



AIGW Policy Observatory
Global AI Governance & Workforce Transformation

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AIGW DEEP DIVE

LONGi: From Quality Inspector to AI Trainer

How AI quality inspection changed frontline work, converted tacit expertise into model knowledge, and reshaped the human role inside a Lighthouse factory

October 2026

A decorative graphic in the bottom right corner consisting of several concentric, curved lines in shades of blue and purple, creating a sense of motion or a stylized 'L' shape.

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SUMMARY

Executive Summary

LONGi's Jiaxing solar-module factory offers an unusually concrete view of what AI-driven manufacturing transition can look like at the level of both the production system and the individual worker.

The factory was recognized by the World Economic Forum in 2023 as the first Lighthouse Factory in the global photovoltaic industry. LONGi says the site deployed more than 30 digital and AI use cases across production, quality, equipment, logistics and workforce management. The World Economic Forum reported that within one year the site reduced unit manufacturing costs by 28%, cut yield loss by 43%, shortened production lead time by 84% and lowered energy consumption by 20%. [1][2]

Those factory-wide outcomes are significant, but they are not the core workforce story. The more revealing transition occurred inside quality inspection.

LONGi progressively moved from experience-heavy manual visual inspection toward machine vision, machine learning, deep learning, traceability systems and full-process AI quality inspection. Its earlier public materials describe AI analysing nearly 200 quality data points, automatically detecting and classifying defects, tracing their sources and providing early warnings.

LONGi reported manufacturing-efficiency gains above 25%, a 42% increase in first-inspection or patrol-inspection efficiency, reduced manual visual-inspection cost, and — in its 2023 sustainability reporting — a 10% reduction in direct labour at reinspection stations alongside a 4.9% improvement in first-pass yield and a 30% reduction in defect rate.[4][5][6]

By 2026, Xinhua reported that the Jiaxing Lighthouse Factory's AI models were being applied across nine major procedures and 198 inspection items. Once the system flagged a defect, human workers still double-checked the result. A frontline worker quoted in the report said inspection labour cost had fallen to one-eighth of its former level.[7]

That worker, Zhang Chen, provides the most important evidence in the case.

Zhang joined LONGi's Jiaxing base as a frontline quality inspector. His work depended on visual inspection and accumulated production experience. As automation expanded above 90%, he did not simply continue inspecting at higher speed. In 2023, according to Xinhua, he transitioned into an AI trainer role. His inspection knowledge became input to the systems now performing a larger share of the repetitive inspection work.[7]

SUMMARY

This is the central workforce mechanism: The domain expert moves from performing the task to helping encode, improve and verify the system that performs the task. The case therefore contains both substitution and augmentation.

AI and machine vision substitute for a substantial share of repetitive visual inspection. Human workers remain in verification and exception-handling loops. At least one documented worker moved from direct inspection into AI training. Later local reporting from Jiaxing shows the transition continuing: LONGi's factory began regular AI training for technical workers in 2026, with the stated aim of developing traditional technicians toward roles such as data analyst, simulation engineer and "digital translator". The same report profiles Zhao Pengfei, described as a senior quality-AI engineer who had previously relied on visual inspection and now uses AI inspection systems to locate problems more quickly.[9]

The strongest conclusion is therefore not that AI inspection eliminated inspection jobs, and it is also not that automation automatically upgrades every worker. The evidence supports something more specific:

1. Manual inspection work was materially substituted. 2. The quality workflow was

redesigned around machine detection plus human verification. 3. Frontline inspection expertise became useful for training, interpreting and improving AI systems. 4. LONGi invested in broader digital capability development for workers.

5. Labour requirements and labour costs fell in parts of the production system, but the public evidence does not provide a complete worker-level reconciliation of who was redeployed, who left, which positions were not backfilled, or how many inspection roles disappeared.

The case is especially valuable because it reveals a mechanism that is likely to recur across manufacturing: tacit frontline knowledge can become training data, model supervision and exception-handling capability. That creates an opportunity for worker transition — but also a governance question. Once workers transfer their expertise into automated systems, institutions must decide whether those workers are:

- retained mainly for verification;
- moved into adjacent technical work;
- reduced through attrition or staffing optimization;
- or displaced after their knowledge has been encoded.

The LONGi evidence shows the first several pathways are possible. It does not establish their distribution across the affected workforce.

FINDINGS

Key Findings

1. AI inspection is part of a wider smart-manufacturing transformation

LONGi's Jiaxing site implemented more than 30 digital and Fourth Industrial Revolution use cases. The World Economic Forum reported a 28% reduction in unit manufacturing cost, 43% reduction in yield loss, 84% reduction in production lead time and 20% reduction in unit energy consumption within one year.[1]

LONGi separately reports that overall automation at the Jiaxing factory exceeded 90% and that single-line manpower allocation fell by 33%.[2]

These are site-level transformation outcomes. They should not be attributed solely to AI quality inspection.

3. Human verification did not disappear

Xinhua's 2026 reporting says that after the system flags a defect, human workers still double-check the result.[7]

This establishes a human verification step in the reported workflow.

It does not establish the precise formal decision rights attached to that double-check, such as whether humans have final veto authority over every automated disposition.

2. Quality inspection moved from human visual judgment toward machine vision and algorithmic detection

LONGi's full-process AI quality system uses machine vision, machine learning and deep learning to analyse quality signals, detect defects, trace sources and generate warnings. Public reporting across 2022–2024 describes nearly 200 inspection data points and multiple AI inspection procedures.[4][6]

By 2026, Xinhua reported nine major procedures and 198 inspection items in the Jiaxing Lighthouse Factory.[7]

The changing counts may reflect scope expansion or different measurement definitions and should not be treated as a clean longitudinal series.

