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Designing for Complementarity: Skills, Work, and Education in the Age of AI — A Review

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Abstract

This review synthesizes 2023–2025 evidence on how generative AI and automation are reconfiguring role structures, skill demands, and entry pathways, and proposes design principles that shift attention from task substitution to role redesign and talent architecture. Theoretical framework: Drawing on task-based labor economics, socio-technical systems design, and human-capital complementarity, the review distinguishes domains where substitution pressures concentrate from those where augmentation dominates. Method: A narrative review of peer-reviewed studies, official statistics, and policy/industry reports prioritized empirically grounded findings on employment effects, skills, governance, and program outcomes; inclusion emphasized methodological transparency and recency. Results and discussion: Convergent evidence shows contraction in routine cognitive tasks and growth in hybrid roles that pair domain expertise with AI orchestration, with early-career pathways especially exposed; high-performing implementations embed skills-first hiring, AI-augmented apprenticeships, and operational governance (provenance, bias testing, incident response) tied to performance. Research implications: Institutions should treat human-AI collaboration as an operating assumption and align curricula, workplace learning, and policy incentives around competence telemetry, credential portability, and equitable mobility.

Keywords

AI-driven labor market, Durable skills, Workforce upskilling, Industry 4.0 education, Automation and employment

Introduction

An evidence-based account of AI's labor effects requires separating near-term displacement headlines from medium-term recomposition, since automation compresses routine cognitive activity while increasing the premium on judgment, exception handling, and stakeholder communication; official projections, for example, anticipate 6.7 million net job additions in the

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United States from 2023–2033 with pronounced growth in health care and selected analytical occupations, demonstrating that churn coexists with expansion (U.S. Bureau of Labor Statistics [BLS], 2024). Employers simultaneously forecast significant skills turbulence—"44% of workers' core skills will be disrupted" by 2027—which reframes durable skills as the scaffolding for safe, useful augmentation rather than as soft adjuncts (World Economic Forum [WEF], 2023). Public sentiment registers anxiety—64% of Americans expect fewer jobs over the next two decades due to AI—yet expert views are more tempered, underscoring the need for governance and design to translate capability into legitimate value (Pew Research Center, 2025). Cross-national surveys by the OECD further complicate simplistic narratives: workers report improvements to job satisfaction, safety, and some wage outcomes when AI is well implemented, even as privacy and work-intensity risks require active management (OECD, 2023; 2024). In short, the most defensible thesis treats the present as a design problem: institutions must compose roles that elevate human judgment and braid AI capability with trustworthy practices, rather than attempt to defend legacy job descriptions.

Materials and Methods

Given a rapidly evolving evidence base, a narrative review was selected to integrate heterogeneous study designs while maintaining emphasis on empirical transparency; sources included peer-reviewed articles and working papers, official statistics (for baseline labor dynamics), and major policy/industry reports published between 2023 and 2025. Search strings combined terms for "generative AI," "automation," "employment," "skills," "apprenticeship," and "governance," supplemented by backward/forward citation tracking to surface adjacent evidence on durable skills and assurance practices. Inclusion criteria required explicit methods or data provenance, direct relevance to employment or education design, and sufficient detail for interpretation; where findings diverged, the review foregrounded convergences and identified boundary conditions. To address reviewer concerns regarding method visibility, the synthesis proceeds problem-first: mapping observed substitution/augmentation, reconstructing early-career pathways, and specifying governance as performance. Recognized limitations include short-horizon indicators in some statistics, non-uniform outcome measures across studies, and sectoral skews; these constraints are mitigated by triangulation across multiple reputable sources (e.g., BLS, OECD, WEF, NBER, Science).

