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NITI Aayog

NITI Frontier Tech Hub

AI FOR INCLUSIVE SOCIETAL DEVELOPMENT

Knowledge Partner

Deloitte.

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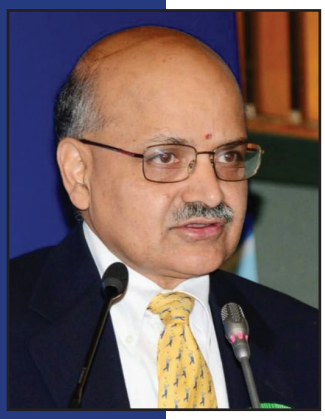
Foreword



As India aspires towards the vision of Viksit Bharat by 2047, one question stands before us: how do we ensure that this journey of prosperity, equity, and innovation includes everyone? Much of the global discourse around Artificial Intelligence has focused on its effects on the formal economy. Yet, the heartbeat of India lies in its 490 million informal workers—the farmers, artisans, healthcare providers, and service professionals who form the bedrock of our society and economy. This roadmap is a pioneering effort to place their stories, struggles, and aspirations at the very center of our national conversation on technology.

In these pages, you will meet Bindu, Samar, Lata, Aman, and Rekha—a healthcare worker, a carpenter, a weaver, an electrician, and a farmer. Their lived realities remind us that the true measure of technological progress is not simply in productivity gains or economic growth, but in its power to transform lives with dignity, opportunity, and hope. For India, the challenge is not just to deploy AI—it is to make AI matter in the lives of millions who have historically been on the margins of formal development pathways.

The vision presented here is both ambitious and achievable. It proposes a *National Mission: Digital ShramSetu*—a technology-driven bridge designed to empower informal workers with trust, access, and skills in the digital age. By harnessing frontier technologies such as AI, blockchain, and immersive learning, we can dismantle systemic barriers and enable inclusion at a scale the world has never witnessed. Our pioneering success with digital public infrastructure—from Aadhaar to UPI—has shown the world what India can achieve when innovation is combined with inclusivity. We now stand at a similar inflexion point, with a once-in-a- generation opportunity to reimagine the future of work for every Indian.

This is not a task for one institution or sector alone. It calls for purposeful collaboration between government, industry, civil society, and academia. If we come together with intent, compassion, and resolve, we will not only accelerate India's development trajectory but also ensure that our growth story is one that belongs to all—resilient, inclusive, and equitable.

It is my privilege to introduce this roadmap. May it serve as a call to action, an inspiration, and most importantly, a reminder that the promise of Viksit Bharat 2047 will be fulfilled only when every worker, formal or informal, stands not just as a beneficiary of progress, but as its catalyst.

Shri B.V.R. Subrahmanyam
CEO, NITI Aayog

Foreword

Across the world, Artificial Intelligence is triggering debates on automation, efficiency, and disruption. But here in India, we are charting a different course—one where technology is not a force of exclusion, but of extraordinary inclusion.

I think the biggest opportunity for AI and other frontier technologies lies in their ability to revolutionise life for the 490 million informal workers who power India's economic engine. How do we put the world's most advanced technologies in the hands of the most overlooked, so they can leapfrog constraints and claim their rightful place in India's growth story?

To answer this, we looked far beyond data sets and algorithms. We immersed ourselves in the lived realities of informal workers—a home healthcare aide in Rajkot, a carpenter in Delhi, a farmer, and others —to understand their challenges and dreams. These stories illuminate the barriers that persist, but also reveal the immense potential that the right technology, thoughtfully deployed, can unlock. For these millions, technology must not replace, but amplify their skills, aspirations, and livelihoods.

This roadmap envisions a 2035 where voice-first, AI-powered interfaces shatter barriers of language and literacy, making digital platforms universally accessible; where smart contracts guarantee timely and transparent payments; where micro-credentials and on-demand learning empower workers to upskill at the speed of their ambition. But achieving this inclusive digital leap will require more than optimism—it will demand concerted investments in R&D, targeted skilling initiatives, and the nurturing of a robust, innovation-driven ecosystem.

At the heart of this blueprint stands the national mission, **'Digital ShramSetu'**, an urgent call to harness frontier technologies for the upliftment of India's informal sector at scale. This is a vision rooted not just in technological possibility, but in moral necessity.

I am deeply grateful to the Expert Council for their invaluable guidance and to Deloitte for being exemplary partners on this journey. This roadmap is an attempt to shape a future in which every Indian worker, irrespective of background or profession, is empowered to be a full participant in our nation's progress. I am confident its insights will serve as a catalytic guide as we build a truly inclusive and prosperous India.

Debjani Ghosh
Distinguished Fellow, NITI Aayog
Chief Architect, NITI Frontier Tech Hub

Executive Summary

Most discussions and reports on Artificial Intelligence (AI) focus on white-collar professionals and predict an almost certain loss of jobs in the segment in the absence of urgent interventions. Little attention, if any, is paid to how AI can serve India's 490 million informal workers [1], the very people who form the backbone of our economy.

This work aims to change that. It is centred on people - Bindu, a 36-year-old health care worker from Rajkot; Samar, a 38-year-old carpenter from Delhi; Lata, a 40-year-old handloom weaver from Lucknow; Aman, a 35-year-old electrician from Patna; Rekha, a 42-year-old farmer from Odisha and millions of others like them who power India's vast informal workforce. They are more than workers; they are the heart of India's economic engine and hold the key to a ***Viksit Bharat***. The true test of AI's promise lies in its ability to transform their lives and livelihoods.

As India approaches its centenary of independence in 2047, the vision of ***Viksit Bharat*** charts a bold, inclusive pathway to becoming a developed nation. At its core lies a critical imperative: integrating India's informal workforce, which comprises roughly 90 percent of the labour force [1] and contributes nearly half of the Gross Domestic Product (GDP). Despite their role in sectors such as construction, textiles, food services, caregiving and handicrafts, these workers continue to operate in low-productivity, insecure environments that are largely excluded from formal systems, social protections and opportunity pathways.

This roadmap highlights the role that AI and frontier technologies can play in unlocking the potential of India's informal trade workforce and transforming them into catalysts for ***Viksit Bharat***, if deployed thoughtfully and inclusively. Importantly, this is a living document, intended to continuously evolve as new insights, technologies, and challenges emerge—ensuring that interventions remain relevant, resilient, and future-ready.

Drawing on ground-level insights and real worker profiles, it identifies five core challenges, namely financial insecurity,

limited market access, lack of skilling, inadequate social protection and low productivity, that continue to hold back this segment from realising its full potential. The mentioned challenges are rooted in four deeper systemic barriers: lack of trust, poor access and usability of services, low awareness and skills and outdated tools and processes.

The roadmap discusses how frontier technologies such as Artificial Intelligence, Internet of Things, blockchain, robotics and immersive learning can be harnessed to break systemic barriers faced by India's informal workforce. It is premised on the evolution of a more accessible, affordable and resilient technology infrastructure capable of supporting scale and inclusion. This roadmap envisions a future where, by 2035, India leads in deploying these technologies to enable transformative solutions: modular and demand-driven skilling smart contracts linked to verified work outcomes and real-time access to jobs, markets and entitlements designed with the realities of the informal sector at the core.

To realise this vision, the roadmap proposes a national mission called **Digital *ShramSetu*** to drive the adoption of frontier technologies across India's informal workforce. It outlines a targeted strategy focused on persona or sector-led prioritisation, state-driven implementation, regulatory enablement and strategic partnerships to ensure affordability and scale. The mission will mobilise stakeholders across government, industry and civil society and will be guided by a robust, multi-level impact evaluation framework.

However, to make this mission a reality, **we need to act now!** India's past successes with digital public infrastructure such as Aadhaar, UPI and Jan Dhan demonstrate our ability to build inclusive, at-scale platforms that change lives. With a strong digital backbone, a young workforce and the untapped potential of the informal sector, India has a once-in-a-generation opportunity. Delayed action would mean leaving millions behind and weakening our development trajectory. However, if we act boldly and with intent, we can place India's informal workers at the centre of our growth story and in doing so, secure the foundations of a truly ***Viksit Bharat***.

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1. VIKSIT BHARAT 2047: EMPOWERING THE INFORMAL WORKFORCE IS THE FOUNDATION OF A TRULY DEVELOPED INDIA

India's centenary of independence in 2047 is more than a symbolic milestone. It is a strategic inflection point. The Government of India's ***Viksit Bharat*** 2047 vision outlines an ambitious transformation: a US$30 trillion economy, a US$18,226 per capita income [2] and a society characterised by prosperity, equity, innovation and sustainability. This ambitious goal builds on seven decades of national progress, further reinforced now by transformative initiatives such as **Digital India, Make in India, Swachh Bharat and Atmanirbhar Bharat**. These reforms have accelerated innovation and laid a strong foundation for digital empowerment and self-reliance, positioning India as the fourth-largest economy [3] in the world. However, realising the vision demands addressing a fundamental challenge: integrating India's vast informal trade workforce of approximately 490 million [1] which remains largely excluded from the country's core economic gains.

Informal trade workers *are individuals engaged in economic activities outside formal employment systems, without written contracts, job security or social protection. They include skilled, semi-skilled and unskilled workers such as carpenters, drivers, agricultural labourers and helpers, who often work in informal, self-employed or subcontracted arrangements across sectors.*

Today, around 90 percent of India's labour force operates in the informal sector, [1] powering essential industries such as construction, agriculture, logistics, retail and artisanal manufacturing. Yet, despite their vital contribution to the economy, trade workers' productivity, measured as per capita income per hour, remains around US$5 per hour, almost half of the overall average of US$11 per hour, [4] reflecting persistent gaps in access to tools, training and support systems.

Trapped in low-wage, low-productivity roles without job security, structured training or social protection, these workers cannot contribute optimally or realise their full potential. Women's participation in the workforce sits at 37 percent, [5] compared with a global average of 47 percent, [6] further eroding overall productivity and economic resilience. Many workers, shoulder unpaid caregiving and domestic responsibilities, such as elder care, household management, children's education. This invisible labour, though central to the social and economic fabric, remains unrecognised in productivity metrics and limits time for paid employment or skill development.

This roadmap calls out the urgent imperative to reverse the trend of marginalisation and accelerate the role of AI in integrating the informal trade workforce into India's long-term development agenda. The year **2047 represents the ultimate point of arrival** for a **high-income India** where every worker, regardless of background or sector, has **access to formal employment pathways**, comprehensive social protection and tools that enhance income levels, improve productivity and elevate the quality of life.

Key national outcomes envisioned for 2047 include the following:

Raising **per-capita income to US$18,226,** driving nominal GDP to **US$30 trillion** and cementing India's high-income status.[7]

Elevating **female labour-force participation to over 70 percent**, reflecting sustained investments in gender-focused education, vocational training and workplace reforms.[8]

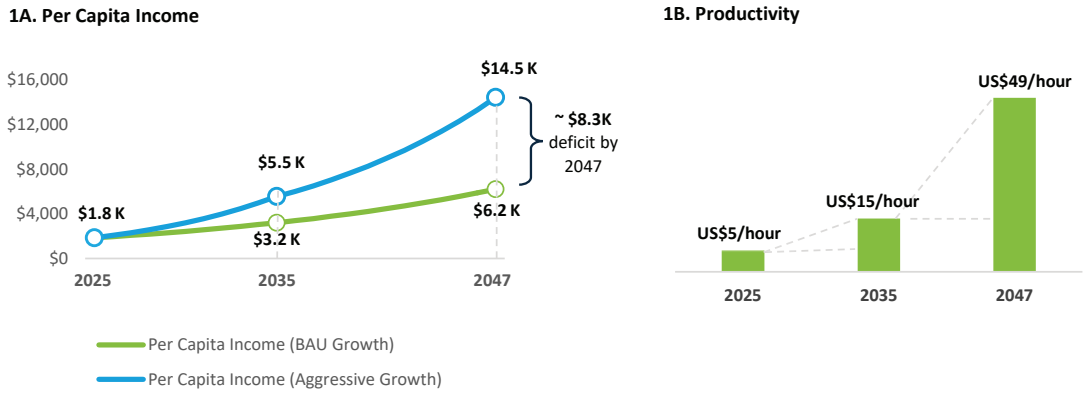
Formalising 73.2 percent of erstwhile informal enterprises [9], reducing the informal sector's share to 40 percent through universal digital registration, streamlined compliance and accessible credit.

Securing a position among the **top 10 nations on the Global Gender Gap Index** [10], demonstrating world-class achievements in closing economic and social gender disparities.

Achieving **universal social-security coverage** for workers, guaranteeing comprehensive benefits that included pensions, health insurance and paid leave for every employee.[19]

However, **national averages** often mask the experience of **India's informal trade workforce**. Our deep dive into this segment reveals a steeper climb and higher potential.

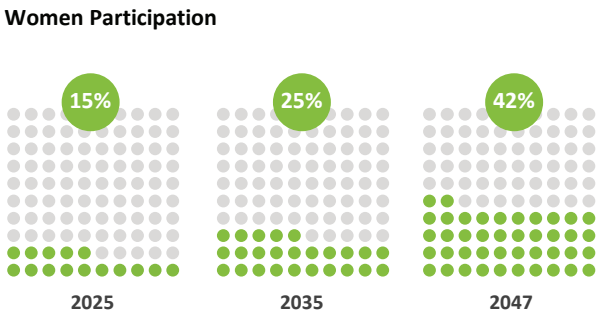
Figure 1: Target benchmarks for India's informal trade workforce by 2035 and 2047



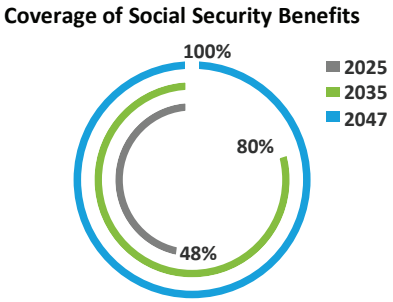
Currently the Productivity (by GDP per hour) for informal worker is approximately US$5 per hour,[13] [22][23] corresponding to an annual **per capita** income of around US$1,800. [11][21] To achieve the **targeted per capita income** of approximately **US$14,500 by 2047**, a substantially higher growth rate will be required. Investing in frontier technologies will enable India to significantly enhance productivity and earnings, supporting progress towards its ambitious target.

With female participation still at a **modest 15 percent** (excluding agriculture) [12] **and 48 percent social protection coverage**, [18] the informal trade sector faces deep inclusion gaps and narrowing these disparities by 2047 will require gender-responsive skilling, inclusive infrastructure and tech-enabled delivery of universal social benefits.

1C. Social security coverage



1D. Female labour force participation



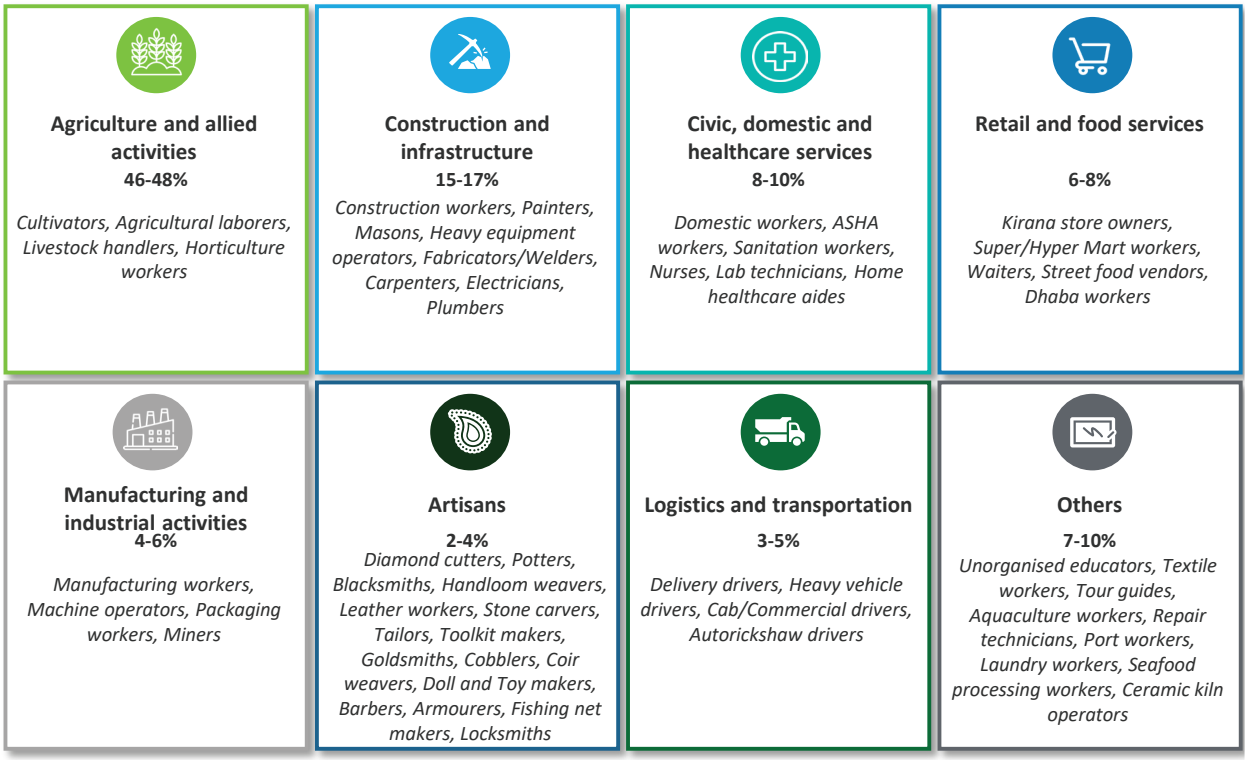
The transformation of India's informal economy hinges on the **strategic use of frontier technologies**, with AI at the forefront. Under #AIforAll, AI is viewed as a tool for innovation as well as the foundation for inclusive growth. By embedding intelligent systems across sectors **ranging from labour markets and financial services to healthcare, skilling and social protection,** India can integrate informal trade workers into the mainstream of the Fourth Industrial Revolution, ensuring that technology becomes a driver for opportunity, not displacement.

This roadmap discusses a potential blueprint for leveraging AI and frontier tech to boost productivity, raise incomes and bridge the gap between high-growth sectors and labour-intensive trades. Empowering the informal workforce is central to India's competitiveness, resilience and the inclusive vision of ***Viksit Bharat*** 2047.

2. UNDERSTANDING THE CURRENT CHALLENGES FACED BY THE INFORMAL TRADE WORKFORCE

India's informal sector contributes around **45 percent of the GDP**[13], playing a critical role in the economy. This informality spans multiple sectors of the economy, as shown in the sectoral distribution and corresponding worker profiles in Figure 2.

Figure 2: Distribution of India's informal trade workforce by sector and corresponding work profiles



Sources: PLFS Report(s), PIB, Deloitte Research and Modelling

Across these sectors, the informal economy is characterised by:

- Casual labour performed mostly through self-employment or small unregistered enterprises
- Limited or no formal skilling and training
- Limited usage of technology
- Low or no health and social security coverage

While national schemes such as e-Shram, PM Vishwakarma, PM SVANidhi, Ayushman Bharat, National Urban Livelihood Mission (NULM) and National Rural Livelihood Mission (NRLM) aims to address these gaps, their impact has been uneven. Strengthening these schemes through technology-driven integration and effective real-time, last-mile delivery is crucial. India has learnt important lessons from the successful deployment of Digital Public Infrastructure (DPI). Using these learnings can help unlock transformative opportunities to empower informal trade workers at scale.

To unleash this potential, we must **understand the real challenges, needs and aspirations** of the informal trade workforce and design solutions that are inclusive, practical and future-ready for ***Viksit Bharat*** 2047.

