A Study of Challenges Faced by Small Businesses in Implementing Effective Strategies for Adoption of Industry 4.0 Technologies in Business Operations.

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Abstract:

Industry 4.0 technologies are transforming business operations by introducing digital and smart systems. However, many small businesses face difficulties in adopting these technologies effectively. This study focuses on the challenges faced by small businesses in implementing effective strategies for the adoption of Industry 4.0 technologies in business operations. The main objective of the study is to understand the level of awareness, preparedness, and strategic challenges of small business owners toward Industry 4.0 adoption. A quantitative research approach was used, and primary data were collected from small business owners using a structured questionnaire. The findings indicate that high implementation costs, lack of skilled workforce, and limited awareness about government support are the major challenges faced by small businesses. The study provides useful insights for business owners and decision-makers to improve strategic planning for Industry 4.0 adoption. It also contributes to academic understanding and practical management applications.

Keywords

Industry 4.0, Small Businesses, Technology Adoption, Strategic Challenges, Business Operations

1. Introduction:

The global business environment is changing rapidly due to advances in technology and digital innovation. Industry 4.0 has emerged; it integrates cyber-physical systems, the Internet of Things (IoT), artificial intelligence (AI), big data analytics, cloud computing, and automation. This shift has transformed how organizations operate, compete, and create value. Large corporations have quickly adopted these technologies because they have more financial and technical resources. In contrast, small businesses face significant challenges in adopting Industry 4.0 technologies in a strategic and sustainable way.

In today's competitive, technology-focused marketplace, small businesses are crucial for economic growth, job creation, and innovation. They play a significant role in national economies by supporting supply chains, encouraging entrepreneurship, and meeting local market needs. However, the urge to digitize operations and adopt modern technologies has grown as customers want higher efficiency, customization, speed, and quality. Industry 4.0 technologies present small businesses with valuable opportunities, such as improved efficiency, cost savings, data-driven decision-making, better customer experience, and increased market competitiveness. Despite these advantages, the adoption rate among small

businesses is still low. The main reason for this gap is the unique challenges faced by small businesses when trying to implement Industry 4.0 strategies. Unlike large companies, small businesses often have limited financial resources, inadequate technology infrastructure, and a shortage of skilled workers. They often focus on short-term survival rather than long-term innovation when planning for technology adoption. Additionally, employee resistance to change, lack of awareness about Industry 4.0 concepts, cybersecurity issues, and uncertainty about returns on investment complicate the adoption process. These challenges are not just technical; they are deeply tied to management, organization, and strategy.

This research is especially important in the current business climate, where digital transformation has become essential. Governments, industry groups, and financial institutions are increasingly pushing for digital adoption through various initiatives. However, small businesses often find it hard to turn these initiatives into effective strategies. Understanding the strategic challenges, they face is crucial for creating practical solutions, policy measures, and management frameworks that can help with successful Industry 4.0 adoption. This research is particularly relevant from an MBA standpoint as it combines ideas from strategic management, technology adoption, innovation, and organizational behaviour.

The research question in this study looks at identifying and analysing the main challenges small businesses encounter when trying to adopt Industry 4.0 technologies effectively. While current literature covers Industry 4.0 adoption in general, much of it focuses on large manufacturing firms or technical aspects instead of the strategic and managerial hurdles that small businesses face. This study aims to fill that gap by looking at the practical barriers faced by small businesses and how these hurdles affect decision-making and implementation. The originality of this study lies in its focus on strategy-related challenges rather than just technological issues. By concentrating on small businesses, the research sheds light on how limited resources, management skills, organizational culture, and external environmental factors affect Industry 4.0 adoption. The findings of this study aim to contribute to academic literature while also providing practical advice for business owners, managers, policymakers, and consultants seeking to aid digital transformation in small businesses.

2. Statement of problem:

Industry 4.0 is the integration of the Internet of Things (IoT), artificial intelligence, cloud computing, and data analytics in the manufacturing industry. The use of these technologies has the ability to change the way industries operate by boosting productivity and competitiveness in the industry. Industry 4.0 has the ability to change the way industries operate by offering the industry the capability to react to market changes due to the use of data exchange and decision-making processes in the industry.