4. A documented frontline worker moved from inspector to AI trainer

Zhang Chen joined the Jiaxing base as a frontline quality inspector and transitioned to an AI trainer in 2023 as the factory became more automated.[7]

His role is important because his prior inspection experience did not become irrelevant. It became an input to the AI system.

CASE CONTEXT

Why This Case Matters

— 5. The capability shift is from visual detection toward AI orchestration and verification —. The emerging work includes:

- interpreting defects; • validating AI flags; • locating failure causes; • working with data and digital tools;
- translating production knowledge into machine-usable rules or examples. This is a change in where human expertise sits inside the workflow.

— 6. Lower labour input is evidenced — but workforce reduction is not cleanly decomposed —. LONGi reported a 10% reduction in direct labour at reinspection stations in its 2023 quality digitalization program.[5] At the Jiaxing Lighthouse Factory, LONGi reports a 33% reduction in single-line manpower allocation.[2] Xinhua later quoted Zhang Chen saying inspection labour cost had fallen to one-eighth of its previous level.[7]

These measures establish lower labour input or labour cost in specific production contexts. They do not tell us the number of workers laid off, redeployed, transferred, lost through attrition or no longer hired.

— 7. LONGi is building a broader digital-skills pathway around intelligent manufacturing —.

LONGi's current workforce disclosures describe digital capability programs covering intelligent manufacturing, big-data analysis, IoT, AI and industrial internet.[8] Local 2026 reporting from Jiaxing says the Lighthouse Factory began regular AI training for technical workers and sought to develop traditional technicians toward roles such as data analyst, simulation engineer and digital translator.[9]

— 1. Why This Case Matters —. A large share of AI-and-work discussion focuses on office workers. Manufacturing creates a different test. On a factory floor, tasks are physical, repetitive, sensor-rich and tightly connected to quality, safety, speed and cost. Automation can therefore change work not only by assisting cognition but by removing entire manual steps from the production sequence.

Quality inspection is a particularly important example. Traditional visual inspection relies heavily on workers' accumulated tacit knowledge:

- which anomalies matter; • which variations are harmless; • how process conditions affect visible outcomes; • when a product should be rechecked;
- how to trace a defect back to a machine or upstream process. That knowledge is difficult to fully capture in a written standard.

CASE CONTEXT

AI changes the economics of that knowledge. Machine vision can repeatedly inspect images without fatigue. Statistical models can compare large data volumes. Deep-learning systems can identify patterns that may be difficult to specify as simple rules. Traceability systems can connect defects to machines, time points and production conditions.

But the system still needs:

- domain judgment; • validation; • escalation; • process context;
- interpretation when the model encounters an edge case. That creates a distinctive workforce transition. The inspector is no longer valuable only because the inspector can personally see the defect. The inspector may become valuable because the inspector knows what the system should learn to see.

LONGi's case makes that transition visible in a named worker.

— 2. Institutional Context: Why Jiaxing Became a Lighthouse —. LONGi began its Jiaxing Lighthouse Factory project in 2022 and says it completed the project within nine months.[2] The site integrated technologies including:

- big data; • artificial intelligence; • machine vision; • digital twins;
- flexible automation. LONGi says it developed more than 30 AI models and algorithms across the

site's smart-manufacturing system.[2] The World Economic Forum selected the Jiaxing site as a Global Lighthouse in December 2023, making it the first Lighthouse Factory in the photovoltaic industry.[1][2]

The site's transformation was driven by several business pressures:

- improving quality; • shortening module lead time; • increasing flexibility; • improving consistency across production. The World Economic Forum's 2023 Lighthouse report presents LONGi Jiaxing as an example of AI and advanced analytics moving beyond isolated pilots into operational scale.[1] The first four measures appear in World Economic Forum reporting and LONGi's own Lighthouse materials.[1][2][3]

The manpower and automation figures are from LONGi's own reporting.[2]

— Evidence boundary — These metrics are site-level outcomes of the broader Lighthouse transformation. They are not a causal estimate of the AI quality-inspection system alone. The site also deployed:

- production planning; • intelligent warehousing; • cell allocation; • equipment analytics;
- workforce planning. A rigorous workforce case must therefore separate: factory transformation from quality-inspection transformation from individual worker transition. This report maintains those three evidence levels throughout.

INSPECTION TRANSITION

The AI Intervention: From Visual Check to Digital Quality System

LONGi's public record shows that the inspection transition happened progressively.

Before AI: Visual inspection as human work

Before the AI transition, visual quality inspection depended materially on frontline workers. Xinhua's profile of Zhang Chen describes his original job directly: as a quality inspector at LONGi's Jiaxing base, he relied on his eyes to identify defects on solar-panel production lines.[7] That simple description contains a large amount of hidden expertise.

A visual inspector does not merely look at a panel. The worker has to learn:

- defect categories; • tolerance boundaries; • common production anomalies; • relationships between defect patterns and process causes;
- when to accept, reject or escalate; • how to operate at production-line speed. The task therefore combines: perception + classification + process knowledge + judgment.

This is exactly the type of work that modern computer vision can partially substitute. Once sufficient images, defect labels and process data exist, a machine-learning system can perform repetitive detection continuously and consistently. But the system's performance depends on the quality of the encoded manufacturing knowledge.

That is where frontline expertise re-enters the workflow.

2022: full-process AI inspection becomes explicit

In 2022, LONGi described what it called the photovoltaic industry's first integrated full-process AI quality-inspection system.[4] The company said the system embedded AI analysis into its digital quality-management infrastructure and analysed nearly 200 quality-inspection data points across production. LONGi reported manufacturing efficiency increasing by more than 25% compared with manual inspection and said missed inspections were reduced.[4]

At this stage, the public framing centered mainly on:

- inspection efficiency; • early warning; • quality stability. The workforce implications were less explicit.