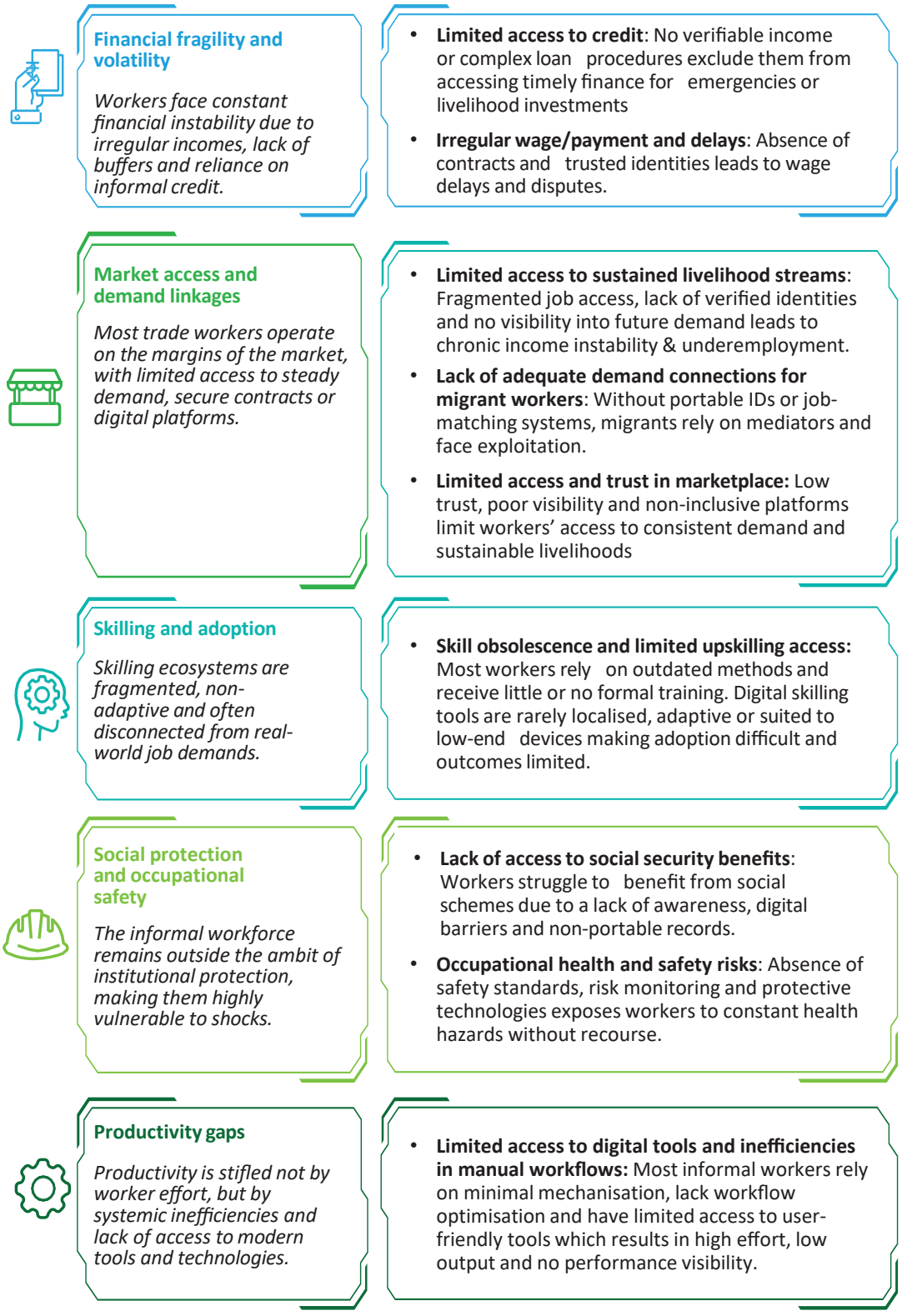
For this purpose, a persona-based approach has been adopted to reflect the fragmented reality of the informal workforce and to highlight the varied challenges faced by different types of workers, instead of relying on a one-size-fits-all perspective.

This approach involves creating research-backed profiles that capture key traits, behaviours and needs of informal trade workers. Post extensive research across different sectors, from a universe of approximately **490 million** informal workers [1] about **55 worker profiles** were developed (refer Appendix A), out of which **eight key personas, namely Cultivators, Textile workers, Artisans** (potters, blacksmith, coir weavers etc.)**, Unorganised educators, Home healthcare aides, Utility trade workers** (electricians, plumbers etc.)**, Kirana store workers and Tour guides** were identified for deeper analysis (refer Appendix B). The persona selection process was driven by **four key dimensions: population size, sectoral alignment, potential for impact and strategic relevance**. In addition, factors such as **female workforce participation, potential for social impact, alignment to emerging sectors, demographic relevance and niche occupations** were considered to ensure balanced and inclusive representation of the informal workforce (refer Appendix C and D). Finally, 8 personas were finalised based on the factors discussed in consultation with the Expert Council (refer to Appendix E). These personas capture common patterns and the insights apply more broadly across the informal trade workforce.

To ensure that the analysis reflects on-ground realities, a deep dive study of these eight informal trade worker personas was conducted. Each persona was examined through a multi-dimensional lens, covering work conditions, skill levels, access to finance and social protection, digital readiness and systemic barriers (refer to Appendix B for detailed challenges by each persona). The analysis was anchored in a mixed-methods approach that integrates rigorous secondary research with in-depth primary field engagement. The resulting insights enabled the development of detailed pain-point profiles for each worker group (refer to Appendix F for methodology and sources). This approach can further be scaled to various other worker profiles and sectors.

The findings reveal a diverse range of structural and operational challenges faced by the informal sector, including **income instability, exclusion from formal systems, weak social protection, workflow inefficiencies and limited access to skilling**. These recurring issues across worker groups were distilled into five core themes that anchor this study: financial fragility & volatility, market access & demand linkages, skilling & adoption, social protection & occupational safety and productivity gaps (refer to Figure 3). Together, they represent the key areas that frontier technologies must address to enable large-scale inclusion.

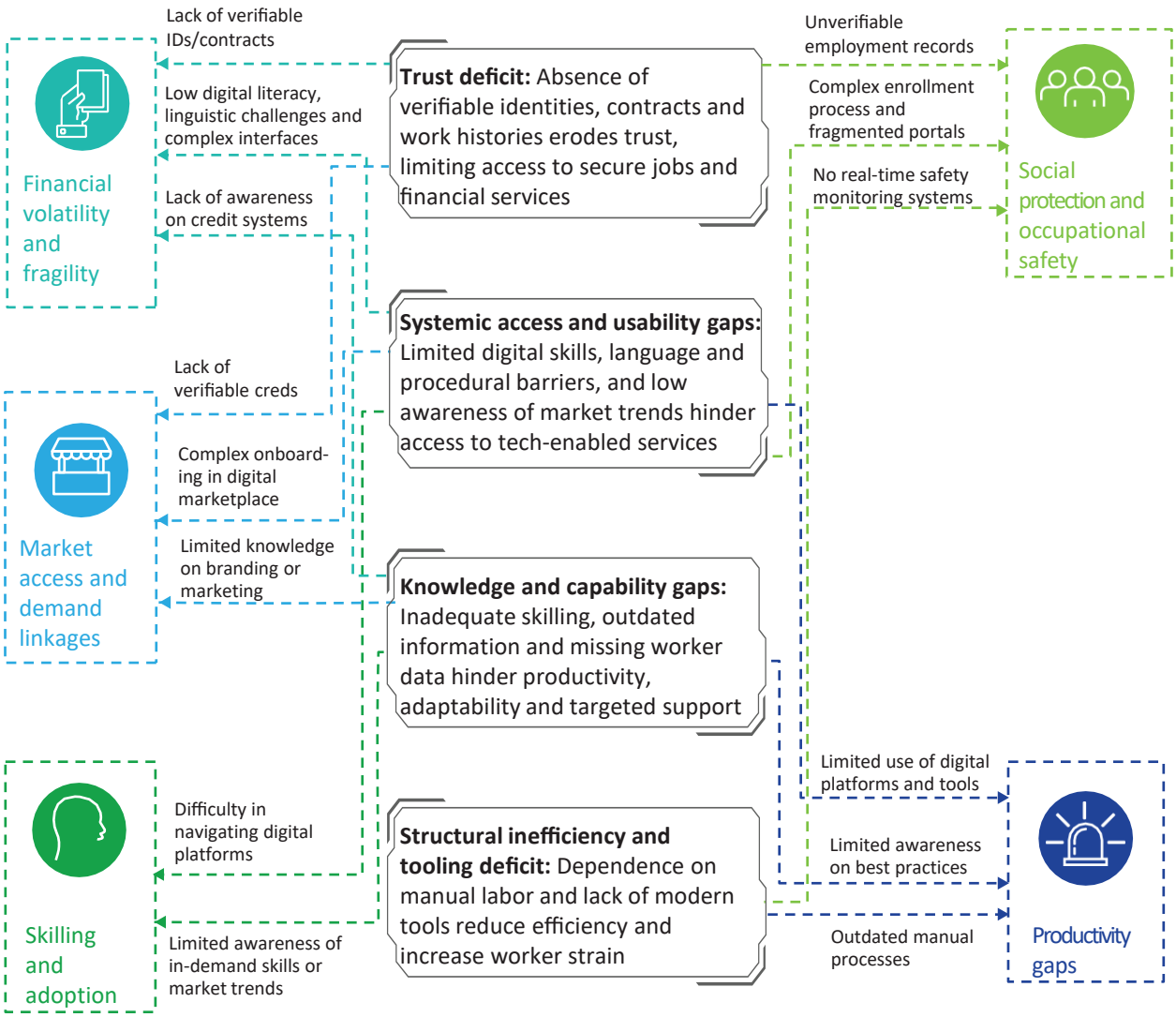
Figure 3: Thematic challenges faced by the informal trade workforce



Looking deeper, these five challenge themes outlined are not isolated or incidental. They are **recurring and cross-cutting patterns** observed across diverse sectors, revealing deeper structural issues within India's informal economy. While the analysis draws from eight representative personas, their challenges were abstracted into foundational systemic barriers, ensuring that the insights and solutions derived are applicable more broadly across the informal trade workforce.

Through a synthesis of field insights, persona-based diagnostics, secondary research and expert interviews, four systemic barriers emerged as the underlying causes of these challenges: **trust deficit, systemic access & usability gaps, knowledge & capability gaps and structural inefficiencies in work processes & tooling deficit** (shown in Figure 4). The figure illustrates how the challenges are shaped by a web of interconnected and systemic barriers, each contributing in unique ways.

Figure 4: Systemic barriers and underlying challenges faced by the informal trade workforce



3. VISION 2035: TRANSFORMING INFORMAL LIVELIHOODS THROUGH TECHNOLOGY

By 2035, AI and other frontier technologies should meaningfully transform India's informal trade workforce into a more inclusive and productive ecosystem. This shift will be enabled by foundational drivers such as affordable smartphones, pervasive connectivity, regional language AI, low-cost hardware and a mature, secure digital infrastructure for trusted transactions, as illustrated below (refer to Figure 5).

Figure 5: Illustrative technology shifts envisioned for 2035

01

Computing costs are reducing and will continue to significantly reduce

The cost of running AI systems at the level of GPT-3.5 dropped by over 280-fold between Nov 2022 and Oct 2024[26], a trend expected to continue amid intensifying innovation and competition.

02

Advanced electronics, Make in India will lower hardware or operating costs

Driven by advances in electronics and Make in India push, hardware costs have been declining at an average rate of 30 percent per year, while energy efficiency has improved by 40percent annually[27].

03

5G adoption will be widespread across urban and rural India

By 2030, over 740 million Indians are expected to have 5G access, including rural areas[28]. This will lay the foundation for deploying technology-backed solutions at scale across the country.

04

Language models in local dialects will be readily available

While Indic Large Language Models (LLMs) are expected to cover all scheduled language by 2026[29], demand for edge-ready, multilingual AI will drive the growth in Small Language Models (SLMs), enabling affordable, on-device applications for localised solutions.

05

Low-cost smartphones will be available with multimodal capabilities

Powered by entry-level new generation chipsets[30], affordable smartphones with AI features that can support voice, text and image-based interactions, making multilingual and multimodal interfaces accessible to millions of users.

06

DLT infrastructure will be strengthened

Fueled by government initiatives like the Vishvasya Stack and the National Blockchain Framework, India's DLT market is set to grow at 65 percent CAGR, reaching US$61.5B by 2033[31]. This push will drive adoption across key areas like identity, governance and supply chain.

Over the next decade, these enablers, coupled with frontier technologies and mature digital public infrastructure will help overcome today's challenges by strengthening trust, providing real-time guidance and enabling adaptive service delivery. These advancements have the potential to transform livelihoods at scale, but realising this future requires more than piecemeal solutions. The section below presents a few technology-driven possibilities to mitigate current barriers by the year 2035.

The technologies illustrated below are expected to become viable at scale over the next decade. This roadmap assumes that, through its recommendations, India will build the innovation ecosystem needed to enable their inclusive and effective use by 2035.

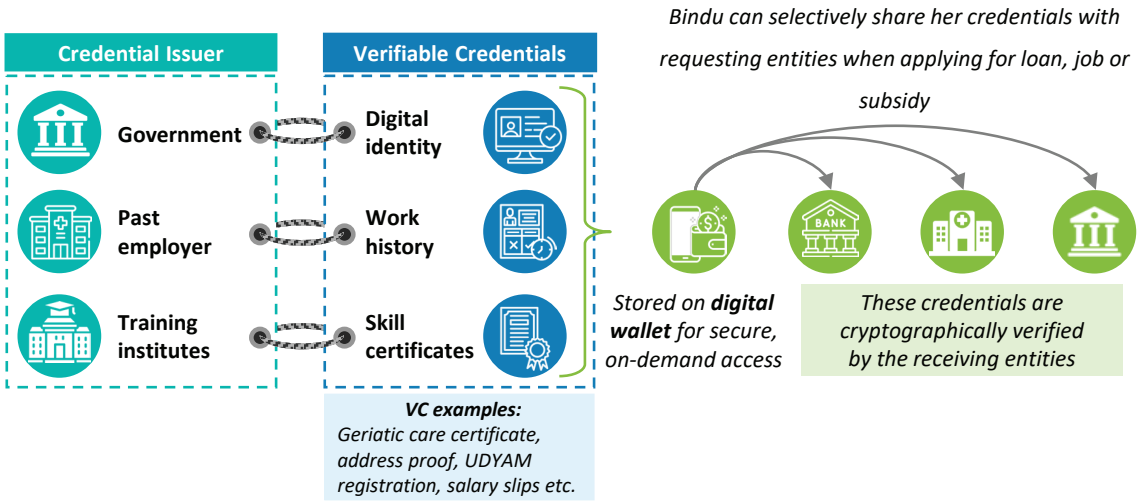
A. Trust deficit across the informal economy

Bindu, a 36-year-old home health aide from Rajkot, *has years of experience and basic certification but no formal proof of her work. She finds jobs through word-of-mouth and private messaging app, exposing her to unsafe conditions and delayed payments due to the lack of contracts or recourse. Without a digital work record or consistent identity across platforms such as Aadhaar, UDYAM and e-Shram, she is excluded from better jobs and credit, making her effectively invisible in the formal digital economy.*

As opposed to today's fragmented and scarce trust landscape, the future informal economy will be anchored in a **unified trust infrastructure** ensuring every informal trade worker, such as Bindu, is digitally visible, verifiable and economically credible. Verified identities and credentials anchored in secure, interoperable systems enable employers to confidently engage workers, while smart contracts and transparent records protect workers from delayed payments and exploitation. Government agencies seamlessly authenticate beneficiaries, ensuring accurate and timely welfare delivery. Trust is no longer a barrier, it is the backbone of a fair, inclusive and thriving informal economy.

Unified trust layer through verifiable digital credentials and digital wallets

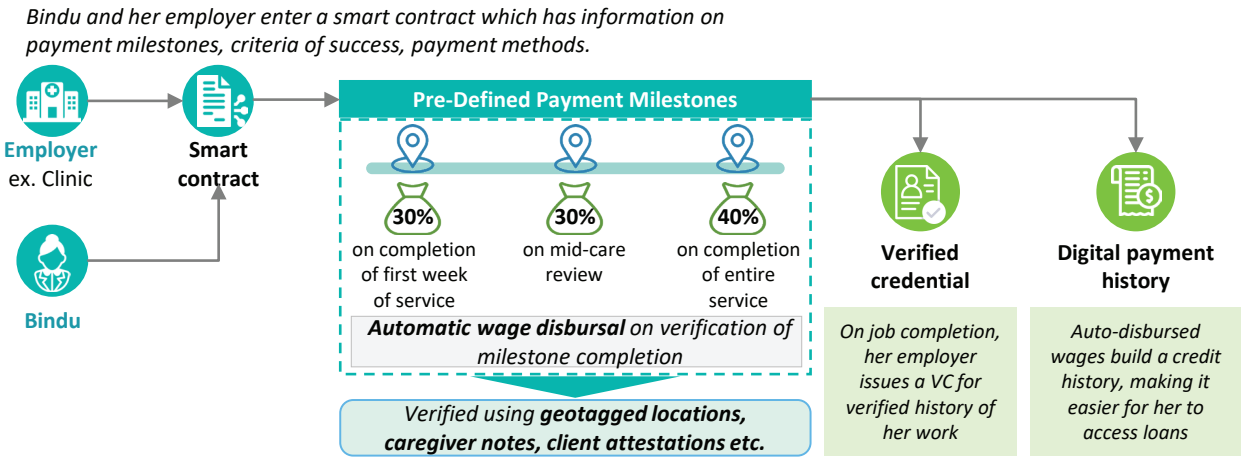
By 2035, workers like Bindu should have their identity, work history and skills securely captured and issued as digitally signed, tamper-proof Verifiable Credentials (VCs) by trusted entities. Stored in her digital wallet, these portable credentials would form a unified trust layer which is cryptographically secure, interoperable across platforms and instantly verifiable, enabling seamless access to jobs, benefits and skilling opportunities.



Building on today's KYC, these interoperable credentials give users like Bindu a **tamper proof, consent driven trust layer**, enabling faster service access, accurate assessments, and **broader financial inclusion.**

Smart contracts for milestones-based payments

Workers should be able to have their service agreements and payment terms embedded in smart contracts i.e. self-executing digital agreements recorded on centralized or distributed ledgers. These contracts would automatically trigger payouts upon milestone completion, ensuring timely, transparent and dispute-free transactions.



Smart contracts ensure **fair, timely payments** without the need for repeated follow-ups, creating a more transparent and reliable work environment for both workers and clients.

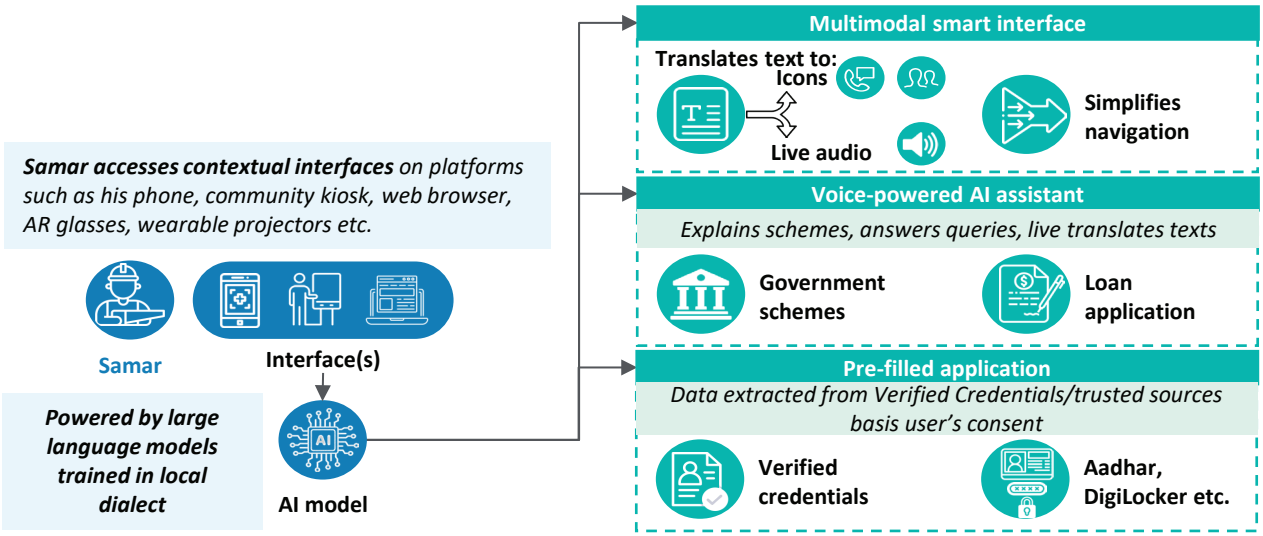
B. Systemic access and usability gaps

Samar, a 38-year-old self-employed carpenter from Delhi, *owns a basic smartphone but struggles to use government digital platforms. These portals are text-heavy, require Aadhaar-linked numbers, complex forms and rarely support his local dialect. With limited reading skills, even private messaging app helplines are unusable. The nearest Common Service Centre is hours away and visiting means losing a day's income—an unaffordable cost. For Samar and millions like him, digital access exists but remains out of reach..*

In contrast to the present-day reality, where digital public infrastructure remains underutilised due to barriers such as low digital literacy, limited regional language support and complex interfaces, the future is radically more inclusive. By the next decade, platforms such as e-Shram, UDYAM Assist and Skill India Digital will be powered by **AI-driven, multilingual and voice-first interfaces** that adapt to users' literacy levels and contexts. For informal trade workers like Samar, accessing government services, upgrading skills or registering for work will then be as simple as speaking in their native language, paving the way for a new era of truly accessible digital empowerment.

Context-aware smart interfaces and voice powered AI-assistants

By 2035, informal trade workers like Samar should be able to engage with **context-aware smart interfaces** i.e. intelligent interfaces that adapt in real-time to their literacy, language and digital comfort for seamless, personalised interaction. These interfaces offer step-by-step guidance and auto-fill forms with secure, verified data. Multilingual AI assistants fluent in local dialects guide them through government schemes, loan applications, etc., using natural speech.



Samar will no longer face a generic dashboard, but a **tailored experience** in his local language, delivered through voice and visual cues. Contextual interfaces and AI assistants **simplify complex systems**, **remove barriers like paperwork and digital literacy**, and **offer real-time support**, empowering him to navigate opportunities with confidence.

