

Talent Demand for Green, Circular and Digital Upgrading in Pakistan's Clothing Small Medium clothing enterprises: Service Design Evidence and China Informed Lessons

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Abstract- The small and medium-sized enterprises Small Medium clothing enterprises in the clothing sector of Pakistan are simultaneously being pressured to cut waste, to lengthen product life and to digitize customer facing services, but there is limited evidence on the skills and competencies required to implement this transition. This paper fills that gap by posing a new framing of the mixed-methods evidence from 289 participants in Lahore, Karachi and Faisalabad: as qualitative talent demand for green, circular and digital upgrading. The study was of a mixed method that involved questionnaires, interviews, , customer journey mapping and prototype feedback, and quantitative analysis was descriptive statistics, chi-square tests and binary logistic regression. There is a significant association between awareness of Sustainable Design and Product-Service System (PSS) and implementation, however the effect size is modest, suggesting an awareness-action gap, but not operational capability. Lack of knowledge and lack of resources was the dominant reported barrier (63.9%), compared with high initial cost (9.0%). Digital willingness was strong: respondents (94.10%) were very likely to use a platform for Recycle or returns, although current digital-tool use was not significantly associated with future platform adoption (chi-square = 7.594, $p = .779$). Service-design evidence further highlighted operational weaknesses in item tracking, pricing, notifications and quality control. From these findings, the paper develops a hybrid competency framework spanning green technical, circular business model, digital service, service-design, coordination, lack of resources and data capabilities, and proposes a five-stage implementation roadmap. China is used as a contextual benchmark for linking talent development with digitalization and circular infrastructure. The contribution is a practical, evidence-grounded capability model for resource-constrained clothing Small Medium clothing enterprises; it identifies competency demand rather than numerical labor demand.

Keywords- Talent demand, green skills, digital skills, product service systems, service design, clothing Small Medium clothing enterprises, Pakistan

INTRODUCTION

Pakistan's textile and clothing sector is economically important, yet much of its SME base remains informal, resource constrained and dependent on a take-make-dispose model. Small firms are concentrated in cutting, stitching, finishing, tailoring and retail, while repair, resale, collection and recycling networks remain fragmented. Sustainable Design strategies seek to retain material value through repair, reuse, resale and recycling[1, 2]. Product Service Systems complement sustainability by shifting value from one-time sales toward alteration, maintenance, recycle , customization and take-back services[3, 4]

For Small Medium clothing enterprises, this transition is not achieved by awareness or technology alone. Tailors need repair and material-recovery skills; CEOs need to price and organize sustainable; Workers need to work with recovered materials; digital facilitators need to manage listings, bookings and records; and cluster intermediaries need to connect firms with recycle, trainers and technology providers. Green and digital upgrading is therefore also a change in work roles, practical competence and managerial capability.

However, two linked research gaps remain in the evidence used here. First, measures of awareness, adoption barriers and digital willingness do not by themselves identify the competencies and work functions needed to deliver sustainable. Second, the evidence does not yet translate these capability needs into a practical development pathway suited to resource-constrained clothing Small Medium clothing enterprises in Pakistan. The original study examined sustainability awareness, adoption barriers, digital tools, stakeholder collaboration and a mobile-service prototype. Its strongest finding was that lack of knowledge and lack of resources, rather than finance alone, limited implementation. This paper addresses these gaps by reframing that evidence as talent demand: the competencies, job functions and learning capacities needed to perform new circular and digital tasks. It does not claim to forecast job numbers, because the dataset contains no vacancy, wage, recruitment or headcount projections.

Three questions guide the analysis: Which green and circular competencies can bridge the awareness-action gap; and which digital and service-design capabilities are needed for repair, recycle, resale and take-back; and which institutional arrangements can develop these capabilities in a low resource setting? The paper begins by laying out the conceptual Then introduces China as a relevant benchmark, explains the analytical reframing, presents the findings, establishes a talent-demand framework and ends with an implementation roadmap.