However, it is necessary to point out that the effective realization of Industry 4.0 technologies cannot be ensured by mere technological acquisition and focus. The acquiring of Industry 4.0 technologies and their successful implementation require adequate strategic planning, major financial outlays, the best possible use of the available workforce, and the provision of technological and organizational infrastructure. Upon close observation, it can be realized that small and medium-scale enterprises face difficulties in satisfying these factors and, hence, the acquisition of Industry 4.0 technologies remains ineffective.

Moreover, small businesses also face other hindrances like resistance to organizational change, a lack of clarity regarding the return on investment, cybersecurity risks, and a lack of awareness regarding the applications of Industry 4.0. Thus, the implementation level of Industry 4.0 in small-scale businesses is not well-developed. This research work will help in understanding the critical hurdles encountered by small-scale businesses in the implementation process of Industry 4.0.

3. Review of Literature:

Masood and Sonntag (2020) highlighted that financial limitations are among the most significant barriers preventing SMEs from adopting Industry 4.0 technologies. Their study emphasized that SMEs often lack sufficient capital to invest in automation and digital infrastructure. Additionally, uncertainty regarding return on investment discourages owners from committing long-term resources. The absence of strong government-backed credit schemes and subsidies further exacerbates the issue, widening the digital divide between SMEs and large enterprises. Their findings underline risk aversion and financial instability as persistent obstacles to digital transformation.

The literature has also extensively explored challenges in strategy and management. It was revealed by **Rauch et al. (2020)** that a lack of strategic vision and managerial readiness constitutes one of the most significant factors preventing SMEs from implementing Industry 4.0. This assumes that most SME managers lack vision on long-term digital benefits, or they strategize their technological implementation independently of their organizational goals and objectives, hence integrating poorly and inefficiently; poor commitment from management and lack of communication within an organization also slow down the implementation process.

Rauch et al. (2020) revealed that the unpreparedness on the strategic and managerial side is one of the biggest factors hindering the adoption of Industry 4.0 in SMEs. This is because most SME owners have little understanding and alignment of technological adoption towards achieving business goals. Lack of alignment on the strategic side leads to poor adoption. Lack of commitment on the part of the leadership and poor communication channels as SMEs become slow in the adoption journey.

Sony and Naik (2020) highlighted employee resistance and non-supportive organizational culture as significant barriers. Employees are seen to resist new technologies owing to fear of job loss, lack of technical comprehension, and inadequate training. The authors insisted that investment in technology along with parallel initiatives in managing change, providing leading support, and engaging employees is required. Similarly, organizational learning and workforce involvement have been considered crucial for the successful implementation of Tortorella and Fettermann (2018). They indicated that SMEs should develop a learning-orientated culture that allows experimentation with digital tools for long-term success.

Frank et al. (2019) noted that a shortage of resources and technical knowledge requires small enterprises to take up digital technologies bit by bit rather than seeking total automation. According to them, a phase-by-phase approach should start with means that are affordable and scalable. Besides, the authors pointed out a partnership with higher education and technology providers that might help bridge knowledge gaps along with cutting costs in general. This practice can accelerate sustainable digital transformation-much needed in resource-poor environments.

According to **Horváth and Szabó (2019),** SMEs are expected to face more acute problems of digitalization than large businesses because of the lack of infrastructure, inadequate finances, and a lack of qualified personnel. This will adversely affect the innovation and competitiveness of SMEs. Moreover, the issue gets aggravated in the case of emerging nations as the disparities in infrastructure at the regional level hamper the application of digital technologies.

According to **Mittal et al. (2018)**, the absence of technical skills in the worker and owner capacities in small and medium-scale enterprises is a significant hindrance to the implementation of Industry 4.0. The majority of small and medium-scale enterprises are not equipped with the right skills and expertise in automation and robotic technology, data analysis, and artificial intelligence. Such a challenge restrains business owners from having the right understanding for effective control and implementation and assessment.

According to **Moeuf et al. (2018)** in their study, it was discovered that SMEs are using outdated production systems, which are not compatible with new digital technologies. There are problems of interoperability, non-standardization, and the cost of integration, which are inhibitors in the process of modernization. This is particularly because there is little access to technical consulting services.

Some studies have investigated the challenges of context-specific environments found within developing countries. **Kamble et al. (2018)**, for instance, carried out a review of the Indian context and found some of the factors acting as a barrier to the adoption of Industry 4.0 among SMEs to be the absence of supportive infrastructure, a stable power supply, good internet connectivity, and favourable institutional support. Inadequate enforcement of some of the initiatives employed by the governments further makes them less effective.