Rwanda's Voice-AI advisory: Enabling inclusive access

Rwanda delivers AI-powered agricultural advisories via voice-based platforms in Kinyarwanda, allowing rural, low-literacy farmers to access real-time information using basic phones with no requirement for smartphones or internet. Built on open-source local language datasets, the system removes interface barriers and personalises support. This model shows how voice AI can effectively bridge both access and usability gaps for rural and blue-collar workers. [15]

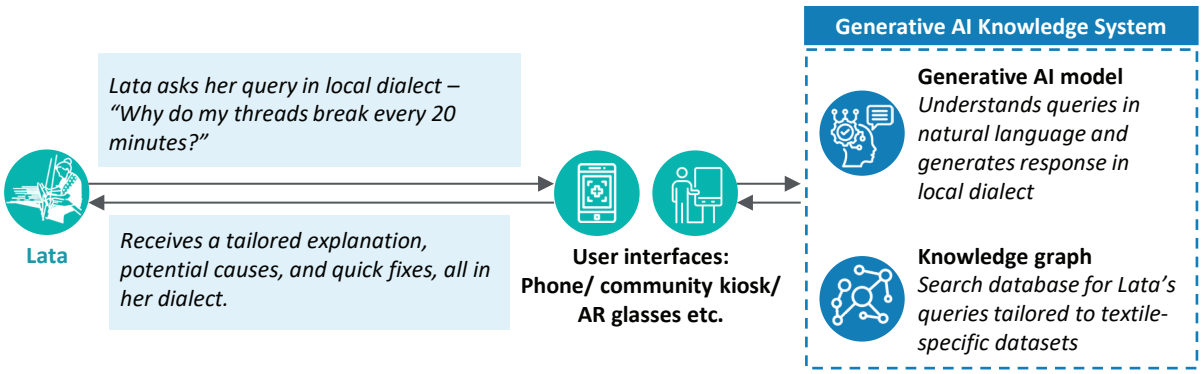
C. Knowledge and capability gaps

Lata, a 40-year-old handloom weaver from Lucknow, *is highly skilled in traditional patterns but has no access to real-time market trends, pricing and modern techniques. When she tries to learn modern weaving techniques to boost her income, the training feels too generic and not useful for her local craft. Even with financial support schemes such as Weaver Credit, she does not know how to apply or if she qualifies. Without help to upskill, fix loom issues or meet changing buyer demands, Lata remains stuck in low-value work with little chance to grow.*

By 2035, trade workers like Lata will have timely, task-specific **access to relevant knowledge and skilling** through intelligent, on-demand systems. Instead of static, generic content future platforms will deliver contextual guidance and skill-building resources directly aligned with real workflows. With improved awareness and accessibility of schemes, workers will be better equipped to adapt, upskill, access tools and grow their income, accelerating individual progress and boosting sector-wide productivity.

AI knowledge graphs for loom-level problem solving

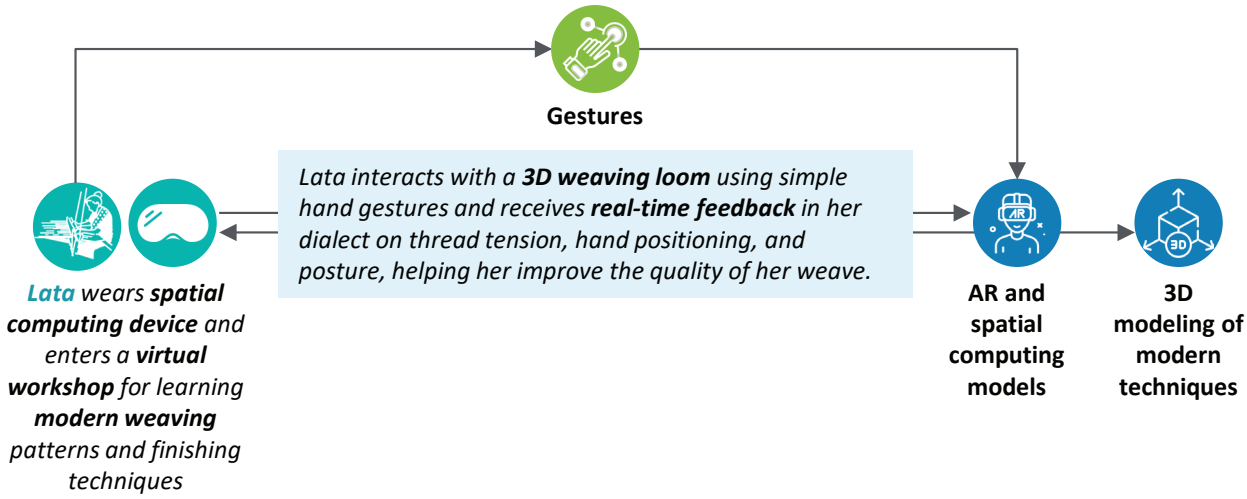
Traditional artisans like Lata should have access to a **Generative AI-powered knowledge system** that synthesises domain-specific information such as loom blueprints, dye recipes, buyer design trends and government schemes into a dynamic, navigable knowledge graph. Accessible through a multimodal interface (voice, text, images and video), this system would offer real-time, context-aware guidance, enhancing productivity, preserving heritage skills and unlocking access to new markets and entitlements.



With an AI-powered textile knowledge assistant Lata dramatically **reduces downtime and improves output quality** without requiring formal training.

Immersive gesture-based environments

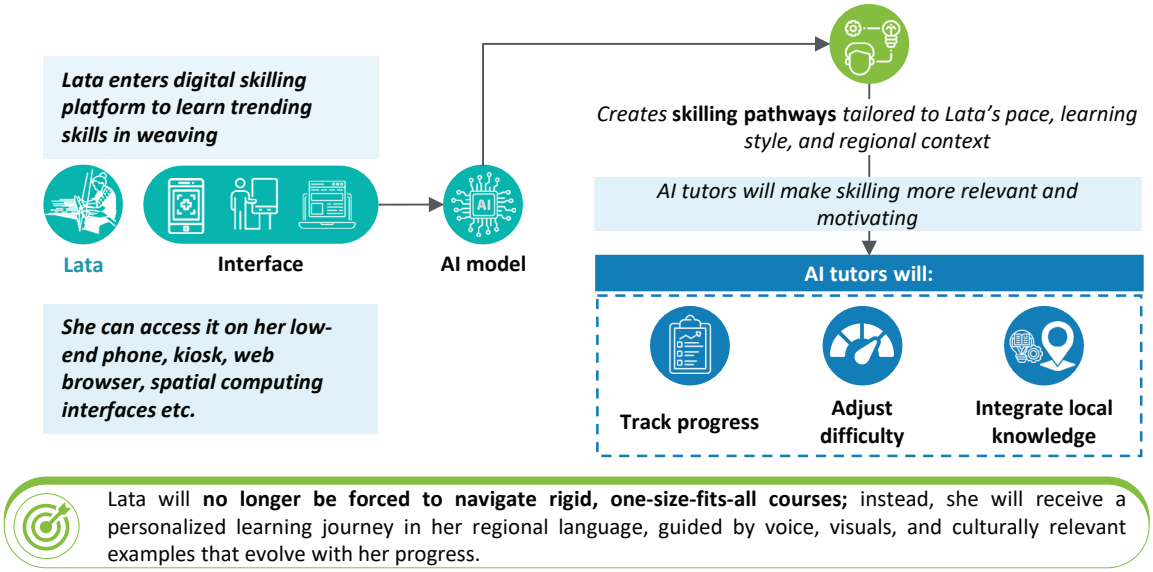
Lata should have access to **immersive, hands-on training** through **Augmented Reality (AR) and spatial computing,** moving beyond passive YouTube-style videos and static e-learning portals in next 10 to 15 years. Whether through a smartphone or a local community kiosk, Lata could enter a virtual workshop to learn modern weaving techniques in real-time. These contextual, interactive experiences would democratise high-quality skilling, making it personalised, practice-oriented and accessible, regardless of literacy or location.



This kinesthetics, language-independent model is more effective for practical trades and **bridges both knowledge and access gaps**.

Adaptive learning systems

Adaptive learning systems should empower workers like Lata with personalised paths tailored to **her pace, learning style and regional context**. AI tutors are making skilling more intuitive and relevant.



Lata will **no longer be forced to navigate rigid, one-size-fits-all courses;** instead, she will receive a personalized learning journey in her regional language, guided by voice, visuals, and culturally relevant examples that evolve with her progress.

Kenya bridging knowledge gaps with their agri-digital services platform

Kenya's agri-digital services platform empowers over 1 million smallholder farmers with personalised, real-time contextual guidance via voice and SMS in multiple local languages. Using AI-driven insights, it overcomes literacy and access barriers, offering a scalable model for bridging knowledge and capability gaps in informal economies.[16]

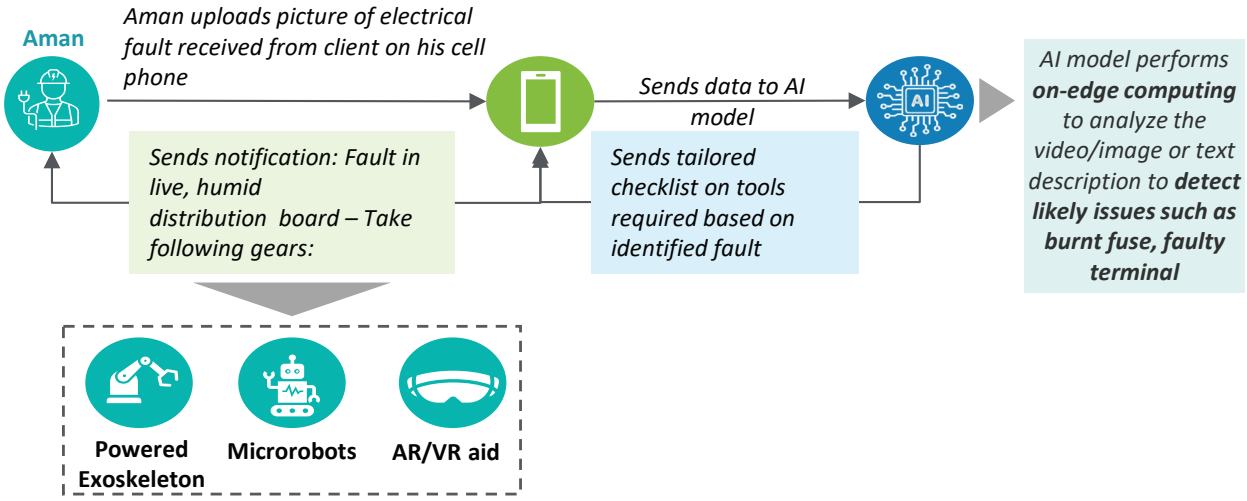
D. Structural work inefficiency and tooling deficit

Aman, a 35-year-old electrician from Patna, *works independently; handling residential and small commercial electrical jobs. He owns a basic toolkit but lacks diagnostic tools, safety gear or support for complex or hazardous tasks. In a single day, Aman climbs unstable ladders, strains to access tight spaces, misdiagnoses faults hidden behind ceilings and manually inspects dangerous switchboards near water. He does all of this without protective equipment or remote assistance. His time is lost, his safety is at risk and his income potential is capped.*

By 2035, informal trade workers like Aman will operate in safer environments with efficient workflows and access to modern tools. Proper equipment, standardised processes and real-time technical support will make daily tasks faster, less hazardous and more productive. Frontier technologies, **particularly AI and robotics**, will fundamentally transform how they work, enabling them to move beyond low-productivity, high-risk jobs towards more efficient, dignified and future-ready livelihoods.

AI-augmented visual diagnostics

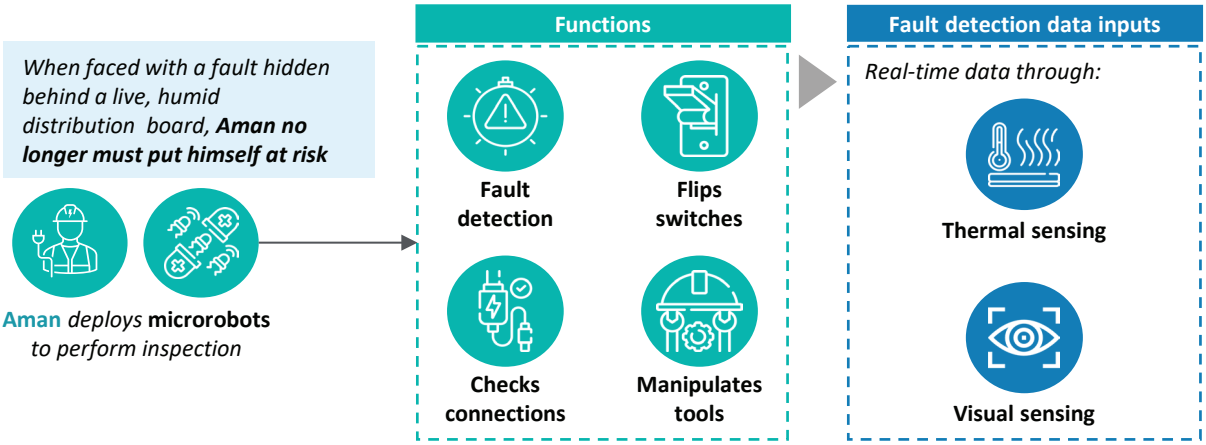
AI-based diagnostic tools should allow workers like Aman to **plan jobs before arriving on site**. When a client sends a short video or image of the electrical fault, Aman uploads it on his cell phone and the AI model analyses it instantly to detect likely issues and recommends the tools needed, while **generating a custom checklist**.



This workflow reduces guesswork, prevents unnecessary trips to hardware stores, and ensures that Aman arrives ready to complete the job quickly and professionally. Over time, he completes **more jobs per day, increases his earnings, and builds trust** as a reliable, tech-savvy service provider.

Mini-robotics assistants for hazardous tasks

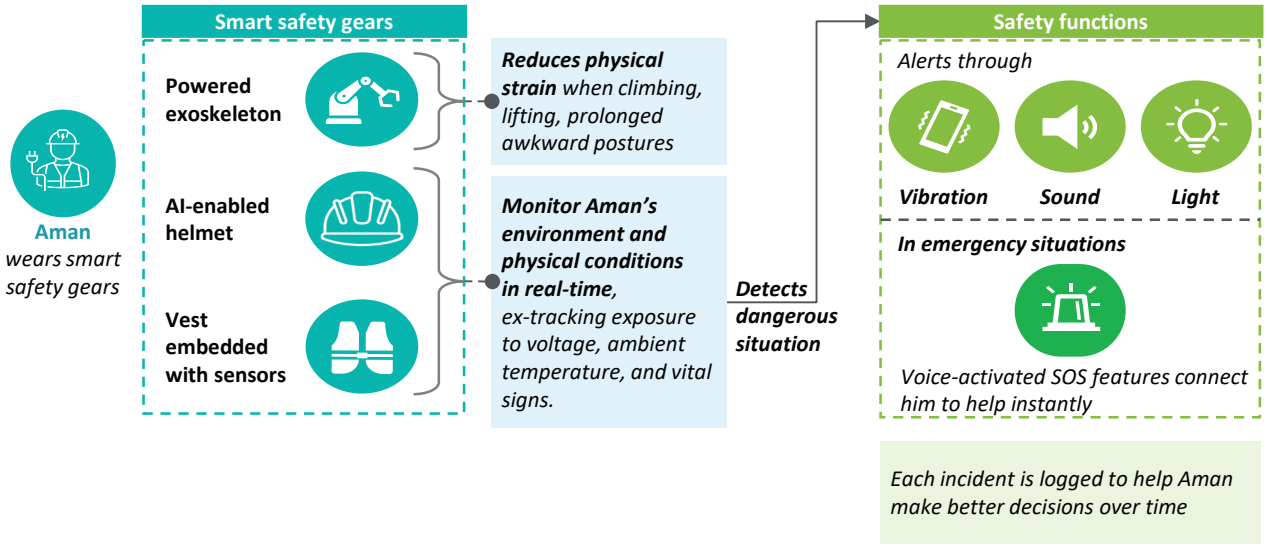
In risky or hard-to-reach environments, informal trade workers like Aman should be able to deploy compact, smartphone-controlled robots equipped with cameras and sensors as remote extensions of themselves. These robots could perform inspections and even assist with simple repairs, enhancing safety, efficiency and reach.



These mini robots enable Aman to **detect faults and carry out fixes without direct physical exposure,** effectively extending his capabilities while ensuring his safety. The result is faster turnaround and increased readiness for complex assignments that previously seemed out of reach

Smart wearable safety gear

Smart wearable safety gear should assist workers like Aman in performing their job more effectively by providing a **tech-enhanced experience.** It reduces physical strain, performs real-time monitoring and gives alerts of potential hazards, ensuring both safety and compliance.



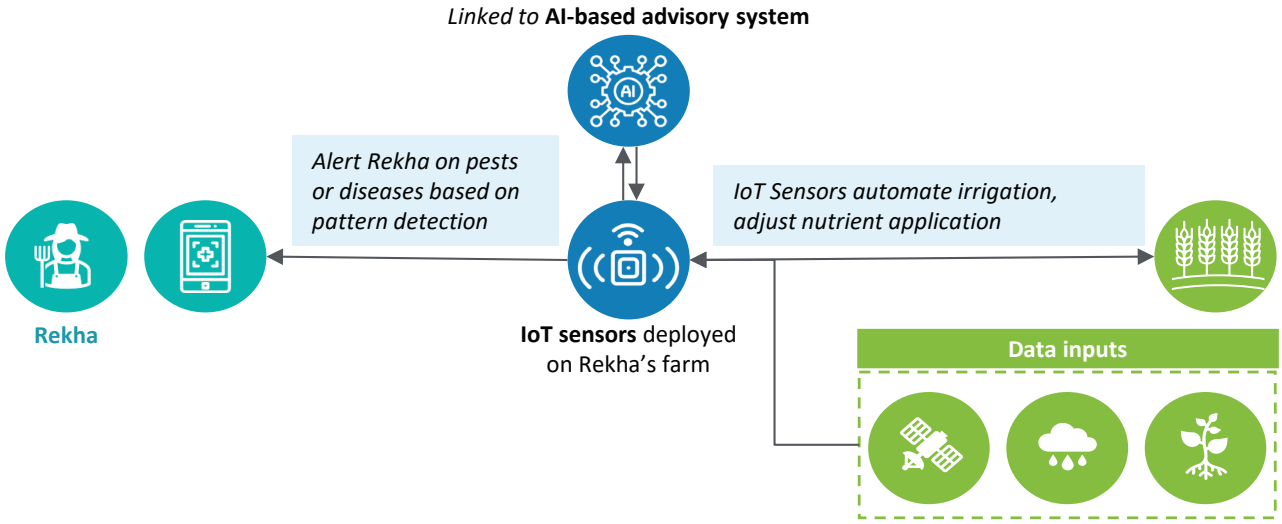
These gears not just ensure Aman's safety but also help signal professionalism to clients, **helping him secure larger or institutional contracts** that require visible compliance with safety norms.

Rekha, a 42-year-old farmer in Odisha, *faces tooling gap firsthand. Her work is physically demanding and repetitive, with no access to affordable automation or precision tools. As a result, her yields remain low, input costs high and fatigue is constant. Though aware of modern tools, she is excluded by high costs, limited local advice and a lack of affordable, worker-friendly automation, trapping her in low-productivity, high-effort farming.*

By 2035, smallholder farmers like Rekha will have access to affordable, context-specific tools and support systems powered by **Artificial Intelligence (AI), Internet of Things (IoT) and robotics**. These technologies will reimagine how they cultivate and manage their fields making farming practices safer, smarter and more sustainable. With enhanced capabilities and improved productivity, farmers will be able to break free from cycles of low income and exhaustion.

AI & IoT enabled precision farming

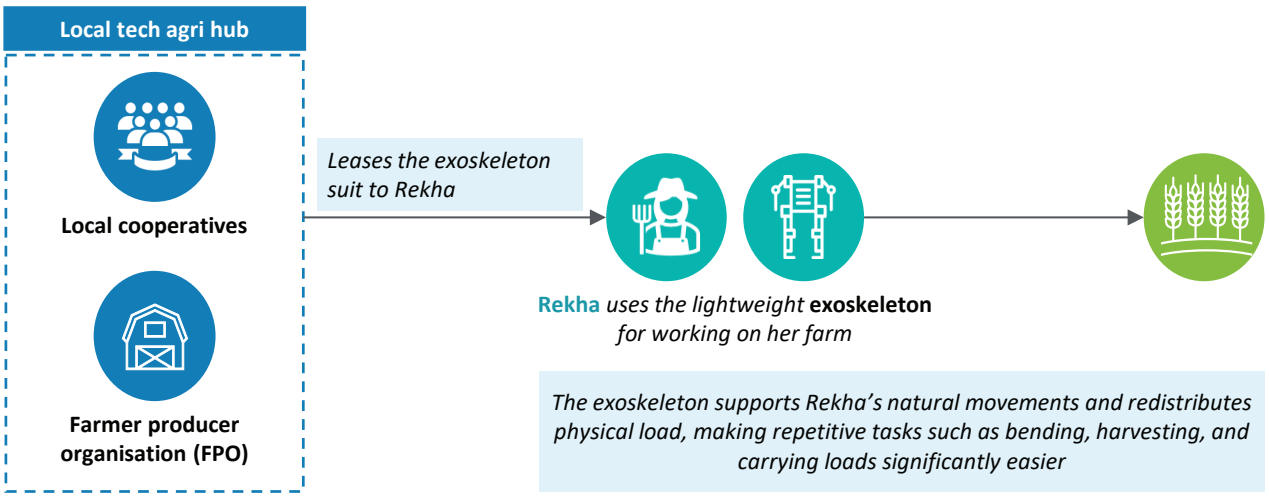
A **network of low-cost IoT sensors** linked to AI systems should enable farmers like Rekha to continuously **monitor soil and climate**, enabling **real-time, hyperlocal decisions** that automate irrigation, optimise nutrients and pre-empt pest risks.



