Financial Strategy and Management Reviews, 2026, 2(2), 41-55
https://doi.org/10.71204/20ympe22

Developing and Applying a Framework to Assess New Quality Productive Forces in New Energy Enterprises from a Supply Chain Integration Perspective

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Received: 15 October 2026 / Accepted: 17 November 2026 / Published online: 18 November 2026

Abstract

Assessing new quality productive forces from public reports is difficult because the available firm-level measures describe financial structure and workforce composition, not the coordination that runs across firms, and because a report that says nothing about a practice is easily misread as evidence that the practice is absent. This paper builds a diagnostic that treats such forces, for photovoltaic and lithium-battery manufacturers, as disclosed supply-chain integration practice. An integrative reading of measurement, integration and industry studies yields four dimensions and twelve indicators, each tied to one interface among internal functions, suppliers, customers and other partners, and each coded on a five-level scale of public evidence. The arithmetic is fixed before any score is read: a dimension score uses only the indicators that have evidence, a conditional total is reported only when at least 80 percent of indicators are scored and every dimension has at least two, and every unscored indicator is kept out of the total and inside an identification bound that places it at the bottom and then at the top of the scale. One coder applied the scheme to the 2025 reports of ten disclosure-rich manufacturers, scoring 114 of 120 firm-indicator cells and leaving six not assessable. The conditional totals run from 54.17 to 62.50, the knowledge dimension has the highest mean and technology flexibility accounts for five of the six gaps. Shifting any dimension's weight to 20 or 30 percent moves a score by at most 1.04 points and reverses no pairwise ordering, although six firms change rank once tied scores are counted. The scores are one coder's reading of disclosed practice, not a measure of productivity.

Keywords: New Quality Productive Forces; Supply Chain Integration; Composite Indicator; Missing-Data Bounds; Photovoltaic And Battery Manufacturing

1. Introduction

A manufacturer that coordinates design, purchasing, production and recovery with its suppliers and customers is doing something that its financial statements do not record. New quality productive forces, as the term is now used in Chinese firm-level research, concern the upgrading of workers, the means and objects of labor, and the way these are configured (Liu et al., 2026; Song et al., 2024). The measures built for that concept rely on financial ratios and workforce composition, which describe outcomes and structure. They say nothing about whether knowledge actually moves between functions, whether a supplier shares quality data, or whether a recovered module returns as material. For listed photovoltaic and lithium-battery manufacturers, whose supply chains are concentrated, long and increasingly circular (International Energy Agency, 2022, 2024), that omission matters: coordination across firms is one place the upgrading can occur, and public reports are often the only evidence available for reading it.

The gap is shared by both literatures that bear on the problem. The measurement studies stop at the boundary of the firm (Liu et al., 2026; Song et al., 2024). The integration studies cross that boundary, distinguishing internal, supplier and customer integration (Flynn et al., 2010), locating advantage in relation-specific assets and shared knowledge routines (Cao & Zhang, 2011; Dyer & Singh, 1998), and linking green information systems and knowledge exchange to innovation (Kong et al., 2020; Qu & Liu, 2022), but they supply no rule for scoring a public report. Industry work on photovoltaic module recovery (Tsanakas et al., 2020) and on the relation between sustainability and resilience describes what a circular chain should contain without separating a design intention from an implemented practice from a counted recovery (Negri et al., 2021). None of these lines specifies what to do when a report is silent, and silence is the usual case rather than the exception.

The objective of this paper is to turn the element-upgrading content of new quality productive forces into observable integration practice, and to state the evidence requirement, the treatment of missing disclosure and the arithmetic before any firm is scored. Three contributions follow. (i) Relative to the financial and workforce measures of Song et al. (2024), the framework maps each integration interface onto an observable capability, so that cross-firm coordination becomes visible at all. (ii) Relative to integration constructs that were built for surveys (Cao & Zhang, 2011; Flynn et al., 2010), it offers a four-dimension, twelve-indicator coding scheme with a per-indicator anchor, a coverage rule fixed in advance and an explicit bound on every unscored item, built under the transparency requirements set out for composite indicators (OECD et al., 2008). (iii) Relative to publishing a bare index, one coder's application to ten 2025 reports the raw level, the coverage and the bound together, so that non-disclosure stays visible instead of entering the score as weakness. No part of the paper claims that more integration produces higher productivity. Figure 1 sets out the chain from interface to evidence level and the branch at which an unscored item leaves the score.

2. Conceptual Basis

2.1. What the Framework Measures

The object of measurement has to be fixed before the indicators are chosen, because new quality productive forces is a wider idea than any one instrument can cover. Song et al. (2024) construct an eleven-indicator firm measure from the two-factor account of productivity, splitting living labor into research personnel and their pay, materialized labor into the objects and the instruments of labor, and adding the means of production, with weights obtained by the entropy method. Liu et al. (2026) carry the same element structure into later work on artificial intelligence and the workforce. Both are coherent measures of structure and outcome. Neither observes a process that crosses an organizational boundary, since a ratio computed from one firm's accounts cannot show whether a supplier took part.

