaaStle Brings Subscription Clothing Rental Platform to UK," https://www.prnewswire.com/news-releases/caastle-brings-subscription-clothing-rental-platform-to-uk-301268769.html (2021)

[12] Business of Fashion, "CaaStle's Christine Hunsicker to Face US Fraud Charges," https://www.businessoffashion.com/news/retail/caastles-christine-hunsicker-to-face-us-fraud-charges/

[13] ACS Clothing, "ACS Accelerates Resale with Reflaunt Partnership," https://acsclothing.co.uk/acs-fulfill-resale-with-reflaunt/ (2022)

[14] Latana, "Reflaunt's Success in the Luxury Second-Hand Market," https://resources.latana.com/post/reflaunt-deep-dive/

[15] Sourcing Journal, "Archive Brings Brand-Owned Resale to the UK," https://sourcingjournal.com/sustainability/sustainability-news/archive-brand-owned-resale-uk-the-north-face-pangaia-advanced-clothing-solutions-emily-gittins-491621/ (2024)

- ***Redivivum*** ***(AI Driven Marketplace Optimisation):*** *ACS also partners with Redivivum to enhance resale performance through AI driven optimisation. Redivivum's machine learning tools improve product listings for third party marketplaces such as eBay and Depop by refining titles, descriptions, keywords, and pricing to maximise visibility and conversion. This partnership represents ACS's dedicated use of AI for marketplace optimisation, separate from the operational and marketplace building roles delivered through Reflaunt and Archive.*

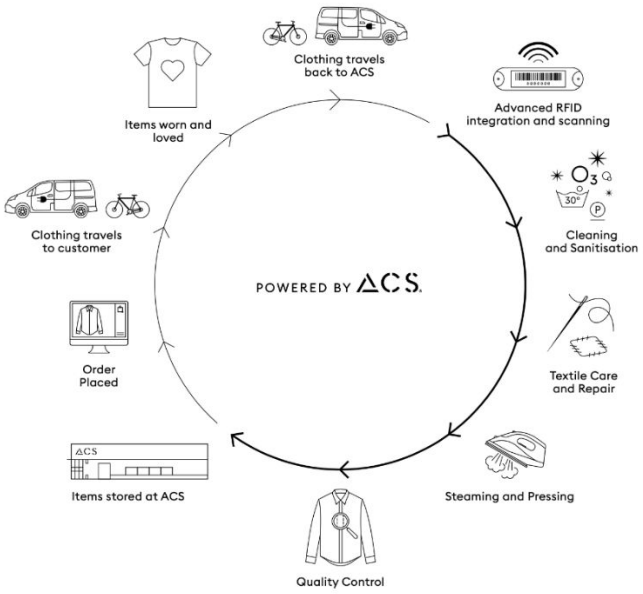

Image 1: ACS powers the entire reverse logistics process

3.4 E-Commerce Integration Architecture

ACS invested significantly in API-driven integration capabilities, working with integration specialists like **Cogent2** to connect their WMS/3PL systems with diverse brand e-commerce platforms[16].

Integration Capabilities:

- **Platform Agnostic:** ACS systems integrate with Salesforce Commerce Cloud, Shopify, Marketplacer, SAP, and custom brand platforms.

[16] Cogent2, "Advanced Clothing Solutions (ACS) and Salesforce Commerce Cloud Integration," https://www.cogent2.com/products/advanced-clothing-solutions-acs-salesforce-commerce-cloud-integration-agency-consultants

- **Real-Time Data Exchange:** Orders data flows from brand e-commerce systems to ACS systems instantly, triggering automated WMS processes.
- **Bi-Directional Synchronisation:** Inventory availability, order status, and delivery tracking information flows back to brand systems in real-time.
- **Microservices Architecture:** Modular approach allows ACS to connect different components; including inventory management, order processing, and fulfilment tracking, independently.