With IoT and AI powered system, Rekha **no longer needs to rely on guesswork,** her inputs are tailored to her field's needs

Solar-powered wearable exoskeletons

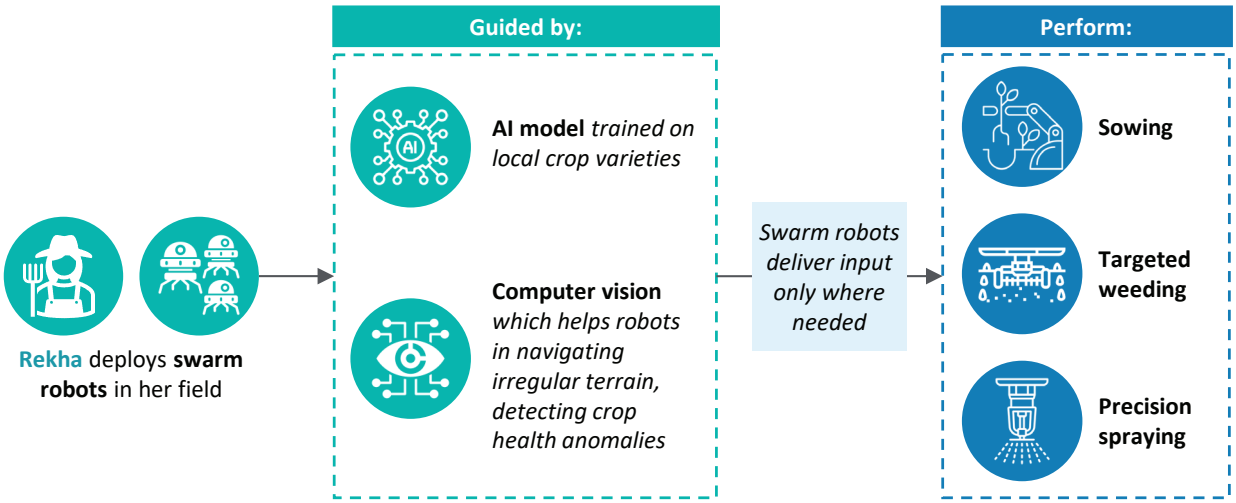
Farmers like Rekha should be able to harvest their crops wearing a lightweight, solar-powered exosuit which is a type of wearable exoskeleton that **supports and enhances the body's natural movements**, **reducing strain on back and joints,** allowing farmers to work longer hours safely and with less fatigue.



These solar-charged suits significantly reduce physical strain, allowing farmers like Rekha to **extend working hours without injury, fatigue, or long-term musculoskeletal damage.**

AI-driven micro-robotics for field operations

Affordable, autonomous swarm robots, **designed for small plots** should be widely deployed in fields like Rekha's. These robots handle tasks such as sowing, weeding and precision spraying with the help of AI models and computer vision.



Unlike large machinery, these **robots are cost-effective, energy-efficient**, and suitable for smallholder use cases, enabling Rekha to spend less time on manual labor and more on decision making.

Netherlands' smart farming platform: AI-driven micro-robotics for small-scale farming

The Netherlands' open-source Smart Farming Platform [17] uses modular, AI-guided micro-robots to automate small-plot tasks such as planting and weeding, using precision GPS and computer vision to boost efficiency and reduce manual labour.

4. BRIDGING THE GAP: KEY ASSUMPTIONS AND ACTIONABLE RECOMMENDATIONS FOR SUCCESS

Assumptions

To enable large-scale transformation of the informal trade workforce by 2035, the following key assumptions must be met in the next 10 to 15 years:

- **Frontier technologies are affordable, localised and inclusive:** Ongoing innovations will drive down hardware costs in next 5 years by ~80 percent[26], enabling cost-effective AI, robotics and immersive tools that are language-adaptive, operable on low-end or offline devices and accessible to informal trade workers through subsidies or shared models, on rental basis or as public infrastructure.
- **Digital access is universal and supported:** Informal trade workers can access reliable internet, affordable devices and in-person digital assistance through community infrastructure such as Common Services Centres (CSCs), public Wi-Fi and digital help points such as kiosks.
- **Ecosystems are interoperable by design:** Public and private data, platforms and services adhere to open standards, allowing seamless integration across employment, finance, skilling and welfare systems.
- **Regulatory systems support digital and AI integration:** Legal frameworks evolve to recognise digital work, enable smart contracts, regulate AI tools in work environments and ensure worker protections, including safety and liability coverage.

Recommendations

Driving large-scale technology adoption across India's informal trade workforce requires a **centrally anchored mission**, ***Digital ShramSetu*** to ensure focused leadership and coordinated action across a fragmented stakeholder ecosystem and clear accountability across institutions, implementers and citizen-facing networks. It should have a formal charter outlining clear objectives, implementation frameworks and measurable outcomes and be supported by a dedicated nodal body responsible for defining metrics, tracking progress through dashboards and centralising reporting.

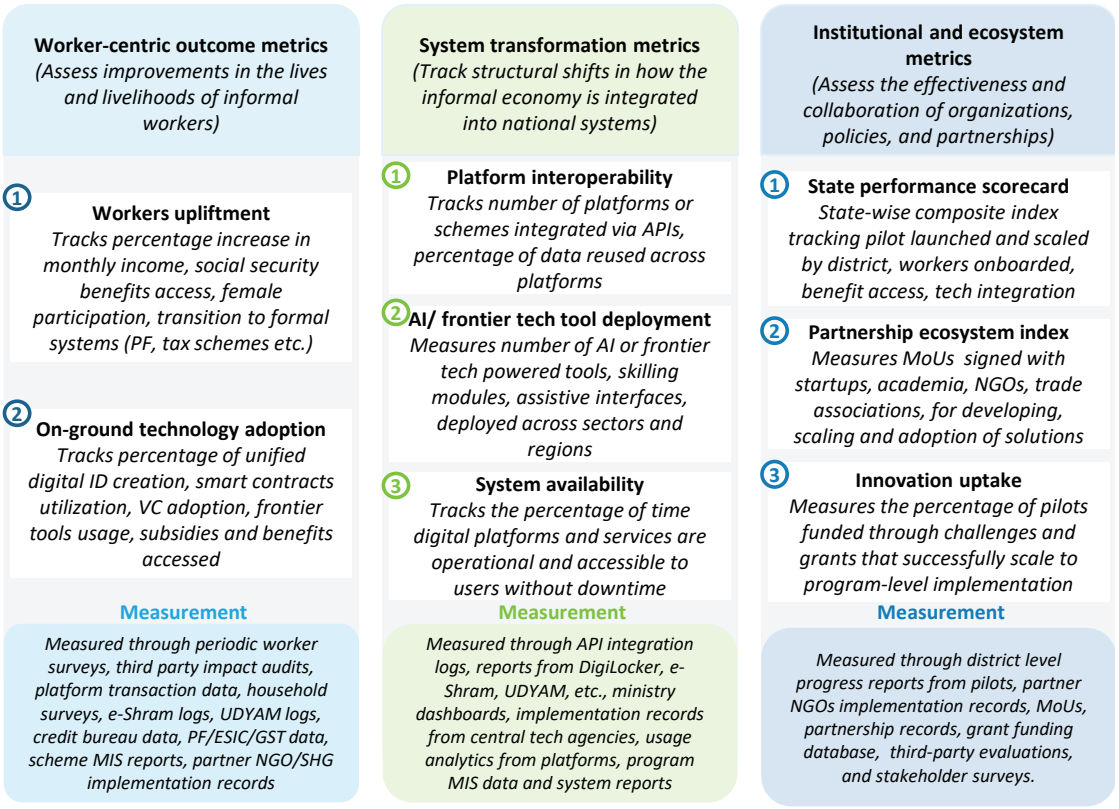
The below recommendations outline key strategic actions to operationalise the mission effectively:

- **Enable a federated trust and credentialing ecosystem:** Develop a federated trust model to enable entities such as training providers, gig platforms, employers and government bodies to issue verifiable work and skill credentials, with real-time updates through standardised protocols. Extend IndiaStack with open-source trust and verifiability layers and promote credential usage through tax and compliance incentives.
- **Encourage innovation and incentivise adoption of frontier technology:** Support startups developing frontier technology-based solutions through grants, tax breaks, regulatory sandboxes, Research & Development (R&D) incentives and public procurement pathways. Pilot these solutions in high-mobility sectors and refine for scalability.
- **Strengthen AI and digital infrastructure for inclusive access:** Scale vernacular AI through initiatives such as Bhashini and AI4Bharat to support local speech and dialects. Fund offline-compatible, lightweight models trained on informal-sector data.
- **Empower Private Sector ownership:** Create sector-specific incentives for private sector organisations to fund and build digital interventions.

- **Digitise and standardise informal sector knowledge:** Partner with industry bodies and training institutes to digitise sector knowledge and integrate it into multilingual AI knowledge graphs for different industries.
- **Invest in affordable tools and local tech workforce:** Promote local R&D and manufacturing of affordable tools under the Make in India initiative, enable tech-rental models via Self Help Groups (SHGs) and trade bodies and train district-level tech operators to drive adoption and support in low-literacy contexts.
- **Uphold data privacy, AI ethics and user protection:** Implement worker-centric data protections under the Digital Personal Data Protection (DPDP) Act, release edge-compliant platform guidelines and establish clear safety, insurance and liability norms for AI and robotic tool usage. There is a need for organisational discourse and accountability mechanisms to uphold workers' rights and build trust in AI systems.
- **Drive grassroots innovation and worker outreach:** Incentivise states to launch mission-mode programmes for informal trades, repurpose district infrastructure as digital workforce hubs, enable co-funding by ULBs/ panchayats, strengthen partnerships with local institutions for digital literacy and drive skill enhancement initiatives through targeted incentives.

To ensure transparency, accountability and continuous improvement, the mission must be underpinned by a robust evaluation framework (refer to Figure 6), designed to systematically track implementation progress, assess outcomes and inform adaptive policy responses.

Figure 6: Impact measurement framework



Having outlined recommendations to overcome systemic barriers, it is equally critical to strengthen existing schemes while creating new ones, to avoid duplication, use established platforms and fast-track adoption. (refer to Appendix G)

5. THE HIGH COST OF DELAY: WHY INDIA MUST ACT NOW!

India stands at a pivotal moment, poised for historic transformation if it acts decisively. Foundational digital infrastructure such as Aadhaar, UPI, Jan Dhan and BharatNet, coupled with a thriving tech ecosystem, has already touched millions of lives. With a young population, increasing digital penetration and the untapped potential of the informal economy, the conditions are ripe for inclusive growth.

However, at the current growth rate of 6.3 percent,[20] India's GDP is projected to reach US$15.3 trillion by 2047 which is significantly below the aspirational US$30 trillion ***Viksit Bharat*** target.[2] At the current growth rate, average income for informal trade workers is projected to reach around US$6,000. However, with accelerated growth of approximately 10 percent driven by transformative efforts, the aspirational target of US$14,500 becomes attainable. Without timely and inclusive action, millions risk being excluded from the digital economy, disconnected from platforms and left behind in an increasingly tech-driven world.

Unlocking inclusive growth requires dismantling systemic barriers faced by informal trade workers. These include a lack of trust between workers and employers, limited access to usable technology, verifiable identity and timely information. This roadmap explores how frontier technologies such as AI, robotics, secure digital ledgers, IoT and immersive platforms can rewire every major touchpoint in an informal trade worker's journey. From AI-enabled safety and adaptive learning to secure, verifiable digital identities, smart contracts and robot-assisted tasks, these innovations are designed to bridge capability and equity gaps in informal work.

India is uniquely positioned to lead this technology-enabled shift, backed by robust digital infrastructure, a growing AI ecosystem and clear national intent. However, lasting change hinges on placing informal trade workers at the centre not as challenges to be solved, but as co-creators of an inclusive, resilient future.

The coming years represent a critical window. Decisions made today will determine whether emerging technologies deepen existing inequalities or unlock a more equitable and resilient future of work. India has the momentum, the means and the mandate to ensure its informal trade workers are not left behind but instead, are front and centre in its development journey as skilled, dignified and future ready.

6. PROPOSED RECOMMENDATION: MISSION *DIGITAL SHRAMSETU*

Vision

To transform India's informal workforce into a formal, empowered and future-ready labour force by leveraging frontier technologies to unlock better livelihoods, expand access to social protection and skilling and enable every worker to participate with dignity, security and opportunity in India's growth story.

Proposed Macro Mission Targets: 2035 as a Strategic Midpoint to 2047

Key indicators	2025 (Current Baseline)	2035 (Mid-Term Milestone)	2047 (Vision Target)
Per Capita Income	$1800[11][21]	$5,500	$14,500
Female Labour Force Participation	15%[12]	25%	42%
Social Security Coverage	48%[18]	80%	100%
Productivity	$5/hour[13][22][23]	$15/hour	$49/hour

To realise this vision, the mission should prioritise building a sustainable ecosystem that advances research and development (R&D) to develop indigenous, cutting-edge technologies, with a deliberate emphasis on reducing technology costs to ensure these solutions are affordable, accessible, and responsive to the diverse challenges of the informal workforce.

Proposed mission scope and deliverables

Mission scope	Illustrative deliverables for mission orientation
Develop a national blueprint	• Constitute a Drafting Committee to codify the Mission Charter. • Set out a precise plan of action to leverage frontier technologies to address systemic barriers such as trust, access, skilling and productivity for India's informal workforce. • Outline the technology pathways to be adopted, define stakeholder roles and responsibilities, assess viable financing models, identify necessary policy and infrastructure enablers, prioritise sectors and worker segments, and streamline the implementation strategy and timelines.

Proposed mission scope and deliverables

Coordinate fragmented stakeholders	• Establish multi-tiered coordination forums across stakeholder groups to ensure convergence of schemes, data systems and delivery mechanisms under the Mission Charter and identify the appropriate programmes.
Catalyse strategic partnerships	• Include plans for facilitating collaboration across technology firms, manufacturers, skilling bodies, AI labs, academia and civil society to co-develop and implement scalable, sector-specific technology solutions. • Outline partnership models and targeted incentive schemes.
Provide policy and regulatory support	• Assess the needs of regulatory harmonisation required for the implementation of the mission goals/programme in the identified sectors. • Create a detailed mapping of regulatory and legal impediments, as well as the enabling tools to balance the need for innovation with worker protection.
Translate innovation into impact	• Identify and quantify gaps between emerging technologies and ground-level outcomes. • Prioritise high impact use cases, facilitating pilots and enabling scale through adaptive deployment models. • Identify pilot programs in 8–10 states with real-time learning loops and feedback systems. • Build a pipeline of high impact use cases mapped to worker needs and sector gaps.
Measure impact	• Define holistic KPIs to track impact • Establish a governance mechanism to review KPIs and course-correct when needed • Build and publish relevant dashboards

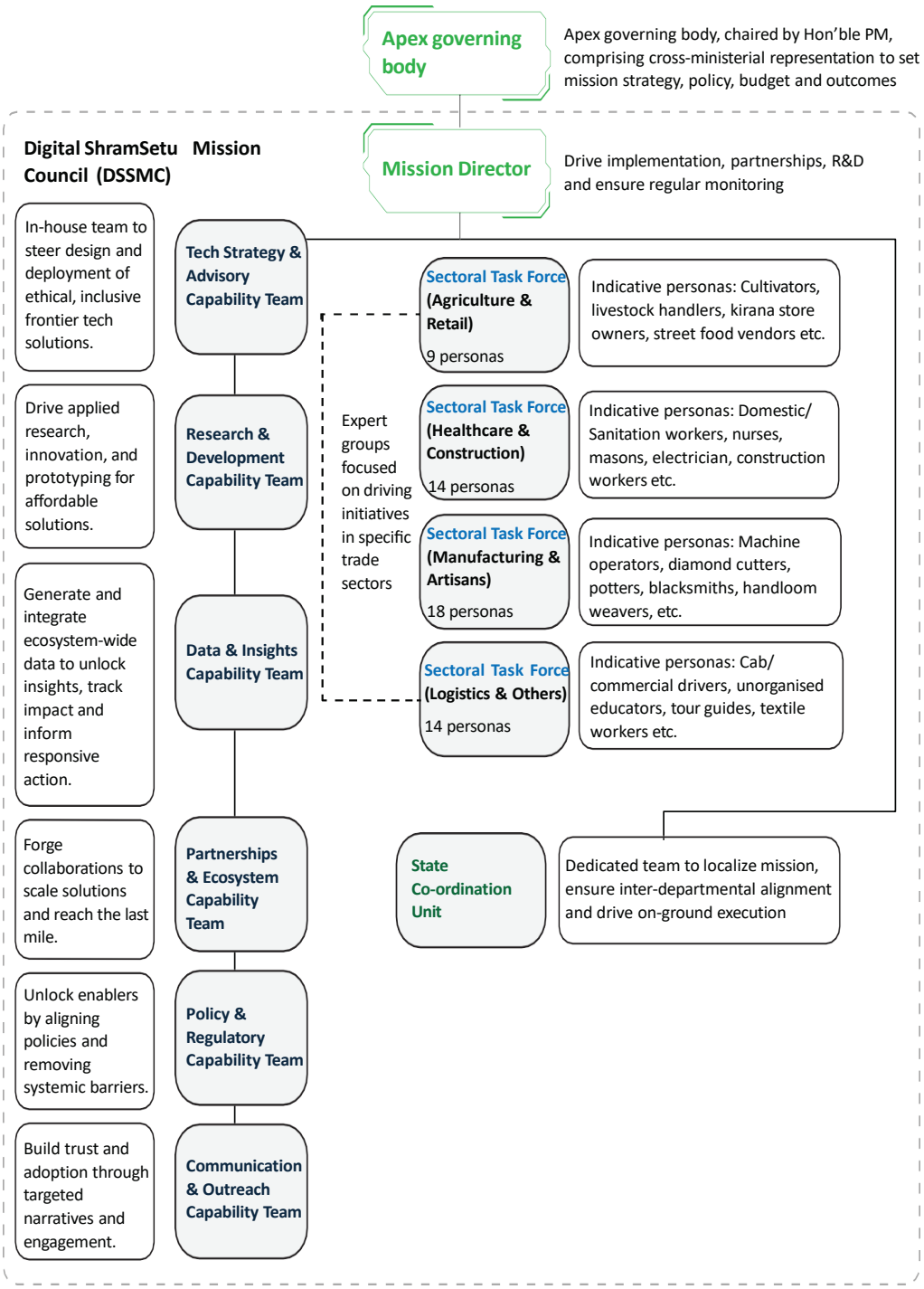
Proposed mission structure and governance

Based on assessment, the mission should follow a multi-layered governance structure combining national-level leadership with decentralised sector-/state- aligned delivery (refer to Figure 7).

In view of the Mission's transformative objectives and its direct relevance to over 490 million informal workers across diverse sectors and geographies, it is proposed that the apex implementation body be chaired by the Hon'ble Prime Minister, with representation from key ministries, departments, and cross-sectoral stakeholders such as Ministry of Labour & Employment, Ministry of Skill Development and Entrepreneurship etc.

It should be supported by capability teams to lead core functions, including technology strategy, research and development, data, partnerships, policy and outreach. In parallel, sectoral task forces comprising line ministries, state governments and institutional partners should drive solution design and implementation across priority sectors. A dedicated state coordination unit should be instituted to adapt the mission to local context, facilitate cross-departmental convergence and oversee implementation across states.

Figure 7: Proposed overall structure of the mission



Proposed mission delivery model

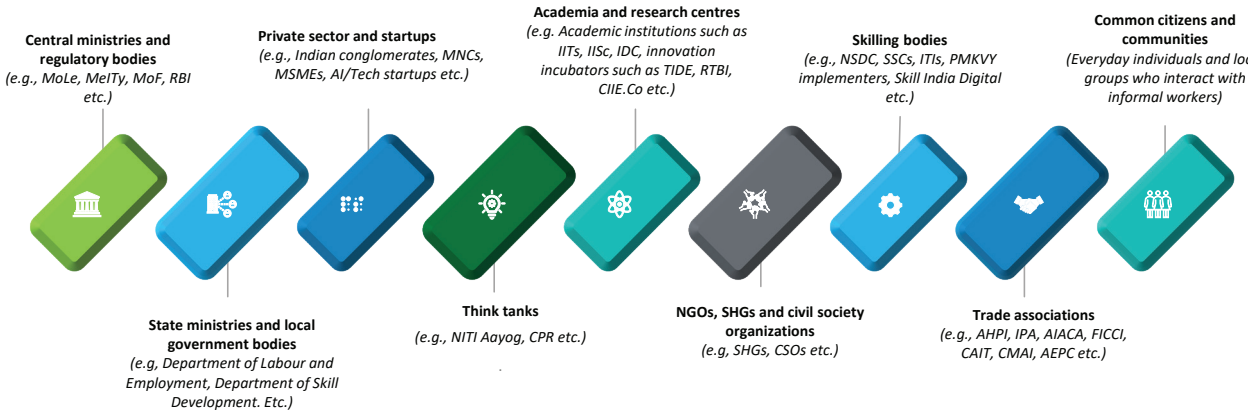
1. **Persona and sector-led prioritisation**
   Undertake ground-level diagnostics to identify high-potential sectors where frontier technologies can deliver maximum impact through targeted interventions and pilot design. These sectoral or persona selection priorities should be periodically reassessed to reflect evolving distributional shifts in the workforce over the next two decades.
2. **Sector-agnostic enabler integration**
   Address cross-cutting enablers such as skilling, financial inclusion, social protection and technology access by recommending tech interventions that can be embedded across sector and use cases.
3. **State-powered delivery enablement**
   Support states in adapting, integrating and implementing mission-aligned interventions through dedicated digital labour missions and localised execution frameworks. The technology interventions will be routed through sector or persona specific delivery channels such as trade associations, federations, NGOs, cooperatives and social enterprises to effectively reach targeted personas and drive last-mile adoption.
4. **Unified execution with institutional ownership**
   Enable coordinated delivery across central institutions, with each anchoring domain-specific interventions under a unified, mission-led architecture.

Proposed mission ecosystem framework

The Mission Charter shall outline mechanisms to establish a dynamic, multi-stakeholder ecosystem that engages relevant actors across all phases of the mission lifecycle, from design and piloting to scale and sustainability (refer to Figure 8). A strong public–private thrust will be essential to the mission's success.