Results and Discussion

Substitution and augmentation: where each actually occurs

The weight of evidence indicates that substitution pressures concentrate in routine cognitive tasks (templated drafting, queue triage, rules-based classification), while augmentation rises in judgment-intensive functions—exception adjudication, risk communication, and multi-stakeholder coordination—where human oversight is critical. A large-scale field study of 5,179 customer support agents reported that access to a generative AI assistant "increases productivity… by 14% on average," with a 34% gain for novice/low-skill workers and little effect on experts, implying that AI narrows performance dispersion by codifying tacit practices (Brynjolfsson, Li, & Raymond, 2023, p. 1). Complementary experimental work on mid-level professional writing found

~40% faster completion and ~18% higher quality, gains that were largest for lower-skilled participants—again highlighting augmentation rather than blanket replacement (Noy & Zhang, 2023). Macroeconomic analyses project sizable growth potential—Goldman Sachs estimates +7% global GDP over a decade if diffusion hurdles are overcome—yet sectoral recompositing will be uneven, reinforcing the need for institution-specific design (Goldman Sachs Research, 2023). Examples illustrate the pattern: call-center reply drafting and first-pass summarization tend to automate under sampling-plan oversight, whereas clinical documentation review, financial-controls exception handling, and public-sector benefits adjudication embed humans at escalation gates.

Rebuilding entry routes: skills-first hiring and AI-augmented apprenticeships

Because many apprenticeship-style tasks sit squarely in the automatable band, early-career pathways have thinned, a trend echoed by recent payroll analyses and employer sentiment; the remedy is to reconstruct on-ramps that combine tool leverage with supervised practice and evidence-bearing assessment. Skills-first hiring is visibly advancing: on LinkedIn, job posts omitting degree requirements rose **36%** between 2019 and 2022, and Indeed's Hiring Lab reports the share of U.S. postings with *no* formal education requirement increased from 48% (2019) to 52% (early 2024), expanding candidate pools without diluting standards (LinkedIn, 2024; Indeed Hiring Lab, 2024). Occupation-level projections help target these on-ramps: BLS lists wind-turbine technicians (+60%), solar installers (+48%), nurse practitioners (+46%), data scientists (+36%), and information security analysts (+33%) among the fastest-growing roles, with each pathway lending itself to AI-augmented practice under explicit supervision gates (BLS, 2025). Programmatically, AI-augmented apprenticeships can scaffold novice work with supervisor sign-offs using telemetry—time-to-autonomy, variance reduction, and error-interception rates—while micro-credentials carry artifacts (model cards, data statements, gold sets, evaluation briefs) that document competence. Concrete examples include customer-support triage where new hires escalate only beyond predefined similarity thresholds, or clinical documentation review where junior staff operate "watch mode" models and must capture provenance notes before sign-off.

Governance as an operating discipline: performance, legitimacy, and trust

Governance connects productivity to legitimacy when it is embedded as day-to-day practice rather than policy preface; as the NIST AI Risk Management Framework states, "Understanding and managing the risks of AI systems will help to enhance trustworthiness, and in turn, cultivate public trust" (NIST, 2023, p. 1). Organizations can instantiate this principle by adopting ISO/IEC **42001**—the first AI management-system standard—which codifies lifecycle risk management, impact assessment, and supplier oversight, providing a certifiable anchor for internal controls and external assurance (ISO, 2023/2024). Operationally, leading guidance emphasizes incident response runbooks, transparency documentation, and continuous monitoring as shared obligations across product, compliance, and engineering; public transparency reporting by major platforms also illustrates how to communicate assurance efforts at scale (Microsoft, 2024–2025). In practice, provenance dashboards, bias testing tied to override/abstention hooks, and post-incident reviews that update runbooks reduce error propagation while generating evidence for regulators and stakeholders. Regional skills compacts and credential registries extend trust beyond the firm by making competence portable, while published cohort-level metrics—internal mobility, wage progression, accessibility indicators, and time-to-productivity—counteract fears that augmentation benefits will bypass under-represented groups.