That is the gap the present framework is built to fill, and it fills it narrowly. What is scored is the public evidence that a practice relevant to element upgrading was disclosed, not the upgrading itself and not a latent level of new quality productive forces. A firm can be upgrading its production without writing it down, and a firm can describe a practice it executes poorly. The score therefore moves with disclosure as well as with practice, and Section 4 reads every number under that condition.

2.2. Why these Interfaces

Once the object is disclosed practice, the question is which practices to look for. Flynn et al. (2010) separate internal, supplier and customer integration and show that their relation to performance is contingent, with internal and customer integration more strongly associated with improvement than supplier integration. Cao and Zhang (2011) add the collaborative processes, including information sharing, goal congruence and joint knowledge creation, through which integration becomes a collaborative advantage. Dyer and Singh (1998) give the reason such processes can matter: relation-specific assets, knowledge-sharing routines, complementary resources and effective governance are sources of advantage that no firm holds alone. These three accounts define the interfaces used here, namely internal functions, suppliers, customers and other partners such as research and recovery organizations, and they define them as connections of process and information rather than as ownership.

The interfaces still need content that a report can evidence. Kong et al. (2020) trace green supply-chain integration into green innovation through knowledge exchange and knowledge combination, which is why joint learning and skill renewal are treated as observable rather than inferred. Qu and Liu (2022) find that green information systems moderate the link between integration and green innovation, which is why shared environmental information and cross-firm data connections are coded as practices in their own right. Ataseven and Nair (2017) pool the integration-performance evidence and find it contingent on the type of integration and the type of performance. That contingency is the reason this paper stops at measurement and does not estimate an effect of integration on productivity.

The resulting chain is drawn in Figure 1. Each indicator is assigned to one interface, the interfaces feed four capabilities, and each capability is read from that year's public report as an

evidence level. The chain splits at the bottom, because a scored level enters the conditional score while an item with nothing found enters only the identification bound.