Given the mission objectives' cross-sectoral nature, stakeholder engagement must go beyond formal consultative platforms, incorporating agile task forces and collaborative working groups to ensure continuous alignment, foster knowledge exchange and uphold shared accountability throughout implementation.

Figure 8: Proposed key stakeholders for mission engagement



- **Central ministries and regulatory bodies** will be actively engaged through the mission governance structure to provide ongoing policy guidance, regulatory support, infrastructure alignment and national-level coordination.
- **State ministries and local government bodies** will co-lead implementation efforts, participating in sectoral task forces and state coordination cell to operationalise solutions, build capacity and localise innovation.
- **Private sector and startups** will serve as strategic partners to co-develop digital solutions, scale platforms and drive innovation through agile collaboration and rapid prototyping
- **Think tanks** will collaborate through working groups and capability panels to shape mission strategy, monitor outcomes and provide real-time policy and implementation insights.
- **Academia and research centres** will partner with capability teams to generate context-specific research, co-develop skilling frameworks and test tools for local adaptation.
- **NGOs, SHGs and civil society organisations** will be mobilised at the grassroots level to facilitate awareness campaigns, drive digital literacy and gather feedback to refine service delivery.
- **Skilling bodies** will be embedded within the mission's delivery framework to provide demand-aligned, tech-enabled skilling and certification pathways.
- **Trade associations** will work closely with sectoral task forces to identify transformation levers, promote adoption and ensure worker integration.
- **Common citizens and communities** will be engaged through targeted outreach or other communication channels to drive awareness, build trust and accelerate grassroots adoption of mission initiatives.

Proposed risk management

Effective risk management is critical to the mission's success and sustainability. These risks below (illustrative), spanning across multiple categories, must be anticipated and addressed in the Mission Charter through a structured approach.

- **Strategic risks** may arise from misalignment between ministries or change in policy priorities, potentially undermining coherence and continuity.
- **Financial risks** include budgetary delays or insufficient co-funding mechanisms, which can constrain execution.
- **Technology-related risks** stem from poor interoperability and the unreliability of technology solutions in field conditions.
- **Operational risks** may arise due to local capacity constraints and inadequate last-mile support, which can hinder implementation.
- **Intellectual property risks** involve ambiguities in ownership and licensing of co-developed digital tools or solutions.
- **Supply chain vulnerabilities** such as hardware shortages and dependence on imports pose additional challenges.
- **Data and cybersecurity risks** encompass breaches, misuse and weak consent protocols, threatening trust and compliance.

To mitigate these challenges, the mission must adopt a dynamic **risk management framework**, supported by regular reviews and agile response mechanisms to enable timely course correction.

Proposed implementation roadmap

The mission is proposed to be implemented through a phased, outcome-driven approach designed to ensure infrastructure readiness, scale and long-term sustainability. Each phase builds upon the previous, aligning governance, infrastructure and innovation pathways toward nationwide transformation.

- **Phase 1: Mission orientation (2025–2026)**
  This phase will involve drafting a mission charter based on the drafting committee's inputs. As such, the mission statement will have a clear direction, time-bound targets and measurable outcomes. Further, this phase will involve government, industry, academia and civil society mobilisation at the agenda-setting process.
- **Phase 2: Institutional setup and governance design (2026–2027)**
  Phase 2 will establish cross-sectoral governance structures, define clear leadership roles and finalise the mission's implementation blueprint, supported by enabling legal, regulatory and digital infrastructure. It will focus on scaling domestic capabilities through cost-effective hardware design, targeted R&D and resilient supply chains. National interoperability protocols and infrastructure standards will be formalised. Public–private partnerships will be launched, alongside a funding and incentive framework to unlock private capital and drive innovation. A multi-level KPI system will track performance across institutional, technical and social dimensions.
- **Phase 3: Pilots and select programme launch (2027–2029)**
  This phase will mark the transition from planning to real-world implementation. Pilot solutions will be deployed in high-readiness sectors to test real-world applicability. Last-mile enablement will be prioritised to ensure accessibility and adoption. Robust monitoring and evaluation systems per the framework will drive iterative refinements based on performance and user feedback.
- **Phase 4: Nationwide rollout and integration (2029 onwards)**
  The final phase will focus on scaling proven solutions across the country. Implementation will be adapted to local contexts, with states and cities incentivised to tailor and adopt solutions that meet regional workforce needs. Efforts will also be made to enable market linkages and worker portability across sectors and geographies, unlocking long-term productivity and resilience. This phase aims to institutionalise the mission's interventions and ensure sustained benefits for India's informal workforce at scale.

Proposed mission success evaluation framework

Alongside the phased implementation, a multi-level KPI framework is advised to monitor performance across three key dimensions, beginning from Phase 2 onwards.

1. **Worker-level KPIs** to assess improvements in the lives and livelihoods of informal workers. For example: median monthly income growth, scheme enrolment rate, average skilling hours/worker
2. **System-level KPIs** to track structural shifts to integrate the informal economy into national systems, such as monthly transaction volume, grievance resolution rate, platform uptime
3. **Ecosystem-level KPIs** to assess the effectiveness and partnerships by state or trade sector, such as active PPP projects, state integration rate, innovation pilot success rate

The mission will empower India's 490 million informal workers [1] by leveraging frontier technologies to unlock better livelihoods, strengthen social protections and expand access to skilling and opportunity. It will drive productivity, inclusion and resilience at scale placing workers at the heart of India's growth story and accelerating the journey toward a truly ***Viksit Bharat***.

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APPENDICES

Appendix A

List of all 55 representative personas identified as an outcome of persona prioritisation criteria

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
1	Agriculture and Allied Activities	Cultivators (farmers)	Engages in growing crops and managing agricultural land for food or commercial produce. Precision agriculture, drones, soil sensors and AI-based advisory platforms can improve productivity. Fragmented landholding, low digital access and climate risks increase vulnerability without targeted support.	20-25%[1] [2]	**Medium impact** as more than half the population are small and marginal farmers and some exposure to agritech reduces vulnerability.	**Low feasibility** as there is a high reliance on manual farming practices, with slow adoption of precision agriculture.	• Associations such as Agricultural Machinery Manufacturers' Association (AMMA-India), Indian Micro Fertilisers Manufacturing Association (IMMA), CropLife India, etc. • Federations/ Cooperatives such as Farmer Producer Organisations (FPOs) supported by Small Farmers Agribusiness Consortium (SFAC) • NGOs such as Ambuja Foundation, Swadesh Foundation, BAIF, Digital Green, etc.

1 ET Online - Economic survey 2024: India has 18.3% unpaid workers, 57.3% of total workforce self-employed (2024)
2 Agrarian Land – Ministry of Agriculture & Farmers Welfare (2020)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
2	Agriculture and Allied Activities	Agricultural labourer	Performs manual farm tasks such as planting, harvesting and irrigation. Tech such as precision farming and drone spraying can boost efficiency, but adoption is low due to digital access and affordability gaps in rural regions.	20-25%[1]	**High impact** as the majority operate in the informal sector, facing extreme income instability and seasonal employment risks.	**Low feasibility** due to limited technological exposure and limited adaptability to mechanised or AI-driven processes.	• Associations such as Agricultural Machinery Manufacturers' Association (AMMA-India), Indian Micro Fertilisers Manufacturing Association (IMMA), CropLife India, etc. • NGOs such as SEWA, PRADAN, Nidan, etc.
3	Agriculture and Allied Activities	Horticulture worker	Grows and maintains fruits, vegetables and ornamental plants. Controlled-environment agriculture and sensor-driven irrigation are emerging, but manual practices dominate due to high setup costs.		**High impact** due to the tendency of facing seasonal employment, low wages and high climate dependence.	**Low feasibility** as specialised manual work is needed, with limited mechanisation feasibility due to crop-specific requirements.	• Associations such as Confederation of Horticulture Associations of India (CHAI). • Federations/ Cooperatives such as VAPCOL (Vasundhara Agri-Horti Producer Co. Ltd.), HOPCOMS (Horticultural Producers' Cooperative Marketing and Processing Society), etc. • NGOs such as BAIF Development Research Foundation, etc.
4	Agriculture and Allied Activities	Livestock handler	Manages animal care, feeding and breeding operations. Wearables and AI-based health tracking offer improvements, but tech use is limited due to fragmented ownership and low awareness among small-scale farmers.	2-5%[3]	**Medium impact** as they largely operate in the informal sector, with limited protection and exposure to disease and climate-related risks.	**Low feasibility** as traditional, hands-on roles with minimal automation potential and low digital adoption.	• Associations such as Indian Dairy Association (IDA), Poultry Federation of India (PFI), Indian Federation of Animal Health Companies (INFAH), etc. • NGOs such as ANTHRA, Heifer International India, BAIF Development Research Foundation etc.
5	Artisans	Stone carvers	Crafts sculptures, reliefs and architectural elements from stone. CNC machines can replicate basic designs, but cultural, religious and custom projects still rely on human artistry and precision.	0-1%[4]	**High impact** as a predominantly informal workforce, facing declining demand and a lack of job security.	**Low feasibility** as traditional craftsmanship and bespoke design needs limit automation feasibility.	• NGOs such as Dastkari Haat Samiti, Surabhi Foundation, etc.

3 Livestock's contribution to Indian Economy – Pashudhan Praharee (2020)
4 e-Shram Dashboard, Ministry of Labour & Employment, GoI (As on date – July 2025)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
6	Artisans	Goldsmiths	Designs and fabricates intricate gold jewellery and ornaments. 3D printing and AI design tools assist in prototyping, but custom work, finishing and client-specific designs continue to need skilled human hands.	0-1%[4]	**Medium impact** as a predominantly informal and skill-based, goldsmiths face income instability and limited access to formal credit or market linkages, especially in rural and traditional settings.	**Low feasibility** as despite advancements in CAD design and precision casting, handcrafted jewellery remains dominant in India due to cultural preferences and intricate custom designs, making full automation challenging.	• Associations such as Gems & Jewellery Export Promotion Council (GJEPC), All India Artisans and Craftworkers Welfare Association (AIACA), etc.
7	Artisans	Cobblers	Repairs and customises footwear, often in informal markets. While industrial footwear production is automated, repair and personalisation services still require manual skill, keeping cobblers relevant in low-cost and local settings.	0-1%[4]	**High impact** as majority of workers operate informally in urban and semi-urban areas with limited income security; factory-produced footwear and changing consumer habits threaten demand.	**Low feasibility** as while machine-based shoe production exists, street-level cobbling is deeply manual and personalised, limiting automation potential.	• Industry and skilling bodies such as • Dalit Indian Chamber of Commerce & Industry (DICCI), Central Leather Research Institute (CLR). • NGOs such as Future Footwear Foundation and Dastkar.
8	Artisans	Tailor (darzi)	Stitches and alters garments for daily and custom use. Automated cutting tables and AI-based size recommendation tools exist, but most tailors work informally with low-tech setups.	0-1%[5]	**Medium impact** as most tailors operate in the informal sector, making them vulnerable to income instability and lacking structured support.	**Medium feasibility** due to AI-based design tools, auto-cutting machines and digital tailoring platforms are increasingly replacing manual processes.	• NGOs such as Usha Silai Schools, Devipeeth India Foundation, Sambhali Trust, etc. • Associations such as Master Tailors Association in India (IMTA), Association of Sewing and Design Professionals (ASDP) etc.
9	Artisans	Potter	Crafts clay items for daily use and rituals. 3D printing and mould-based production offer efficiency, but cultural, artistic and rural context limits tech substitution.	0-1%[4]	**High impact** as the majority deal in informal work, with declining traditional markets posing high risks.	**Medium feasibility** as AI-driven 3D printing and automated pottery wheels support transition but require skill and design adaptation.	• Associations such as All India Artisans and Craftworkers Welfare Association (AIACA), Khadi and Village Industries Commission (KVIC), Mittikalaa Societies etc. • NGOs such as Gramodaya Sangh, Dastkar, etc.

5 Rentech Digital - List of Tailors in India (2025)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
10	Artisans	Diamond cutter	Shape and polish diamonds using high-precision tools. Laser cutting and AI-based grading are industry standards in formal setups, but smaller units continue to rely on hand-based expertise.	0-1%[6]	**Medium impact** as a partially formal workforce with export dependence impacting job stability.	**Medium feasibility** as laser-cutting technology and AI-driven precision enhance automation, but craftsmanship is still valued.	• Skill partners such as Kaushalya Skill Foundation, Gems and Jewellery Skill Council of India (GJSCI), etc. • Associations or co-operatives such as Surat Diamond Association (SDA), etc.
11	Artisans	Barber	Provides grooming and hair care services in communities. Online booking and digital payments can modernise service delivery. Requires personal interaction and a skill-based nature to secure demand.	0-1%[4]	**Medium impact** as the majority of the workforce is informal, with income vulnerability during health crises or economic downturns; however, they continue to provide essential services.	**Low feasibility**, as while digital tools support business operations, haircutting and grooming remain manual, craft-based services that relies on personal engagement and skill.	• Associations or skilling bodies such as All India Nai Samaj, Regional Barber Unions in UP, Bihar, Odisha, Beauty & Wellness Sector Skill Council (B&WSSC), etc.
12	Artisans	Coir weaver	Weaves mats, ropes and brushes traditionally using coconut fibre or similar natural materials. Automation in weaving and demand for synthetic materials may reduce the need. A low-income, traditional craft with limited access to modernisation.	0-1%[4]	**High impact** as primarily women-led rural craft, with income fluctuations and limited formal backing; the sector is price-sensitive and labour-intensive.	**Medium feasibility** as automated spinning and weaving technologies exist, but the artisanal and household nature of the work makes full automation difficult.	• Associations or skilling bodies such as All India Artisans and Craftworkers Welfare Association (AIACA), National Coir Training & Design Centre, etc.
13	Artisans	Toolkit makers	Fabricates and assembles customised toolkits for tradespeople. 3D printing and mass production may impact manual toolkit fabrication. A niche, informal role with limited scalability or potential digital adoption.	0-1%[4]	**Medium impact** as mostly small-scale producers with little formal protection, facing pressure from standardised factory-made toolkits.	**Low feasibility** as precision manufacturing tech exists, but local production remains handcrafted or semi-mechanised, with low automation suitability.	• NGOs such as Dastkari Haat Samiti, Craftizen Foundation, etc.

6 Infomerics Ratings - India's diamond industry: Trends, opportunities and challenges (2024)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
14	Artisans	Doll and toy makers	Creates toys by hand or semi-mechanised methods, often for local or craft markets. Competition from mass-produced and digital toys reduces market share. Operates in the informal sector, vulnerable to market and technology disruption.	0-1%[4]	**High impact** as small-scale artisans face intense competition from imported toys and large-scale manufacturing, with low job security.	**Low feasibility** as 3D printing and automated toy production exist, but most traditional artisans rely on manual methods and lack capital or access to technology.	• Association or co-operatives such as All India Artisans and Craftworkers Welfare Association (AIACA), Channapatna Handicrafts Cooperative, etc. • NGOs such as Dastkari Haat Samiti, Craftizen Foundation, etc.
15	Artisans	Locksmiths	Smart locks and electronic access systems are transforming traditional locksmithing. Requires upskilling, but demand persists due to personalised service.	0-1%[4]	**Medium impact** as rising urban security needs and smart lock tech are shifting traditional locksmith roles, particularly in metros.	**Medium feasibility** as digital lock systems and smart access tools are available but require reskilling; manual key-cutting still dominates in Tier 2/3 cities.	• Associations or co-operatives such as Dindigul Lock Workers' Industrial Co-operative Society, Urban Toolsmith Guilds, etc.
16	Artisans	Fishing net maker	Crafts nets for local fishing communities, tailored to specific fishing techniques and environments. Synthetic fibre technologies and machine-made nets dominate the market. Artisanal makers face competition from mass production.	0-1%[4]	**Medium impact** as predominantly coastal and informal workforce, with rising input costs and reduced market stability due to competition.	**Medium feasibilit**y as mechanised net weaving machines are used in industrial settings, but traditional manual net-making still dominates local markets.	• Federation or co-operatives such as National Federation of Fishers Cooperatives (FISHCOPFED), Fishermen's Cooperative Federations in different states, etc. • NGOs such as Dakshin Foundation, MSSRF (M. S. Swaminathan Research Foundation), etc.
17	Artisans	Blacksmiths	Shapes metal using traditional forging techniques for tools, hardware and ornamental work. Mass production reduces demand, but artisanal and custom metalwork retain niche value. Technology has a limited impact due to the manual nature of the craft.	0-1%[7]	**Medium impact** as a highly informal workforce, but niche demand in rural areas provides some stability.	**Medium feasibility** as automated forging and CNC metalworking are increasing efficiency, but still require craftsmanship.	• Associations such as All India Artisans and Craftworkers Welfare Association (AIACA), State-level Artisans Cooperatives, etc. • NGOs such as Devipeeth India Foundation, Dastkari Haat Samiti, etc.

7 Rentech Digital - List of blacksmiths in India

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
18	Artisans	Armourer	Traditionally makes protective gear and weaponry; now largely ceremonial or artisanal. Minimal direct tech impact; may benefit from digital marketing or restoration tech. Rare, heritage-based profession with declining relevance.	0-1%[4]	**Low impact**, as it is a heritage craft with niche ceremonial or decorative demand; low workforce size and high cultural value.	**Low feasibility** as no significant tech substitutes; craftsmanship is core to value and automation would reduce cultural authenticity.	• Associations such as Rural Toolmakers' Guilds, Local Artisan Cooperatives, etc. • NGOs such as Dastkari Haat Samiti, Vishwakarma Association Trusts (region-specific), etc.
19	Civic, domestic and healthcare services	Domestic workers	Perform household tasks such as cleaning, cooking and caregiving. Smart home devices reduce some tasks, but trust, flexibility and affordability keep this role human centred.	6-10%[8]	**Medium impact** due to growing awareness and the need for formalisation offers some protection.	**Low feasibility,** as Smart home technology may assist, but full automation is not widely feasible.	• Federations/ Skilling bodies such as National Domestic Workers Federation (NDWF), Domestic Workers Sector Skill Council (DWSSC), etc. • NGOs such as SEWA (Self Employed Women's Association), Jagori etc.
20	Civic, domestic and healthcare services	Sanitation workers	Handle waste collection, sewer cleaning and public sanitation. Mechanised cleaning is expanding in cities, but manual scavenging persists in many regions, demanding urgent tech-driven reforms.	0-1%[9]	**High impact** due to hazardous working conditions and low wages, making them highly vulnerable.	**High feasibility**, as automated cleaning robots, AI-based waste sorting and smart sewage systems enhance the transition potential.	• Associations or co-operatives such as India Sanitation Coalition, National Safai Karmachari Finance and Development Corporation (NSKFDC) etc. • NGOs such as Sulabh International, Hasiru Dala etc.
21	Civic, domestic and healthcare services	Nurses	Provides direct patient care and supports medical procedures. AI tools assist in diagnostics and monitoring, but empathy, physical care and critical decisions keep the role firmly human-centric.	0-1%[10]	**Low impact** due to high formal employment with demand-driven stability in healthcare	**Medium feasibility** as AI-driven patient monitoring, robotic assistance and predictive diagnostics are transforming healthcare; however, human touch is required in patient care.	• Associations such as Trained Nurses Association of India (TNAI), All India Government Nurses Federation (AIGNF), etc. • NGOs such as HelpAge India, Nurses for You Foundation, etc.

8 Statista - Registered unorganised workers by sector in India (2025)
9 WaterAid - The hidden world of sanitation workers in India (2021)
10 Medical Buyer - India faces nurses shortage; nurse-population ratio hits 1.96:1000 (2024)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
22	Civic, domestic and healthcare services	ASHA worker	Delivers community-level healthcare services in rural areas, often acting as the first point of contact. AI-powered health apps and telemedicine can assist but cannot replace physical outreach and trust-based care. Technology enhances efficiency, but cannot fully automate the role.	0-1%[11]	**Medium impact** as a semi-formal workforce, with variable pay and a lack of permanent employment benefits.	**Medium feasibility** as digital health tools and AI-powered remote diagnostics aid transition but require adaptation.	• Associations such as ASHA Workers' and Facilitators' Federation of India (AWFFI), etc. • Other organisations such as Public Health Resource Network (PHRN), Centre for Health and Social Justice (CHSJ) etc.
23	Civic, domestic and healthcare services	Lab technician	Conducts diagnostic tests, prepares samples and maintains lab equipment. Automation improves speed and accuracy, but human supervision remains necessary for test accuracy and complex diagnostics.	0-1%[12]	**Low impact** as higher formalisation with steady demand in healthcare and diagnostics.	**Medium feasibility** as AI-based automated testing and diagnostics are growing, but still require human oversight.	• Association or skill councils such as All India Medical Laboratory Technologists Association (AIMLTA), Life Sciences Sector Skill Development Council (LSSSDC), Healthcare Sector Skill Council (HSSC), etc. • Training Partners such as Apollo MedSkills, IL&FS Skills, MedVarsity, etc.
24	Civic, domestic and healthcare services	Home healthcare workers	Supports basic medical care, elder care and rehabilitation in home settings, including administering medicines, hygiene assistance and monitoring vitals. Largely informal workforce.	0-1%[13]	**High impact** as frontier tech can boost home healthcare efficiency. IoT monitors, remote diagnostics and app platforms enable better elderly care for a marginally ageing population.	**Medium feasibility** as smartphone penetration and low-cost devices enables remote supervision, though digital literacy and regulatory gaps persist.	• NGOs or providers such as HelpAge India, Nightingale Empowerment Foundation, Care24, Portea Medical, etc.