Conceptual Basis: From Sustainable Adoption to Talent Demand

The environmental and business-model foundation is given by sustainability and PSS. Circular models in clothing Small Medium clothing enterprises are paid repair, alteration, maintenance, recycle second-hand resale, offcut reuse, upcycling and take-back. These models transform work of the staff: they have to evaluate the condition of the garments, estimate the effort, communicate the service standards, record the items, coordinate the delivery, and route the recovered materials into productive use [3-6]. Service design is an explanation of how these tasks can be organized. , links the customer touchpoints with the backstage processes, and customer journey mapping uncovers issues in booking, pricing, communication, waiting time and returns[7, 8] . For a micro enterprise, the service design role can be filled by an owner, senior tailor, or a digitally savvy assistant, instead of a specialist. The key factor is the need to standardize the service and enhance the customer experience. Theory of Planned Behaviour provides an explanation as to why awareness does not always translate into action when perceived control is low [9]. Frugal-innovation research focuses on resource-limited solutions that are affordable, accessible and adaptable[10, 11] . In this study, that logic is reflected in the use of mobile and WhatsApp communication, visual forms, offline functions, Urdu language access. Stakeholder theory extends this concept by stating that the competence of the firm needs to be complemented by the relationship with customers, suppliers, recycle lack of resources providers and public agencies[12]. Research on digital-transformation also indicates that technology adds value by complementing capabilities and reconfiguring processes[13, 14] . These are complementary views that suggest a hybrid demand for talent. The reverse logistics, service experimentation, partner coordination and continuous learning are identified as needs in circular-business research [15, 16]. Thus, the unit of analysis is not just an occupation or qualification, but a set of technical, business, digital and relational tasks that need to be completed reliably within an SME or across a cluster. This literature, however, does not indicate how these hybrid capabilities can be developed and configured in the resource constrained clothing Small Medium clothing enterprises in Pakistan, which is what the empirical reframing in this paper seeks to address.

China Informed Lessons for Talent Led Textile Upgrading

The Chinese government's waste-textile recycling policy also converts circular targets into operational capacity. The Chinese government's policy on waste-textile recycling also converts circular targets into operational capacity. It links green design, material information, internet-enabled collection, sorting standards, data platforms and university-industry cooperation[17] . A proportionate Pakistani adaptation could start with common material names, WhatsApp based. collection records, clustering of sorting points, SME partnerships, vocational institutes, universities and recycle. This comparison reinforces the case for having individuals who can enforce

standards as policy targets and coordinate flows. The Chinese empirical studies provide an important caveat. The study is based on 553 firm year observations of 74 listed Chinese firms. textile and apparel companies finds that digitalization and environmental performance have a U-shaped relationship, and That relationship is moderated by top-management technical, financial and educational backgrounds[18] . A separate The study of 339 Masters in Chinese textile and apparel manufacturing companies associates environmental orientation with organizational green culture and green dynamic capabilities and finds green innovation to be an important mediating Business sustainability mechanism [19]. In this context, Pakistan's digital readiness is a potential that needs to be nurtured, as it is a significant strength. must be transformed by lack of resources , management practices and green performance measurement.