INSPECTION TRANSITION

2023: labour input becomes measurable

LONGi's 2023 Sustainability Report provides a more direct workforce signal. Under the company's "1+7+1" quality-information management system, LONGi reported that AI algorithms:

- increased first-pass yield by 4.9%;
- reduced the defect rate by 30%.[5] This is stronger than a generic efficiency claim. It demonstrates that the digital quality system changed the labour requirement attached to a specific part of the inspection workflow.

It still does not tell us what happened to the workers removed from that station.

2024: inspection becomes more integrated with process intelligence

LONGi's 2024 Sustainability Report describes an AI detection platform spanning seven AI inspection procedures and nearly 200 quality-inspection data points.[6] The system uses:

- machine learning; • deep learning; • automatic determination; • early warning;
- defect attribution. LONGi reports that the system:
- significantly reduced missed detection; • addressed hard-to-detect issues such as scratches and dents; • reduced manual visual-inspection costs;
- increased first-inspection or patrol-inspection efficiency by 42%.[6] The report also says LONGi uses knowledge graphs and related AI methods to identify defect types, connect them to machine-specific issues, warn on similar problems and provide possible causes and improvement measures.[6]

This represents a move beyond simple visual substitution. The system is increasingly involved in: detection → attribution → recommendation. That changes the human role again. The human is no longer only checking whether a defect exists. The worker can increasingly spend time on:

- root-cause investigation; • process adjustment; • system improvement.

WORKFORCE TRANSITION

From Inspection to AI-Enabled Work

— 2026: The Workflow Becomes Visible at Worker Level —. The clearest public description of the human-AI workflow appears in Xinhua's July 2026 reporting from Jiaxing.[7] According to that report:

- the system covered 198 inspection items; • a solar module rolled off the line roughly every 16 seconds; • when the AI system flagged a defect, human workers double-checked it.

A worker quoted by Xinhua said the labour cost of the inspection process had fallen to one-eighth of its previous level.[7] This metric should be used carefully. It is:

- highly relevant to the inspection workflow. It is not: • a headcount figure; • proof that seven-eighths of inspectors were laid off; • proof that every inspection station experienced the same reduction. The safest formulation is: Xinhua reported a LONGi worker saying inspection labour cost had fallen to one-eighth of its previous level as AI assumed more routine detection, while humans remained responsible for double-checking flagged defects.

That is strong evidence of labour-intensity reduction. It is not a workforce-reduction count.

— 6. Worker Transition: Zhang Chen — Inspector → AI Trainer —. Zhang Chen's career transition is the most important people-level evidence in this case. Xinhua reports that Zhang joined LONGi's Jiaxing base roughly four years before the 2026 profile and worked as a frontline quality inspector. His role relied on direct visual inspection of solar-panel defects.[7] As the factory accelerated automation, Zhang transitioned in 2023 into an AI trainer role. [7]

The phrase deserves analysis. In an industrial setting, an AI trainer is not necessarily a generic data annotator and not necessarily an AI engineer. The value of the role can come from domain knowledge. A worker who has spent years inspecting production defects knows:

- which apparent anomalies are false positives; • which defects are associated with particular processes; • how edge cases differ from standard examples; • what quality language means operationally;
- where a system is likely to misclassify; • what a technically correct label may miss about production reality.

WORKFORCE TRANSITION

Xinhua says Zhang now transfers his inspection experience into the AI systems used in the factory. [7] The exact technical interface is not fully documented in the public record. Xinhua refers to "large language models", while LONGi's quality-management materials describe machine vision, machine learning, deep learning, automated optical inspection, knowledge graphs and other digital-quality technologies.[6][7]

AIGW therefore does not infer a single model architecture. The evidence-safe conclusion is: Zhang's role shifted from directly performing visual inspection toward supplying domain expertise to AI-enabled quality systems. That is a meaningful capability transition regardless of whether the underlying system uses vision models, multimodal models, language models or a combination.

— 7. Tacit Knowledge Becomes Machine-Usable Knowledge —. The Zhang case reveals a wider mechanism of AI-enabled manufacturing transition. Traditional manufacturing expertise often exists as tacit knowledge. A skilled worker may know that:

- a recurring visual pattern points to a specific machine;
- two defects that look similar require different responses;
- a nominally acceptable variation is actually a precursor to failure. That expertise may never have been formalized in a database.

AI creates an incentive to make it explicit. The transition can be represented as: worker experience → examples / labels / rules / feedback → AI model → automated detection → human verification → model/process improvement This is not merely a technology pipeline. It is a knowledge-transfer pipeline.

— Why this matters for workers — The worker's bargaining position can change depending on where the worker remains in that loop. There are at least four possible roles:

— 1. Performer — The worker still carries out the original inspection task.

— 2. Verifier — The AI performs first-pass inspection and the human checks flagged or uncertain cases.

— 3. Trainer / orchestrator — The worker supplies examples, labels, feedback and production knowledge that improve the system.

— 4. Process improver — The worker uses AI outputs to identify upstream process causes and improve manufacturing. LONGi's evidence shows movement across at least the first three categories and, in the broader quality system, toward the fourth.[6][7] This is a more useful account of workforce transition than saying simply that "AI replaced inspection".

WORKFORCE TRANSITION

— 8. A Second Worker Signal: Zhao Pengfei and the Emerging Quality-AI Role —. The strongest case studies should avoid relying on a single success story. A later local report from Zhejiang provides a second worker-level signal. In August 2026, Hangzhou News, republishing China Blue News reporting, described LONGi's Jiaxing Lighthouse Factory as running regular AI training for technical workers. The stated direction was to help traditional technicians develop toward roles including:

- simulation engineer; • digital translator.[9] The same report profiled Zhao Pengfei, identified as a senior quality-AI engineer at the Jiaxing Lighthouse Factory. It said that Zhao had previously worked as a quality inspector relying on visual observation to judge equipment status. After training, he used AI inspection systems to identify faults more quickly.[9]

This evidence is not as strong as an audited company workforce report. It is nevertheless useful because it shows that Zhang Chen's transition is not the only public example of quality work becoming more digital and AI-oriented at the site.