11 Press Information Bureau, Ministry of Health & Family Welfare. (2020)
12 Aspire Circle - Diagnostic report: HLTH (2022)
13 Indian Home Healthcare 2.0 : Redefining the Modern Care Continuum – Nat Health India (2022)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
25	Construction & infrastructure	Plumber	Installs and maintains piping systems in homes and buildings. Sensor-driven leak detection and digital blueprints aid large projects, but most jobs remain manual and require on-site diagnosis.	0-1%[14]	**Low impact** as mostly an informal workforce, but specialised skills offer stable job prospects.	**High feasibility** as AI-driven leak detection, automated diagnostics and smart plumbing solutions support the transition.	• Skill council or associations such as Water Management & Plumbing Skill Council (WMPSC), Indian Plumbing Association (IPA), etc.
26	Construction & infrastructure	Mason	Builds walls and structures using bricks, concrete and mortar. Robotic bricklayers and prefab tech exist but are mostly used in large-scale projects. Site variability and skill requirements make full automation difficult.	0-1%[15]	**Low impact** as the majority of the workforce is in informal work, but skill-based employment offers relative stability compared to general labourers.	**Medium feasibility,** as some automation in bricklaying and 3D printing exists, but manual skill remains essential.	• Skill Council or associations such as Construction Skill Development Council of India (CSDCI), Builders Association of India (BAI), CREDAI local chapters, etc. • NGOs or social enterprises such as LabourNet, TNS India Foundation, GMR Varalakshmi Foundation, etc.
27	Construction & infrastructure	Painter	Prepares and paints surfaces in construction and renovation work. Industrial automation is feasible, but residential and decorative painting still requires manual skill, precision and adaptability.	0-1%[16]	**Low impact** as mostly informal, but demand fluctuation is lower and skills are transferable across sectors.	**High feasibility,** as spray-painting robots and AI-driven precision painting offer high transition feasibility.	• Skill Council or associations such as Construction Skill Development Council of India (CSDCI), Builders Association of India (BAI), etc. • Training Partners such as Berger Paints iTrain, Nerolac Paint Academy, etc.
28	Construction & infrastructure	Electrician	Installs and repairs wiring, appliances and lighting systems. Smart home devices and energy monitoring tools are growing, especially in urban areas, but field adaptability remains key.	11-15%[17]	**High impact** with limited to moderate formalisation, with steady demand for services ensuring employment continuity.	**Medium feasibility** as smart home technologies, AI diagnostics and automation improve efficiency and ease of transition.	• Skill Council or associations such as Power Sector Skill Council (PSSC), Construction Federation of India (CFI), etc. • NGOs such as Pratham, Don Bosco Tech, etc.

14 Book Clean Go - Plumbing statistics
15 Empowering Communities: CSDCI's Impact in Upskilling Masons for PM Awas Yojana-Rural in Lucknow (2023)
16 Paint and Coalition Skill Industry - Indian Paint Industry
17 India's construction sector second largest employment generator: Report – Economic Times (2023)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
29	Construction & infrastructure	Heavy equipment operator	Operates large machinery such as cranes and bulldozers at infrastructure sites. While semi-automated systems are emerging, high costs and unpredictable environments mean human operators remain essential. Tech augments but does not replace the role.	11-15%[18]	**Low impact** as higher formal sector presence, with steady demand and specialised training reducing job vulnerability.	**Medium feasibility** as AI and automation are enhancing efficiency, but manual control remains dominant in operations.	• Skill Council or associations such as Infrastructure Equipment Skill Council (IESC), National Highways Builders Federation (NHBF), etc. • Training partners such as L&T Construction Skill Training Institutes, Tata Hitachi Operator Training Centres, Volvo CE Operator Training Schools, etc.
30	Construction & infrastructure	Carpenters	Builds wooden structures, furniture and fixtures. Computer numerical control (CNC) routers and automated cutting tools improve precision, but high equipment costs and artisanal demand preserve manual relevance.		**Medium impact** as the majority in informal work, but skills allow flexibility and adaptability in various industries.	**Medium feasibility** as CNC machines and AI-driven design tools allow for easy adoption of automation.	• Skill Council such as Construction Skill Development Council of India (CSDCI). • NGOs or social enterprises such as LabourNet, TNS India Foundation, etc.
31	Construction & infrastructure	Fabricator/ welder	Cuts and joins metal parts for machinery, buildings and vehicles. Robotic welding is common in industrial setups, but in small workshops and informal units, manual skills remain central.		**Low impact** as higher formal employment share with technical expertise, reducing the risk of displacement.	**High feasibility** as robotic welding and automated fabrication are increasingly used in large-scale manufacturing.	• Skill Council or associations such as Construction Skill Development Council of India (CSDCI), Indian Welding Society (IWS), etc. • NGOs such as Don Bosco Tech, Tata STRIVE, etc.
32	Construction & infrastructure	Construction workers	Engages in site-level labour including brickwork, concreting and material handling. While prefabrication and site automation are rising, informal hiring and job variability keep tech integration low.		**Medium impact** as majority of the workforce operates in the informal sector, but large-scale infrastructure projects provide some stability.	**Medium feasibility** due to increasing adoption of AI-driven site management and mechanised processes, but still labour-intensive.	• Skill Council or associations such as Construction Skill Development Council of India (CSDCI), Builders Association of India (BAI), CREDAI local chapters, etc. • NGOs or social enterprises such as LabourNet, Aajeevika Bureau, GMR Varalakshmi Foundation, etc.

18 India's construction sector second largest employment generator: Report – Economic Times (2023)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
33	Manufacturing and industrial activities	Machine operator	Runs and monitors machinery in manufacturing units. Automation and AI are increasingly handling repetitive tasks, but operators are still needed for supervision, troubleshooting and precision control. Partially formalised sector, but skill-based roles offer some security.		**Medium impact** as a partially formalised sector, but skill-based roles offer some security.	**High feasibility** as AI-based process control and automated manufacturing equipment ease transition.	• Skill council such as Capital Goods Skill Council (CGSC), Automotive Skill Development Council (ASDC) etc. • NGOs such as Tata STRIVE, Deshpande Foundation, Pratham Institute, etc.
34	Manufacturing and industrial activities	Manufacturing worker	Works on shop-floor operations in textiles, engineering or Fast-moving Consumer Goods (FMCG) units. Automation, IoT sensors and quality control AI are growing in formal sectors, but majority are still in informal settings.	0-1%[19]	**High impact** as a large majority of workers operate in informal employment, with automation posing risks to long-term job security.	**High feasibility** as robotic assembly lines and AI-driven quality control significantly improve automation potential.	• Skill council or associations such as Capital Goods Skill Council (CGSC), Federation of Indian Micro and Small & Medium Enterprises (FISME), etc. • NGOs or social enterprises such as LabourNet, Pratham, etc.
35	Manufacturing and industrial activities	Packaging workers	Perform manual or semi-automated tasks such as sorting, labelling and sealing goods in manufacturing, food processing or logistics units. In India, many work in informal setups with limited mechanisation, though automated packaging lines are emerging in large-scale industries.		**Medium impact** as predominantly informal, but FMCG and e-commerce growth provide steady demand.	**Low feasibility** as AI-powered sorting and packaging machines enhance efficiency, but human oversight is still required.	• Skill council or associations such as Food Industry Capacity and Skill Initiative (FICSI), All India Food Processors' Association (AIFPA), etc.
36	Manufacturing and industrial activities	Miners	Extracts minerals and resources from underground or surface mines. While autonomous drilling and safety tech are expanding, harsh and unpredictable conditions still require human intervention and oversight.	2-5%[20]	**High impact** due to high exposure to hazardous conditions, with a mix of formal and informal employment.	**Medium feasibility** as AI is improving safety and automation, but underground operations still require human oversight.	• Skill council or research bodies such as Mining Sector Skill Council (MSSC), National Institute of Miners' Health (NIMH) etc. • NGOs such as Mines, Minerals & People, etc.

19 Total employment in manufacturing industries up 7.5% in FY23: Govt survey – Business Standard (2025)
20 Overview of Mining Sector in India - National Mining Ministers' Conference 2025 (2025)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
37	Logistics & transportation	Delivery drivers	Transport goods across urban and rural areas. Route optimisation apps and last-mile tracking are common, but gig-model instability and limited skilling restrict broader tech usage.	2-5%[21]	**High impact** as the majority work in the gig economy, lacking job security and labour protection.	**Medium feasibility** as autonomous delivery vehicles and drone deliveries are emerging, but human involvement remains.	• Skill council or associations such as Logistics Sector Skill Council (LSSC), All India Transporters Welfare Association (AITWA), Express Industry Council of India (EICI), etc.
38	Logistics & transportation	Auto rickshaw driver	Drives three-wheeled auto-rickshaws for short-distance public transport. E-rickshaws and aggregator apps are improving operations and customer reach. Tech adoption is growing, but regulatory and financial vulnerabilities exist. The majority exist in unions and have access to bargaining power.	0-1%[22]	**Medium impact** as the workforce is mostly informal, although it operates through unions. High local demand provides relative income stability.	**Low feasibility** as there is limited adoption due to low infrastructure for automation and cost barriers.	• Associations such as Auto Rickshaw Drivers' Unions, All India Road Transport Workers Federation, etc.
39	Logistics & transportation	Heavy vehicle driver	Operates trucks and transport vehicles over long distances. Fleet tracking, route optimisation and automation impact long-haul logistics. It is a critical role but susceptible to gradual automation trends.	0-1%[23]	**Medium impact** as mostly informal employment with long working hours and high job risks.	**Medium feasibility** as AI-driven fleet management and driver-assist technologies are improving transition feasibility.	• Skill council or industry bodies such as Logistics Sector Skill Council (LSSC), Indian Foundation of Transport Research and Training (IFTRT), etc. • NGOs such as SaveLIFE Foundation, Muskaan Foundation for Road Safety, etc.
40	Logistics & transportation	Cab/ commercial driver	Drives taxis or commercial vehicles for passenger or goods transport. Ride-hailing platforms and GPS tech improve efficiency; EV shift underway. Platform integration may boost access but may lead to labour fragmentation.	0-1%[24]	**High impact** as predominantly informalised, with ride-hailing services disrupting traditional employment.	**Medium feasibility** as self-driving technology is advancing, but full adoption is still distant.	• Skill council or federations such as Automotive Skill Development Council (ASDC), Indian Federation of App-based Transport Workers (IFAT), etc. • NGOs such as SaveLIFE Foundation, Muskaan Foundation for Road Safety, etc.

21 Food delivery economy crucial, generates large-scale employment: Gadkari – Business Standard (2024)
22 Assessing the Viability of Using Autorickshaws for Urban Freight Delivery in India – WRI India (2023)
23 Transportation Problem in India – FR8 (2024)
24 Wanted: More women in taxi, logistics lane – The Economic Times (2024)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
41	Retail and food services	Supermarket/ hypermart workers	Manages stocking, billing and customer assistance in retail settings. Self-checkouts and AI-based inventory tools are rising, but human workers remain key for customer interaction and on-floor flexibility. This role has a higher potential to be formalised given that its operations exist largely in Tier 1/Tier 2 cities.	0-1%[25]	**Medium impact** due to higher formalised employment, but automation and e-commerce may impact job stability.	**Medium feasibility** as self-checkout systems, AI inventory tracking and robotic assistants are increasingly adopted.	• Associations such as Retailers Association of India (RAI), National Supermarket Association, etc.
42	Retail and food services	Waiters	Serve food and assist customers in eateries and restaurants. While automated kitchens and AI-driven ordering exist in chains, personalised service makes human staff indispensable in most setups.	0-1%[5]	**Medium impact** as mostly informal but hospitality industry growth offers steady job opportunities.	**Low feasibility** as while robotic servers exist, widespread adoption remains cost-prohibitive in most settings.	• Skill council or associations such as Tourism and Hospitality Sector Skill Council, National Restaurant Association of India (NRAI) • NGOs such as Don Bosco Tech Society, Pratham Hospitality Training, etc.
43	Retail and food services	Kirana store workers	Manages small-format grocery operations, handling stocking, billing and sales. POS systems and digital payments are rising, but face uneven adoption in Tier 3 towns and rural areas.	2-5%[26]	**Medium impact** as the majority operates in the informal sector, with digital retail posing risks but local demand sustaining employment.	**Low feasibility** due to high reliance on manual customer interaction and local knowledge, limiting full automation.	• Associations such as Retailers Association of India (RAI), Trust for Retailers and Retail Associates of India (TRRAIN), etc.
44	Retail and food services	Street food vendor	Prepares and sells food in informal roadside setups. While mobile ordering and automation are growing in fast food chains, the street vendor model thrives on customisation, affordability and local engagement.	0-1%[27]	**High impact** as almost entirely in the informal sector, facing financial and job security risks.	**Low feasibility** as customisation, live cooking and customer interaction limits the scope of automation.	• Associations such as National Association of Street Vendors of India (NASVI), National Hawkers Federation (ILWF), etc. • NGOs such as Aajeevika Bureau, Janpahal, etc.

25 List of Supermarkets in India – Rentech Digital Smartscrapers (2025)
26 Modernisation of Kirana Stores in India – Invest India (2021)
27 Project Clean Street Food – FSSAI (2016)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
45	Retail and food services	Dhaba worker	Supports food preparation and service at informal highway eateries. Large-scale automation and cloud kitchens are emerging, but they cannot replicate the local flavour, familiarity and low-cost appeal of dhabas.	0-1%[28]	**High impact** as predominantly informal with no labour protections and irregular/ unstable income.	**Low feasibility** as personalised cooking and local hospitality make AI adoption challenging.	• Associations such as State-level Dhaba/ roadside restaurateur associations and NGOs such as Aajeevika Bureau, Janpahal, etc.
46	Others	Aquaculture workers	Farm and manage aquatic species such as fish and shrimp. IoT-based water quality sensors and feeding automation are being piloted, but smallholders face high barriers to entry.	6-10%[29]	**Medium impact** due to high informal employment, but increasing government focus provides growth opportunities.	**Low feasibility** as AI-powered monitoring and automated feeding exists, though hands-on work remains dominant.	• Federations and academia such as All India Fishers and Fisheries Workers Federation (AIFFWF), Society of Aquaculture Professionals, Central Institute of Fisheries Technology (CIFT), etc. • NGOs such as Dakshin Foundation, MSSRF (M.S. Swaminathan Research Foundation), etc.
47	Others	Unorganised educators	Provides subject-specific academic support at homes or in informal settings, often supplementing school education. Operates outside formal school systems with high variability in quality and pay.	0-1%[5]	**Medium impact** due to rising EdTech penetration, voice-AI tutors and adaptive content tools. But personal trust and localised learning remain strong drivers.	**Medium feasibility** with growing mobile-first learning platforms, vernacular video content and AI-driven performance tracking; many are already using technology informally via WhatsApp or YouTube.	• Associations such as Bharat Gyan Vigyan Samiti (BGVS), State-level Shikshak Sanghs, etc. • NGOs such as Piramal Foundation, Pratham Education Foundation, ShikshaLokam, etc.

28 Why are dhabas more famous than hotels in India? – Punjabi Vaishno Dhaba (2025)
29 Press Information Bureau - e-Shram portal crosses 27 crore registrations (2022)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
48	Others	Port worker	Loads, unloads and manages goods at ports and shipping terminals. Port automation, scanners and logistics tech can optimise operations. The role is highly manual and faces risk from full-scale digitisation and mechanisation.	0-1%[30] [31] [32]	**Medium impact** as a partially formalised sector, but mechanisation and efficiency measures may impact jobs.	**Medium feasibility** as AI-powered cargo tracking and robotic cranes improve efficiency, but manual work persists.	• Associations or co-operatives such as All India Port and Dock Workers Federation, Coastal Container Transporters Association (CCTA), India Private Ports and Terminal Associations (IPPTA), etc.
49	Others	Leather workers	Design and produce leather goods. Computer-aided Design (CAD) software and automated cutting machines are being adopted by larger units, but small-scale workers still rely on manual craftsmanship.	0-1%[33]	**High impact** as workers are vulnerable with unstable wages and declining traditional demand.	**Medium feasibility** as AI-driven pattern cutting and automated processing improve transition potential.	• Skill council or associations such as Leather Sector Skill Council (LSSC), Indian Leather Products Association (ILPA), etc. • Academic bodies such as Footwear Design & Development Institute (FDDI), Central Leather Research Institute (CLR), etc.

30 Cargo handled at India's major ports rises 4.3% to 855 million tonnes in FY25 – Mint (2025)
31 Employments In Ports – Manpower at Non Major Ports as on 31st March 2013 - Open Government Data (OGD) Platform India (2013)
32 Employments In Ports - Manpower at major ports as on 31st March 2013 2013 - Open Government Data (OGD) Platform India (2013)
33 INDIAN LEATHER INDUSTRY – OVERVIEW, EXPORT PERFORMANCE & PROSPECTS - COUNCIL FOR LEATHER EXPORTS (2021)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
50	Others	Laundry workers (dhobi)	Wash and iron clothes using manual or semi-automatic tools. Industrial laundromats are growing in cities, but traditional methods persist in smaller towns and communities.	0-1%[34]	**Medium impact** as the workforce is mostly informal, but steady demand in smaller cities/ towns ensures relative income stability.	**Low feasibility** as AI-assisted dry cleaning and industrial washing automation exists, but manual work is still prevalent.	• Association such as Dhobi Kalyan & Dhobi Seva Samitis (State Federations), All India Washermen Federation, etc. • NGOs such as Goonj, SelfEmployed Women's Association (SEWA), etc.
51	Others	Seafood processing worker	Cleans, sorts and packages seafood in coastal or export hubs. Processing automation and hygiene tech may replace manual labour. Physically demanding and repetitive work with low job security.	0-1%[35]	**High impact** as the majority of workers are in the informal sector. They are highly vulnerable to automation, export compliance regulations and seasonal employment instability.	**Medium feasibility** as AI enhances sorting, grading and de-shelling, but human oversight is needed for quality control and delicate seafood handling.	• Associations such as National Fishworkers' Forum (NFF), Seafood Exporters Association of India (SEAI), etc. • NGOs such as Dakshin Foundation, MSSRF (M.S. Swaminathan Research Foundation), etc.

34 A Journey Of Laundry Business From Dhobi Ghats To Online Marketplace – Entrepreneur (2016)
35 India has robust regulatory framework for seafood units: Commerce min – Business Standard (2024)

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
52	Others	Repair technician	Repairs consumer electronics, appliances or machinery. Diagnostic tools, smart devices and tech support platforms augment work. Demand such asly to rise with tech proliferation; role must evolve with skills to keep pace with advancing technologies.	0-1%[36]	**Medium impact** as the majority is an informal workforce, but demand for repair services provides job security.	**Medium feasibility** as AI-based diagnostics and predictive maintenance improve efficiency but require skilled oversight.	• Skill council or associations such as Electronics Sector Skills Council of India (ESSCI), Consumer Electronics and Appliances Manufacturers Association (CEAMA), etc. • NGOs such as Don Bosco Tech Society, TNS India Foundation, etc.
53	Others	Ceramic kiln operator	Manages high-temperature kilns for firing pottery, tiles and ceramics. While automated kilns improve precision and energy efficiency, the role still demands human control for temperature regulation, loading and quality checks in artisanal and small-scale production.	0-1%[37]	**High impact** as majority of workers i.e. kiln operators face high job displacement risks due to automation, sustainability regulations and energy-efficient manufacturing processes.	**Medium feasibility** as AI-driven temperature control, automated kiln monitoring and predictive maintenance enhance efficiency, but manual material handling and supervision remain essential.	• Associations such as Khadi and Village Industries Commission (KVIC), All India Pottery Manufacturers Association, etc. • NGOs such as Gramodaya Sangh, Dastkar, etc.

36 Home Appliances Repair & Services in Gurgaon
37 Sector Detail – Ceramics – UNIDO

#	Sector	Persona name	Description	Percentage of total population*	Ability to impact	Adoption feasibility	Illustrative organisations
54	Others	Tour guides	Leads domestic and foreign tourists through heritage sites, natural landscapes or urban tours; interprets history, culture and local context. The role is seasonal and heavily dependent on language, storytelling and interpersonal skills.	0-1%[5]	**Medium impact** as AR navigation, AI audio guides and digital ticketing reduce dependency on in-person guides. Human-guided experiences still valued for personalisation.	**Medium feasibility** with gradual tech adoption via mobile-based tour platforms, AI translation tools and digital storytelling apps, though it varies by region and digital comfort.	• Associations such as Tourist Guides Federation of India (TGFI), Indian Association of Tour Operators (IATO) etc.
55	Others	Textile workers	Textile workers, including handloom weavers, produce, stitch and finish fabrics using manual or semi-mechanised methods, often in home-based or small informal units. Many remain artisanal due to heritage value and limited access to automation.	0-1%[5] [38]	**Medium impact** as the majority are part of the informal workforce, but government schemes/ NGOs/SHGs support livelihood sustainability.	**Medium feasibility** as AI-powered textile machinery is replacing manual weaving, though heritage industries still rely on artisanal skills.	• Skill council or associations such as Apparel Made-Ups and Home Furnishing Sector Skill Council (AMHSSC), National Federation of Handloom and Handicraft Workers (NFHHW), etc. • NGOs such as SelfEmployed Women's Association (SEWA), Women Weave, etc.