These integrations allow ACS to plug into partners' existing tech systems with minimal disruption, typically achieving full integration in weeks rather than months[17].

3.5 Data Analytics and Operational Intelligence

ACS's digital operations are anchored in a **robust data-driven framework** designed to maximise both **garment longevity** and **operational scale**.

By **tracking individual garment lifecycle data**, including rental frequency, cleaning cycles, and repair history, ACS gains a granular view of **condition degradation patterns**. These **metrics are critical because they transform physical inventory into actionable intelligence**, with *optimal cleaning and maintenance schedules* and an impressive *84% recovery rate on returned garments requiring repair,* directly ensure consistent garment quality while minimising waste. Furthermore, by **calculating carbon emissions per garment cycle**, ACS provides the comprehensive transparency required for credible sustainability reporting[18].

This analytical approach enables **predictive maintenance** to intercept garments before they approach end-of-life, **quality optimisation** that uses repair patterns to advise brands on more durable designs and identifies **operational efficiency** bottlenecks in real-time to maintain peak efficiency.

4. Unexpected Outcomes

The integration of digital technologies frequently produces unintended effects. By examining these unplanned outcomes, ACS has gained critical insights that now drive their executive decision-making.

[17] Cogent2, "Advanced Clothing Solutions (ACS) Integration iPaaS," https://www.cogent2.com/collections/advanced-clothing-solutions-acs-integration-ipaas-agency
[18] VIBES, "ACS Clothing Ltd Case Study," https://www.vibes.org.uk/case-studies/2024/acs-clothing-ltd (2024)

- **RFID's Exponential Value:** While implemented primarily for tracking accuracy, RFID's most valuable benefit proved to be speed of processing. The *ability to scan entire batches collectively transformed throughput rates*.
- **Data as a Differentiator:** Operational data became ACS's most valuable offering to brand partners. Beyond providing logistics services, ACS delivers insights about garment performance, customer behaviour, and sustainability metrics that brands can't obtain elsewhere.
- **Technology Interdependencies:** The CaaStle collapse highlighted how dependent circular digital ecosystems are on every component functioning well. Despite ACS flawlessly executing operations, front-end technology failure cascaded through to client relationships, prompting strategic discussions about developing proprietary front-end capabilities.
- **Digital Expectations Evolve Rapidly:** Features considered "advanced" when implemented (i.e., Real-time inventory visibility) became baseline expectations within 18 months, creating permanent pressure to continuously innovate the digital stack.

5. Key Learnings:

Below are the critical lessons learned from leveraging digital systems within the circular economy.

- **Build Platform-Agnostic from Day One:** ACS initially optimised integrations for specific partner platforms. When partners changed systems or providers went bankrupt, rework was necessary. Starting again, they'd invest earlier in fully abstracted, platform-agnostic integration architecture.
- **Invest in Proprietary Core Technology:** While partnering with platforms accelerated growth, over-dependence created vulnerabilities. ACS learned to balance between differentiating capabilities (build in-house) and commodity services (partner).
  "We should have developed our own core inventory management and operational intelligence platform earlier," ACS Leadership reflected.
- **Data Infrastructure Before Data Applications:** ACS built many data analytics capabilities reactively. They would now invest first in a comprehensive data infrastructure: data lake, standardised metrics, robust APIs , then build applications on top.
- **Strategic Technology Partnerships Require Different Contracts:** When CaaStle collapsed, standard vendor agreements didn't adequately address interdependencies. ACS would now structure partnerships with explicit provisions for technology escrow, transition rights, and shared risk/reward.