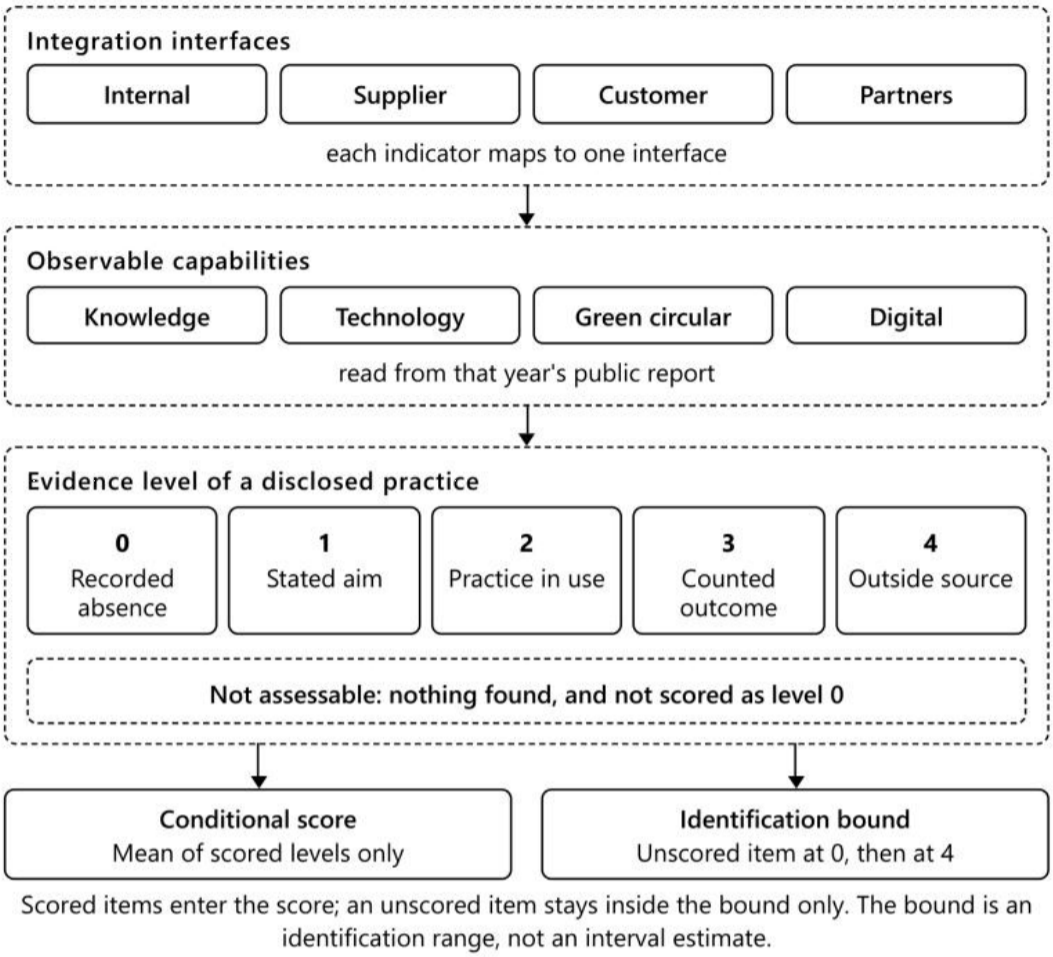


Figure 1. Concept chain of the assessment framework

2.3. Why this Industry

The four capabilities are general, but two of them take their shape from the industry. Tsanakas et al. (2020) review the recovery, repair, refurbishment and re-certification of photovoltaic modules and show that design-stage recyclability, a functioning take-back route and a counted volume of material actually processed are different things. Collapsing them into one green indicator would credit an intention with a result. The same separation applies to batteries, where the International Energy Agency documents supply chains that are geographically concentrated and exposed to disruption (International Energy Agency, 2022, 2024), so that traceability of materials and the ability to reconfigure production are substantive capabilities rather than reporting niceties. Negri et al. (2021) review the overlap of sustainability and resilience and note that the two are pursued through different practices and can conflict with efficiency goals. The framework keeps them apart: green and circular value covers design, shared environmental information and reverse flows, while digital coordination covers interoperability, joint planning and traceability. Potential, implemented practice and counted result are then separated again by the evidence scale itself.

3. Framework and Scoring

3.1. How the Indicators were Selected

The indicators come from an integrative review rather than from a single existing scale (Snyder, 2019). The material read covers firm-level measurement of new quality productive forces, supply-chain integration and collaboration, green innovation and circular chains, and the two industry reports already cited. An indicator was kept only when it corresponded to one concept, could be observed in a public report, was available for the reporting year, and did not duplicate another indicator. Equal weighting, a disclosed coverage rule and a sensitivity check follow the transparency requirements of the composite-indicator handbook (OECD et al., 2008), which treats the weighting scheme as a choice that must be stated and tested rather than as a result. The search strings and the exclusion rules are recorded in a reproducibility note so that the selection can be retraced; the body of the paper uses only the indicators that survived it.

3.2. The Twelve Indicators

The twelve indicators are set out in Table 1. The four dimensions correspond to the element-upgrading account, but they are not a relabeling of the eleven-indicator measure of Song et al. (2024): knowledge and skill reconfiguration stands in for the upgrading of workers, technology and production upgrading for the means and objects of labor, and the green-circular and digital dimensions for the innovative configuration of the elements. Every indicator is an operationalization proposed here, built from the studies named in the last column, and none is taken unchanged from a published scale. Where a practice could be read under more than one dimension, it is coded by its primary function and only on evidence that is independent of the evidence used elsewhere.

Table 1. The twelve indicators, their interfaces and their anchors

Code	Indicator	Interface	What level 2 requires	Anchor studies
K1	Cross-functional knowledge integration	Internal	A running cross-functional review, platform or process	Cao & Zhang, 2011; Flynn et al., 2010; Kong et al., 2020
K2	Joint external learning and development	External partners	A named partner and a joint activity underway	Cao & Zhang, 2011; Dyer & Singh, 1998; Flynn et al., 2010; Kong et al., 2020
K3	Renewal of workforce skills	Internal, supplier	Training tied to manufacturing or development tasks	Kong et al., 2020; Liu et al., 2026; Song et al., 2024
T1	Joint development and engineering	Internal, external partners	Joint work reaching trial, process or production use	Cao & Zhang, 2011; Flynn et al., 2010; Kong et al., 2020

Code	Indicator	Interface	What level 2 requires	Anchor studies
T2	Process and quality coordination	Supplier, internal	Shared quality standards, data exchange or closed-loop correction	Ataseven & Nair, 2017; Cao & Zhang, 2011; Flynn et al., 2010
T3	Flexibility of technology upgrading	Internal, customer	Reconfiguration of the firm's own equipment, process or line	Ataseven & Nair, 2017; Flynn et al., 2010
G1	Green design and material coordination	Supplier, customer	Eco-design or low-carbon material linked to purchasing	Negri et al., 2021; Qu & Liu, 2022; Tsanakas et al., 2020
G2	Environmental information and joint improvement	Supplier, internal	Accounting and sharing of product or chain environmental data	Negri et al., 2021; Qu & Liu, 2022; Tsanakas et al., 2020
G3	Reverse supply and circular use	Customer, recovery partners	A recovery network, return flow or remanufacturing activity	International Energy Agency, 2024; Negri et al., 2021; Tsanakas et al., 2020
D1	Cross-firm information interoperability	Supplier, customer	A data interface or connection platform in operation	Cao & Zhang, 2011; Flynn et al., 2010; Qu & Liu, 2022
D2	Collaborative planning and scheduling	Supplier, internal, customer	Joint demand, inventory, production or delivery planning	Ataseven & Nair, 2017; Cao & Zhang, 2011; Flynn et al., 2010
D3	Product and material traceability	Supplier, internal, customer	Recording of material or product origin and movement	Flynn et al., 2010; Qu & Liu, 2022; Tsanakas et al., 2020

Note: All twelve indicators are operationalized in this paper. Level 2 is the implementation level; the full anchor text for levels 1 and 3 is given in the supplement.