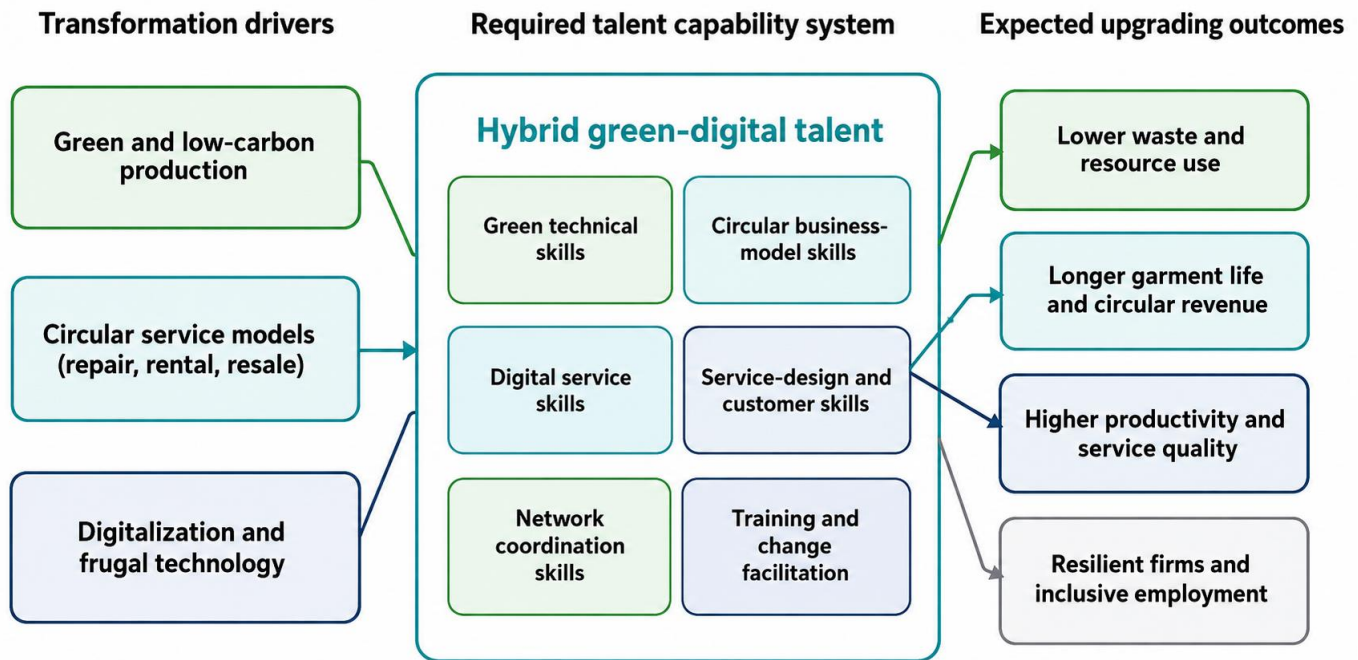


Figure 1. Integrated framework connecting transformation drivers, talent capabilities and SME upgrading outcomes.

Research Design and Analytical Reframing

The original study was a design based, sequential explanatory mixed-methods study. Purposive and Accumulate 289 respondents were obtained from Lahore, Karachi and Faisalabad through sampling. The data set is for the clothing sector not 289 separate Small Medium clothing enterprises: it involves 110 SME CEOs, Masters, Customers, policy makers, Workers, suppliers and other participants. The predominantly urban and male sample supports an ecosystem interpretation but does not allow for national generalization. Questionnaires were distributed face to face and through WhatsApp and Facebook. They covered sustainability and PSS awareness, sustainable-practice implementation, barriers, digital tool use, interest in sustainable, collaboration and platform adoption. Interviews, prototype feedback, , and customer journey mapping added operational detail and are used here to contextualize survey patterns rather than estimate frequencies. The proposed mobile concept included service listings, booking, messaging, location support, offline functions, icons and Urdu-language access.

The original quantitative analysis used descriptive statistics, chi-square tests and binary logistic regression. Chi-square tests assessed categorical associations, with Cramer's V used for effect size; the regression treated implementation as the outcome and this paper reports the available coefficients for collaboration willingness and perceived barriers. For conference alignment, results are interpreted as indicators of competency demand. A barrier is treated as a skill gap only when it corresponds to an identifiable task, and digital willingness as readiness for learning rather than current proficiency. Statistical non-significance is retained, and China remains a contextual comparison rather than additional empirical evidence.

Findings Relevant to Transformation and Talent Demand

The first finding is an awareness-action gap. The manuscript reports sustainability awareness of 65.7% and PSS awareness of 80.3%, while implementation was much lower. Awareness and implementation were significantly associated for sustainability (chi-square =

63.67, $p < .001$, Cramer's $V = 0.233$) and PSS (chi-square = 62.16, $p < .001$, Cramer's $V = 0.280$). The modest effect sizes indicate association, not proof that awareness causes implementation or establishes operational capability.

The second finding concerns barriers. Lack of knowledge and lack of resources was reported by 63.9%, compared with lack of customer demand (11.0%), high initial cost (9.0%), supply-chain problems (7.7%), infrastructure limitations (6.7%) and lack of government support (3.7%). Interest in repair and Recycle remained high across categories. The practical implication is that grants and equipment will have limited effect unless CEOs and workers can design, price, deliver and monitor sustainable [13, 15, 20, 21].