6. The Outcome

ACS's digital transformation delivered measurable impacts across operational, environmental, and business dimensions:

6.1 Operational Excellence

- **Processing Capacity:** 400,000+ garment orders annually with capacity to scale significantly
- **Inventory Accuracy:** 99.99% tracking accuracy through RFID implementation
- **Processing Speed:** 45,000 garments cleaned per week, 1,400 jackets steamed per hour
- **Recovery Rate:** 84% of resale items successfully returned to market
- **Storage Capacity:** 3 million items with vertical automated storage systems

6.2 Environmental Impact

- **Carbon Reduction:** 24% year-over-year reduction in CO2 emissions despite business growth (380 tonnes saved)[19]
- **Waste Elimination:** Zero textile waste to landfill through intelligent routing to resale, recycling, or donation
- **Garment Lifespan Extension:** Average rental garments exceed typical 8-wear lifespan substantially
- **Resource Efficiency:** Smart LED lighting, wastewater recycling, and optimised cleaning cycles reduce environmental footprint

6.3 Business Growth and Recognition

- £10 million investment from Circularity Capital (April 2023)[20]
- Workforce growth from 60 to 160+ employees
- Partnership with Europe's leading brands (H&M, The North Face, Belstaff, Decathlon, Monsoon)
- Two King's Awards for Enterprise (Sustainable Development 2023, Promoting Opportunity 2025)[21]
- B Corporation Certification (2022)

6.4 Enabling Partner Brand Success

[19] Ibid
[20] Circularity Capital, "Circularity Capital announces investment of £10m in ACS," https://circularitycapital.com/news/2022/11/24/circularity-capital-announces-investment-of-10m-in-leading-circular-fashion-enabler-acs (2022)
[21] UK Fashion & Textile Association, "ACS Kings Award Promoting Opportunity," https://ukft.org/acs-kings-award-promoting-opportunity/ (2025)

Brand launches powered by ACS technology include H&M Preloved Archive, The North Face Renewed UK, PANGAIA ReWear, Decathlon rental, and Monsoon x eBay resale program.

7. Looking Forward

ACS's digital transformation journey continues to evolve with several strategic initiatives on the horizon:

- **Proprietary Platform Development:** Reducing dependency on external platforms through brand-facing portals for real-time visibility and white-label consumer rental/resale interfaces
- **AI and Machine Learning:** Developing internal models for demand forecasting, computer vision quality grading, predictive maintenance, IT and HR help desks, and dynamic pricing
- **Digital Product Passports:** Exploring blockchain integration to track garment lifecycle from manufacturing to recycling, definitely a game-changer [22]
- **European Expansion:** Replicating the Glasgow hub model across European markets using proven digital infrastructure
- **Vertical Integration:** Connecting design and manufacturing with retail and circular services, including design feedback loops based on circularity performance data
- **Industry Infrastructure Provider:** Positioning ACS as the AWS of circular fashion – providing scalable digital infrastructure for other regions and operators
- **Carbon Intelligence Platform:** Transforming operational data into comprehensive carbon accounting for precise environmental impact measurement per garment and transaction

Key Takeaways

ACS's journey offers critical insights for organisations seeking to enable circular business models through digital technology:

[22] PwC Netherlands, "Future proofing sustainable fashion via digitalisation and transparency," https://www.pwc.nl/en/insights-and-publications/services-and-industries/retail-and-consumer-goods/future-proofing-sustainable-fashion-via-digitalisation-and-trans.html

1. **Digital Infrastructure is the Bottleneck:** The barrier to scaling circular fashion isn't consumer demand – it's operational complexity. Digital technology that solves reverse logistics unlocks circular viability at scale.
2. **Balance Platform Strategy:** Partnering accelerates capabilities but creates dependencies. Build proprietary core technology while partnering for commodity services.
3. **Data is the Product:** Operational data about garment performance, customer behaviour, and sustainability metrics became as valuable as logistics services. Design data capture from inception.
4. **Integration Architecture Determines Growth:** Rapid integration with diverse brand e-commerce systems determines scaling speed. Modular, API-driven architecture enables growth; tightly coupled integrations create friction.
5. **Continuous Evolution is the Model:** Circular businesses exist in permanently evolving states. Embed perpetual innovation into culture rather than treating digital transformation as a finite project.