— What the Zhao example supports — It supports:

- movement from manual visual judgment toward AI-supported diagnosis; • emergence of hybrid quality + AI job identities.

— What it does not support — It does not establish:

- how formal the reskilling program was; • whether pay or grade increased; • whether all former inspectors were offered similar transitions; • whether the new roles are permanent. Individual worker stories show pathways. They do not show transition rates.

— Overview · Capabilities that become less central to direct execution —. The LONGi case suggests that AI changes the value of frontline expertise rather than simply making expertise unnecessary. The following activities can be reduced when machine vision performs first-pass inspection:

- repeated comparison against known defect patterns; • manual identification of obvious defects; • repetitive recording of inspection outcomes. That does not mean those capabilities vanish from the organization. They may be transferred into system design and verification.

— Domain expertise —. AI quality systems need people who understand:

- defect taxonomy; • quality tolerances; • equipment behavior; • root-cause relationships. The value of domain expertise moves from doing every check toward teaching and challenging the system.

— AI orchestration · Judgment and verification —. Workers increasingly need to know:

WORKFORCE TRANSITION

- which outputs require attention; • how to provide feedback; • how to identify model failure; • how to route exceptions;

- how to connect digital outputs to physical action. A human double-check step creates a new responsibility. The worker is no longer only detecting a defect.

The worker may be asked to determine whether the machine's detection is credible and what should happen next.

— Data literacy · Translation —. Workers in AI-enabled production environments increasingly interact with:

- image data; • defect records; • traceability systems; • model outputs;
- performance indicators. The "digital translator" language reported from Jiaxing is especially revealing.[9] Industrial AI often fails not because the algorithm is incapable, but because technical teams and frontline experts do not share the same representation of the problem.

A worker who can translate between: production language ↔ quality language ↔ data language ↔ AI system can become unusually valuable.

— 10. LONGi's Wider Skills Infrastructure —. The individual worker transitions sit inside a wider company-level effort. LONGi's current sustainability disclosures say the company has established digital capability enhancement programs covering:

- big-data analysis; • Internet of Things applications; • artificial intelligence; • industrial internet.[8] The stated purpose is to help employees develop digital skills, technical application capability and innovative problem-solving ability.[8] LONGi also maintains broader professional and managerial development tracks, including manufacturing-base talent programs and technical certification support.[8]

These programs matter as organizational context. But the public evidence reviewed for this case does not provide a clean number for:

- how many became AI trainers; • how many became quality-AI engineers; • how many remained in verification roles. The organizational training infrastructure is therefore supportive evidence, not a substitute for worker-transition data.

— Possible control architectures —. The phrase human in the loop is often too vague to be useful. LONGi's public evidence allows a slightly more precise description. In the 2026 Xinhua account:

WORKFORCE TRANSITION

1. the AI system flags a defect; 2. a human worker double-checks the result.[7] That establishes human verification. It does not establish all of the following: • whether the human checks every defect or only some; • whether clean/non-defect outputs are sampled; • whether the human can override an AI pass/fail result;

- whether override decisions are recorded; • whether some product dispositions occur automatically; • who is accountable for model errors; • what confidence threshold triggers review;
- what happens when AI and human judgment disagree.

These questions matter because "human verification" can represent very different governance models.

— Model A — advisory AI — AI recommends; human decides every case.

— Model B — AI first pass, human exception review — AI clears routine cases; humans review flags or uncertain cases.

— Model C — AI decision with human audit sampling — AI acts automatically; humans audit a sample afterward.

— Model D — AI decision with escalation — AI acts below defined thresholds; humans receive exceptions. The public LONGi material reviewed here does not provide enough detail to place the full inspection system definitively into one of these models. The Xinhua description is most consistent with AI flagging plus human double-check for detected defects, but it does not describe the treatment of non-flagged items.

— Evidence boundary —. The correct conclusion is therefore: Human verification is directly evidenced in the reported defect workflow. Formal approval, veto and override rights across the full inspection system are not publicly specified.

OUTCOMES · A

Outcomes: Separate the Metrics Before Interpreting Them

FIGURE 1.1

reported

Level A — Lighthouse factory-wide transformation

Indicator	Reported outcome	Source scope
Unit manufacturing cost	-28%	Jiaxing Lighthouse transformation ^[1] ^[2]
Yield loss	-43%	Jiaxing Lighthouse transformation ^[1] ^[2]
Production lead time	-84%	Jiaxing Lighthouse transformation ^[1] ^[2]
Unit energy consumption	-20%	Jiaxing Lighthouse transformation ^[1] ^[2]
Single-line manpower allocation	-33%	Jiaxing Lighthouse transformation ^[2]
Overall automation	>90%	Jiaxing factory ^[2]
Digital / 4IR use cases	30+	Jiaxing factory ^[3]

Source: [1] World Economic Forum, 2023; [2] LONGi, n.d.; [3] LONGi, n.d.

Note: Factory-wide results reflect multiple technologies and operating changes, not quality inspection alone.

LONGi has published many impressive manufacturing metrics.

A Deep Dive becomes misleading if they are put into one chart without scope labels.

The evidence belongs to at least three levels.