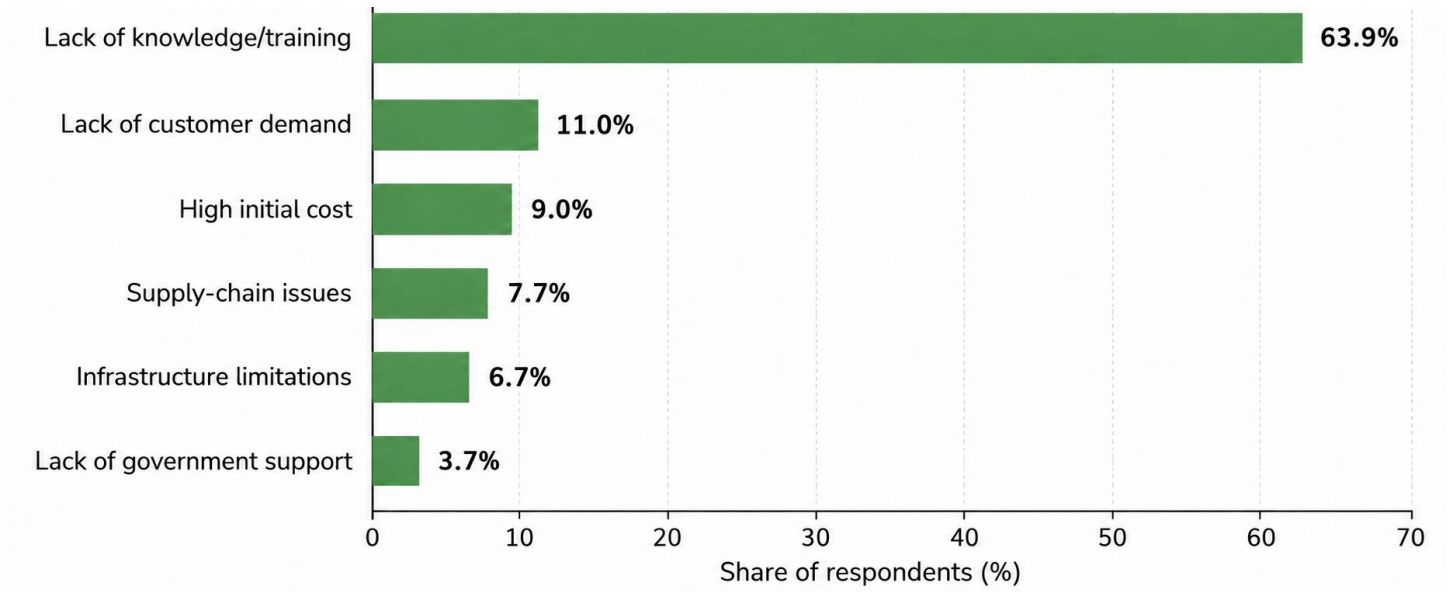


Figure 2. Reported barriers to sustainable and circular service adoption.

The third finding is broad digital readiness. Overall, 272 of 289 respondents (94.1%) were very likely to use a digital platform for Recycle s, repairs or returns. Readiness was high among users of mobile apps, websites, WhatsApp or SMS and among respondents with no current tool. However, the association between present tool use and platform adoption was not significant (chi-square = 7.594, $p = .779$), and many expected cell counts were small. The defensible conclusion is strong willingness to learn a simple platform, not proof that existing digital use predicts adoption[3, 13, 14] .