3.3. The Evidence Scale

The unit of coding is a firm, a reporting year and an indicator. The reporting year is 2025; the reports were published in 2026 and are not read as 2026 production data. Each coded cell keeps the firm identifier, the indicator, a short evidence statement, the source document and the level assigned.

The level records how far the disclosed evidence supports the indicator, on a scale from 0 to 4. Level 0 is reserved for a documented absence, a statement that the practice does not exist or does not meet the definition, and it is never inferred from silence. Where a search of the report and the

supplementary filings finds nothing, the cell is marked not assessable and stays out of every score. Level 1 is a stated policy or target. Level 2 is a specific mechanism or practice that matches the indicator definition and is described as operating. Level 3 requires, beyond implementation, a count, a coverage or a result with its scope stated. Level 4 requires an independent third-party source for that indicator's specific result; a general assurance of the report, a self-reported certificate or an unspecified award does not qualify. When the evidence meets more than one level, the highest defensible level is taken, and levels are not added together. A larger quantity does not by itself raise the level.

In the ten reports coded here the levels actually assigned are 1, 2 and 3, with six cells not assessable. No cell is scored 0 or 4. Treating the steps between levels as equal is a convention adopted so that the aggregation is transparent, and it is not a property this study tests. Because of that, the raw levels are reported alongside the scores, and a score quoted to two decimals is not to be read as a precise measurement of capability.

3.4. Aggregation and the Treatment of Missing Disclosure

Let s_{ij} be the level of firm i on indicator j, taking a value in $\{0,1,2,3,4\}$, and let a cell with no evidence be recorded separately as not assessable. Dimension d contains three indicators, O_{id} is the set of them that have a level, and n_{id} is the size of that set. The dimension score uses the observed indicators only:

$$D_{id} = 100 \times \frac{\sum_{j \in O_{id}} s_{ij}}{4 \times n_{id}} \tag{1}$$

It is reported only when at least two of the three indicators are scored. The conditional total gives the four dimensions equal weight and is reported only when two further conditions both hold: coverage of at least 80 percent, and at least two scored indicators in every dimension.

$$S_i = \frac{1}{4} \sum_d D_{id} \tag{2}$$

Both thresholds were set before the scores were computed. They are disclosure-sufficiency rules chosen for this study, not industry standards. A firm that fails either one is reported at indicator level with its coverage, and it receives no total. With three indicators in each dimension and equal dimension weights, a complete record gives every indicator a weight of one twelfth. Where indicators are missing, the conditional total redistributes weight toward the indicators that were observed inside their dimension, which is why the total is never published without the bounds below.

Coverage is the share of indicators that received a level:

$$C_i = \frac{n_i}{12} \tag{3}$$

The bounds keep the denominator fixed at the complete set of twelve indicators, whose maximum sum of levels is 48. The lower bound scores every unscored indicator at 0 and the upper bound scores it at 4:

$$L_i = 100 \times \frac{\sum_{j \in O_i} s_{ij}}{48} \tag{4}$$

$$U_i = 100 \times \frac{\sum_{j \in O_i} s_{ij} + 4\,(12 - n_i)}{48} \quad (5)$$

The interval from L_i to U_i is an identification range. It states how far the score could move if the missing evidence were found and coded at one extreme or the other. It does not impute a value, it is not a confidence interval, and it collapses to the conditional total whenever the record is complete.

Equal weights are used because ten illustrative cases cannot support a data-driven weighting and because no expert judgement matrix was collected, so neither entropy weighting nor an analytic hierarchy process would be defensible. Equal weights are a transparency choice made in the absence of evidence for any other ordering of importance. They are not a claim that the four dimensions matter equally, which is why Section 4 recomputes every score with the weights disturbed.

3.5. Overlapping Practices

Several practices cut across dimensions, and the coding rules stop one piece of evidence from earning two quantified results. A single platform may support both a data connection under D1 and joint planning under D2, but only if the two functions are evidenced separately; the same count cannot be used twice. A count of joint development projects under K2 is not a count of production outcomes under T1. A design-stage recyclability rate under G1 is not a volume of material actually processed under G3. Traceability under D3 is evidence about information, not about digital productivity as a whole.

