# 3.2  Case Selection

The multiple–case strategy underpinning this research hinges on a \*\*theoretical‑replication sampling logic\*\* rather than statistical representativeness.¹ Three companies—DHL Group, Unilever PLC and BMW AG—were selected through a two‑stage screening that balanced cross‑sector diversity with data richness and Industry 4.0 maturity.

\*\*Stage 1: Sectoral stratification.\*\* A preliminary scan of Global Lighthouse Network reports and IFR statistics identified sectors where digital‑operations pilots had demonstrably scaled: logistics, fast‑moving consumer goods (FMCG) and automotive.² These sectors exhibit distinct product–process archetypes (service‑dominant, high‑variety batch, and capital‑intensive flow), offering fertile ground for “literal replication” tests of common mechanisms across contrasting contexts.

\*\*Stage 2: Firm‑level filtering.\*\* Within each sector, candidate firms were evaluated against five criteria:

1. \*\*Public data availability.\*\* Continuous annual and ESG reporting between 2015 and 2024, allowing construction of a ten‑year panel.   
2. \*\*Documented I4.0 adoption.\*\* Inclusion in at least one recognised digital‑manufacturing index (e.g., WEF Lighthouse, Gartner Supply‑Chain Top 25) to ensure substantive, not aspirational, deployment.   
3. \*\*Supply‑chain complexity.\*\* Global multi‑tier networks whose performance KPI disclosures extend beyond financials (e.g., OTIF, inventory days).   
4. \*\*Sustainability transparency.\*\* CDP or GRI datasets containing scope‑1/2/3 emissions, energy and waste metrics.   
5. \*\*Sector comparability.\*\* Similar revenue scale (> €50 bn) to mitigate size effects.

DHL Group emerged as the logistics exemplar, operating more than 350 smart warehouses and publishing granular “Operations 4.0” metrics.³ Unilever, with its extensive portfolio and blockchain‑based traceability pilots, met all FMCG criteria while providing open eco‑efficiency data going back to 2010.⁴ BMW AG represents automotive; its Regensburg plant was among the first twenty lighthouses and the firm discloses detailed digital‑capex and robot‑density figures.

\*\*Rationale for three‑case scope.\*\* A trio balances analytic depth with replication power. Yin suggests two to four literal replications as sufficient for uncovering pattern regularities, provided cases vary on key contextual dimensions.¹ Three also respects pragmatic constraints on data cleaning and timeline reconstruction, keeping the study feasible within a master's timeframe.

\*\*Exclusion considerations.\*\* Aerospace and electronics leaders (e.g., Airbus, Foxconn) were excluded despite advanced automation because supply‑chain KPI transparency remained limited or proprietary. SMEs and privately held firms were omitted owing to patchy disclosures and incomparable scale.

\*\*Embedded units alignment.\*\* Each chosen firm supplies: (i) a decade of firm‑year quantitative metrics; (ii) discrete intervention events (e.g., DHL’s 2019 global robotics roll‑out); and (iii) rich qualitative artefacts—analyst calls, press briefings, Lighthouse case notes—enabling triangulation across embedded units. Collectively, the cases create a \*\*maximum‑variation design\*\* that strengthens external validity while holding constant data‑quality and firm‑size confounds.

By satisfying these selection criteria, the trio provides a robust canvas on which to test how Industry 4.0 technologies propagate through diverse supply‑chain architectures, why performance outcomes diverge, and under what conditions sustainability synergies arise. The next subsection details the variable operationalisation and data‑collection workflow that will be uniformly applied to each case.

## Footnotes

1. Robert K. Yin, \*Case Study Research and Applications: Design and Methods\*, 7th ed. (Los Angeles: SAGE, 2023). https://us.sagepub.com/en-us/nam/case-study-research-and-applications/book268467

2. World Economic Forum, \*Global Lighthouse Network: Shaping the Next Chapter of the Fourth Industrial Revolution\* (Geneva: WEF, 2023). https://www3.weforum.org/docs/WEF\_Global\_Lighthouse\_Network\_2023.pdf

3. DHL Group, \*Operations 4.0 Annual Report\* (2024). https://www.dhl.com/content/dam/dhl/global/core/documents/pdf/dhl-operations-4-0-report-2024.pdf

4. Unilever, \*Sustainable Living Report\* 2024. https://www.unilever.com/files/92u9a/sustainable-living-report-2024.pdf