These measures reflect multiple technologies and operating changes, not quality inspection alone.[1][2]

OUTCOMES · B

Quality-System and Inspection Outcomes

FIGURE 1.2

reported

Level B — Quality-system and inspection outcomes

Indicator	Reported outcome	Evidence boundary
Manufacturing efficiency vs manual inspection	>25% improvement	LONGi quality-system reporting ^[4] ^[6]
Reinspection-station direct labour	-10%	2023 quality information system ^[5]
First-pass yield	+4.9%	2023 quality information system ^[5]
Defect rate	-30%	2023 quality information system ^[5]
First/patrol inspection efficiency	+42%	2024 sustainability reporting ^[6]
Inspection coverage	nearly 200 quality data points; 7 AI procedures in 2024	Definitions differ from later source ^[6]
2026 inspection scope	198 inspection items across 9 major procedures	Xinhua worker/factory report ^[7]
Inspection labour cost	reported at 1/8 of previous level	Worker statement reported by Xinhua ^[7]

Source: [4] LONGi, n.d.; [6] LONGi, n.d.; [5] LONGi, n.d.; [7] Xinhua, 2026

Note: Public sources use different definitions for the procedure and inspection-item counts; they are not a trend series.

OUTCOMES · C

Worker-Transition Outcomes

FIGURE 1.3 reported

Level C — Worker-transition outcomes

Worker or pathway	Reported transition	Boundary
Zhang Chen	quality inspector → AI trainer in 2023	Named individual; scale unknown ^[7]
Zhao Pengfei	traditional visual inspection → senior quality-AI engineer using AI systems	Local-media profile; scale unknown ^[9]
Technical workers	regular AI training toward data analyst, simulation engineer, digital translator roles	2026 local reporting; participation/completion not published ^[9]

Source: [7] Xinhua, 2026; [9] Hangzhou News / China Blue News, 2026
Note: Named individual examples establish pathways, not transition rates.

A 28% factory-wide cost reduction does not mean inspection alone reduced cost by 28%; a 33% manpower-allocation reduction is not

a one-third layoff count; and one named transition does not establish workforce-wide outcomes.[1][2][7][9]

WORKFORCE OUTCOMES

Task Substitution Does Not Equal Worker Elimination

— Overview · What was substituted? —. The LONGi case provides a useful test of one of the most important distinctions in AI workforce analysis. A material share of repetitive visual-inspection work. The technology is explicitly designed to replace experience-heavy manual detection with machine vision and algorithmic analysis.[4] That is genuine task substitution.

— What remained? · What changed economically? —. Human verification, exception handling, domain interpretation and system improvement. At least some workers moved toward those activities.[7][9] The labour intensity of inspection fell. LONGi's own reporting shows lower direct labour requirements in quality workflows, and worker-reported evidence suggests a major reduction in inspection labour cost.[5][7]

— What do we still not know? —. We do not know the complete worker-level outcome. The public evidence does not provide a table such as: Without that reconciliation, it would be methodologically wrong to convert labour-efficiency figures into a layoff count.

— AIGW interpretation · Worker outcomes not reported —. The case demonstrates why the sequence: automated task → fewer labour hours does not automatically prove: automated task → equivalent number of workers dismissed. Workforce outcomes depend on redeployment, attrition, hiring, growth, scheduling and organizational choices.

• became verifiers: ? • became AI trainers: ? • moved to other factory roles: ? • left through attrition: ?

• were laid off: ? • positions not backfilled: ?

ENTERPRISE CONTEXT

14. A Complication: LONGi's Later Enterprise Workforce Contraction

FIGURE 2.1

reported

LONGi enterprise workforce and PV direct-labour cost

Year	Total employees	Production personnel	PV direct-labour cost
2024	37,853	22,255	RMB 4.32 billion ^{[10] [11]}
2025	32,775	18,454	RMB 3.27 billion ^[11]

Source: [10] LONGi, 2024; [11] LONGi, n.d.

Note: Company-wide figures; they do not isolate Jiaxing or AI quality inspection.

LONGi attributed the decline in PV direct-labour cost to a lower average employee count and increased automation.[11] LONGi's 2025 operating environment was also shaped by severe photovoltaic-industry pressures. The company reported:

- low-price competition; • low capacity utilization; • cost-reduction efforts; • significant financial pressure.[12] Therefore the company-wide workforce contraction in 2025 may reflect a combination of:
- industry overcapacity; • weaker economics;
- capacity adjustments; • organizational restructuring;

• other business decisions. The public evidence reviewed here does not provide a causal decomposition. The later headcount data should be included as enterprise context and a caution against overclaiming. It should not be presented as:

The 5,078-person decline should not be attributed to LONGi's AI inspection system: the public evidence does not isolate its contribution. Nor should the enterprise workforce data be used to reclassify Zhang Chen's documented transition as representative of the whole workforce.

WORKFORCE IMPLICATIONS

Enterprise Context and Workforce Implications

LONGi's enterprise workforce and production headcount declined between 2024 and 2025, and the company attributed lower direct labour costs partly to fewer employees and higher automation. However, the company was also operating through a severe industry downturn, and public reporting does not isolate the share of workforce change caused by AI quality inspection or by automation more broadly.

This is a stronger conclusion precisely because it does not pretend the causal evidence is cleaner than it is.

— 15. The Business Context: Automation Under Cost Pressure —. The Jiaxing Lighthouse project began before the deepest phase of the photovoltaic industry's later downturn, but cost competitiveness was already part of the transformation logic. The World Economic Forum described the site as seeking to:

- improve quality; • shorten lead time.[1] LONGi later faced even stronger cost pressure as photovoltaic manufacturing moved into a period of supply-demand imbalance and low pricing.[12] This context matters for workforce analysis. Automation is rarely adopted for only one reason. The same investment can simultaneously serve: • quality; • consistency;
- speed; • throughput; • traceability; • labor productivity;
- cost reduction; • resilience. That makes causal interpretation difficult. If a factory later reduces staffing, it may be because: • automation reduced required labour; • demand weakened;
- capacity consolidated; • processes improved; • production moved; • roles were redesigned. The LONGi case therefore reinforces a core AIGW rule: Do not infer a worker outcome from an operational efficiency metric without direct workforce evidence.