*Based on numbers published in the cited reports or articles

38 Handloom Weavers – Ministry of Textiles

Appendix B:

Challenges identified through deep dives into eight representative personas, reflecting broader patterns across the informal workforce

1. Cultivators

Pain point	Description
Land fragmentation and small holdings	India's average operational holding size was just 1.08 ha in 2015–16, with 86.08 percent of holdings classified as small or marginal (<2 ha) according to the All India Agricultural Census 2015–2016. This fragmentation prevents farmers from achieving economies of scale, makes ownership of modern machinery uneconomical and traps cultivators in labour-intensive low-yield practices.
Low and volatile farm incomes	The 77th NSSO Situation Assessment Survey (2018–2019) reported an average monthly income of INR 10,218 for agricultural households, up from INR 6,426 in 2012–2013. Notably, 37 percent of this came from crop cultivation (INR 3,798), with the rest from wages (INR 4,063), animal farming (INR 1,582) and other sources, highlighting that cultivation alone does not provide a stable livelihood.
Widespread indebtedness	In 2018–2019, over 50.2 percent of agricultural households were indebted, with an average outstanding loan of INR 74,121, a 58 percent increase from 2012–2013. Notably, 20.5 percent of this borrowing was from informal moneylenders (at 24–36 percent interest) compared with 69.6 percent from banks, indicating severe financial stress and reliance on high-cost credit.
Limited market access and price realisation	Field studies show that only 23–26 percent of cultivators are aware of the Minimum Support Price (MSP) for their crops and less than 20 percent can identify procurement agencies for wheat or paddy. This lack of awareness undermines bargaining power and often forces farmers to sell at local distress prices.
Infrastructure deficit and post-harvest losses	Despite irrigation schemes, only 55 percent of gross cropped area was irrigated in 2020–2021. Cold chain capacity is underbuilt (ffi31.8 Mt vs. a needed 61 Mt) and only 250+ pack houses exist versus the 70,000 required, leading to post-harvest losses of 5.5 percent (69 Mt), worth an estimated INR 1.5 lakh crore. Mechanisation covers just 47 percent of farm operations with farm power at 2.5 kW/ha.
Technology and extension gaps	Only 24 percent of rural households use the internet, limiting access to market and weather information. In Kharif 2018–2019, just 49 percent of agricultural households received any technical advice and formal extension services were directly reached by less than 10 percent of cultivators.
Climate vulnerability	Over 60 percent of India's farmland is rain-fed, exposing cultivators to monsoon variability and extreme weather. Rising temperatures are projected to reduce agricultural labour capacity by 30–40 percent, shortening working hours and delaying critical operations.
Social and gender barriers	Women own only 13.9 percent of operational landholdings and control 11.6 percent of farmland despite comprising a majority of the field workforce in many regions. Female cultivators earn roughly 69 percent of male daily wages (INR 287 vs. INR 416), reflecting a persistent 31 percent gender pay gap. Among Scheduled Castes, the Land Access Index is just 0.45, signalling deep caste-based inequities.

2. Kirana store workers

Pain point	Description
Financial fragility and low margins	Typical kirana stores operate on 3–5 percent gross margins on FMCG products. This low margin leaves little buffer for fluctuations in supplier prices, rent or utilities. Most stores depend on daily sales to fund reorders and meet overheads; any sales dip (e.g. due to holidays or local events) can trigger cash-flow shortfalls, delaying wage payments to staff and forcing owners to take expensive informal credit.
Excessive work hours and low-value tasks	With no back-office help, storekeepers and staff routinely work 12–14 hours a day seven days a week. A recent survey of field staff in retail found they spend 45 percent of their workweek (ffi18 hours) on low-value tasks, manual record-keeping, debt follow-ups and reconciliations, leading to burnout and reduced time for customer engagement.
Lack of formal retail training	Over 98 percent of kirana outlets are run single-handedly by owner-operators with little to no formal retail management or customer service training. This skills gap hampers efficient store layout, upselling and the adoption of new digital tools.
Poor inventory visibility and stockouts	Manual stock-takes lead to frequent stockouts of fast-moving items and overstocking of slow-moving perishables. A study reports 60 percent of kiranas lack any systematic inventory control, resulting in 10–15 percent lost sales and higher spoilage costs.
Cash-only transactions and security risks	Around 80 percent of transactions at neighbourhood kiranas remain cash-based, exposing workers to theft risk, time-consuming cash reconciliation and customer reluctance for large purchases.
Competition from quick-commerce platforms	The rise of online instant delivery apps has slashed neighbourhood footfall by 15–20 percent in metros, with an estimated 200,000 kiranas closing in the past year due to quick-commerce pressure. Such rapid-delivery players have eroded kirana footfall, with some stores reporting a 25–30 percent drop in business compared to pre-COVID levels, threatening livelihoods of store workers.

3. Unorganised educators

Pain point	Description
Low and irregular wages	Income fluctuates with exam seasons, holidays and student dropouts. Many tutors struggle to maintain a steady student base, especially in areas with high competition or low demand.
	There is no wage protection or standard fee structure; rates are negotiated individually and can be very low, especially for new or less-experienced tutors.
	Most payments are made in cash, with no documentation. This excludes tutors from formal benefits such as insurance, paid leave or pension and income often goes unreported for tax and credit purposes.
	Many home tutors, operating in the informal sector, lack access to formal banking services, making it challenging to save securely, obtain credit or invest in their tutoring services.
Job insecurity and lack of professional recognition	Tutors are typically hired informally, with no written agreements, making them vulnerable to arbitrary termination or payment disputes.
	As they operate independently and without school affiliation, tutors lack access to grievance redressal, professional development or legal support.
	Without formal teaching degrees (e.g. B.Ed.) or school positions, these educators often face scepticism from parents and students regarding their credibility.
	Home tutors often lack formal certifications or recognition, leading to challenges in establishing credibility and commanding fair compensation.

Difficulty in student acquisition and retention	The growing popularity of home tuition means more people are entering the field, making it harder to secure and retain students, especially in urban areas.
	Tutors are limited by their locality, as most parents prefer someone nearby for convenience and safety, restricting the market size.
	Without formal marketing channels, most tutors rely on personal networks and referrals, which can be unreliable.
	Many home tutors lack an online presence or digital marketing skills, restricting their ability to reach a broader student base.
Parental interference and student motivation	Excessively involved parents may micromanage sessions, interrupt lessons or set unrealistic expectations which can lead to stress and conflict for tutors.
	Many students view home tuitions as an extra burden, leading to a lack of motivation, absenteeism or disruptive behaviour, which the tutor must manage alone.
Lack of access to skill development and training	Most home tutors do not have access to structured training or upskilling, making it hard to improve teaching methods, classroom management or subject expertise.
	Many tutors, especially older or less-educated ones, struggle to adapt to new teaching technologies, online resources or hybrid models.

4. Tour guides

Pain point	Description
Low and irregular wages	Tour guides in India are heavily dependent on the tourism calendar, with most of their earnings concentrated in peak months (October–March). During off-seasons, such as monsoons or extreme summers, there is virtually no demand, leading to several months with zero income. This seasonality makes long-term financial planning nearly impossible, with many guides forced to take up short-term odd jobs or borrow money to survive the lean months. The unpredictability of tourism due to external shocks (pandemics, geopolitical tensions, natural disasters) adds another layer of uncertainty to their income stability.
	The salary range for Indian tour guides remains well below industry standards seen in other skilled service jobs. Most entry-level guides earn INR 15,000–INR 25,000 per month, while those with years of experience or foreign language proficiency may earn up to INR 50,000 per month in high-tourism zones. However, these figures are not guaranteed and are subject to fluctuations based on demand and tourist reviews. The absence of base pay, commission-only models and operator-controlled pricing structures prevent tour guides from earning what their expertise merits.
	The employment model is largely unstructured and gig-based, with most guides not on fixed contracts. They rely on being handpicked for individual assignments by operators or walk-in tourists. On days with low footfall, especially in less commercial tourist spots, many guides do not get selected at all. This overreliance on third-party discretion leads to inconsistent earnings, undermines professional dignity and often results in long idle hours without remuneration.
	Most earnings continue to be in cash or via informal digital transfers, which leaves no paper trail or income history. This lack of documentation affects eligibility for financial products such as loans, credit cards and insurance. Additionally, in case of payment disputes or cancellations by tourists, there is no legal protection or grievance redressal available, especially when working outside of established tour operators or agencies. This deeply entrenched informality perpetuates economic invisibility.
	No minimum wage notification is given for the tour guide profession under state or central labour codes. This results in unregulated pricing, especially for freelance guides who lack institutional backing. Tourists often negotiate rates based on perceived value, leading to guides accepting unreasonably low fees just to secure work. The absence of rate cards or sector norms also leads to undercutting among peers, further driving down earnings in the sector.
Migration and geographic mobility challenges	To find work, guides often migrate from rural or Tier 2 cities to tourism hotspots such as Delhi, Jaipur, Agra and Goa. This leads to higher living costs, unstable housing and disrupted family life. The pandemic forced many to return to their hometowns, where opportunities are even scarcer.
	Guides from states with low tourist footfall (such as Bihar, Chhattisgarh or Odisha) must compete in overcrowded hubs, where both licensed and unlicensed guides vie for limited work. The absence of a local tourism ecosystem forces migration and increases competition.

Exclusion from formal financial systems	Guides, often self-employed or working informally, lack the employment proof or regular bank statements required for loans, housing finance or small business credit lines. This exclusion makes it difficult to invest in upskilling or weather periods of low income.
	Most guides do not fall under formal social insurance schemes such as Employers' Provident Fund Organisation (EPFO) or Employees' State Insurance Corporation (ESIC), nor are they automatically covered by government insurance programmes. Unless they self-enrol (which few do), they remain unprotected in case of illness, accident or old age.
Inadequate social protection	Tour guides are not automatically registered under government social security schemes such as PM Shram Yogi Maandhan or Pradhan Mantri Jeevan Jyoti Bima Yojana. Self-enrolment is rare due to lack of awareness and bureaucratic hurdles. There is no unemployment allowance, on-the-job life insurance or other safety net.
	During COVID-19, most guides, despite being government-licensed, were excluded from major relief packages. Many reported no income for over 18 months and received little to no direct support from state or central governments, forcing them to change professions or take up odd jobs.
Job insecurity	Frequent changes in licensing rules such as new eligibility criteria, online certifications or language-specific mandates leave guides uncertain about the future of their licenses. This instability is compounded by the lack of guaranteed assignments, even for experienced guides.
	Unlicensed local guides and free audio guide apps now compete directly with professional guides, especially at low-cost monuments and heritage sites. Digitisation and self-guided tours have further eroded the demand for traditional guiding services.
	Even government-certified guides must compete for a limited number of foreign-language tour opportunities, often dependent on travel agents or inbound tour operators who may switch vendors frequently. There is no job security and many guides are forced to seek alternative livelihoods.
Limited skill development and training opportunities	Tour guide training in India lacks a unified national standard, resulting in fragmented programmes with varying quality and content across regions. While some states and organisations offer short-term courses, comprehensive and standardised training remains limited. This inconsistency affects the skill levels of guides and their ability to meet evolving tourist expectations. For example, recent regional training programmes include modules on cultural sensitivity, guiding techniques, history, heritage and language skills, but access and quality vary widely.
	Many existing training programmes emphasise traditional knowledge of history and culture but often lack adequate focus on modern skills such as foreign language proficiency, digital literacy, customer engagement and safety protocols. This gap leaves guides underprepared for diverse tourist needs and emerging trends such as virtual tours or tech-enabled guiding. For instance, the Incredible India Tourist Facilitator (IITF) Certification Programme offers online, self-paced learning to address some of these gaps, but uptake and awareness remain limited.
	Once certified, many guides have few formal opportunities for ongoing skill enhancement or specialisation in niche tourism sectors (e.g. art tours, eco-tourism). Continuous training programmes are sparse, limiting guides' ability to update their skills or adapt to changing market demands. New initiatives such as The Art Tour Guides Training Programme aim to fill this gap by offering specialised modules on art history and cultural institutions, but such programmes are still emerging.

5. Home healthcare aides

Pain point	Description
Low and irregular wages	Many home healthcare workers, especially attendants and aides, earn well below state-mandated minimum wages, often INR 8,000–INR 15,000 per month in cities. This is compounded by a drastic pay gap between caregivers and nurses and between nurses and doctors reflecting deep class and gender inequalities.
	Agencies commonly retain 30–50 percent of client fees, further reducing take-home pay and discouraging skilled professionals from entering or staying in the sector.
	Homecare workers often face unpredictable workloads, with income fluctuating based on patient demand. Payments may be delayed or withheld, especially for those hired informally or on a per-assignment basis.
	Workers regularly perform long shifts (12–16 hours) without overtime pay or benefits such as paid leave, health insurance or retirement security.

Migration and geographic mobility challenges	Most skilled homecare workers cluster in cities, leaving rural and remote areas underserved. This forces families in these regions to rely on underqualified or informal workers.
	Workers who migrate for better pay face language and cultural barriers, reducing care quality and increasing attrition.
Exclusion from formal financial systems	Many homecare workers lack bank accounts, relying on cash payments that are vulnerable to theft and financial exclusion.
	Informal status and irregular income prevent access to loans, insurance or pension schemes, making workers financially vulnerable during emergencies.
	For women in particular, home-based care work often mirrors unpaid domestic responsibilities, further undermining recognition, fair compensation and pathways to formal employment.
Inadequate social protection	Most homecare workers are not covered by health insurance, paid leave or maternity benefits, leaving them financially exposed during illness or emergencies.
	Job loss or patient death leaves workers without any safety net or unemployment allowance.
	Workers, especially women, are vulnerable to harassment or abuse from patients or their families, with little institutional support or legal protection.
Job insecurity	Most homecare workers are hired verbally or on informal contracts, enabling arbitrary termination and exclusion from social security benefits.
	Families often hire cheaper, unskilled attendants, increasing job insecurity for trained workers.
	There is little recourse for wage theft, harassment or unfair dismissal, as the sector lacks robust regulatory oversight.
	Many are labeled “helpers” or “volunteers,” justifying low pay and denying professional recognition.
Limited skill development and training opportunities	Attendants rarely have access to regular upskilling or continuing education, limiting their ability to keep up with new medical practices and technology.
	Many workers struggle to use new home health monitoring systems, telemedicine tools or electronic health records, particularly in tier-2 and tier-3 cities.
Workplace safety and harassment risks	Workers face physical hazards, including lifting patients, exposure to infectious diseases and lack of personal protective equipment (PPE) especially during pandemics.
	The emotional burden of caring for critically ill or elderly patients, combined with long hours and a lack of support, leads to fatigue, stress and burnout.
	Homecare workers, particularly women, are vulnerable to harassment or abuse from patients or their families, with little institutional support or legal protection.
Regulatory and systemic challenges	The homecare sector remains largely unregulated, with no uniform government norms or accreditation for workers or agencies, resulting in inconsistent service quality and confusion about roles and responsibilities.
	Most homecare services are not covered by insurance, limiting patient access and financial sustainability for providers.
	Workers often face shortages of medical supplies, equipment and medicines and lack timely access to emergency services, especially outside major cities.

6. Artisans

Pain point	Description
Low wages and job instability	Artisans often receive meagre wages, making it difficult to sustain their livelihoods and forcing many to abandon traditional crafts for other work.
	Seasonal demand and lack of stable work opportunities lead to persistent job insecurity and financial vulnerability among artisan families.
Market access and middlemen dependence	Most artisans have limited access to domestic and international markets, relying on local fairs or middlemen who take a large share of profits.
	Fragmented supply chains and weak connections with buyers prevent artisans from scaling up and earning fair value for their products.

Digital and business skills gap	Many artisans, especially in rural areas, lack digital literacy, making it hard to use e-commerce or social media for marketing and sales.
	Limited knowledge of business management, branding and market trends restricts their ability to adapt to changing consumer preferences.
Raw material and infrastructure constraints	Artisans face difficulty in procuring quality raw materials at reasonable prices, often due to low bargaining power and lack of aggregation.
	Poor infrastructure, such as inadequate workspaces, storage and transport, hampers production quality and timely delivery.
Skills upgradation and technology adoption	Outdated production methods and a lack of access to modern tools or training reduce productivity and product quality.
	Artisans struggle to integrate traditional skills with modern designs and consumer needs, risking the loss of cultural heritage.
Financial exclusion and credit access	Most artisans lack access to affordable credit, forcing them to borrow from moneylenders at high interest rates, which erodes their earnings.
	Low financial literacy and the absence of formal business registration further restrict their ability to benefit from government schemes.
Social stigma and declining recognition	Crafts are often perceived as inferior or backwards, leading to declining social status and discouraging younger generations from continuing these traditions.
	The fading recognition of cultural heritage threatens the survival of many traditional crafts.
Export barriers and regulatory hurdles	Artisans face challenges in meeting international quality standards, certifications and compliance requirements, limiting their global market reach.
	Intellectual property issues and a lack of support for protecting traditional designs further disadvantage artisans in export markets.

7. Textile workers

Pain point	Description
Raw material and supply chain constraints	Textile workers face rising and unpredictable prices for cotton, polyester and viscose, driven by global supply chain disruptions, domestic tariffs and quality control restrictions-making Indian textiles less competitive internationally.
	Import duties on cotton and man-made fibers (MMF), meant to protect farmers, have instead raised input costs for textile workers, while competitors such as Bangladesh and Vietnam enjoy cheaper, duty-free access to raw materials.
Skills gap and labour shortages	Despite a large workforce, there is a persistent shortage of workers trained in advanced textile manufacturing, technical textiles and modern machinery, limiting productivity and innovation.
	The sector faces high attrition rates (around 10 percent) and instability due to reliance on migrant labour, especially in hubs such as Tirupur, leading to production disruptions and increased training costs.
Low wages and job insecurity	Textile workers, including handloom weavers, often earn wages below subsistence levels, with seasonal demand and lack of formal contracts creating chronic job insecurity.
	A large proportion of workers remain in the informal sector, lacking social security, health benefits and consistent employment, especially in small and medium enterprises (MSME)-dominated clusters.
Infrastructure and technology deficits	Many textile units use obsolete machinery and lack access to modern technology, resulting in lower efficiency and product quality; infrastructure gaps in logistics, electricity and water further hamper productivity.
	MSMEs, where most textile workers are employed, struggle to access affordable credit for modernisation and expansion, limiting their ability to compete globally.
Competitive pressure and export challenges	Countries such as Bangladesh and Vietnam outcompete India in textiles due to lower labour costs, better trade agreements and more integrated supply chains, threatening job security for Indian textile workers
	Despite being a top exporter, India's textile exports have stagnated or declined. Complex customs procedures and a lack of free trade agreements (FTAs) further limit market access.

Technological disruption and digital divide	Many textile workers, especially in traditional and rural segments, lack digital literacy and access to e-commerce, limiting their ability to reach new markets and adapt to industry shifts.
	The rise of automation and AI in textile manufacturing threatens low-skilled jobs, requiring urgent upskilling and reskilling of the workforce.
Gender and social inequities	Women constitute a large portion of the textile workforce but often receive lower wages, have less job security and are underrepresented in supervisory and decision-making roles.
	Most textile workers lack access to health insurance, pension schemes and other social protections, increasing their vulnerability to economic shocks.
Health, safety and working conditions	Workers face exposure to dust, chemicals and repetitive strain injuries, with inadequate enforcement of workplace safety regulations in many units.
	Basic amenities such as clean drinking water, sanitation and safe housing are often missing, especially for migrant and contract workers.

8. Utility trade workers

Pain point	Description
Low and irregular wages	Earnings for informal carpenters, plumbers and electricians are often low, unstable and paid in cash. Unlike formal jobs with monthly salaries, these workers' incomes depend on the availability of work each day. Many spend hours waiting at bazaars or street corners, hoping to get picked for a job. On lean days, they earn nothing. Even when work is available, wages can be modest.
	Wage payments are uncertain. Being informal, these jobs lack legal wage protections or timely payment guarantees. It is not uncommon for workers to be underpaid or paid late by contractors. As one journalist noted, informal workers often have no "guarantee of getting paid fairly and on time." The lack of standardised rates means some accept whatever they can get, especially migrants desperate for work. Gender pay gaps also exist, in the rare cases where women engage in these trades, they may be offered lower pay due to bias or assigned only helper roles.
	Large cities sometimes offer higher nominal wages than villages, but once adjusted for cost of living, real incomes can be meagre. For example, an electrician in Delhi with formal Industrial Training Institute (ITI) training earned about INR 20,000 per month, yet still struggled to make ends meet for a family of five in the city. By contrast, a self-taught electrician in a Tier-3 town might earn only half as much, but if living costs are low and he has supplementary income (e.g. small farming), the strain could be similar. Overall, income insecurity remains a defining pain point: even during good months the earnings barely provide a "guzara" (basic livelihood) and there is little cushion for bad months.