3.6. Coding Quality

All 120 firm-indicator cells were coded by one coder, with the source and the reasoning retained for each cell. No second coder reviewed them, so no agreement statistic is reported and none should be inferred. This is a property of the application rather than only a limitation to be noted afterwards: every number in Section 4 comes from that single pass. The evidence ledger is published with the paper, and a reader who disagrees with a level can rescore the cell and recompute the total. The rules in Sections 3.3 to 3.5 are what keep non-disclosure visible. An unscored cell never enters a dimension score as a low level; it widens the identification bound instead, and the coverage figure shows how much of the record that bound rests on.

4. Illustrative Application

4.1. The Case Set

The coding scheme was applied to one reporting year, 2025, for manufacturers in the photovoltaic and lithium-battery chain. The sampling frame holds 195 firms meeting the roster definition. Ten were drawn at random without replacement with seed 20261111, and redrawing the sample under the same seed reproduces that draw. Five of the ten met the entry rule, which requires at least ten of the twelve indicators to be scorable and at least two per dimension. Five further firms were then taken from the verified candidates, in the recorded replacement order, until ten firms qualified. The candidates that were not verified were not coded at the same depth,

so the resulting set is conditioned on disclosure. It represents manufacturers in this chain whose reports contain enough scored evidence to pass the rule, and it does not represent the chain as a whole.

The sources are the 2025 sustainability report of each firm (DR Laser, 2026; EVE Energy, 2026; Flat Glass, 2026; GCL System Integration, 2026b; Great Power, 2026b; Hongyuan Green Energy, 2026; Jolywood, 2026; Laplace, 2026; Sunwoda, 2026; Zhongke Electric, 2026b), supplemented for three firms by the 2025 annual report (GCL System Integration, 2026a; Great Power, 2026a; Zhongke Electric, 2026a) and for one firm by a company notice (Sunwoda Energy, 2025). Each of the 120 cells in the evidence ledger records the level, a summary of the evidence and the location in the source document.

4.2. Scores, Coverage and Bounds

Every firm clears both sufficiency rules, so all ten receive a conditional total. Table 2 reports the four dimension scores, the total, the coverage and the identification bounds.

Table 2. Dimension scores, conditional totals, coverage and identification bounds for the ten firms

Firm	Code	Segment	K	T	G	D	Total	Scored	Bounds
DR Laser	300776	PV processing equipment	58.33	50.00	66.67	50.00	56.25	11/12	52.08–60.42
Sunwoda	300207	Lithium battery	58.33	58.33	58.33	58.33	58.33	12/12	58.33–58.33
Flat Glass	601865	PV auxiliary materials	66.67	62.50	66.67	50.00	61.46	10/12	52.08–68.75
EVE Energy	300014	Lithium battery	58.33	62.50	66.67	50.00	59.38	11/12	54.17–62.50
Jolywood	300393	PV cells and modules	58.33	58.33	66.67	41.67	56.25	12/12	56.25–56.25
GCL System Integration	002506	PV cells and modules	66.67	58.33	58.33	50.00	58.33	12/12	58.33–58.33
Hongyuan Green Energy	603185	Polysilicon and wafers	58.33	62.50	66.67	41.67	57.29	11/12	52.08–60.42
Zhongke Electric	300035	Battery materials	66.67	58.33	50.00	50.00	56.25	12/12	56.25–56.25
Laplace	688726	PV processing equipment	66.67	50.00	50.00	50.00	54.17	11/12	50.00–58.33
Great Power	300438	Lithium battery	75.00	50.00	75.00	50.00	62.50	12/12	62.50–62.50

Note: K, T, G and D are the knowledge, technology, green-circular and digital dimension scores from Equation (1). The total is the conditional score from Equation (2). Bounds are the identification range from Equations (4) and (5). All figures are one coder's reading of the 2025 reports.

The totals span a narrow band, from 54.17 for Laplace to 62.50 for Great Power. That band is where a body of evidence concentrated at the implementation level should fall. Of the 120 cells, 114 are scored and six are not assessable; the scored cells are three at level 1, 71 at level 2 and 40 at level 3. No cell reaches the documented-absence level or the third-party-evidence level, so the score cannot move to either end of its theoretical range on the evidence in hand.

Three patterns organize the matrix, and all three are read against the disclosure filter that produced the set. The dimension means across the ten firms are 63.33 for knowledge, 62.50 for the green-circular dimension, 57.08 for technology and 49.17 for the digital dimension, so the knowledge dimension is the highest and the digital dimension the lowest. The ordering is a property of these ten disclosure-rich reports, not of the industry. Second, collaborative planning and scheduling is scored at level 2 for every firm: joint planning is described as operating everywhere in the set, and nowhere is it supported by a scoped, counted outcome. The other two digital indicators are not uniform, so the pattern belongs to that one indicator and not to digital coordination as a whole. Third, technology flexibility accounts for five of the six unscored cells, at DR Laser, Flat Glass, EVE Energy, Hongyuan Green Energy and Laplace. The sixth is Flat Glass on cross-firm information interoperability, where a group supplier portal was located but its date of activation within 2025 and the scope of its interfaces could not be confirmed, so the cell is left unscored rather than entered at a low level.