WORKFORCE IMPLICATIONS

— 16. The Lighthouse Talent Layer —. The World Economic Forum's original LONGi Lighthouse profile is useful because it did not treat workforce management as separate from technology. Among the highlighted use cases was data-backed career planning for workers, associated with a reported 35% improvement in direct labour productivity.[1] The report also highlighted:

- neural-network production planning; • flexible automation; • big-data order optimization. This combination matters. The Jiaying transformation was not presented simply as: automate machines. It included: use data to allocate and develop people alongside the technology.

LONGi's own Lighthouse Project language similarly says intelligent human-resource management aims to match skills and workforce allocation with production demand, and to turn employee skills and experience into data that can support continuous optimization.[13] This is a striking organizational idea. It implies that frontline knowledge is treated as both:

- data capital, capable of being encoded into systems. That dual use creates value. It also creates a governance question about how workers benefit when their expertise is converted into organizational AI capability. The public evidence does not answer that question.

— 17. External Benchmark: Frontline AI Is Becoming a Talent Strategy Problem —. LONGi's case sits inside a broader manufacturing transition. The World Economic Forum's work on industrial talent argues that leading manufacturers increasingly treat workforce transformation as part of digital transformation rather than as an HR program that happens afterward.[14][15] Its 2025 Empowering Frontlines report highlights:

- digital upskilling; • immersive onboarding; • personalized skills-based career planning; • workforce retention and development. The report says that nearly 40% of the core skills used in advanced manufacturing and supply-chain work are expected to change by 2030, drawing on the Forum's Future of Jobs 2025 analysis.[15]

Separately, the Forum's analysis of Lighthouse submissions found that roughly three-quarters of Lighthouse sites had an explicit talent focus, and many digital use cases were accompanied by upskilling, work redesign or workforce-management innovation.[14] These are sector-level observations, not LONGi outcomes. But they explain why the worker transition at Jiaying matters.

AI-enabled manufacturing is not only creating a technical challenge: How do we automate inspection? It is creating a talent challenge: How do we move the worker from manual inspection into the new system of work?

WORKFORCE IMPLICATIONS

— Overview —. The International Labour Organization's 2026 report on AI in manufacturing frames the issue more broadly. The ILO examines AI in manufacturing through:

- working conditions; • rights at work; • social protection; • social dialogue;
- just-transition considerations.[16] That framing is useful for interpreting LONGi. The Jiaxing evidence is strong on: • productivity; • cost; • quality;
- workflow redesign; • worker upskilling pathways. It is much weaker on: • distribution of gains; • worker consultation;
- wage effects; • job security; • transition guarantees; • voice in automation decisions. This does not imply those mechanisms are absent. It means the public case evidence does not establish them.

— China-specific context —. An ILO research brief published in September 2026 on AI adoption in Chinese enterprises found widespread enterprise adoption and substantial productivity gains, while also identifying concerns around skills gaps, job displacement and worker incomes.[17] The research covered 21 enterprises and surveyed 1,591 professionals across sectors including manufacturing.

Again, this is external context, not LONGi-specific evidence. Its value is analytical: Productivity improvement and workforce risk can coexist. The existence of a successful reskilling pathway for

Zhang Chen does not remove the need to measure what happens to workers who do not make that transition.

— Overview · Wuhu as a follow-on signal —. LONGi has not treated Jiaxing as a one-off demonstration. The company announced a broader "Lighthouse Project" to replicate agile intelligent-manufacturing capabilities across additional production bases.[13] This matters because a workforce transition that is small at one plant can become material when scaled across a manufacturing network.

In 2026, LONGi reported that its Wuhu production base had reached Level 4 of China's Manufacturing Maturity Model and deployed seven AI engines across:

- production scheduling; • quality inspection; • equipment maintenance; • process optimization;
- energy management; • warehousing and logistics. [18] LONGi said the site's full-chain AI quality-inspection platform: • increased defect-detection efficiency by 80%; • reduced the incidence of quality issues across the production line by 40%. [18] The site also reported improvements in:
- production efficiency; • dispatch efficiency; • energy consumption. These are follow-on enterprise signals. They should not be retroactively serialized as Jiaxing outcomes. They do, however, show that the underlying model — AI embedded across production plus workforce/skill management — is being scaled.

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— Why this matters for workforce research ·

Overview —. The most important future question may no longer be: Can LONGi automate quality inspection? That has already been demonstrated. The more important question is: What workforce model emerges when this operating system is replicated across factories? At scale, researchers would want to know:

- how many workers become verifiers; • how many become AI trainers or quality-AI engineers; • whether staffing reductions occur through attrition, layoffs or non-hiring; • how pay and career progression change;

- whether training access is universal or selective.

Those data would determine whether LONGi's transition becomes a broad worker-upgrading model or a high-productivity model with a much smaller core workforce. The LONGi case suggests a useful framework for frontline work after AI substitutes repetitive tasks.

— 1. Physical execution value · 2. Verification value

— The worker performs the task directly. LONGi example: traditional visual inspection. AI reduces the amount of value created through this mode. The worker checks AI-detected defects or uncertain cases. LONGi example: human double-check after a defect is flagged.[7] This work depends on judgment rather than continuous scanning.

— 3. Training value · 4. System-improvement value

— The worker helps the AI learn what counts as a defect and how production context should be interpreted. LONGi example: Zhang Chen's transition to AI trainer.[7] The worker's experience becomes part of the model-improvement process. The worker uses AI output to diagnose root causes and improve the upstream manufacturing system.

LONGi context: AI attribution systems connecting defects to machines and recommending improvement measures.[6]

— The transition —. A mature AI workforce strategy may try to move employees from: execution → verification → training → system improvement Not every worker will make the full transition. The model is useful because it gives employers a more precise workforce-design question: Which part of the value chain can each worker move into when execution is automated?

— Overview —. The same mechanism that creates transition opportunity can create worker risk. A skilled inspector's knowledge can be used to train a system. Once encoded, the system may need less direct input from that worker. This creates what AIGW calls an experience extraction risk: An organization may need the worker's expertise intensely during model development, but need fewer workers after that expertise has been successfully embedded into the system.