Finally, the misalignment of strategy and lack of planning were identified by **Ghobakhloo (2018)** as the root causes of the failure of Industry 4.0 projects. Many SMEs focus on stand-alone technologies without any long-term digital strategy. The successful implementation of an innovation should be aligned to the long-term business strategy and the goals of the innovation.

Research Gap

Although existing literature provides valuable insights into the financial, technological, strategic, human, and institutional challenges faced by small businesses in adopting Industry 4.0, most studies are conceptual or based on developed economies. Limited empirical research focuses on small businesses in developing regions, particularly at the grassroots operational level. Moreover, existing studies often examine challenges in isolation rather than analysing their combined impact on strategic implementation. There is also a lack of primary data-driven research capturing owners' and managers' perspectives on Industry 4.0 adoption challenges. Therefore, the present study seeks to bridge this gap by empirically examining the key challenges faced by small businesses in implementing Industry 4.0 strategies, with a specific focus on practical, organizational, and contextual factors. this study aims to examine the strategies adopted for the implementation of Industry 4.0 technologies and to analyse the major challenges faced by small businesses in this process, with the objective of identifying potential solutions and recommendations to ensure successful and sustainable adoption of Industry 4.0 in small businesses.

4. Research objective:

1.To study the strategic framework required for the implementation of Industry 4.0 technology.

2.To assess small business owners' awareness, preparedness, and flexibility with regard to Industry 4.0 adoption.

3.To identify the challenges faced by small businesses in implementing effective strategies.

4.To identify the most prominent challenge among all the challenges faced by small businesses.

6. Research Methodology

6.1 Research Design

In this research, a descriptive research design was employed to explore the challenges that small businesses face when adopting Industry 4.0 technology.

6.2 Sampling Design

i. Sample Universe

The universe of observation of this study is comprised of all small business enterprises operating under the Amravati district.

ii. Sample Population

The population for the study comprises small business units established in the Amravati MIDC, and the Nandgaonpeth MIDC, and local area businesses operating in the Amravati city.

iii. Sample Unit

The unit of analysis includes owners, managers, and key decision-makers of small business units who have knowledge of digital technologies and are either practicing or planning to practice Industry 4.0 in their business processes.

iv. Sample Size

The data were collected from 30 active respondents in decision-making and strategy formulation in their respective small business enterprises**.**

v. Sampling Technique

The convenience sampling technique was used in the study, wherein data is collected from small business units that are easily accessible and willing to participate.

6.3 Sources of Data Collection

a) Primary Data

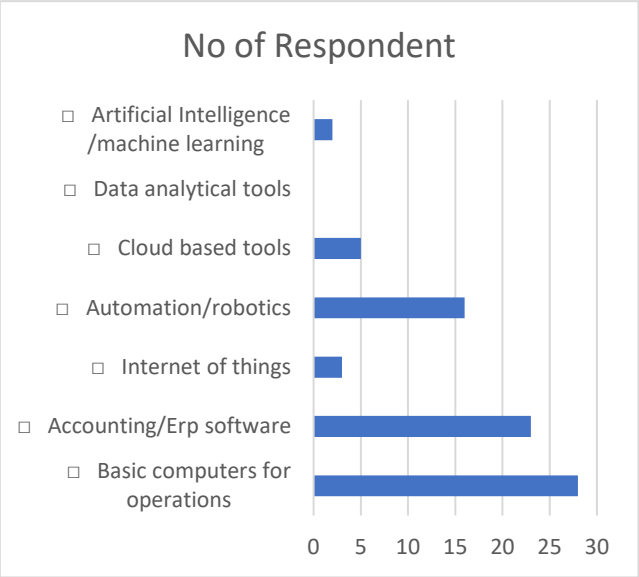
Primary data were collected through the use of a structured questionnaire for the selected respondents**.**

b) Secondary data

secondary data were collected from research journal, research paper and online data source.

1.Which among the following technologies your business currently uses?