Because the patterns sit at the level of individual indicators, the dimension scores in Table 2 hide as much as they show. Figure 2 gives the level assigned to each firm on each indicator, with the six unscored cells hatched.

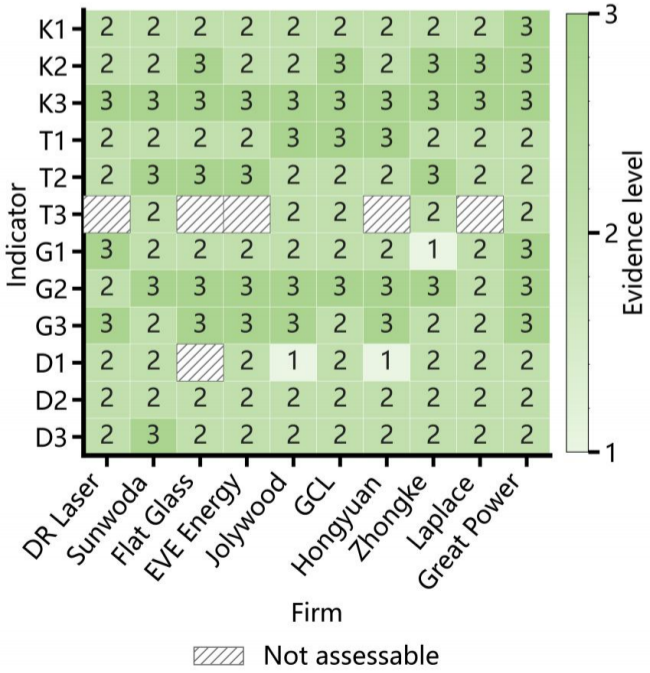


Figure 2. Evidence level by firm and indicator

The concentration is visual as well as numerical. Level 2 fills most of the grid and level 3 clusters in the knowledge and green-circular columns, while the technology-flexibility column is hatched for half the firms. A firm can therefore stand high on the technology dimension while disclosing nothing about its ability to reconfigure production, which is precisely the distinction the coding rules were written to preserve. The evidence statements and page locations behind each cell are in the supplement.

The same six cells determine how far a total can be trusted. Figure 3 orders the firms by coverage and draws the identification bound around each conditional score.

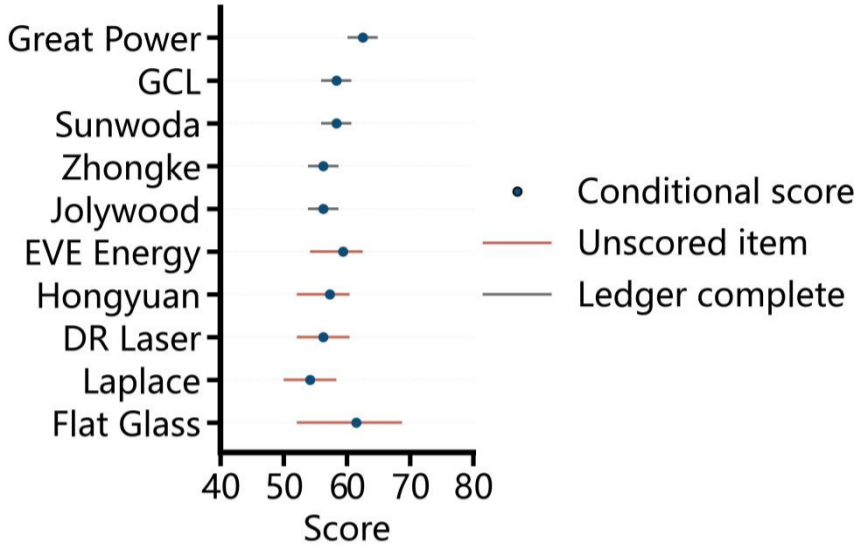


Figure 3. Conditional score and identification bound by firm

Where the ledger is complete the bound collapses to the score, so Sunwoda, Jolywood, GCL System Integration, Zhongke Electric and Great Power appear as points. The bound widens with every unscored cell and is widest for Flat Glass, the only firm with two, running from 52.08 to 68.75 around a total of 61.46. Flat Glass ranks second on the conditional score, yet the lower end of its bound falls below the totals of seven other firms. Publishing the score without the bound would turn two missing disclosures into an apparent advantage, which is the misreading the bounds are there to prevent.

4.3. Weight Sensitivity

Equal weights were a choice, so the totals were recomputed under eight alternatives. Each scenario moves one dimension to 20 percent or to 30 percent and splits the remainder equally across the other three, using the unrounded dimension scores. Ranks are competition ranks computed in exact arithmetic, because several totals recur and a floating-point comparison would treat an exact tie as a reversal.