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LONGi's public evidence does not show that this happened to Zhang Chen. His own documented outcome was a transition into an AI-trainer role. But the structural risk matters for manufacturing more broadly.

— Questions an employer should answer —. If frontline workers are asked to transfer tacit expertise into AI systems:

- Does pay increase with the new skill requirement? • Is training provided before automation reduces staffing need? • Can workers move into adjacent technical roles? • Are transition opportunities available to the majority or only a small high-performing group?
- How is employee contribution to system improvement recognized? • Does career progression improve after the transition? • What happens once the AI requires less active training?

These questions belong inside workforce governance, not only ethics.

— For manufacturing CEOs and COOs —. Measure automation and workforce transition together. A plant transformation dashboard should distinguish:

- defect rate; • yield; • cycle time; • labor hours;
- staffing allocation; • workers reskilled; • workers redeployed; • new technical roles;

- attrition; • non-backfill; • involuntary exits.

Without this decomposition, leaders can know that automation worked operationally without knowing whether workforce transition worked institutionally.

— For CHROs —. Identify the knowledge hidden inside automatable tasks before automating them. The worker who performs a repetitive task may hold the expertise needed to:

- verify edge cases; • diagnose process failures; • define exception rules. The talent process should begin before deployment: 1. map task; 2. map tacit expertise; 3. define future human roles; 4. identify transition candidates; 5. train; 6. deploy technology; 7. track worker outcomes. If training starts only after the old role has disappeared, the organization may lose both people and knowledge.

— For plant and quality leaders —. Design the exception system as carefully as the detection system. A quality-AI business case should include:

- false-negative rate; • human review burden; • escalation criteria; • override process;
- defect severity; • model drift; • retraining triggers; • root-cause closure. A high automated detection rate is not enough if the human verification layer becomes overloaded or under-skilled.

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— For L&D leaders —. Train toward a destination role, not generic digital literacy. Useful manufacturing pathways might include:

- quality-AI engineer; • process-data analyst; • simulation engineer; • digital translator;
- automation technician; • model-verification specialist. The strongest programs should map: old task → transferable expertise → new capability gap → destination role.
- For policymakers and workforce institutions —. Track worker flows inside automated factories. Factory productivity statistics can rise while entry-level or repetitive production opportunities decline. Useful indicators include:
 - technical employment; • retraining participation; • redeployment rates; • new-role creation;
 - wage progression; • reduced hiring; • apprenticeship opportunities. The unit of measurement should not be only "jobs lost".

— For workers —. Domain expertise can become more valuable when paired with digital capability. The LONGi examples suggest that the most defensible transition strategy is not to abandon manufacturing knowledge and become a generic AI worker. It is to combine: deep process knowledge + AI tools + data literacy + verification judgment.

That combination is harder to automate because it connects abstract system output to physical production reality.

— 23. What the Evidence Establishes —. The reviewed public evidence establishes that:

- The site became the first World Economic Forum Lighthouse Factory in the global photovoltaic industry in 2023. • The factory achieved large reported improvements in manufacturing cost, yield loss, lead time and energy consumption. • Overall automation at Jiaxing exceeded 90%. • LONGi implemented full-process AI quality inspection using machine vision, machine learning and related digital-quality technologies.
- The quality system analyses nearly 200 inspection data points in multiple procedures. • LONGi reported manufacturing-efficiency and inspection-efficiency improvements. • LONGi reported a 10% reduction in direct labour at reinspection stations in 2023. • LONGi reported a 33% reduction in single-line manpower allocation at the Lighthouse Factory.
- Xinhua reported 198 inspection items across nine procedures in 2026. • Xinhua reported that workers double-check defects flagged by the AI system. • Xinhua quoted a worker saying inspection labour cost had fallen to one-eighth of its previous level. • Zhang Chen transitioned from frontline quality inspector to AI trainer in 2023.

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- A later local report describes Zhao Pengfei moving from visual inspection toward work as a senior quality-AI engineer using AI inspection systems.
- LONGi has broader digital-capability programs covering AI, intelligent manufacturing, IoT and industrial internet.
- Local reporting says the Jiaying factory began regular AI training aimed at moving traditional technicians toward digital and AI-related roles.
- LONGi's company-wide 2025 direct labour cost fell, with the annual report citing both fewer employees and increased automation as factors.

- LONGi's total and production workforces were lower at year-end 2025 than at year-end 2024.
- The company was also facing a severe photovoltaic-industry downturn, meaning those workforce changes cannot be cleanly attributed to AI inspection.
- LONGi has continued scaling AI-enabled manufacturing to other production bases.

— 24. What the Evidence Does Not Establish —. The reviewed evidence does not establish:

- how many inspectors remained after deployment;
- how many became verifiers;
- how many became AI trainers;
- how many became quality-AI engineers or other technical workers;

- how many were redeployed outside quality;
- how many positions disappeared through attrition;
- how many workers were laid off because of AI inspection;
- that the 33% reduction in single-line manpower allocation equals a 33% headcount reduction;

- that inspection labour cost falling to one-eighth means seven-eighths of workers were removed;
- that every flagged defect requires final human approval;
- that humans formally retain veto or override rights over every AI quality decision;
- that Zhang Chen's pathway is representative;

- that Zhao Pengfei's pathway is representative;
- that all workers receive the same AI training opportunity;
- that reskilled workers receive higher compensation;
- that the new AI-related roles are more secure;

- that factory-wide cost, yield and lead-time improvements were caused solely by quality inspection;
- that enterprise headcount changes in 2025 were caused solely by automation;
- that later Wuhu results are outcomes of the Jiaying workforce transition.