Technologies	No of Respondent	Percentage %
□ Basic computers for operations	28	93.3
□ Accounting/Erp software	23	76.6
□ Internet of things	3	10
□ Automation/robotics	16	53.5
□ Cloud based tools	5	16.7
□ Data analytical tools	0	0
□ Artificial Intelligence /machine learning	2	6.7



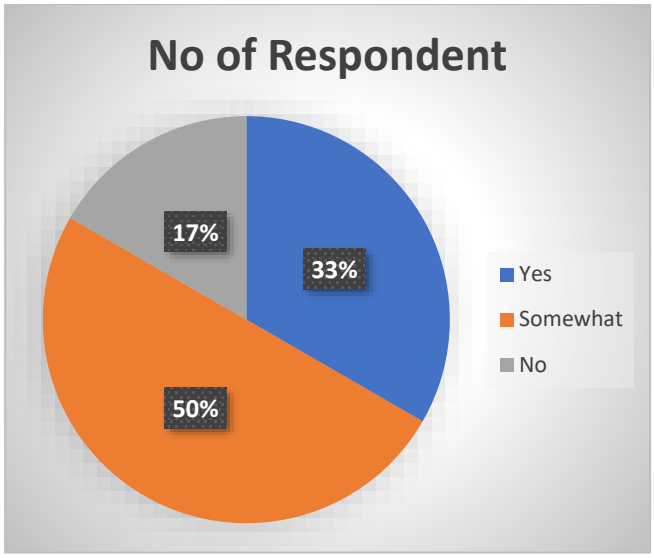
Interpretation:

The results show a high reliance on basic computers for their operations (93.33%) and accounting/ERP software (76.67%) among the participants. Conversely, the use of Industry 4.0 technologies such as IoT (10%), cloud-based solutions (16.7%), AI/ML (6.7%), and data analytics (0%) remains low. This shows that most of the companies are still at a nascent stage of digital transformation, where there has been limited assimilation of smarter technologies.

2. Do employees of your organization have required skills for successful

implementation of Industry 4.0?

Option	No of Respondent	Percentages %
Yes	10	33.3
Somewhat	15	50
No	5	16.7

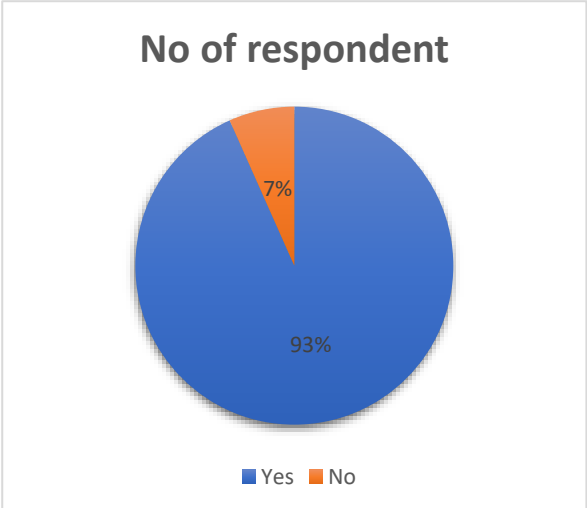


Interpretation:

Only a third of respondents (33.3%) believe their employees fully possess the required skills, while half (50%) feel employees are somewhat skilled. Additionally, 16.7% report a lack of required skills. This indicates that a significant portion of the workforce may not be fully prepared, and organizations need targeted training and skill development programs to ensure effective implementation of Industry 4.0 technologies.

3. Do you believe that the cost is an important factor in designing strategy for implementation of industry 4.0 technology?

Option	No of respondent	Percentages%
Yes	28	93
No	2	7



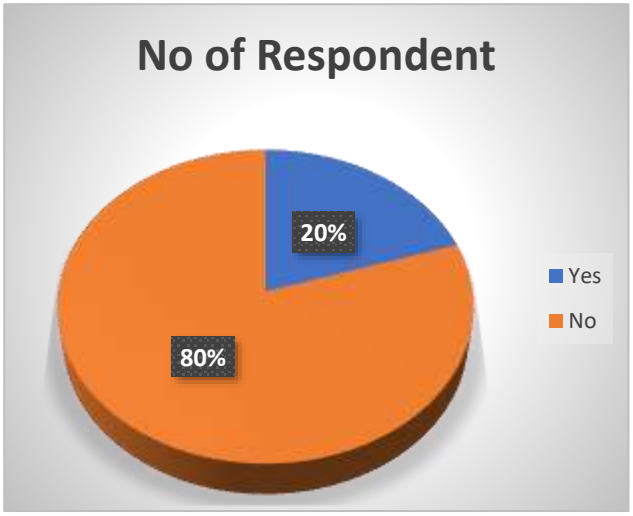
Challenges	No of Respondent	Percentage%
High cost	30	100
Lack of digital skills	13	43.30
Poor internet /infrastructure	19	63.30
Lack of awareness	9	30
Resistance from employees	11	36.70
Cybersecurity concerns	4	13.30

Interpretation:

Results indicate that 93% of the total respondents believe that cost is an influential factor in strategy design for Industry 4.0 technology implementation, while 7% do not share the same opinion. This indicates that the financial perspective plays a vital role in making strategic decisions for the adoption of Industry 4.0 among enterprises.

