

A Meta-Analytic Study on Evolving Skillsets and the Upskilling and Reskilling in Industry 4.0

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Abstract

When changes have taken over charge in this era, strategic standards such as quality, benchmarks, competitive edge and uniqueness become inevitable. In view of overcoming competitive challenges, organizations have started to acknowledge the essential nature of upskilling and reskilling initiatives. The realization of its importance has been at a rising state wherein the workforce in the organization(s) tend to be resistant to the upskilling and reskilling initiatives. Organizations have shifted from conventional ways towards transforming interventions leading to developmental outcomes. It has been researched as the level of skill gap has widened as compared with yester-years particularly with the rise of Fourth Industrial Revolution. Therefore there is a need to conduct analysis that explores and identifies the important factors that influence the competency building requirement among the working employees in an organization. The research intends to collate the research work done and suggests solutions that enable in addressing the issues and challenges faced by organizations while choosing to upskill and reskill their workforce. This research work also ensures in exploring the possible means through which the issues of digitization and artificial intelligence can be tackled in organizations in an effective and efficient manner eradicating the work-skill misalignment issues in particular.

Keywords : Industry 4.0, Technological advancements, skills , Upskilling , Reskilling ,workforce.

1.Introduction

The Economic prosperity of any country is determined by a healthy skilled workforce. Skills and knowledge are inevitable for any nation and they are the fundamental forces of economic progress and development(Smita Dayal.,2016). Skillsets change over the years due to the advancements in technology. The transformation of industry through emerging technologies is reconstructing business structures and challenges the global economies. It is more robust than the previous three industrial revolutions(Schwab k.,2024)(a).Modern industrial revolution is centered on sophisticated technologies(Nelesh dhanpat et al.,2020). Fourth Industrial revolution(4.0 or 4IR) changes the Industrial environment with digitization, automation and cyber physical systems. These advancements along with their integration and development are happening at an accelerated pace and the returns to scale are equally staggering(Klaus Schwab.,2024)(b). 4IR creates new jobs and demand new skill sets. It replaces existing jobs and widens the scope of new job profiles. New technologies opening new doors and industries are witnessing an emergence of new roles. Diverse knowledge, new skill sets, and digitalization provide new difficulties for today's industries(Md. Tota Miah et al.,2024). Training employees becomes paramount to remain competitive.

According to the World Economic Forum's Future of Jobs Report 2023, 44% of workers' skills are expected to be disrupted by 2047.The future emerging and most demanding jobs as mentioned in the NASSCOM Survey (2022) includes Data Science, User Interface (UI), User experience (UX), Artificial intelligence/Machine Learning, Cloud Computing, Internet of Things (IoT), Cybersecurity, Full Stack Development, Virtual Reality/Augmented Reality. These advancements increase efficiency and productivity and reduce time constraints. Upskilling and reskilling have become critical for sustaining workforce agility and optimizing performance in the fluctuating market amid instantaneous technological advancements (Mahedi Hasan et al.,2024). Organisations are compelled to reboot or retrain their workforce talents and proficiencies for the fourth industrial revolution. More than one third of organisations have reskilled one group of their employees and others have initiated reskilling programs.(McKinsey Global Survey.,2020).Various countries have adopted new frameworks and policies to align with the fourth industrial revolution.

Upskilling means upgrading existing skills or acquiring new skills specifically in the relevant field. Upskilling is done to keep the employees aligned with the latest industry shifts. Upskilling helps the employees to become more proficient in their current roles and prepares them for advancement within their field.

Reskilling refers to developing entirely novel skills to remain resilient and competitive in the business landscape. Reskilling is completely different from upskilling when an employee learns entirely different and new skills outside his existing skill set to take new roles in his current organization (Siti Norida Wahab et al.,2021). However, the primary objective of both reskilling and upskilling is continuous learning.

The level of knowledge and skill set would vary according to different sectors. The emerging technological revolution requires a heightened level of expertise in every field. Today's industry landscape demands a multifaceted human capital that is capable of managing challenges arising from the industry's digital transformation(Tugce Akyazi.,et al,2022). Industries across the business world are currently experiencing a high level of skills instability(Zaira Pedron.,2018).

Hence, this meta analytic study examines the evolving skill requirements and the need for upskilling and reskilling the human resources to meet the demands created by the fourth industrial revolution. The significance of reskilling and upskilling would reflect as an outcome of long-term employee engagement with the organizations and quality of delivery in the work executed by the workforce.

2.Review of literature

This literature review presents a comprehensive examination of upskilling and reskilling, focusing on recent trends and strategies associated with training initiatives in these areas. The review explores the digital transformation in relation to the rise of new jobs and the need for skill enrichment programs. And the challenges associated with implementing these initiatives is discussed here.

2.1 Upskilling

Upskilling is the deliberate development of a worker's skill set to improve their efficacy and flexibility in their current roles(R Rangarajan et al,2024). Training programs are important for developing the employee skills to fit dynamic job expectations. Upskilling is the process of improving present abilities with fresh or important knowledge that is directly related to a worker's current position or sector(Sofia Morandini et al.,2023). Upskilling employees can be achieved by strengthening technical and soft skill competencies. Upskilling needs continuous monitoring of the external environment of an organization to detect signals of change as early as possible(Tim Beichter et al,2023). Upskilling and reskilling programs effectively bridge talent shortages and equip employees to manage future challenges, promoting enduring sustainability and market relevance(Ling Li., 2022).

2.2 Reskilling in digital era

Human potential is the determinant factor of all business operations therefore individuals must adapt their skills and capabilities to the digital revolution. Learning a whole new skill in order to transition to a new field that requires new abilities and resources is known as reskilling. Reskilling prepares the current workers for different roles. The introduction of modern technologies into the industrial workspace makes some jobs obsolete and produces new jobs where it demands an enormous amount of higher order technical skills and thinking skills. Thus, reskilling becomes unavoidable. Employees already engaged in the reskilling process in the tech field not only foster innovation but also reduce their future job vulnerability (Rhea Sawant et al,2022).

2.3 Trends in research related to upskilling and reskilling

Recent research studies are accelerating in the field of organizational upskilling and reskilling initiatives. Industry 4.0 shifts all production processes and social structures(Veronika Bikse et al.,2022). It is transforming the nature of jobs today, and the workforce often struggles to sustain a high degree of job satisfaction as existing skills and competencies become redundant(Asrini Mahdia.,2024)(a). Studies highlighted the growing skill gaps and the companies reporting a lack of employees with the necessary skills to meet their needs(Trenerry et al., 2021) (Bouwman et al., 2024). 4IR requires highly potential human capital as its foundation(Vito Di Sabato et al.,2021).The culture of multi-skilled labour force is evolving in organizational climate and research is actively progressing to develop appropriate upskilling and reskilling initiatives in response to this significant change.

2.4 Strategies of upskilling and reskilling

Strategies for keeping the workforce competitive are specific to individual organizations. Organizations can implement various strategies to effectively upskill and reskill their employees, benefiting both the workforce and the organization. The initial step is to identify the skills necessary to meet both present and future demands. Every industry faces different challenges due to shifts in technological innovations. Organizations must strategically redesign their business models and proactively prepare for the evolving skills landscape of their workforce(Maayan Nakash.,2024). The effectiveness of these programs largely depends on how well they align with employees career objectives, the level of support from the organization, and the relevance of the skills gained(Bolatito Oluwajinmi et al,2023).Strategies include developing specific

skill oriented training programs, deploying technology for personalized learning, virtual reality simulations, workshops and seminar programs, collaboration with educational institutions, online and E-learning platforms, microlearning ,gamification, cross training. Studies have shown that upskilling and reskilling strategies implemented in EduDigital had a positive impact on improving teacher skills, student performance, and overall student satisfaction with online education(Ruiz Valdes et al,2023). Technology driven reskilling and upskilling programs offer employees easy access, enabling them to learn at their own pace and integrate learning seamlessly into their active work routines(Asrini Mahdia,2024)(b).

Objective of the study

The objectives include the below primary ones, such as:

- To identify the key skills sets demanded by the Industry 4.0 or Smart manufacturing and digital innovation.
- To study the significance of upskilling and reskilling training initiatives to confront difficulties created by Industry 4.0
- To prioritize the skill set derived out of the study based on the skill requirement factors
- To analyse the key indicators influencing those skills identified and which are found to be in priority.

3. Analysis

This meta analytic study ensures in compiling the literary reviews pertaining to the skill requirement with that of scenarios relevant to upskilling and reskilling platforms for a workforce. From the analysis of articles the factors are categorized under five themes.

Table 3.1

Themes	Factors
Workforce characteristics and skills	-Digital skills, entrepreneurship, collaboration, communication -Upskilling & reskilling -technical and personal competencies -Soft and social skills -Functional and operational skills -Lifelong learning & adaptability -Skill obsolescence & gaps -Resilience

Organisational dimension

- Organizational support and structure
- Financial feasibility
- Customer centricity
- Top management support
- Learning culture, development opportunities
- Workplace dynamics
- HR barriers
- Internal resources
- Leadership(transformational, supportive)
- Talent retention
- Employee engagement and retention
- adaptability to change
- Collaboration and agility

Technological and environmental dimension	<ul style="list-style-type: none">-Technological changes and evolution-Digital integration and transformation-Industry 4.0 demands and challenges-Technology readiness and adoption-Techno-stress and evolving jobs-Compatibility and technological enablers
Education and Training systems	<ul style="list-style-type: none">-Support from training and education institutes-Education/training programs and infrastructure-Knowledge sharing-Mismatch between education and industry-Curriculum structure & teaching methods-National and EU interventions-Interdisciplinary training & evidence-based learning

Policy and external support	<ul style="list-style-type: none"> -Government policy and regulatory support -Labour market flexibility -Policy frameworks and implementation -Gig economy -Large informal sector -Market demand and business environment -Industry pressure and national interventions -Education and industry collaboration
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Based on the studies, Industry 4.0 includes critical dimensions that affect the organization. Technology will not replace human capacity but amplify it. And in overall Industry 4.0 is propelled by sophisticated technology, high levels of expertise, intricate supply chains, and advanced research and development. Table 3.1 describes the themes and their associated factors. From these, most frequently cited factors were selected for the study. The following three factors have been extracted for the purpose of the study due to its significance.

Table 3.2

Sl.No	Factors	Mentions in Literature
1	skills and competencies	22
2	Training workforce(upskilling, reskilling)	19
3	Leadership and top management	7

3.1 Skills and competencies :
3.1.1 Technical skills

Technical competencies essential for industry 4.0 includes digital literacy, automation and control systems, data analytics, Internet Of Things(IoT),artificial intelligence and machine learning(ML),cyber security, cloud computing, additive manufacturing or 3D printing , systems integration, virtual and augmented reality. These intelligent innovations redefine the practices in the industries and enable smart manufacturing. Expertise in these fields is essential. Integrating these technologies urges the workforce to be highly skilled and knowledgeable.

3.1.2 Soft skills and social skills

The high tech modules change the industrial structure and it challenges human capital to be more agile and assertive. Research studies place a great emphasis on higher order cognitive skills like critical thinking, decision making, problem solving, creativity, analytical skills. And strong emotional skills and social skills are the greatest need of the hour fostering collaboration, adaptability and workplace well being. Emotional skills or emotional intelligence helps to be aware of one's own self and emotions enabling self regulation and innate effectiveness. Social intelligence helps to understand other people's emotions and in organisations it promotes greater rapport with peers and creates positive relationships aids in resolving conflicts and creates team work, diversity.

3.1.3 Continuous learning

All the studies highlight a common factor that is continuous learning and its importance. The goal of life is the quality for flourishing (Aristotle). This goal extends beyond the organisational objectives and global competitiveness. The true purpose of life is to learn everyday and grow everyday. It not only enriches individuals but also creates a valuable human society and ultimately impacts every corner of the world.

To maximize the benefits of technological change and to mitigate job insecurity training the workforce becomes essential. The above mentioned skills demanded by the new industrial revolution can be developed through upskilling reskilling programs.

3.2 Upskilling and reskilling:

Training greatly amplifies organizational performance. Suitable training programs to enrich the skills and competencies are more focused on the studies. It is subject to the needs of the organization. Training differs based on the financial and technological feasibility of the organizations. Majority of the studies focused on increasing the investment on human capital through upskilling and reskilling training modules. Retraining the workforce is the primary challenge of the Industry 4.0 revolution. The newly emerged jobs need new skill sets and it cannot be imparted to employees within a short span of time. It requires strategically designed training programs and a reasonable time frame to equip the workforce. As a result, upskilling and reskilling the workforce becomes indispensable.

3.3 Leadership and top management support:

Industry 4.0 transforms the entire workplace dynamics. It is the accountability of the top management to ensure that necessary measures are taken to address this transformation. Studies reveal that continuous support from the top management motivates employees and enhances the overall organizational performance. There is a growing need for visionary leaders capable of leading, advocating change and revolutionizing organizations. Top management should prioritize evaluating employee readiness in the face of disruptive change. Their responsibility is crucial in setting the vision, leveraging resources and fostering organizational culture that embraces industrial transformation. Organizations must modify their capabilities to meet emerging challenges.

4. Results and discussion

The analysis found that Industry 4.0 affects the entire business world. From the organisational dimension, retraining the workforce plays an indispensable role in industrial transformation. Innovative tech instruments, advanced machines can replace the work dynamics but they can't supersede the unique capabilities and potential of the human workforce. However, these advancements change the nature of jobs. The impactful response from the individuals and organizations would be to acquire the requisite skills to manage the disruptions caused by the tech driven industrial revolution. Studies reveal that a blend of technical skills and soft skills will be in high demand in the present era. Technical skills with subject expertise are imperative for this industrial revolution 4.0. Technology also shifts the industrial working pattern. Interactions with people also change. Accordingly great emphasis is placed on soft skills and social skills. All these places a great burden on top management and require a highly agile leadership to handle the changes effectively.

4.1 Strengths and threats to the organization while implementing upskilling and reskilling strategies.

Activation of upskilling and reskilling programs in an organization provides a great competitive advantage to it by bridging the skill gaps. It will increase the workforce competency, improves Employee Engagement and Retention and increases organizational agility. From the studies it is evident that retraining the workforce is inevitable and it enhances the organizational stability over new paradigm shifts. The foremost challenge in implementing skill training programs is identifying well suited technologies and designing effective training modules and finding out the best training module tailored to industry needs and learner capabilities. The complexity arises from the fact that training requirements vary across different sectors. The challenges to the skill development programs are insufficient support from top management, lack of alignment with organizational goals, high cost training, employee resistance to change, unequal access to training and gender disparities. These threats may be less for larger enterprises who can adopt high cost training. MSME faces greater challenges compared with large scale enterprises such as limited access to training infrastructure, financial hurdles, and low level awareness.

4.2 Effective choices of strategies to address issues pertaining to upskilling and reskilling.

From the papers reviewed it is evident that reskilling and upskilling are the primal requirements for every institution to cope up with the fourth industrial revolution. The findings of the study conveys the importance of organizational roles in adapting to this technological revolution. Every sector is experiencing digital transformation associated with challenges. It is clear that skill gap exist among the global workforce due to the digital transformation. Effective strategies and training initiatives should be designed to align with the organization's specific needs and goals. Mainly human resource(HR) professionals hold great importance in developing reskilling and upskilling programs for organizations. From a global perspective all the nations, their governments and all the stakeholders of industries should implement policies and schemes for skill development to build a competitive and healthy workforce. It is the collective responsibility of all stakeholders to address future skill requirements. Collaboration between industry and educational institutions plays a pivotal role in developing effective training program. And industries can use the leveraging technology as a training tool to enhance their workforce and skills.

5. Conclusion and suggestions

This meta analytic study concludes the changing skill sets and importance of upskilling and reskilling interventions in the fourth industrial revolution. This literature study provides the overall changes happening in industries as a result of the fourth industrial revolution and how organizations can tackle this challenge in an effective way. Training programs are subjected to the individual organizational environment. Each organization must create their own customized upskilling and reskilling programs. Also, the stakeholders and governments should rethink the policies that play a key role in this upskilling and reskilling initiatives by facilitating strategic frameworks, funding opportunities, and regulatory support. Since this is a review paper the scope is limited to the analysis of selected studies. More empirical research is required on this area with respect to different sectors. Further research is needed on all factors associated with the organizational dynamics.

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