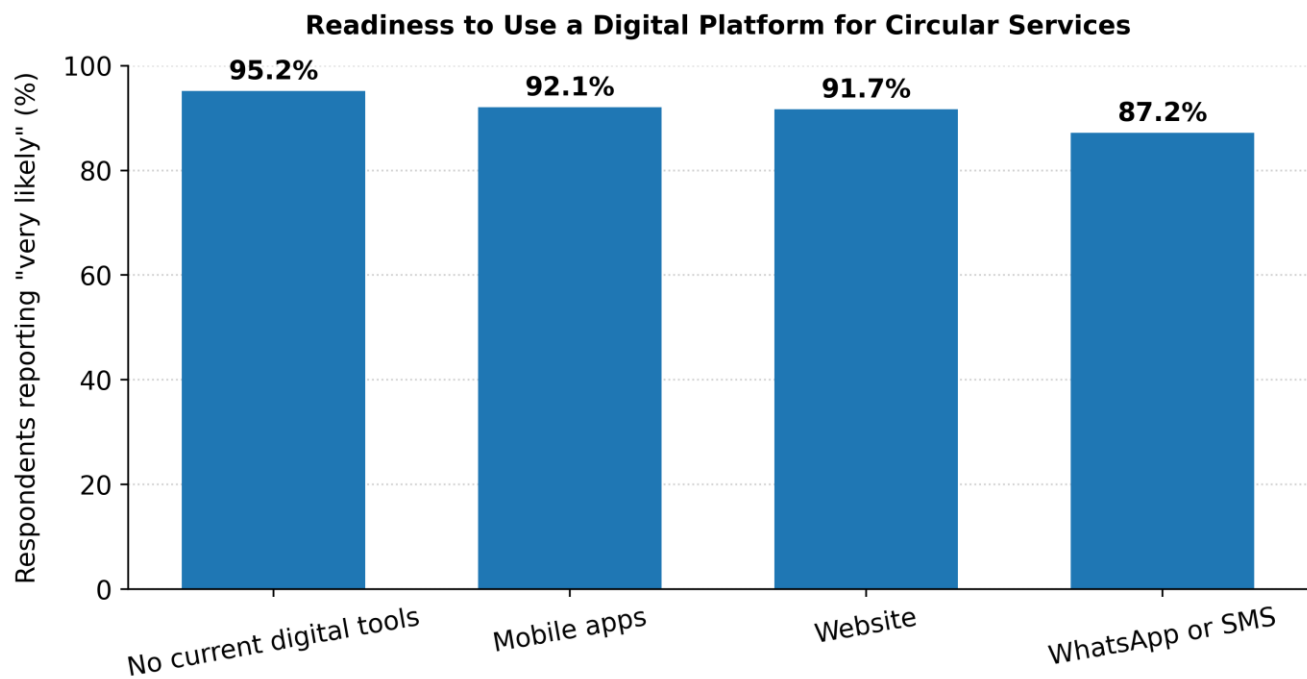


Figure 3. Descriptive readiness to use a digital platform for Recycle, repair and return services.

The fourth finding concerns multivariable analysis. Willingness to collaborate did not independently predict implementation ($p = .508$). The overall binary logistic regression model was significant ($p = .027$) but explained only 5.9% of the variance. Perceived barriers were the only reported significant predictor (odds ratio 1.318, $p = .005$), with a positive coefficient. This counterintuitive association may reflect greater barrier recognition among firms already attempting sustainability or measurement and coding limitations; it should not be read causally.

Finally, ,, journey mapping and prototype feedback add contextual design evidence: they point to untracked items, inconsistent pricing, weak notifications, uneven quality control and a need for simple, Urdu supported digital functions. The study also used barriers as a proxy for low perceived behavioural control and suggested mediation between awareness and adoption. Formal mediation is not established because direct control measures were absent and the required paths were not fully tested. A cautious interpretation is that confidence, practical knowledge, usable tools and support may shape the ability to act, linking adoption analysis to talent demand and performance focused lack of resources.

Talent Demand Framework for Green and Digital Upgrading

The findings support six connected talent categories plus a cross-cutting data capability. They are presented as functions because microenterprises may combine several functions in one person, while larger firms may assign them to separate roles. The three level model based on China helps to organize responsibility: leaders set direction, professional technical staff design systems, and technical skills workers implement practices [22]. Green and circular technical talent refers to tailors, cutters, Workers and supervisors who are able to evaluate the condition of garments, provide durable repairs, sort materials, reuse offcuts, upcycle products and route non-reusable waste. Real garments and practical competency tests should be used for lack of resources. The goal is not just awareness of waste, but regular decisions to prolong the life of products and minimize the amount of waste. Second, talent is required for circular service and business model design for pricing repair, Recycle, resale and take back, for defining deposits and liability, for assessing product condition, for scheduling turnaround, for tracking margins, and for managing customer trust. These capabilities are particularly relevant to the CEOs, Masters and service coordinators, as a circular service needs to be commercially viable in addition to being environmentally desirable [5, 6]. Third, digital-service talent encompasses mobile postings, photography, WhatsApp messaging, booking, customer records, and fundamental data protection. The offline and Urdu friendly design of the prototype lowers the hurdles to access, however, the interface still needs to be standardized for data entry and troubleshooting. Digital lack of resources must therefore be practical and connected to a real repair, Recycle or resale process, and not a computer course. Fourth, service design and customer-experience talent addresses the operational failures identified through blueprinting and journey mapping: untracked items, inconsistent pricing, weak notifications and uneven quality control. CEOs or senior staff must ensure that intake is consistent, documented, and that completion

dates and feedback are communicated. These practices can be made possible with simple visual templates, without the creation of a specialist service-designer position. Fifth, network coordination talent links Small Medium clothing enterprises to recycle, collection points, lack of resources institutions, NGOs and technology providers. Only when someone sets up roles, quality specifications, records, logistics and incentives, can collaboration become productive. Industry associations or cluster organizations can offer shared coordinators and databases, as a microenterprise may not be able to afford this role. Sixth, there is a need for talent in lack of resources and change facilitation to fill the dominant knowledge gap. Teachers must have credibility in the clothing sector, adult-learning skills, and must be able to deliver in the local language and demonstrate tasks in the workplace. Peer mentors can provide for repeated practice and follow up. Curricula and assessment can be developed by universities and vocational institutes, and the delivery is short, practical and accessible to informal businesses[23, 24]. Data and low-carbon performance literacy is the cross-cutting requirement. Small Medium clothing enterprises should be able to document garments repaired, recycles, items resold, kilograms of offcuts recovered and customer returns and revenue from sustainable. At the initial stage, simple mobile forms or spreadsheets will suffice. Good records enable CEOs to make better decisions and for buyers or public agencies to link lack of resources investment to environmental and business results. The configuration should be different for different sizes of enterprises. A micro tailoring shop might have the owner, an experienced tailor and a family member who is digitally literate each doing a different part of the work. A small company can designate a service coordinator, a medium-sized company can split sustainability, digital commerce and quality control. Professional expertise can be provided by shared cluster services where individual recruitment is not affordable. This framework also provides opportunities for women, younger workers and rural participants as customer communication, design, digital administration, quality control and lack of resources. Safe lack of resources sites, flexible lack of resources hours, and recognition of informal experience and access outside of major cities will be required for inclusion. Future employer surveys should break down skill shortages and recruitment intentions by gender, age, location and enterprise type. The core message is not about trendy job titles but hybrid capability. A future-ready tailor can combine repair skills with digital booking, a designer can combine aesthetics with upcycling, an owner can combine entrepreneurship with service system design, and a cluster coordinator can combine logistics with recycling knowledge and data management. The important thing is that all the necessary functions are carried out correctly.

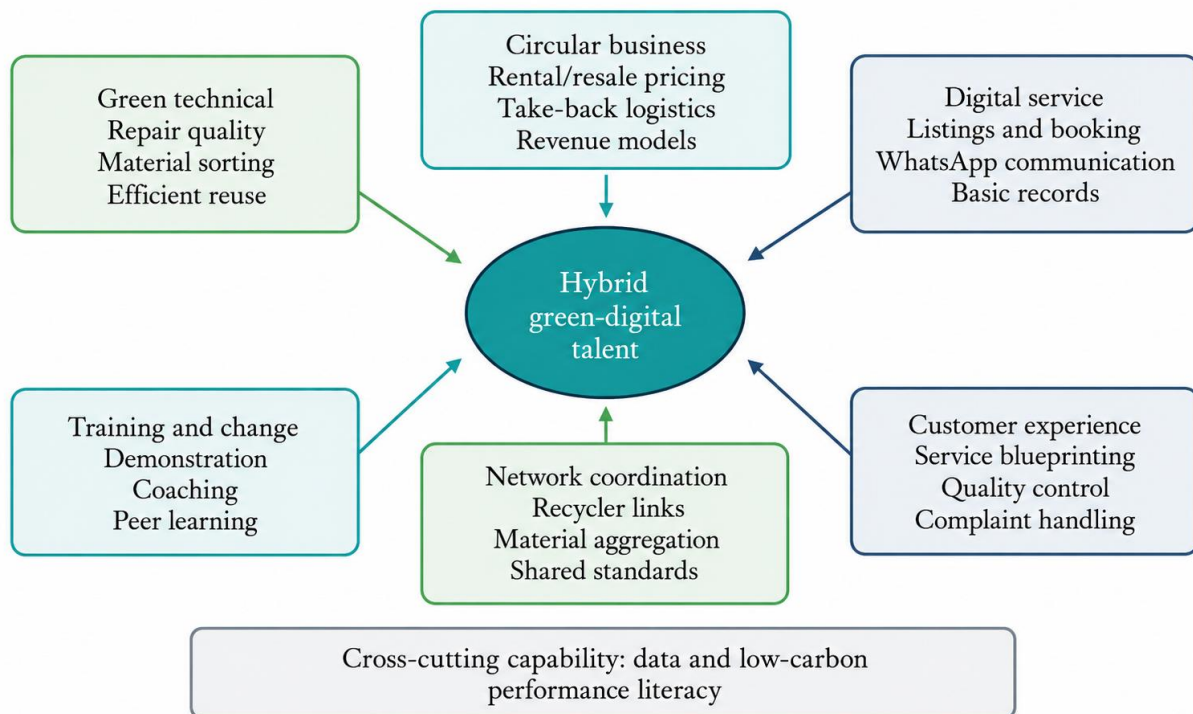


Figure 4. Talent demand architecture for green, circular and digital transformation.

Table 1. Talent-Demand Framework for Clothing-SME Transformation

Transformation area	Priority roles/functions	Core competencies	Preferred development method
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Green and circular production	Tailors, cutters, Workers, supervisors	Repair quality; material sorting; offcut reuse; upcycling; waste routing	Workplace demonstrations and competency tests
Sustainable and business models	CEOs, Masters, service coordinators	Pricing; Recycle and resale rules; take back design; risk control; performance tracking	Short business-model modules plus a live pilot
Digital service delivery	Digital facilitators, younger staff, owner-Masters	Listings; photography; booking; messaging; record keeping; basic data protection	Hands-on mobile lack of resources with Urdu and offline support
Service design and customer experience	CEOs, senior tailors, customer-service staff	Blueprinting; intake standards; notifications; quality control; feedback	Visual templates and coached process redesign
Network coordination	Cluster coordinators, associations, recycle	Partnership building; aggregation; logistics; specifications; record keeping	Shared cluster roles and partnership protocols
Lack of resources and change facilitation	Vocational instructors, peer mentors, university partners	Adult learning; demonstration; follow-up; evaluation; local-language delivery	Train the-trainer and peer-mentor programs
Data and low carbon performance	CEOs, digital facilitators, sustainability leads	Repair and reuse records; waste indicators; simple spreadsheets; honest reporting	Mobile forms, coached measurement and periodic review

Implementation Roadmap and Stakeholder Implications

Implementation should start with a competency audit on waste sorting, repair quality, offcut re-use, service pricing, digital listings, booking, customer communication, return handling and recycle coordination. The audit pinpoints tasks that are present, inconsistent or absent and translates the general framework into an enterprise-level lack of resources plan. Modular reskilling is the second stage. In short modules, green production, circular-service design, mobile tools, customer-process management and basic measurement should be covered. Delivery should be practical and Urdu supported and connected with real work. In line with international green-and digital-skills recommendations [21, 24, 25], participants should be given a task to complete and demonstrate competence, instead of an attendance certificate. The third stage is a workplace pilot. Each SME should try one small change, for example, a standardized repair intake form, a WhatsApp booking number or a weekly offcut collection system. Results can be analyzed by trainers and cluster coordinators after 4-6 weeks, problems can be solved and expansion decisions made. A focused pilot minimizes risk and demonstrates the value of new skills. The fourth stage is institutional coordination. Repair, upcycling, digital customer management and circular entrepreneurship can be integrated in the tailoring program at vocational institutes. Universities can provide support for service design and evaluation; associations can provide shared digital facilitators and databases of recycle; technology developers can maintain simple offline tools and tools in local languages; and public agencies can provide funding for lack of resources, demonstration projects and cluster coordination. The China-informed model implies differentiated development of managerial, professional technical and technical-skills talent[22]. The fifth stage is measurement. Key metrics are workers who have finished practical assessments, volume of repair and alteration, offcuts reused or collected, digital response time, repeat-service customers, garments diverted from disposal

and revenue from sustainable. These measures link talent development to business and environmental performance and serve as a foundation for subsequent productivity, job quality and numerical labor demand estimates.

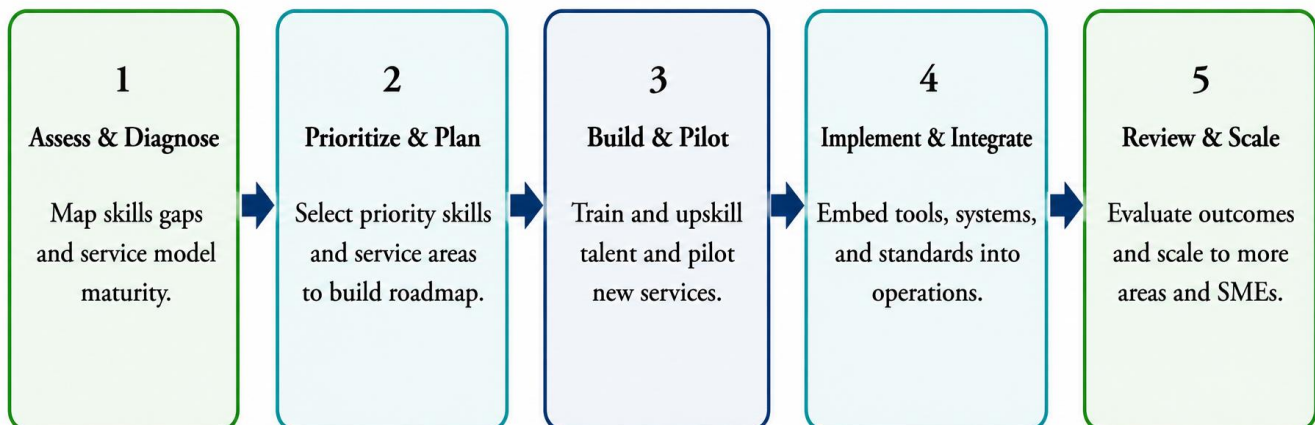


Figure 5. Five stage implementation roadmap for capability led SME upgrading.

Financial support should be used to support this roadmap, not as a standalone process. Small grants can be used to purchase repair equipment, storage, smartphones or connectivity, but recipients must also undergo appropriate lack of resources and participate in a service pilot with monitoring. Milestone-based support can tie an initial payment to lack of resources and setup, a second to verified implementation, and a third to follow-up support for operational issues. This is a reaction to the higher knowledge barrier and a small investment requirement.

Limitations and Future Research

The study is cross-sectional, predominantly urban and gender-imbalanced. It includes several stakeholder groups and should not be described as 289 separate Small Medium clothing enterprises. Perceived behavioral control was measured indirectly; some chi-square tables contained small expected counts; the conference analysis relies on the original study's coding of awareness and implementation; and the regression explained little variance. Qualitative and service-design materials are interpreted contextually rather than as frequency estimates. Most importantly, the survey did not measure vacancies, occupations, wages or recruitment plans. The framework therefore identifies competency demand, not job numbers. Future research should survey employers directly, measure proficiency and recruitment intentions, document qualitative sampling and analysis more fully, and compare demand by enterprise size, region, gender and technology stage.

Conclusion

Clothing Small Medium clothing enterprises are very interested in digital delivery, but it is not yet consistent. The main barrier is knowledge and lack of resources, and awareness is only moderately correlated with adoption and collaboration intentions are not sufficient to explain performance. This talent demand is multi-dimensional: green technical skills, circular business knowledge, digital-service skills, service design skills, network coordination, workplace lack of resources and basic performance data. Thus, the paper views industrial transformation as a capability building process. Policy needs to shift from awareness raising to competency audits, brief practical units, workplace trials, shared cluster services and tangible results[23]. The Chinese experience helps to confirm the system logic: talent cultivation, digital infrastructure, technical standards and recycling networks should be developed in parallel[19, 22]. Pakistan should follow the logic at SME-cluster level using low cost tools and local institutions instead of copying the Chinese industrial scale. Coherent capability development can transform the willingness of Small Medium clothing enterprises into commercially viable sustainable, increased competitiveness and reduced environmental impact.

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