Contributions to business practice: five design moves with measurable payoffs

First, redesign roles around decisions rather than legacy task lists by specifying where human judgment is non-delegable and instrumenting these checkpoints; field evidence shows that codifying expert moves can lift the long tail of performance, particularly among novices (Brynjolfsson et al., 2023). Second, build AI-augmented apprenticeships with explicit decision gates and supervisor attestations linked to telemetry—*e.g.*, require two consecutively clean audits of escalation decisions before expanding autonomy. Third, translate governance into incentives by tying provenance completeness, bias-test coverage, and incident response latency to managerial objectives; the AI RMF and ISO 42001 supply practical scaffolds (NIST, 2023; ISO, 2023/2024). Fourth, make training evidence-bearing: require artifacts (model cards, gold sets, evaluation briefs) that travel with workers and support mobility; organizations that publish such documentation in internal registries accelerate reuse and trust. Fifth, expand opportunity through skills-first hiring and bridge programs that convert general AI literacy into domain-specific competence; labor-market data and employer surveys justify this shift and indicate where investment yields the largest mobility gains (LinkedIn, 2024; Indeed Hiring Lab, 2024; BLS, 2025; OECD, 2024; WEF, 2023).

Interpreting Figure 3: Role-Design Matrix for Human-AI Workflows

Figure 1 conceptualizes tasks on two axes—automation susceptibility and complementarity potential—with iso-risk contours indicating where governance intensity must rise as autonomy increases; managers should sequence transitions across bands, beginning with templated segments under sampling plans, insulating high-judgment functions with clear guardrails, and instrumenting transitional work to learn where complementarity improves with better data, tools, and training. Concretely, templated correspondence and first-pass summarization fall in the high-susceptibility/low-complementarity band and should automate with human sampling; clinical documentation review, financial-controls exceptions, and public-benefits adjudication occupy the low-susceptibility/high-complementarity quadrant and should remain human-anchored with AI assistance for retrieval and drafting; intermediate tasks migrate as data quality and toolchains mature. This frame operationalizes a key insight—augment where oversight is indispensable, automate where variance is costly and context minimal—and echoes both micro-level productivity findings and macro-level projections.

Table 1 — Taxonomy of AI-Complementary Competencies

Competency (Durable Skill)	Observable Behaviors in Human-AI Teams	Typical AI Contribution	Evidence/Artifacts for Assessment
Analytical reasoning	Frames hypotheses; tests outputs against gold sets; flags edge cases	Pattern surfacing; retrieval	Evaluation brief; error-interception log
Communication	Explains model limits; writes provenance notes; negotiates tradeoffs	Drafting under human control	Provenance memo; stakeholder FAQ
Collaboration	Coordinates cross-functional incidents; maintains shared context	Memory/hand-off scaffolds	Incident postmortem; runbook update

Competency (Durable Skill)	Observable Behaviors in Human-AI Teams	Typical AI Contribution	Evidence/Artifacts for Assessment
Adaptability	Iterates prompts/tools as data shift; documents decisions	Orchestration across tools	Prompt trace; change log with outcomes
Ethics & governance	Triggers overrides; records abstentions; tests for bias & privacy	Monitoring hooks	Bias-test report; override/abstention record

Conclusion and Limitations

The contemporary labor question is less whether AI displaces jobs in the abstract and more how institutions redesign roles to protect human judgment while harvesting machine leverage—an approach consistent with productivity studies that show large gains concentrated among novices and routine tasks alongside stable or modest effects for experts (Brynjolfsson et al., 2023; Noy & Zhang, 2023). A feasible roadmap begins with skills-first hiring and AI-augmented apprenticeships that rebuild entry routes, continues with governance as performance "understanding and managing risks" to cultivate trust—and culminates in evidence-bearing credentials that make competence portable (NIST, 2023, p. 1). Policymakers can accelerate diffusion with incentives for incumbent upskilling, interoperable credential registries, and regional skills compacts, while educators braid AI literacy with durable skills in applied contexts that mirror hybrid workplace demands; employers should publish cohort-level mobility and safety metrics to ensure gains do not bypass under-represented groups. Limitations include the recency of several sources, heterogeneous outcome measures, and sectoral skews; readers should interpret directional findings alongside refreshed telemetry and updated datasets as adoption scales. Properly designed, augmentation outcompetes displacement as the organizing principle: institutions compose roles that elevate human decisions, align machine capability with assurance, and translate technological promise into widely shared prosperity.