No scenario moves any firm's score by more than 1.04 points from its equal-weight value. That largest movement belongs to Hongyuan Green Energy when the digital dimension is cut to 20 percent; the same firm also has the widest span between its lowest and highest scenario, 2.08 points, against 1.94 for Jolywood. No pairwise ordering reverses in any scenario. Rank and ordering are not the same thing here, because tied scores share a rank and the next rank is

skipped. Under equal weights Great Power ranks first, Flat Glass second, EVE Energy third, Sunwoda and GCL System Integration share fourth, Hongyuan Green Energy ranks sixth, DR Laser, Jolywood and Zhongke Electric share seventh, and Laplace ranks tenth. Once ties are counted, six firms change rank in at least one scenario.

Each firm's equal-weight rank is set against its rank under the single scenario that moves it furthest (Figure 4).

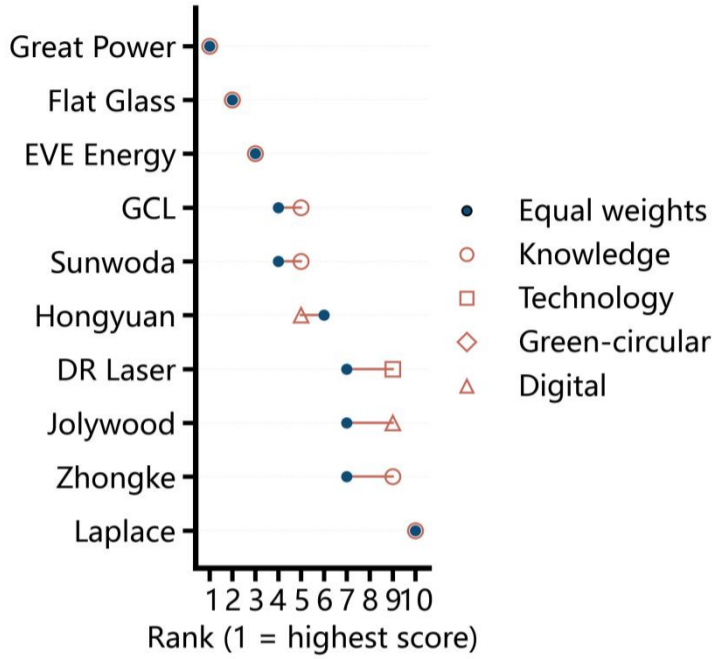


Figure 4. Equal-weight rank and furthest rank by firm

DR Laser, Jolywood and Zhongke Electric each drop two ranks at their furthest scenario, Sunwoda and GCL System Integration drop one, and Hongyuan Green Energy rises one. Flat Glass, EVE Energy, Laplace and Great Power keep their rank in every scenario. The weight choice therefore changes which tied firms share a rank, and it changes nothing about which firm scores above which other firm. Both statements hold only inside this set and only for the eight scenarios tested. The full scenario scores are reported in the supplement.

5. Discussion and Limitations

What the framework adds to the financial and workforce measurement of new quality productive forces is a view of coordination and a view of silence (Song et al., 2024). Song et al. can compare firms on research staffing, asset composition and the means of production, and they can do so for a large panel. They cannot see whether a firm runs a joint quality loop with its suppliers or whether its reports contain nothing at all about production flexibility. The twelve indicators make the first visible, and the coverage figure together with the identification bounds make the second visible. The cost of that gain is scale. The instrument needs a close reading of each report, it covers ten firms rather than a market, and it produces a diagnostic rather than a validated construct.

The digital evidence clustering at the implementation level calls for an explanation, and only an inference is available. Collaborative planning and scheduling is described as operating by every firm in the set, yet not one firm reports a scoped count of what that planning covers or changes. One reading is that joint planning has become an ordinary operational routine in this chain, worth describing but not yet worth quantifying in a sustainability report. Another is that the reporting format rewards a description of a system and rarely asks for its measured reach. The two cannot be separated with these data, and neither reading should be taken as a finding about digital capability in the industry. It is a statement about what these ten reports contain.

The limitations bind specific claims. The set of ten firms in a single reporting year, filtered by a disclosure rule, is the whole of the empirical basis, so the dimension ordering and the rank behavior under reweighting describe this set and nothing wider. Equal dimension weights and the convention of equal spacing between evidence levels mean that any ranking is conditional on two untested choices, even though the sensitivity check shows the ordering survives the weight disturbances that were tried. Coding by one person means that no statement about reliability is possible; an independent coding of at least twelve ledger rows, with disagreements resolved against the written anchors before the scores are touched, is the smallest step that would change this. Because the evidence is self-reported, the score cannot support a claim about practice that was not disclosed, and it does not measure new quality productive forces as such. Because the frame is limited to manufacturers in the photovoltaic and lithium-battery chain, nothing in the results extends to other new-energy businesses.

6. Conclusion

Public reports can support an assessment of new quality productive forces only for the part of that concept which surfaces as integration practice, and only when the assessment shows its own gaps. The four dimensions and twelve indicators give that assessment a defined object, drawn from the integration, knowledge and circular-chain literature and tied to interfaces a report can evidence. The coverage rule and the identification bounds give it a way to leave missing disclosure unscored without hiding it. Applied by one coder to ten disclosure-rich manufacturers in 2025, the scheme returns conditional scores between 54.17 and 62.50, a knowledge dimension above the others, and a technology-flexibility indicator that five firms do not evidence at all.

Disclosure conditions every one of these numbers, and no weight adjustment removes that dependence. The concrete next step is an independent second coding of at least twelve cells in the published ledger, or, on a larger set, a test of whether the scored practices correspond to any productivity outcome. Until one of those is done, the framework is a way to organize and to challenge public evidence, not a measure of the forces named in its title.

Author Contributions:

All authors contributed equally. All authors have read and agreed to the published version of the manuscript.

Funding:

This research received no external funding.

Institutional Review Board Statement:

Not applicable.

Informed Consent Statement:

Not applicable.

Data Availability Statement:

The raw data supporting the conclusions of this article will be made available by the authors on request.

Conflict of Interest:

The authors declare no conflict of interest.

References

Ataseven, C., & Nair, A. (2017). Assessment of supply chain integration and performance relationships: A meta-analytic investigation of the literature. International Journal of Production Economics, 185, 252–265.

Cao, M., & Zhang, Q. (2011). Supply chain collaboration: Impact on collaborative advantage and firm performance. Journal of Operations Management, 29(3), 163–180.

DR Laser. (2026). 2025 environmental, social and governance report. Shenzhen: DR Laser.

Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. Academy of Management Review, 23(4), 660–679.

EVE Energy. (2026). 2025 sustainability report. Huizhou: EVE Energy.

Flat Glass. (2026). 2025 environmental, social and governance report. Jiaxing: Flat Glass.

Flynn, B. B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. Journal of Operations Management, 28(1), 58–71.

GCL System Integration. (2026a). 2025 annual report. Suzhou: GCL System Integration.

GCL System Integration. (2026b). 2025 environmental, social and governance report. Suzhou: GCL System Integration.

Great Power. (2026a). 2025 annual report. Guangzhou: Great Power.

Great Power. (2026b). 2025 environmental, social and governance report. Guangzhou: Great Power.

Hongyuan Green Energy. (2026). 2025 sustainability report. Wuxi: Hongyuan Green Energy.

International Energy Agency. (2022). Special report on solar PV global supply chains. Paris: IEA.

International Energy Agency. (2024). Batteries and secure energy transitions. Paris: IEA.

Jolywood. (2026). 2025 environmental, social and governance report. Changshu: Jolywood.

Kong, T., Feng, T., Huang, Y., et al. (2020). How to convert green supply chain integration efforts into green innovation: A perspective of knowledge-based view. Sustainable Development, 28(5), 1106–1121.

Laplace. (2026). 2025 environmental, social and governance report. Shenzhen: Laplace.

Liu, G., Huang, Z., Zhang, Z., et al. (2026). The impacts of AI on new quality productive forces: An empirical study. Management & Marketing, 21, 25.

Negri, M., Cagno, E., Colicchia, C., et al. (2021). Integrating sustainability and resilience in the supply chain: A systematic literature review and a research agenda. Business Strategy and the Environment, 30(7), 2858–2886.

OECD, European Union, & European Commission Joint Research Centre. (2008). Handbook on constructing composite indicators: Methodology and user guide. Paris: OECD Publishing.

Qu, K., & Liu, Z. (2022). Green innovations, supply chain integration and green information system: A model of moderation. Journal of Cleaner Production, 339, 130557.

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. Journal of Business Research, 104, 333–339.

Song, J., Zhang, J., & Pan, Y. (2024). ESG development and corporate new quality productive forces: Evidence from Chinese A-share listed firms. Contemporary Economic Management, 46(6), 1–11.

Sunwoda Energy. (2025, October 24). Completion of the Sunwoda Tengzhou energy-storage and recycling projects [Company notice].

Sunwoda. (2026). 2025 sustainability report. Shenzhen: Sunwoda.

Tsanakas, J. A., van der Heide, A., Radavičius, T., et al. (2020). Towards a circular supply chain for PV modules: Review of today's challenges in PV recycling, refurbishment and re-certification. Progress in Photovoltaics: Research and Applications, 28(6), 454–464.

Zhongke Electric. (2026a). 2025 annual report. Yueyang: Zhongke Electric.

Zhongke Electric. (2026b). 2025 environmental, social and governance report. Yueyang: Zhongke Electric.

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