Migration and geographic mobility challenges	Migration is a double-edged sword for these workers. On one hand, migrating from rural to urban areas (or from poorer regions to wealthier ones) is often a necessity to find work that pays enough. A large portion of carpenters, plumbers and electricians in Tier-1 cities are inter-state migrants. For instance, plumbers from Uttar Pradesh and Bihar, or electricians from Odisha, commonly seek work in Delhi and Mumbai's booming construction and housing market. This rural–urban migration is driven by wage differentials: a skilled plumber might earn only INR 300 a day in his village but could make twice that in a city.
	Migrant workers often live away from their families for long periods. They may reside in group dorms or squatter settlements under harsh conditions (as noted, many live in urban slums near project sites). The separation from family and community support can affect mental well-being. Those who bring families face other issues like lack of schooling for children or insecure living environments.
	Migrants are frequently more vulnerable to exploitation. Far from their home area, with limited local networks, they may accept poorer terms. Contractors sometimes prefer hiring migrants for this reason. A case study in Delhi's satellite towns revealed migrant informal workers toiled for "low-productivity, low-paying jobs", often below the legal minimum wage. Language barriers can further marginalise them in unfamiliar cities.
	Migrants often follow the ebb and flow of construction seasons. Many return to their villages during agricultural seasons or festivals and then come back to cities. This circular migration means continuity of work is broken and each cycle, they must often hunt for new employment again. During crisis (such as the COVID-19 lockdown), migrants were left stranded without income, highlighting their precarious position.
	Migration also flows in an alternative route for some; a small number of highly skilled tradesmen seek opportunities abroad (for example, Indian electricians and plumbers working in Gulf countries). Such international migration can yield much higher earnings, though it is only accessible to those with formal certifications or networks. Within India, geographic mobility is primarily a survival strategy. Tier-2 and Tier-3 towns often lose their best skilled workers to metros, leading to local shortages. Meanwhile, metros gain labour but struggle to provide adequate housing and services to migrant workers. Thus, migration presents a complex challenge: it is necessary for livelihoods yet fraught with difficulties at both origin and destination.
Exclusion from formal financial systems	Informal workers historically have had limited access to formal financial services such as banking, credit or insurance. Many utility trade workers are paid in cash and manage finances within the informal economy. Access to bank accounts has improved recently (especially after the government's Jan Dhan Yojana financial inclusion drive), but active usage remains an issue. In the past, a day labourer might not even have a bank account; now, a majority do on paper, yet they often withdraw all funds immediately and operate in cash, meaning they still lack savings or credit history. Until a few years ago, cash was king for these transactions – an estimate from 2016 noted that about 80 percent of clients paid informal handymen in cash. This made workers vulnerable during events such as demonetisation (sudden cash shortages), many saw work dry up when clients had no cash to pay. Workers with no bank linkage had no buffer.
	Most informal carpenters or plumbers cannot easily get a bank loan or formal credit line. Lacking collateral or proof of steady income, they rely on informal lenders or community networks if they need money (for example, to buy new tools or to cover a health emergency). Interest rates in these informal loans can be exorbitant, trapping them in debt. They are largely outside the ambit of institutional finance such as housing loans or business loans, which stifles any chance to expand their work (e.g. setting up a small workshop).

Inadequate social protection	There is no pension for informal workers by default. Though the government offers the Atal Pension Yojana (a voluntary contributory pension) and other schemes, enrolment among daily-wage tradesmen is very low due to limited awareness or ability to contribute regularly. Thus, older carpenters or electricians often must keep working until physically incapable or depend on family support.
	Aside from the Employees' State Insurance (ESI) scheme which only covers those on registered contracts (a minority of these workers), most have no health insurance. The government's Ayushman Bharat programme (which provides hospital coverage for poor families) might cover some, but many migrant workers are not documented in the locale to avail it or the specific occupational diseases/injuries they face may not be addressed fully. High out-of-pocket medical costs push many into debt whenever a serious injury or illness strikes.
	As discussed, injuries on the job are common, but compensation is rare. There are Building and Other Construction Workers (BOCW) Welfare Boards in each state (under a 1996 Act) meant to register construction workers (including carpenters, masons, etc.) and provide benefits such as accident coverage and scholarships for children. In practice, however, registration rates are low and many plumbers/electricians (especially those doing repair work, not big projects) are unaware or fall outside the definition. Enforcement of any mandatory benefits is weak in the informal segment.
	The informal sector had a law in 2008 for social security and more recently, the Code on Social Security 2020 aims to extend certain benefits to gig and informal workers. But on the ground, these have yet to tangibly improve the lives of most informal tradespeople. Coverage under Provident Fund or state welfare schemes is scant. As economists Santosh Mehrotra and K.E. Raghunathan note, even regular wage workers in informal setups usually "do not receive social security benefits".
Job insecurity	Informality inherently means job insecurity. Most carpenters, plumbers and electricians in this sector work without any written contracts. They are engaged as casual labour or piece-rate workers. The vast majority (over 80 percent) of construction trade workers are employed as casual labourers rather than regular salaried staff. This status leaves them vulnerable to sudden unemployment, when a project ends or demand dips, they have no layoff benefits or notice period. For instance, an electrician working through a contractor for a large firm has no guarantee of continued work beyond the current project.
	Unlike formal employees, informal trade workers do not enjoy paid leave, retirement security or steady tenure. They typically work until their bodies give up, since there is no concept of retirement with a pension in informal work. While formal sector workers may retire at 60 with some gratuity or provident fund, an informal carpenter or plumber keeps hustling daily to feed his family, often into old age. The Periodic Labour Force Survey confirms that only about 9 percent of Indian workers are in formal jobs with any social security; the rest, including practically all in these trades, lack such security. As a result, these workers face constant uncertainty about the future. The aspiration for a stable government job is widespread among skilled tradesmen, precisely because their current private work is so insecure. One study noted that "wages of skilled workers in India's private sector remain so depressed, benefits so dismal and jobs so precarious" that many dream of escaping informality by securing a government position.
	In Tier-1 cities, some experienced tradesmen might find semi-regular engagement (e.g. an electrician attached to a housing society for maintenance or a carpenter who gets repeat orders from an interior design firm). However, even these arrangements are often informal and can be terminated at any time. In smaller towns and rural areas, a portion of these workers are self-employed own-account workers who rely on their local reputation to get gigs. While being one's own boss can be empowering, it still does not guarantee work; they are at the mercy of local demand and seasonal fluctuations. There is also seasonal insecurity: demand for construction-related trades tends to slump during monsoons and agricultural peak seasons (when rural clients have less cash flow or when migrant workers return home for planting/harvest). Across all geographies and trades, the lack of an enforceable contract or steady employer makes job security a chronic pain point.

Limited skill development and training opportunities	Despite the skill-centric nature of their work, most informal carpenters, plumbers and electricians have little formal training. They typically learn through apprenticeships or on-the-job experience, which can result in uneven skill quality and limited advancement. Official data underscores this gap: only about 2–5 percent of India's workforce has received formal vocational training, compared to over 50–90 percent in countries such as the USA, Germany or South Korea. In other words, most Indian tradespeople are "informally trained" or self-taught.
	Many workers lack up-to-date technical knowledge (e.g. a plumber might not know the latest piping standards, an electrician may not be certified for complex wiring). A skills audit once found that a third of trained plumbers in India could not handle modern plumbing tasks, highlighting the deficits in training quality. Poor training can also lead to safety risks due to improper techniques.
	Without certification or formal credentials, informal workers struggle to command higher wages or get hired by large contractors who prefer certified labour. This traps them in low-paying, small-scale jobs. As one commentary noted, "barely 5 percent of the workforce has formal vocational skills" and this lack of certified skills makes these jobs less aspirational and keeps earnings low.
	Access to skill development programmes is uneven. Tier-1 cities host more ITIs and private vocational centres, so young people there (or migrants who move there) have a better chance of finding training courses. In contrast, many rural areas and Tier-3 towns have few training facilities; a talented youth in a village might have no option but to learn informally from a relative or local tradesman. Even when government mobile training camps exist, awareness and attendance can be low.

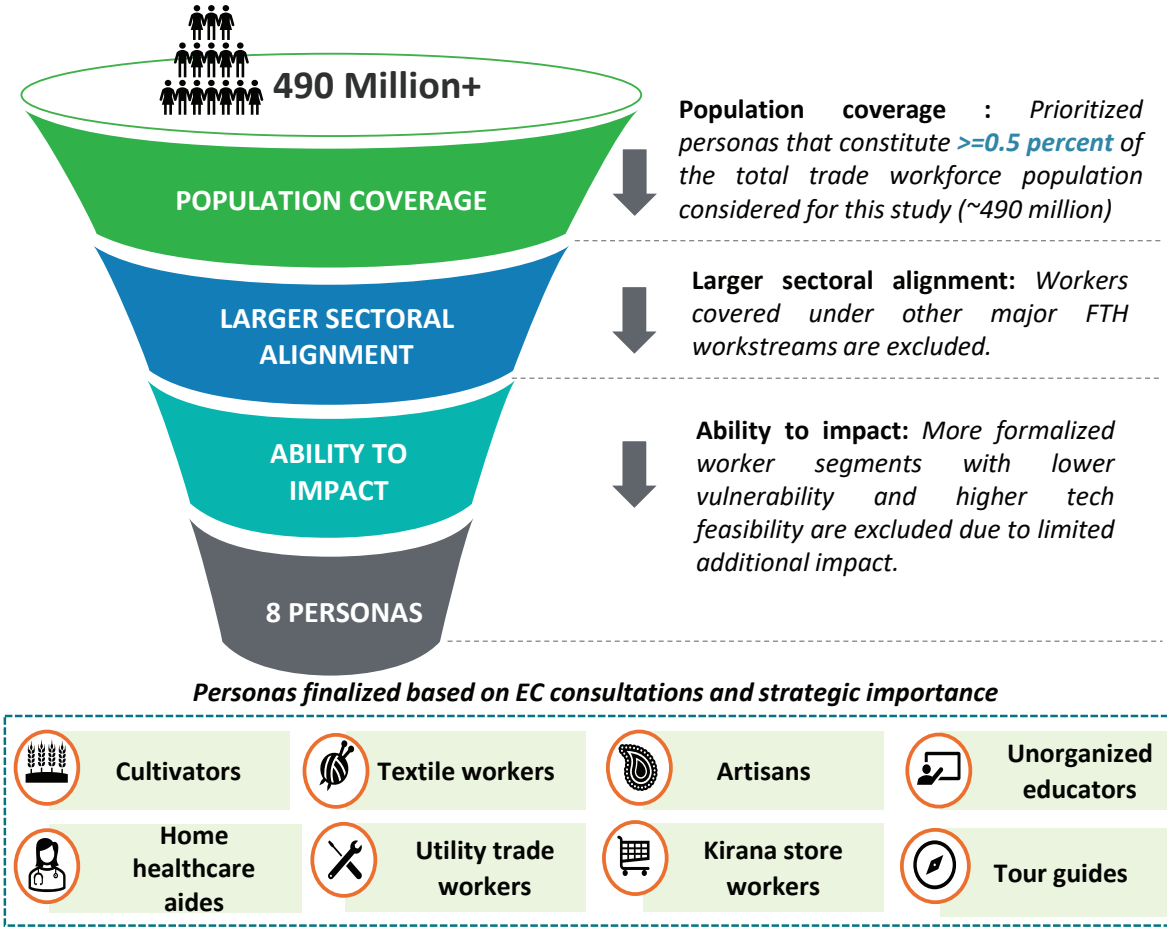
Appendix C:

Out of 490 million informal workers, the pool was narrowed down to 55 personas using specific filtration criteria outlined below.

- **Population coverage**: Prioritising personas representing significant portions of the workforce.
- **Large sectoral alignment**: Excluding sectors already addressed by parallel workstreams.
- **Ability to Impact:** Refers to the potential for meaningful improvement in livelihoods by prioritizing:
  - Degree of vulnerability – Focusing on personas facing high disruption risks from automation and informality.
  - Adoption feasibility – Selecting personas where AI and frontier technologies can feasibly enhance work with minimal role displacement.

Eventually, 8 representative personas were selected in consultation with the Expert Council (EC).

Figure 9: Persona prioritisation criteria



Appendix D:

Personas finalised based on Expert Council (EC) consultations and strategic importance

An initial pool of 20 personas was shortlisted from an extended list of 55, using **four key dimensions**: **population size, sectoral alignment, potential for impact and strategic relevance.** This set was further refined to 13 by consolidating personas with sector overlaps and shared contextual characteristics. Moreover, additional factors such as **female workforce participation, potential for social impact, alignment with emerging sectors, demographic relevance and representation of niche occupations** were applied to finalise the 8 personas. The final list was validated and endorsed by the Expert Council (EC). The key considerations influencing the inclusion of each persona are elaborated below.

Large workforce segments such as **cultivators (farmers), artisans, utility trade workers** and **kirana store workers** were prioritised due to their population size, potential impact and high adoption feasibility. **Textile workers** were included due to the sector's strategic significance and its predominantly female workforce, with women accounting for nearly 70 percent of handloom sector[39]. **Unorganised educators** were selected for the critical social impact they have on communities while **tour guides** were included to represent niche occupations aligned with India's growing presence in the global tourism landscape.

39 Press Information Bureau - 25,46,285 women working in handloom sector of textiles industry (2022)

Another critical domain identified is the care economy, which includes essential caregiving activities such as childcare, elder care, disability support and domestic work, all foundational to individual and societal well-being. Shaped by India's shifting demographic profile, the care sector is undergoing significant transformation.Within this, **home healthcare aides** represent a rapidly expanding segment, driven by evolving post-pandemic service models and growing demand for in-home medical and supportive care. Transforming this segment is critical to expanding care infrastructure, creating employment pathways including the potential for international deployment of caregiving expertise and increasing female participation in the labour.

Together, these eight personas were selected to ensure representation across diverse sectors of the informal workforce in India.

Appendix E:

In addition to the Expert Council, We also consulted the below Stakeholders:

Other Stakeholders

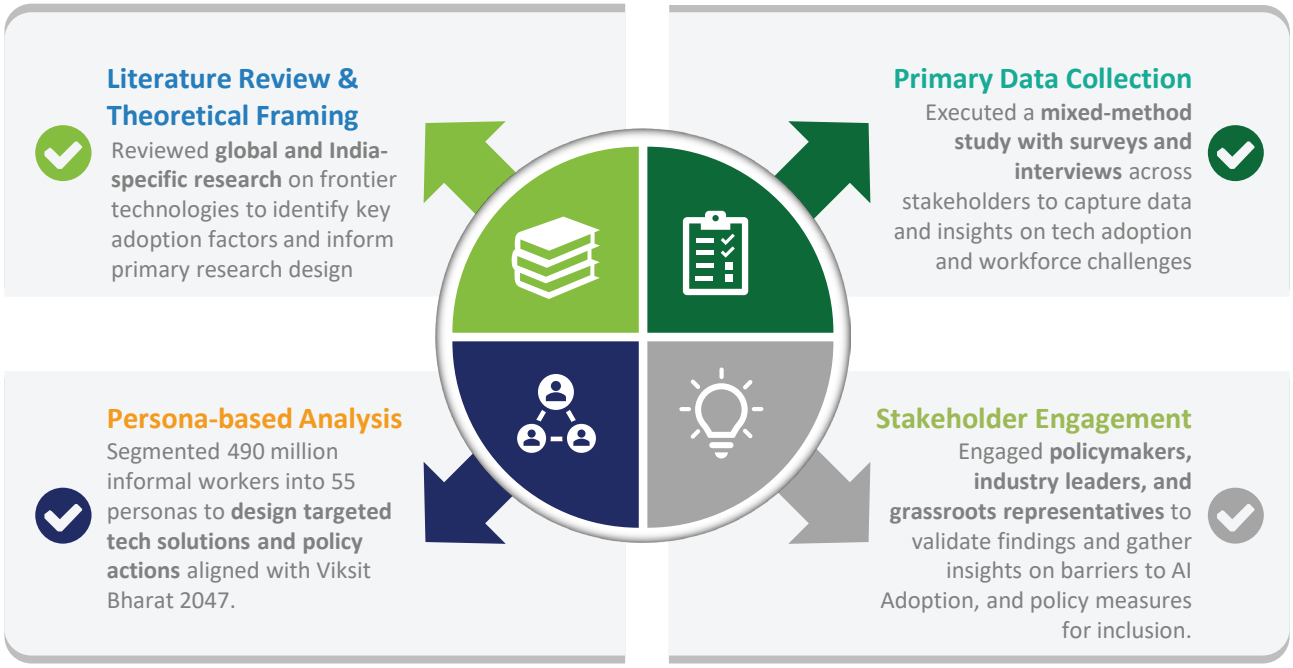
- Sattva Consulting – Social impact consulting and implementation partner
- Haqdarshak Empowerment Solutions – Technology-led platform for welfare access
- Swades Foundation – Rural development organisation focused on holistic empowerment
- Piramal Foundation – Philanthropic arm of Piramal Group driving scalable solutions for public health, education and social sector transformation in underserved communities

Appendix F:

Comprehensive research framework to decode informal workforce dynamics

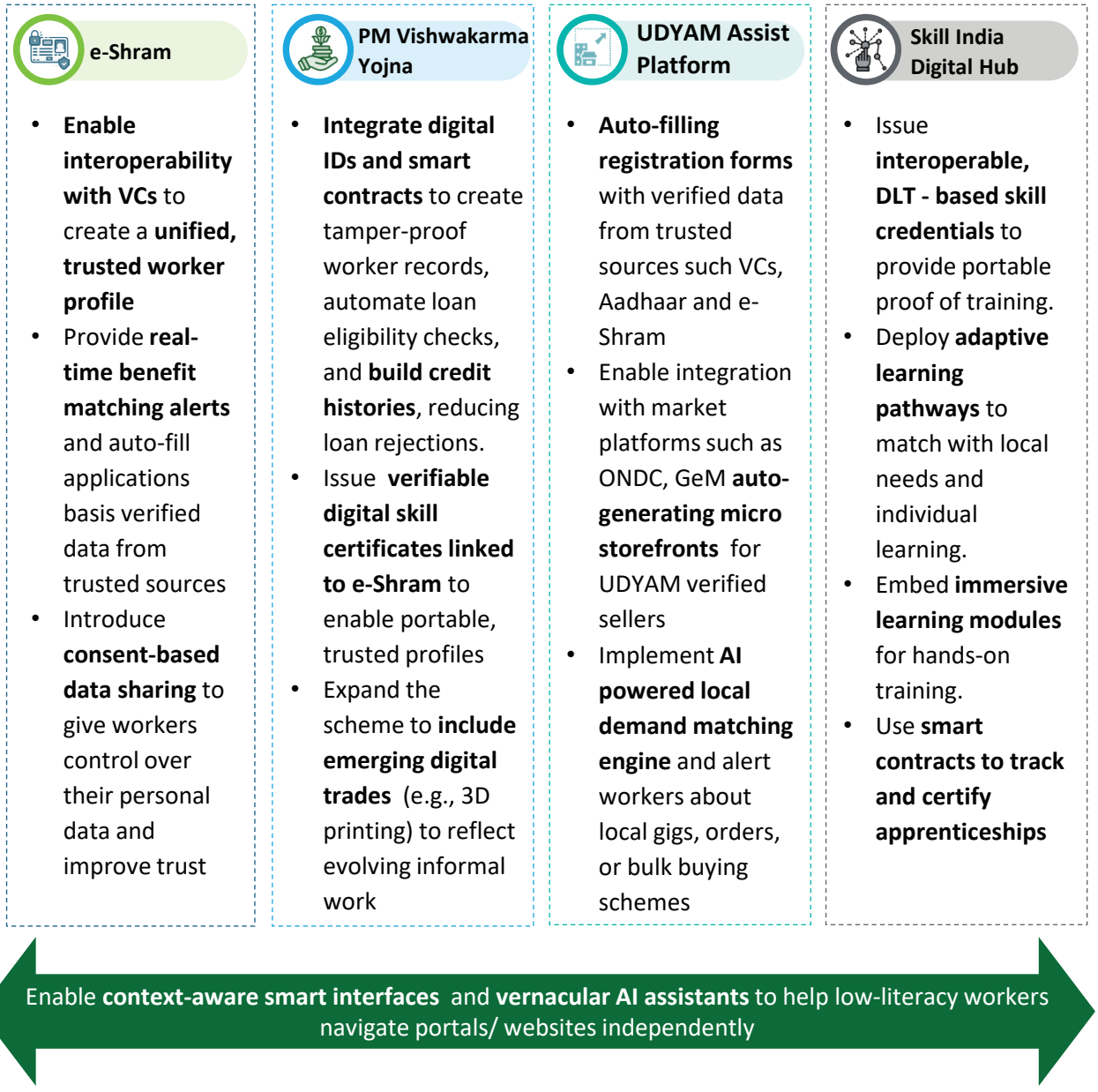
This study employs a multi-pronged, mixed-methods approach (as illustrated in Figure 10) that integrates rigorous secondary research with in-depth primary field engagement. Working in partnership with NITI Aayog, an Expert Council and leading NGOs, the methodology is designed to uncover actionable insights and policy recommendations on how AI and frontier technologies can accelerate the societal development of India's informal trade workforce.

Figure 10: Research approach and methodology



Appendix G:

Figure 11: Potential recommendations to flagship schemes



Apart from the flagship schemes mentioned above, a wide range of other government-led schemes across ministries like Pradhan Mantri Kaushal Vikas Yojana (PMKVY), Ayushman Bharat (PM-JAY), Jan Shikshan Sansthan (JSS), AgriStack etc. are set up to support and empower the informal workers. For instance, AgriStack is a digital infrastructure initiative led by the Ministry of Agriculture, designed to provide farmers particularly small and marginal cultivators with access to tailored advisory, credit, insurance and input services through integrated data platforms. These schemes can be leveraged as critical enablers and further looked into during the implementation phase.

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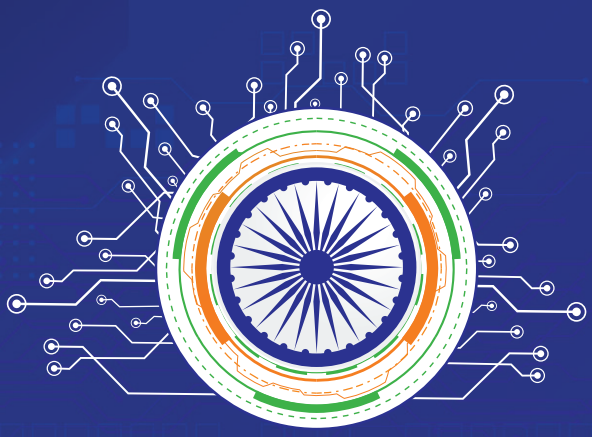

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