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References

Baldwin, R., & Okubo, T. (2023). Are Software Automation and Teleworkers Substitutes? Preliminary Evidence from Japan. *National Bureau of Economic Research*, *Working Paper 31627*. 1-25. https://doi.org/10.3386/w31627

Brynjolfsson, E., Li, D., & Raymond, L. (2023). Generative AI at Work. *National Bureau of Economic Research*, *Working Paper 31161*. 1-67. https://doi.org/10.3386/w31161

Goldman Sachs. (2023). Generative AI could raise global GDP by 7%. *Goldman Sachs*. https://www.goldmansachs.com/insights/articles/generative-ai-could-raise-global-gdp-by-7-percent

Indeed Hiring Lab. (2024). Educational requirements are gradually disappearing from U.S. job postings. *Indeed Hiring Lab* https://www.hiringlab.org/2024/02/27/educational-requirements-job-postings/

International Organization for Standardization. (2023). ISO/IEC 42001:2023 Information Technology-Artificial intelligence—Management system. *ISO*. https://www.iso.org/standard/42001

LinkedIn. (2024). The future of recruiting 2024. *LinkedIn Business Solutions*. https://business.linkedin.com/talent-solutions/resources/future-of-recruiting/archival/future-of-recruiting-2024

LinkedIn Economic Graph. (2025). Skills-based hiring: Unlocking talent and opportunity (White paper). *LinkedIn Economic Graph*. https://economicgraph.linkedin.com/content/dam/me/economicgraph/en-us/PDF/skills-based-hiring-march-2025.pdf

McKinsey Global Institute. (2023). Generative AI and the future of work in America. *McKinsey & Company* https://www.mckinsey.com/mgi/our-research/generative-ai-and-the-future-of-work-in-america

McKinsey & Company. (2025). Superagency in the workplace: Empowering people to unlock AI's full potential. *McKinsey & Company* https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/superagency-in-the-workplace-empowering-people-to-unlock-ais-full-potential-at-work

National Institute of Standards and Technology (NIST). (2023). Artificial Intelligence Risk Management Framework (AI RMF 1.0) (NIST AI 100-1). *NIST Publications* https://nvlpubs.nist.gov/nistpubs/ai/nist.ai.100-1.pdf

Noy, S., & Zhang, W. (2023). Experimental evidence on the productivity effects of generative artificial intelligence. *Science*, *381*(6654), 187–192. https://doi.org/10.1126/science.adh2586

OECD. (2023). *OECD Employment Outlook 2023: Artificial intelligence and the labour market*. OECD https://www.oecd.org/en/publications/oecd-employment-outlook-2023_08785bba-en.html

OECD. (2024). Using AI in the workplace (Policy report). *OECD* https://www.oecd.org/content/dam/oecd/en/publications/reports/2024/03/using-ai-in-the-workplace_02d6890a/73d417f9-en.pdf

Pew Research Center. (2025). How the U.S. public and AI experts view artificial intelligence. *Pew Research Center* https://www.pewresearch.org/internet/2025/04/03/how-the-us-public-and-ai-experts-view-artificial-intelligence/

U.S. Bureau of Labor Statistics. (2024). Employment projections—2023–2033 (News release). *Bureau of Labor Statistics* https://www.bls.gov/news.release/pdf/ecopro.pdf

U.S. Bureau of Labor Statistics. (2025, April 18). Fastest growing occupations, 2023–2033 (Table 1.3). *Bureau of Labor Statistics* https://www.bls.gov/emp/tables/fastest-growing-occupations.htm

World Economic Forum. (2023). The Future of Jobs Report 2023. *World Economic Forum* https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf