

Influence of Disruptive Technologies on Inclusive Workforce Development Practices in Manufacturing SMEs of North Karnataka

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ABSTRACT:

The manufacturing work is being re-defined through disruptive technologies, which are changing the production systems, job roles, skills needs, training approaches, and human resource practices. The digital transformation in small and medium manufacturing enterprises is usually analyzed in terms of productivity, efficiency, innovation, and competitiveness indicators. The question of whether the adoption of technology can reinforce disability-inclusive workforce development has received less attention, particularly within the regional industrial ecosystems where companies are limited by financial, infrastructural, and skills factors. This article explores how disruptive technologies have impacted disability-inclusive practices in workforce development in manufacturing SMEs of North Karnataka using a conceptual synthesis approach. With a conceptual synthesis approach, the article builds a mechanism-based framework and roadmap of implementation to be tested in the future. Based on the research on the adoption of Industry 4.0, literature on disability employment, literature on assistive technology scholarship, Technology-Organization-Environment framework, human capital theory, the social model of disability, inclusive recruitment, career development, and retention of persons with disabilities, the article establishes a comprehensive framework that connects the adoption of disruptive technologies with accessible training, reskilling, assistive support, reasonable accommodation, inclusive recruitment. The article maintains that disruptive technologies do not necessarily bring about inclusion. They are based on their inclusive value that is determined by their digital training capacity, HR digital readiness, inclusive leadership, policy awareness, accessible design and minimization of cost, skill, infrastructure and stigma-based barriers. The model will add to the body of literature about inclusive education and workforce development by redefining SME digital transformation as an inclusion-conversion process where learning in the workplace, assistive technology, and reasonable accommodation become the core components of the technological modernization process. The

article provides feasible advice to manufacturing SMEs, skill-development institutions, policymakers, and disability-inclusion stakeholders to harmonize technological modernization and equitable employment and inclusive industrial development.

Keywords: disruptive technologies, disability inclusion, inclusive workforce development, manufacturing SMEs, North Karnataka, assistive technology, accessible training, Industry 4.0, inclusive HRM, reasonable accommodation.

1. Introduction

The manufacturing SMEs are also emerging to embrace disruptive technologies like artificial intelligence, automation, robotics, the Internet of Things (IoT), cloud computing, enterprise resource planning solutions, data analytics, additive manufacturing, and immersive training technologies. These technologies are able to enhance efficiency, flexibility, quality, traceability, and competitiveness, yet they also re-engineer tasks and introduce new skills needs among the workers (Masood and Sonntak, 2020; Mittal et al., 2020). In the case of SMEs, the issue does not only lie in the fact that they need to buy digital tools but to build the organizational capacity to convert technology into productive, inclusive, and sustainable work practices (Ghobakhloo et al., 2022).

This issue is specifically relevant in the context of the Indian policy. The MSME ecosystem focuses on the technology support, incubation, entrepreneurship development, and skills training as highlighted by the Ministry of Micro, Small and Medium Enterprises (Ministry of Micro, Small and Medium Enterprises [MSME], 2025). The Industrial Policy 2025-30 of Karnataka also aims to put the state on the path of high-technology production, industrial investments, job creation, and equal regional growth (Government of Karnataka, 2025). These policy priorities render North Karnataka a significant location to analyze the possibility of digital transformation of manufacturing SMEs to facilitate inclusive workforce development and not just operational modernization.

Inclusive workforce development is a set of recruitment, training, reskilling, career development, workplace support, and retention practices that enable an equal opportunity to all workers. Accessible training, assistive technology, reasonable accommodations, barrier-free workplaces, inclusive supervision, and equal opportunity policies are all components of inclusion in the disability aspect

(Aksnes and Ulstein, 2024; Kersten et al., 2023). The United Nations Convention on the Rights of Persons with Disabilities acknowledges the right of persons with disabilities to accessible, open, and inclusive labour market (United Nations, 2006). Establishments in India are required by the Rights of Persons with Disabilities Act, 2016 and the related equal opportunity policy framework to provide non-discriminatory, accessible, assistive devices, post-recruitment, and pre-promotion training (Government of India, 2016; Office of the Chief Commissioner for Persons with Disabilities [CCPD], 2024).

There is a complex relationship between inclusion and technology. Digital tools can be used to facilitate flexible learning, simplify tasks, make work safer, offer communication support, remote monitoring, and assistive participation. Simultaneously, digital transformation can exacerbate exclusion in cases where workers do not have access to devices, digital skills, or available training content, or have a supportive workplace design. Jetha et al. (2023) demonstrate that new technologies at the workplace may provide opportunities and inequalities to disabled individuals, particularly in cases when there is an unequal distribution of digital access, personal resources, and job skills. Thus, disruptive technologies must be considered with regard to not just economic results but also their impact on participation, dignity, skill development, and sustainable employment.

The current paper resolves this problem by coming up with a conceptual framework of understanding the impacts of disruptive technologies on the disability-inclusive workforce development practices in North Karnataka manufacturing SMEs. The article lies at the crossroad of inclusive education, special education, rehabilitation, human resource management, organizational behavior, and technology management. The key point of its argument is that disruptive technologies can only be inclusion-enhancing when

they are integrated into available learning systems in the workplace, inclusive HR practices, leadership commitment, policy awareness, and reasonable accommodations mechanisms.

There are three contributions made in this article. First, it builds on the Industry 4.0 and SME adoption literature by framing disability inclusion as a workforce-development consequence of the digital transformation. Second, it incorporates disability employment, assistive technology, inclusive workplace learning and HR digital readiness into a single framework of mechanism. Third, it provides a region-sensitive maturity rubric and implementation roadmap of manufacturing SMEs in North Karnataka, which can be used in the future to test empirically and intervene practically.

2. Research Problem and Knowledge Gap

The number of studies focusing on Industry 4.0 and manufacturing SMEs has been increasing at a high rate, and most of the literature is dedicated to the readiness to adopt, cost, technological ability, operational performance, and competitiveness (Ghobakhloo et al., 2022; Masood and Sonntag, 2020). These studies offer valuable information on why SMEs embrace or shun digital technologies, but often do not focus on whether it enhances inclusion among workers who experience training, recruitment, or workplace participation barriers. This is a major gap since the change in technology may change the work requirements more quickly than SMEs are able to re-design their training and HR systems.

The research on disability employment has also singly identified a number of practices in the work place that could be used to promote sustainable employment, such as accommodation, leadership, HRM practices, workplace support, participation, and training (Aksnes and Ulstein, 2024; Cavanagh et al., 2017). Senior management commitment, inclusive recruitment, performance development, job accommodation, supportive culture, external collaboration, and monitoring are also employer-oriented practices that facilitate vulnerable workers (Kersten et al., 2023). Nevertheless, this literature tends to talk about inclusion without necessarily incorporating the role of disruptive technologies, assistive technologies and digital training system in the manufacturing of SMEs.

The second gap is related to regional industrial contexts, especially manufacturing SMEs not found in major metropolitan industrial centres. The North Karnataka is a region with a unique developmental profile and forms the centre of the balanced regional development discourse of the industrial policy in Karnataka. However, there is a dearth of theoretical or empirical concern regarding the ways in which manufacturing SMEs in this area can bridge the digital modernization and the development of disability-inclusive workforce. The framework that has been used with large multinational firms can not be easily applied to SMEs, which are resource-constrained, informal in their HR practices, have limited training budgets, and lack awareness of disability inclusion.

The underdeveloped relationship between inclusive education, disability-sensitive skills, and workplace learning in SME manufacturing environments is the third gap. Training in manufacturing SMEs tends to be informal, supervisor-led, task-focused and practical. Such training should be accessible, adapted and assisted by assistive technologies and reasonable accommodation to persons with disabilities. The article thus considers workforce development as a type of adult and workplace education where the accessibility, design of learning, and inclusive learning are critical to successful employment results.

3. Research Objectives

The article is guided by three objectives:

1. To examine how disruptive technologies reshape skill requirements, training needs, and workforce participation conditions in manufacturing SMEs of North Karnataka.
2. To analyze how technology-enabled training, assistive support, HR digital readiness, inclusive leadership, and policy awareness can strengthen disability-inclusive workforce development practices.
3. To develop an integrated conceptual framework, testable propositions, maturity rubric, and SME implementation roadmap linking disruptive technology adoption with accessible training, reasonable accommodation, reskilling, career development, and retention of persons with disabilities.

4. Literature Review

4.1 Disruptive technologies and manufacturing SMEs

Connected machines, real-time data, digital planning, automated quality monitoring, predictive maintenance, collaborative robots, cloud-enabled coordination, and digital decision support are all related to disruptive technologies in manufacturing. In the case of SMEs, adoption can enhance responsiveness and competitiveness, yet it is usually limited by finances, skills shortages, lack of understanding of the payback, limited technical expertise, and poor alignment with the current processes (Ghobakhloo et al., 2022; Masood and Sonntag, 2020). Mittal et al. (2020) believe that the implementation of smart manufacturing in SMEs should be done in stages, which involve the identification of available manufacturing information, the evaluation of readiness, awareness creation, the development of an SME-specific vision, and the choice of the appropriate tools.

The SME environment is important since small and medium businesses often lack the slack resources, formal human resource department or systematic training departments that large organizations have. The introduction of technology without the development of the workforce can also cause workers to feel displaced or anxious or exclude them. On the other hand, disruptive technologies may be used as a tool of capability building when it is adopted with digital training, participatory change management, and the availability of work design (Becker, 1964; Ghobakhloo et al., 2022). Thus, the adoption of technologies should be considered a socio-technical process, but not a technical investment.

The relevance of manufacturing SMEs in North Karnataka is particularly applicable since the industrial policy in the region promotes high-technology manufacturing, but also focuses on employment and balanced development (Government of Karnataka, 2025). This brings about a necessity of SME-level structures that can bridge technological modernization to workforce inclusion. Unlike this kind of integration, digital transformation might continue the current exclusion in favor of skilled people at the expense of marginalized workers who need access to accommodations or training.

4.2 Disability-inclusive workforce development

Workforce development that considers disability does not just entail the employment of individuals with disabilities. Determining the right positions, recruitment accessibility, workplace accommodations, training material adaptation, supervisor support, career growth, and retention chances are all part of it. Accommodation, cultural practices, HRM practices, leadership, participation, support, and training are workplace practices that Aksnes and Ulstein (2024) identify as having a positive impact on employment outcomes of persons with disabilities. This fact implies that sustainable disability employment is based on organizational practices and not individual charitable or compliance-based actions.

Another aspect demonstrated in the literature on HRM is that disability inclusion needs managerial competence, organizational commitment, and inclusive employment practices. Cavanagh et al. (2017) believe that HRM can be a key element in facilitating the work of disabled workers, yet organizations need to work on attitudes, accommodations, and managerial practices. Schloemer-Jarvis et al. (2022) also emphasize the significance of the HR practices in the process of recruiting, developing, and retaining individuals with disabilities. Kersten et al. (2023) elaborate on this point of view by demonstrating that employer-focused practices of inclusion encompass recruitment and selection, job performance, job redesign, supportive culture, external collaboration, and monitoring.

Disability inclusion also has a business case to apply to SMEs. According to Lindsay et al. (2018), the positive effects of employing people with disabilities can be the increase in profitability, retention, reliability, the image of the company, and the inclusive workplace culture. Business gains do not however come on a silver platter. They rely on the availability of work systems, supervisor support, job matching and accommodations. A workforce development lens thus changes the debate on whether people with disabilities can work to how organizations can create jobs, technologies, and training systems that can enable different workers to do so.

4.3 Assistive technology and accessible workplace learning

Assistive technology incorporates devices, software, equipment, adaptations and digital tools that sustain or

enhance functioning, independence, participation, and quality of life. WHO (2024) highlights the fact that assistive technology helps individuals to engage in education, the labour market and civic life. Examples of assistive technology in the workplace are screen readers, speech-to-text, hearing support, modified input devices, visual alarms, ergonomic, mobility support, accessible interface, and task-specific adaptations.

The assistive technology is directly related to the disruptive technology as both of them alter the way people have to deal with the work systems. A collaborative robot can alleviate physical workload; an augmented-reality training module can aid task learning; a digital dashboard can increase the visibility of production information; and speech or vision-based interfaces can increase participation. These, however, are benefits that are by design dependent on access. According to Alanazi and Benlaria (2024), the work participation of persons with disabilities can be supported by assistive technology, although its effect can be hindered by various factors including cost, awareness, technical support, and workplace readiness.

Inclusive digital transformation thus revolves around accessible learning in the workplace. Training can not be inclusive when it presupposes one learning style, the level of language, one sensory mode, or one speed of learning. The digital training capability among SMEs must encompass plain-language training resources, visual aids, captioned video, tactile/demonstration-based training, easy access to e-learning, supervisor training, peer training, and accommodations during testing. This is in line with the concept of inclusive education, since workplace skilling is an adult-learning setting whereby accessible and participatory learning is required to achieve equal results.

4.4 Policy context: equal opportunity, accommodation, and regional development

Disability-inclusive workforce development is supported by the legal and policy environment. The

United Nations Convention on the rights of persons with disabilities defines work and employment as a right to be fulfilled in inclusive, open and accessible labour markets (United Nations, 2006). The equality, non-discrimination, reasonable accommodation, and participation are the larger legal frameworks in India, which is enshrined in its RPwD Act, 2016 (Government of India, 2016). According to the Office of the Chief Commissioner of Persons with Disabilities, all establishments should post an equal opportunity policy on persons with disabilities, and the private establishments that employ twenty or more people should provide information about facilities and amenities, appropriate postings, post-recruitment and pre-promotion training, assistive devices, and barrier-free accessibility and liaison arrangements (CCPD, 2024).

To manufacturing SMEs, these requirements are not only compliance requirements; these are design principles of inclusive development of workforce. Equal opportunity can be facilitated by digital transformation in the cases of recruitment systems that are accessible, digital training that is flexible, job redesign, integration of assistive devices into production systems and promotion and career development to employees with disabilities. Technology, on the other hand, may erode equal opportunity through inaccessibility of digital tools or training that does not include workers with sensory, physical, intellectual or learning requirements.

The policy focus on high-technology production, employment generation, and equal-regional growth by Karnataka provides a possibility to link industrial modernization with disability integration (Government of Karnataka, 2025). In the case of North Karnataka, this means that inclusive skilling is to be incorporated in the industrial development at the district level, cluster programs, industry associations programs and the MSME technology-support programs.

Table 1: Literature streams, research gaps, and relevance to the present framework

Literature stream	Core insight	Research gap addressed	Implication for this article	Key citations
Industry 4.0 and SME adoption	SMEs benefit from smart manufacturing but face financial, technical, readiness, and skill-related barriers.	Existing studies focus mainly on productivity, readiness, and competitiveness, with limited attention to disability inclusion.	Technology adoption must be assessed together with accessible training, workforce development, and organizational readiness.	Ghobakhloo et al. (2022); Masood and Sonntag (2020); Mittal et al. (2020)
Disability employment and HRM	Sustainable employment is supported by accommodation, HRM practices, leadership, culture, participation, support, and training.	Disability employment literature often underexplores how disruptive technologies reshape inclusion practices in SMEs.	Inclusive workforce development must include recruitment, reskilling, reasonable accommodation, career growth, and retention.	Aksnes and Ulstein (2024); Cavanagh et al. (2017); Kersten et al. (2023); Schloemer-Jarvis et al. (2022)
Assistive technology	Assistive products and accessible technologies enable participation in education, labour markets, and daily life, but barriers remain.	Assistive technology is often treated separately from industrial digital transformation.	Assistive technology should be treated as part of SME digital transformation, not as a separate welfare measure.	Alanazi and Benlaria (2024); WHO (2024)
Policy and rights framework	Equal opportunity, reasonable accommodation, accessibility, and post-recruitment training are legal and policy priorities.	Policy obligations are often not translated into practical SME-level workforce development mechanisms.	SMEs need inclusion practices aligned with RPwD requirements, equal opportunity policy, and regional development priorities.	Government of India (2016); CCPD (2024); United Nations (2006); Government of Karnataka (2025)

5. Theoretical Foundation

5.1 Technology-Organization-Environment framework

Technology-Organization-Environment (TOE) model describes the use of technology in an organization in three contexts, namely, technological context, organizational context and environmental context (Tornatzky and Fleischer, 1990). The technological context entails the relative advantage, compatibility, complexity, and availability of digital

tools. The organizational environment comprises size of firm, resources, management support, HR capability, training infrastructure and culture. Policy, competition, industry associations, suppliers, customers, government schemes, and labour-market conditions are all a part of the environmental context (Oliveira and Martins, 2011).

In this article, TOE is expanded to include disability. The technological environment will encompass the availability of disruptive and supportive technologies, which are affordable, interoperable, and adaptable.

The organizational environment comprises HR online preparedness, comprehensive leadership, training aptitude, and accommodation frameworks. The environmental context comprises RPwD policy awareness, institutions of skill development, the policy of the region, and external support networks. This extension is beneficial since adopting disability-inclusive technology goes beyond technical availability to organizational and environmental alignment.

5.2 Human capital theory

The human capital theory considers education, training and skill development as an investment which increases the productivity and economic performance of the workers (Becker, 1964). The disruptive technologies in the context of manufacturing SMEs enhance the necessity of reskilling and lifelong learning. But a more traditional human capital perspective can ignore an uneven access to training. A disability-inclusive understanding is that an investment in human capital should be available, accommodated, and with reasonable accommodation.

This view holds significance as employees with disabilities might not be excluded due to their inability, but rather training systems are not accessible or jobs are not designed in a way that they can be accessed. Digital training ability has the potential to increase human capital in cases where it offers various learning opportunities, supportive interfaces, demonstrations, and sufficient time to learn a skill. Inclusive workforce development, therefore, considers training as an investment in productivity and an equity tool.

5.3 Social model of disability

The social model of disability changes the focus on the individual impairment to social, organizational, technological and environmental impediments that limit participation (Oliver, 1990). The Convention on the rights of persons with disabilities also has a similar definition of disability via the interplay between impairments and barriers that impede the full participation on the same terms as other persons (United Nations, 2006). This perception is a key aspect to production of SMEs, as obstacles can be either entrenched in non-accessible machines, training materials, hiring processes, work stations, employer attitudes, or computerized interfaces.

In this respect, disruptive technologies are not neutral. They are able to either eliminate obstacles or introduce

new ones. To illustrate, automation can minimize physically strenuous work, though a worker with visual impairment might not have access to an inaccessible control panel. Digital learning module can help enhance consistency in training, yet the absence of captions, screen-reader accessibility, or plain-language design can marginalize sensory or cognitively challenged learners. Inclusive digital transformation therefore should emphasize on the elimination of barriers and design accessibility.

5.4 Resource-based view

According to the resource-based view, firms derive enduring benefits because of valuable, rare, imperfectly imitable and non-substitutable resources and capabilities (Barney, 1991). Inclusive digital workforce capability can be a strategic asset to manufacturing SMEs when they integrate technology, talented employees, inclusive human resource policies, available training, and enabling culture. This kind of capabilities cannot be easily imitated since they are ingrained in routines, leadership practices, trust of the workforce, and local institutional relations.

The resource based view can thus be used in explaining why two SMEs with similar technologies can attain different results in terms of inclusion. An organization that is HR prepared, has an inclusive leadership and training that is accessible can turn technology into employee ability and retention. The other company might invest in the machines without establishing workforce support systems and thus might be faced with skill gaps, exclusion or opposition.

Combined, the four theoretical perspectives describe various levels of the suggested framework. The TOE framework describes the conditions of technology, organization and environment which influence adoption. The theory of human capital justifies the need to develop capability by means of reskilling, which is available. The social model of disability is used to understand why unattainable technologies, training regimes and workplaces turn out to be obstacles towards participation. Resource-based view describes the way the inclusive digital workforce capability can be a strategic resource of firms. Their combination helps substantiate the main argument of the article that the inclusion of digital transformation requires the transformation of the technology uptake into the available organizational ability.

6. Conceptual Methodology

The conceptual research design is taken in this article. Conceptual articles are suitable in case a subject is interdisciplinary, theoretically disjointed, and an integrated framework is required to be tested empirically in the future (Snyder, 2019; Webster and Watson, 2002). No primary survey/interview data are reported in the current article. Instead, by synthesizing peer-reviewed literature on Industry 4.0 deployment in SMEs, disability-inclusive employment, assistive technology, HRM, inclusive workplace practices, and official policy papers pertaining to India and Karnataka, it builds a theory-based framework.

The conceptual development was done using a four-step synthesis process. First, literature streams pertaining to manufacturing SMEs, adoption of disruptive technology, employment of people with disabilities, assistive technology, inclusive HRM, workforce development, and policy towards people with disabilities were identified. Second, the important constructs were identified on the basis of the streams such as disruptive technology adoption, digital training capability, HR digital readiness, assistive technology and accessibility, inclusive leadership, policy awareness, barriers, and inclusive workforce development practices. Third, the constructs were mapped using the TOE framework, human capital theory, the social model of disability and the resource-based view. Fourth, a maturity rubric, conceptual propositions and practical implementation roadmap were built around manufacturing SMEs in North Karnataka.

This method is appropriate since the key objective is to explain how disruptive technologies can be transformed into disability-inclusive workforce development as opposed to estimating statistical associations. The framework can inform future empirical research based on surveys, interviews, case studies, or structural equation modelling. It also can assist SME managers and policymakers that require a systematic approach to gauge inclusive digital transformation preparedness.

7. Conceptual Framework

The proposed framework connects disruptive technology adoption with the development of disability-inclusive workforce in three ways, the digital training capability, HR digital readiness, and integration of assistive technology. It also

acknowledges inclusive leadership and policy awareness as facilitating factors and cost, skill gap, stigma and infrastructure constraints as barriers. Figure 1 demonstrates the general conceptual model, with Figure 2 detailing the process pathway whereby the adoption of disruptive technologies is converted into the development of workforce that is inclusive of disability.

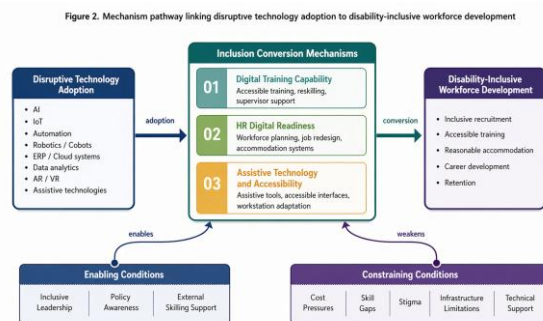


Figure 1: Conceptual framework linking disruptive technologies and disability-inclusive workforce development

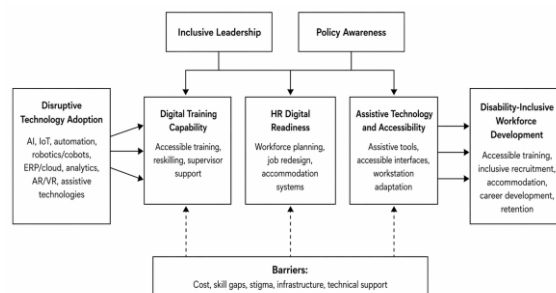


Figure 2: Mechanism pathway linking disruptive technology adoption to disability-inclusive workforce development

The framework starts with the adoption of disruptive technology. In the manufacturing SMEs, this involves AI-based planning, monitoring via IoT, automation, robotics and cobots, cloud and ERP platforms, data analytics, AR/VR-based training, additive manufacturing, and assistive technologies. Adoption alters work, skill requirements, rate of work, communications, safety, and training requirements. It thus presents an opportunity and risk. The possibility is that technology can help to provide safer work, tailored learning, accessible engagement, and productivity. The danger is that the workers who

lacked access to digital devices, training, and accommodation might be left out (Jetha et al., 2023).

The first mechanism is digital training capability. When technology alters job descriptions, SMEs need to offer workers reskilling opportunities that are easily accessible. This involves induction training, digital literacy, equipment-specific training, safety training, task demonstrations and supervisor coaching. Employees with varying physical, sensory, intellectual or learning requirements should be able to access training. In the absence of this ability, adoption of technology can lead to greater disparity in skills, as opposed to labor inclusion.

The second mechanism is HR digital preparedness. The HR preparedness involves the capability to plan workforce transitions, evaluate training requirements, determine appropriate roles, redesign jobs, document accommodations, support supervisors and equitable career progression. HR structures are not as formal in most of the SMEs; hence in most cases, the owner-managers and production supervisors undertake the HR work. These actors need to be aware of technology and disability inclusion in order to be inclusive in digital transformation.

Accessibility and assistive technology make up the third mechanism. Disruptive technology is disability-inclusive when it is integrated with assistive equipment, accessible digital interfaces, workstation adaption, safety assistance, and barrier-free training. This relocates assistive technology as an independent welfare intervention to a fundamental part of the production and workforce development. Figure 2 shows the mechanism pathway by which the adoption of disruptive technology is converted to disability-inclusive workforce development.

8. Conceptual Propositions

Future research on manufacturing SMEs in North Karnataka can test seven of the framework's hypotheses empirically. The conceptual reasoning shown in Figures 1 and 2 is the source of these claims.

P1: Disruptive technology adoption positively influences disability-inclusive workforce development when the adopted technologies are accompanied by accessible training and work-design support.

P2: Digital training capability mediates the relationship between disruptive technology adoption and disability-inclusive workforce development practices.

P3: HR digital readiness strengthens the ability of SMEs to convert technology adoption into inclusive recruitment, reskilling, accommodation, and career development.

P4: Assistive technology and accessible interface design increase the participation, productivity, and retention potential of employees with disabilities in technology-enabled manufacturing work.

P5: Inclusive leadership strengthens the relationship between disruptive technology adoption and inclusive workforce development by creating a culture of participation, dignity, and support.

P6: Policy awareness strengthens inclusive digital transformation by encouraging equal opportunity policies, reasonable accommodation, post-recruitment training, and accessibility practices.

P7: Financial constraints, skill gaps, stigma, inaccessible infrastructure, and lack of technical support weaken the relationship between disruptive technology adoption and disability-inclusive workforce development.

Table 3: Conceptual propositions, expected direction, and empirical testing possibilities

Proposition	Conceptual pathway	Expected direction	Main theoretical support	Possible empirical indicators	Suggested empirical test
P1	Disruptive technology adoption, when supported by accessible training and work-design support, improves disability-inclusive workforce development.	Positive	TOE framework; social model of disability; human capital theory	AI/IoT/automation/ERP/AR-VR use; accessible training availability; job redesign practices; inclusive recruitment and retention practices	Regression analysis / PLS-SEM direct-effect testing
P2	Digital training capability mediates the relationship between disruptive technology adoption and disability-inclusive workforce development.	Positive mediation	Human capital theory; inclusive workplace learning	Digital literacy training; accessible learning materials; captioned/visual training content; supervisor-led reskilling; training participation of workers with disabilities	Mediation analysis / PLS-SEM
P3	HR digital readiness strengthens the conversion of technology adoption into inclusive recruitment, reskilling, accommodation, and career development.	Positive	TOE framework; resource-based view	Training-needs assessment; HR documentation; accommodation records; job-matching systems; digital HR tools; development tracking	Moderation analysis / interaction-effect testing
P4	Assistive technology and accessible interface design improve participation, productivity, and retention potential of employees with disabilities.	Positive	Social model of disability; assistive technology literature	Assistive devices; accessible software; ergonomic adaptations; multi-sensory alerts; screen-reader compatibility; workstation modifications	Regression analysis / path analysis
P5	Inclusive leadership strengthens the relationship between disruptive technology adoption and inclusive workforce development by promoting dignity, voice, and support.	Positive moderation	Inclusive HRM; disability employment literature	Supervisor support; management commitment; employee voice mechanisms; anti-stigma practices; participation in work redesign decisions	Moderation analysis / multi-group analysis

P6	Policy awareness strengthens inclusive digital transformation by encouraging equal opportunity policies, reasonable accommodation, post-recruitment training, and accessibility practices.	Positive moderation	TOE environmental context; RPwD Act; CRPD rights framework	Awareness of RPwD Act; equal opportunity policy; reasonable accommodation procedures; accessibility audits; liaison arrangements	Moderation analysis / comparative group analysis
P7	Financial constraints, skill gaps, stigma, inaccessible infrastructure, and weak technical support weaken the relationship between disruptive technology adoption and disability-inclusive workforce development.	Negative moderation	TOE framework; SME adoption literature; social model of disability	Budget constraints; lack of skilled trainers; inaccessible premises; limited technical support; negative attitudes; low disability-inclusion awareness	Moderation analysis / barrier-index regression

9. Inclusive Digital Workforce Development Maturity Rubric

One of the practical contributions of the article is a maturity rubric that enables manufacturing SMEs to determine whether or not their digital transformation is disability-inclusive. The scale is not an empiric finding; it is a diagnostic instrument that is structured

and designed to be used by managers, consultants, training institutions, and future researchers. The score between 1 and 5 is increasing maturity in the ability to connect technology adoption and disability-inclusive workforce development. The rubric is supposed to be a diagnostic tool but not a validated measurement scale.

Table 4: Inclusive digital workforce development maturity rubric

Value	Maturity level	Description	Typical SME evidence
1	Ad hoc	Technology decisions are made mainly for production or cost reasons. Inclusion, accessibility, and disability-related training are not considered.	No equal opportunity policy; no accessible training; limited awareness of accommodation.
2	Compliance-aware	The firm is aware of disability-related obligations but treats inclusion as documentation or compliance rather than workforce development.	Basic policy language; occasional accommodation; little integration with technology adoption.

3	Training-linked	Technology adoption is connected with employee training and reskilling, but accessibility and assistive support are inconsistent.	New machine training is provided; some workers receive support; training materials may not be fully accessible.
4	Inclusion-integrated	Digital training, job redesign, assistive support, and supervisor involvement are integrated into workforce development.	Accessible learning formats; accommodation records; inclusive recruitment; supervisor coaching; identified suitable roles.
5	Strategic inclusive transformation	Inclusion is embedded into digital strategy, HR systems, production design, skill partnerships, and continuous improvement.	Inclusive technology procurement; accessibility audits; retention tracking; career pathways for persons with disabilities; external collaboration.

10. Discussion

10.1 Technology adoption is not automatically inclusive

The key learning point of the framework is that disruptive technologies do not necessarily lead to inclusive workforce development. Adoption of technology can enhance productivity without any changes in recruitment, training, accommodation and career development. This aligns with Jetha et al. (2023), who demonstrate that digital transformation has the potential to add to the disparity in disability employment in the case of unequal access, resources, and skills. Inclusion should therefore be planned during technology implementation contrary to being introduced after exclusion has taken place as indicated in the mechanism pathway in Figure 2.

To manufacturing SMEs, it implies that workforce questions should be incorporated in technology procurement: Who will use the technology? What are the new skills needed? Are learning resources available? Are the workers with sensory or physical disabilities able to use the interface? Are workstations adaptable? Do supervisors receive training to support? These questions transform digital transformation into a workforce development project instead of a technical project.

10.2 Inclusive workforce development requires coordinated practices

The disability employment literature indicates that positive results can be linked to a set of practices in the workplace instead of individual interventions. Accommodation, HRM practices, leadership, participation, support, and training are some of the categories identified by Aksnes and Ulstein (2024). Kersten et al. (2023) also focus on senior management commitment, recruitment and selection, performance development, job accommodation, culture, external collaboration, and monitoring. These results confirm the argument of the article that SMEs require an integrated strategy to inclusion.

A bundled strategy in manufacturing SMEs might comprise of availability of induction, skill mapping, task-specific training, job redesign, supervisor coaching, assistive technology, reasonable accommodation and retention review. Every element can be supported by technology, yet it is necessary to make inclusion visible and an ordinary practice within the organizational system. In the absence of these routines, the attainment of inclusivity rests on the goodwill of an individual as opposed to the institutional practice.

10.3 Assistive technology should be part of digital transformation

Assistive technology is commonly considered distinctly as compared to industrial technology. This

division is not good. Provided that SMEs are embracing the use of digital tools, robotics, data systems, and AR/VR training, the issue of accessibility and assistive support should also be incorporated in the same design discussion. WHO (2024) stresses that assistive technology facilitates inclusion and participation, even in the labour market. Alanazi and Benlaria (2024) also demonstrate that the benefits offered in the workplace are limited in the case of poor awareness, low affordability, and technical support.

The framework thus considers assistive technology as an adoption of disruptive technology. An inclusive SME must enquire about the compatibility of digital tools with screen readers, the visual and physical accessibility of machine interfaces, the multi-sensory nature of the safety alerts, the captioning of training videos, plain language instructions, and adaptation of workstations. These questions are not only applicable to employees with disabilities but also to older workers, semi-skilled workers and those employees with temporary injuries or different learning needs.

10.4 North Karnataka requires a region-sensitive SME approach

The relevance of North Karnataka is in the overlap of the manufacturing development, regional balance, job creation, and skill development. A system that is geared towards big companies in urban manufacturing belts might not be applicable to SMEs with small HR

departments and unstructured training systems. The industrial policy orientation of Karnataka towards high-technology manufacturing and balanced regional development offers a chance to incorporate inclusion in industrial upgrading (Government of Karnataka, 2025).

The region-sensitive approach must include industry associations, industry centres in the district, MSME development institutes, skill universities, ITIs, polytechnics, rehabilitation professionals, disability organizations, and technology providers. This type of collaboration can help to lighten the load on individual SMEs and develop a collective solution like the availability of training modules, affordable assistive adoptions, awareness training, cluster-wide accessibility audit, and accessible apprenticeship schemes.

11. Practical Implementation Roadmap for Manufacturing SMEs

The conceptual framework is applied into action steps at the SME level in the proposed roadmap. It is aimed at SMEs which might lack big budgets or formal human resource departments. The roadmap commences with awareness and moves towards strategic inclusive transformation. Table 5 shows the implementation roadmap to transform the conceptual framework into actions at the SME level.

Table 5: SME implementation roadmap for disability-inclusive digital transformation

Stage	Managerial action	Inclusion focus	Expected outcome
1. Map technology and jobs	List existing and planned technologies; identify changed tasks and skill requirements.	Identify which jobs can be made suitable or more accessible for persons with disabilities.	Clear view of technology-related workforce changes.
2. Assess training accessibility	Review induction, safety, machine, and digital training materials.	Provide captions, plain-language instructions, demonstrations, accessible formats, and flexible pacing.	Training becomes more inclusive and understandable.
3. Build HR readiness	Assign responsibility for inclusive recruitment, accommodation, records, and supervisor support.	Integrate equal opportunity policy and post-recruitment training requirements.	Inclusion becomes part of routine management.

4. Integrate assistive technology	Identify low-cost and task-specific assistive tools and workplace adaptations.	Support communication, mobility, sensory access, ergonomics, and safe task participation.	Employees with disabilities can participate more effectively.
5. Develop inclusive leadership	Train supervisors to support dignity, participation, feedback, and work redesign.	Reduce stigma and increase employee voice.	Improved trust, retention, and morale.
6. Collaborate externally	Work with ITIs, skill centres, industry associations, rehabilitation professionals, and disability organizations.	Access expertise that SMEs may not possess internally.	Lower cost and stronger implementation support.
7. Monitor and improve	Track training access, accommodations, retention, promotion, and employee feedback.	Use data to improve inclusive workforce development practices.	Continuous improvement and stronger compliance.

12. Implications

12.1 Implications for SME managers

Disability inclusion is a design aspect of digital transformation that should be addressed by the managers of SMEs. The managers ought to evaluate accessibility, the skill requirement of the employees, the job redesign opportunity, and the need of accommodation before implementing new machines, platforms, or trainers. The first step is a low-cost one, which involves the inclusion of disability inclusion in training checklists, procurement questions, supervisor meetings, and HR documentation. Managers are also advised to appreciate the fact that inclusive training is beneficial to a broader workforce such as semi-skilled workers, older workers, women re-entering work, rural workers, and less digitally exposed workers.

The framework further recommends that SMEs should not differentiate between productivity and inclusion. Inclusive digital workforce development has the potential to enhance retention, trust, learning, safety, and reputation. These results are important in SMEs since the cost of losing trained personnel may be high and because local reputation determines labour supply and relationships with stakeholders.

12.2 Implications for policymakers and skill-development institutions

Technology-support schemes must be associated with the inclusion-support needs by the policymakers. Digital training modules, disability inclusion audits, assistive technology demonstrations that are low-cost, polytechnics, and agency access to digital training modules, industry associations, and skilling institutions can be offered at accessible levels. Pedagogy that is inclusive and exposure to assistive technology should be introduced into the manufacturing-related training programs at skills-development institutions.

The requirements of the equal opportunity policy within the framework of the RPwD can be implemented with the help of practical templates, awareness, and identification of the roles within the manufacturing of SMEs (CCPD, 2024). This kind of support is necessary since most SMEs might be keen on accommodating persons with disabilities, but they might not have the technical expertise on how to do it, the type of job to offer, and the available training.

12.3 Implications for inclusive education and rehabilitation practice

The article is a contribution to inclusive education, the extension of the principles of accessibility and learning design to training in the workplace. In the case of the disabled, education-employment transition frequently

hinges on the ability of employers to offer accessible skilling and task-specific learning to the disabled. SMEs can be assisted through rehabilitation workers and special educators who can advise on functional assessment, training adaptations, assistive equipment, supervisor training and support, and inclusive communication.

This view also promotes the partnership between the education institutions and manufacturing SMEs. By establishing inclusive apprenticeships, accessible internships, and job-readiness programs that are in line with the disruptive technology settings, vocational programs, disability support centres and community-based organizations can assist.

12.4 Theoretical implications

The framework expands the TOE model through disability inclusion as a cross cutting lens within technological, organizational and environmental settings. It also builds on the human capital theory by highlighting the fact that investment in training should be available to generate fair capabilities creation. A barrier-removal perspective is introduced by the social model of disability, whereas the resource-based view describes how the inclusive digital workforce capability can become a unique organizational resource.

The article hence adds to theory by relating the adoption of technology, inclusive HRM, assistive technology, workplace learning, and disability rights in a single framework. This integration is significant as the research carried out up to now tends to separate these areas.

13. Limitations and Future Research

It is a conceptual article which lacks primary empirical evidence of manufacturing SMEs, workers with disabilities, HR managers, production supervisors and skill-development stakeholders in North Karnataka. It is valuable in the development of theory, framework building and practical guidance. The framework and its validation should be tested by surveys, interviews, case studies, and longitudinal designs with SME owners, HR managers, production supervisors, trainers, workers with disabilities, skill-development officers, and disability organizations in the future.

The propositions can be tested in future empirical studies with the help of constructs like disruptive

technology adoption, digital training capability, HR digital readiness, assistive technology and accessibility, inclusive leadership, policy awareness, barriers and disability-inclusive workforce development practices. Regression, structural equation modelling or PLS-SEM can be employed as quantitative studies and qualitative research can be conducted to determine how SMEs actually redesign work, training and accommodation following adoption of technology. The difference in inclusion practices between micro, small and medium enterprises can be identified through comparative studies across districts, sectors and size of firms.

Longitudinal research is particularly crucial since the results of inclusive workforce development can take a long time to manifest themselves. The retention, promotion, wage progression, job satisfaction, safety, skill confidence, and organizational reputation should be investigated in the future. Employees with disabilities should also be able to be heard in the research as opposed to having managers or owners as the only source of information.

14. Conclusion

Manufacturing SMEs are being transformed by disruptive technologies, whose value of inclusiveness is determined by their implementation. Digital transformation should not be confined to automation, productivity, or competitiveness in North Karnataka, where policy priorities are industrial growth and balanced development of the region. It must also facilitate available training, reskilling, assistive technology, reasonable accommodation, inclusive recruitment, career development and retention of individuals with disabilities.

The article has built a conceptual framework and pathway of mechanisms that indicate that the adoption of disruptive technology affects the development of disability-inclusive workforce by enabling digital training capacity, HR digital preparedness, integrating assistive technology, inclusive leadership, and policy awareness. It also identified obstacles like cost and skills mismatch, stigma, inadequate infrastructure and poor technical support. The overall conclusion is that technology can only be inclusive when SMEs strategically make it human capability-based, accessible, and dignified. The main contribution of the article is the redefinition of digital transformation as

an inclusion-conversion process, as opposed to a technological or productivity-focused transformation, to enable manufacturing SMEs to develop stronger,

more equitable, and more sustainable workforce development frameworks.

Table 2: Constructs, operational meanings, and theoretical roles for future empirical testing

Construct	Operational meaning	Indicative dimensions	Theoretical role
Disruptive technology adoption	Extent to which SMEs use digital and advanced technologies in production, training, HR, or decision-making.	AI, IoT, automation, robotics/cobots, ERP/cloud, analytics, AR/VR, assistive technologies.	Independent variable
Digital training capability	Ability to use accessible digital and practical training systems for upskilling and reskilling.	Digital literacy, training access, inclusive learning materials, supervisor coaching, reskilling pathways.	Mediator
HR digital readiness	Preparedness of HR/management systems to manage workforce change and inclusion during digital transformation.	Training needs assessment, job redesign, inclusive recruitment, accommodation planning, documentation.	Mediator/enabler
Assistive technology and accessibility	Integration of assistive tools and accessible design into workstations, digital systems, and training.	Assistive devices, accessible software, ergonomic adaptations, barrier-free access, technical support.	Mechanism/enabler
Inclusive leadership	Management commitment to dignity, fairness, voice, participation, and support for workers with diverse needs.	Top management support, supervisor empathy, employee participation, inclusive culture.	Moderator
Policy awareness	Awareness of disability inclusion responsibilities and equal opportunity requirements.	RPwD Act, equal opportunity policy, reasonable accommodation, post-recruitment training, accessibility.	Moderator
Barriers	Factors that weaken the conversion of technology adoption into inclusive outcomes.	Cost, skill gaps, stigma, infrastructure, lack of technical support, low awareness.	Negative moderator

Disability-inclusive workforce development	Workforce practices that provide equitable recruitment, training, reskilling, accommodation, career development, and retention.	Accessible training, inclusive recruitment, reasonable accommodation, career growth, retention, equal opportunity.	Dependent variable
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