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— 25. Research Gaps to Watch —

1. What was the pre-AI headcount of quality inspectors at Jiaying?
2. What is the current quality-inspection headcount?
3. How many former inspectors became AI trainers?
4. How many became verifiers, data analysts or quality-AI engineers?
5. What happened to workers who were not selected for new roles?
6. How long does the transition from inspector to AI trainer take?
7. What curriculum is used?
8. Is training delivered during paid working time?
9. Are certifications attached to the new roles?
10. Do wages or grades increase after reskilling?
11. How are workers selected for transition?
12. What share of AI-training work is ongoing versus temporary model-building work?
13. How much human verification is required per unit of output?
14. What is the false-positive and false-negative rate of the AI inspection system?
15. Can human workers override an AI quality decision?
16. Are override decisions captured and used for retraining?
17. What happens when human and AI judgments disagree?
18. How many of the nine 2026 inspection procedures are fully automated versus AI-assisted?
19. Why do public sources refer to seven AI procedures in 2024 and nine major procedures in 2026?
20. Are the "nearly 200 data points" and "198 inspection items" comparable concepts?
21. What share of the factory's 33% manpower-allocation reduction

comes from inspection versus other automation?

22. What share of LONGi's enterprise 2025 workforce decline is attributable to automation versus market conditions?
23. How are worker representatives or labor unions involved in automation decisions?
24. What career path follows the AI-trainer role?
25. Does knowledge transfer into AI improve or weaken workers' long-term bargaining power?
26. Can independent research verify worker outcomes at Jiaying?
27. How does the Jiaying workforce model compare with LONGi's Wuhu and other factories as Lighthouse practices scale?

— 26. Method and Source Quality —. This Deep Dive separates evidence by both source type and analytical level.

— A. World Economic Forum Lighthouse evidence —

The World Economic Forum's 2023 Global Lighthouse reporting is the strongest external institutional source for factory-wide transformation outcomes. It supports:

- the overall transformation story;
 - 30+ use cases;
 - major factory-wide operational outcomes;
 - highlighted workforce/career-planning use cases.
- It does not provide a worker-level reconciliation of inspection employment.

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— B. LONGi first-party operational evidence — LONGi's technology, sustainability and quality materials provide detailed evidence on:

- AI inspection; • quality data architecture; • automation; • manpower allocation;

- training infrastructure; • factory replication.

These sources are strong for describing the company's systems and reported outcomes. They are first-party and should not be treated as independent validation.

— C. Worker-level journalistic evidence — Xinhua's 2026 reporting provides the clearest evidence of:

- the human double-check step; • inspection scope;
- the worker-reported one-eighth labor-cost figure.

The worker pathway is more concrete than a corporate claim of "upskilling". However, one profile does not establish workforce-wide outcomes.

— D. Local workforce reporting — The 2026 China Blue News / Hangzhou News report provides a second worker example and evidence of recurring AI training at the Jiaxing factory. It is useful supporting evidence, but it is not a formal LONGi workforce disclosure.

— E. Annual-report workforce evidence — LONGi's 2024 and 2025 annual reports provide enterprise-level employment and labor-cost data. These are important for preventing an overly positive case narrative. They show that company-wide headcount and production employment later contracted. They do not establish the causal contribution of Jiaxing AI inspection to that contraction.

— F. External sector benchmark evidence — World Economic Forum and ILO manufacturing research is used to frame:

- digital talent strategy; • just-transition questions;
- employment and worker-governance risks. These sources are not LONGi outcome evidence.

— 27. Evidence Architecture: A New AIGW Rule for Manufacturing Cases —. This case suggests a useful improvement to the AIGW Deep Dive methodology. For manufacturing, metrics should be tagged at one of four levels:

— Level 1 — technology metric — Example: model accuracy, inspection speed, automation rate.

— Level 2 — workflow metric — Example: first-pass yield, inspection efficiency, defect rate, lead time.

— Level 3 — workforce metric — Example: manpower allocation, labor hours, headcount, redeployment, training completion.

— Level 4 — worker-outcome metric — Example: role transition, wage change, career progression, job retention. The levels are related but not interchangeable. For example: higher inspection efficiency does not automatically mean: lower headcount. And: lower manpower allocation does not automatically mean: workers were dismissed. And:

one worker became an AI trainer does not automatically mean: workforce transition succeeded. This four-level evidence architecture should be retained in future industrial Deep Dives.

CONCLUSION

Conclusion

— Conclusion —. LONGi's Jiaxing factory provides a powerful example of how AI can change frontline manufacturing work before the full employment outcome becomes visible. The quality-inspection system substitutes a meaningful share of repetitive visual detection. Human workers remain in parts of the verification loop. The factory's quality infrastructure increasingly connects defect detection to traceability, attribution and process improvement.

Most importantly, at least one named frontline inspector moved into a role where his accumulated production knowledge became input to the AI system itself. That is a different form of work. The worker is no longer valuable primarily because he can personally inspect every product. He becomes valuable because he can:

- verify the system; • interpret the system; • improve the process around the system. Later worker and training evidence suggests LONGi is extending this logic toward a wider set of hybrid manufacturing roles. But the case also has a harder edge.

Automation materially reduced labour requirements in parts of quality and production. LONGi's broader workforce later contracted during a severe industry downturn, and its 2025 annual report explicitly links lower direct labour cost partly to fewer employees and higher automation. The public evidence does not allow those outcomes to be decomposed cleanly.

That uncertainty is not a weakness to hide. It is part of the central lesson. AI-driven manufacturing transition can simultaneously improve quality, reduce labour intensity, preserve human verification, create new technical pathways and reduce the number of people required to produce the same output. Whether that becomes worker upgrading or worker displacement depends on the mechanisms between automation and employment:

training, redeployment, hiring, attrition, career design and management choice. LONGi gives us a rare view of one worker crossing that bridge. The next research task is to determine how many others are able to cross it.

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