4. Are you aware about the govt support for implementation of industry 4.0 technology?

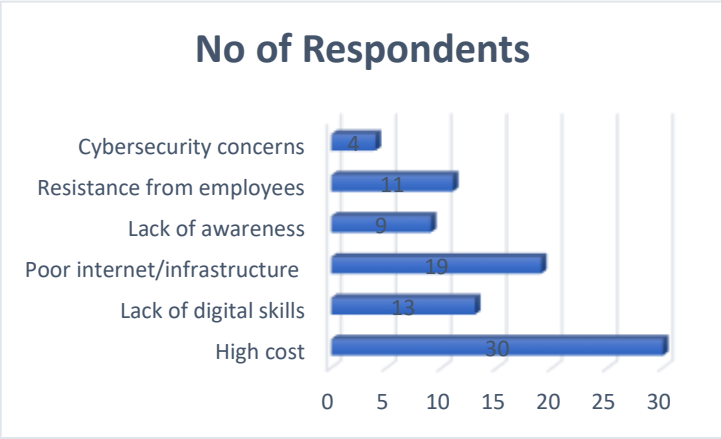
Option	No. of Respondent	Percentages%
Yes	6	20
No	24	80



Interpretation:

The results show that 80% of the respondents are not aware of the schemes by the government to implement Industry 4.0 technology, while only 20% said they are aware. This is an important awareness gap which may become an important constraint to the successful adoption of Industry 4.0 among the business sector.

5. Which according to you is major challenge at strategic level in implementing industry 4.0 technology?



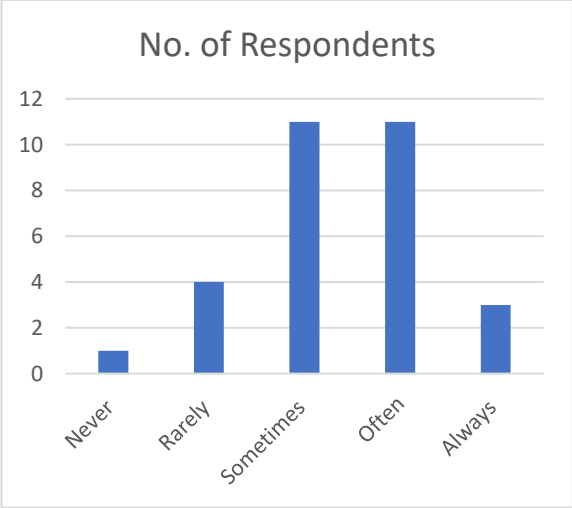
Interpretation:

The findings reveal that high cost represents the most prominent strategic issue since it has been identified by 100% of the participants, followed by poor internet/infrastructure with 63.3%, lack of digital skills with 43.3% compared to resistance from employees with 36.7%. While lack of awareness and cybersecurity threats share relatively less important strategic issue positions with 30% and 13.3% respectively. This highlights that financial and infrastructural

considerations are mainly strategic to businesses by which Industry 4.0 implementation can be impeded.

6. How often do you follow updates related to emerging digital or smart technologies in your industry?

Frequency	No. of Respondents	Percentage%
Never	1	3.3
Rarely	4	13.3
Sometimes	11	36.7
Often	11	36.7
Always	3	10

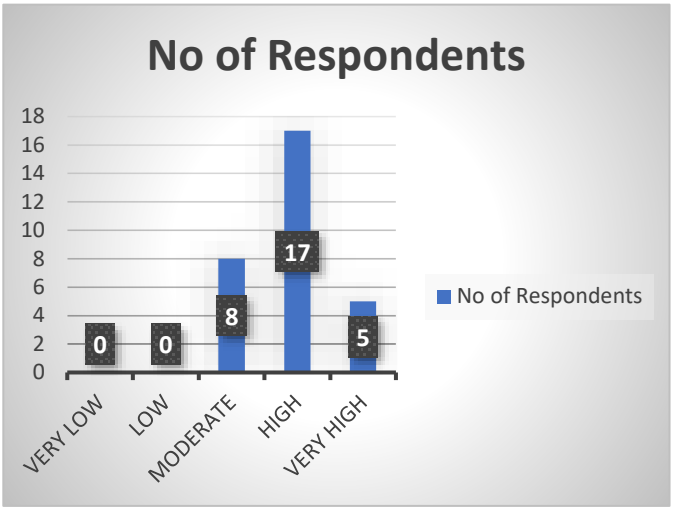


Interpretation:

It is clear from the analysis that the majority of the respondents track updates on digital or smart technologies, as indicated by the percentages – 36.7% said they did so "Sometimes," and 36.7% said they did so "Often." Very few respondents said they never track updates on digital/smart technologies "Never" (3.3%) and "Rarely" (13.3%), respectively, while 10% said they always track them "Always." This suggests the level of awareness is relatively high in the business sectors concerning new technology in the industry.

7. Does your business have flexibility to change its process when new technologies emerge?

Frequency	No of Respondents	Percentage%
Very low	0	0
Low	0	0
Moderate	8	26.7
High	17	56.7
Very High	5	16.7

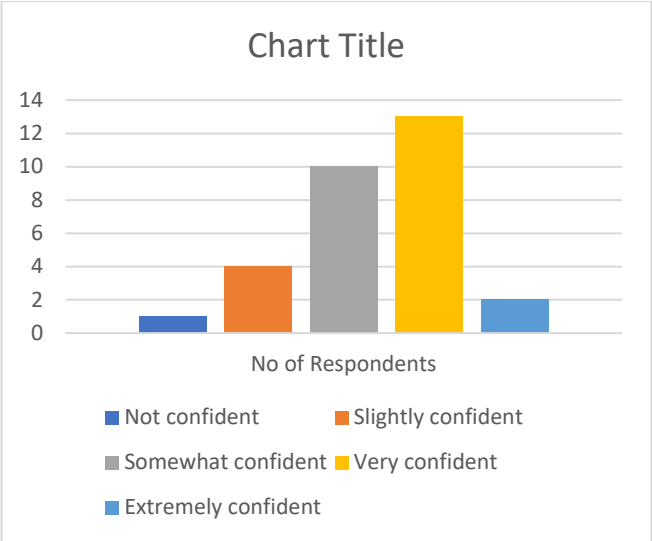


Interpretation:

These results show that most of the businesses (56.7%) recorded a high level of flexibility in their processes in responding to new technologies, followed by those that recorded a moderate level of flexibility (26.7%), and then those with a very high level of flexibility (16.7%). None recorded low and very low flexibility.

8. How confident are you that your employees can adopt to new digital tools if required?

confidence	No of Respondents	Percentage %
Not confident	1	3.3
Slightly confident	4	13.3
Somewhat confident	10	33.3
Very confident	13	43.3
Extremely confident	2	6.7

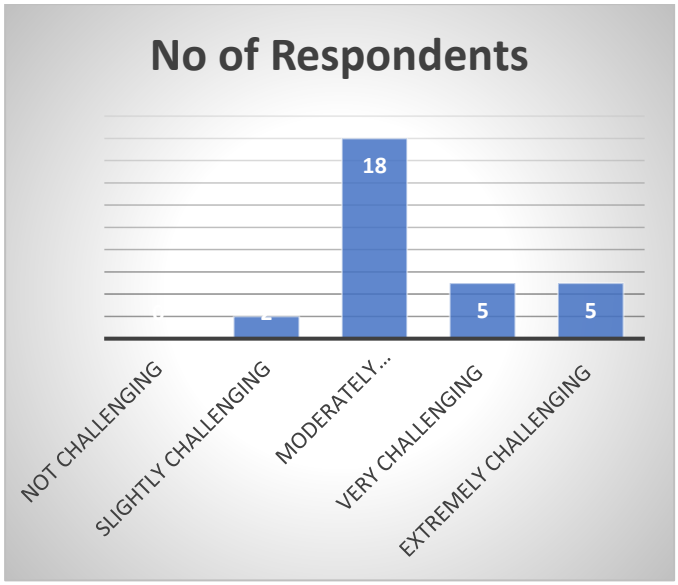


Interpretation:

The data illustrates that a significant number of respondents are very confident in their employees' adaptability in using digital changes with a total of 43.3% who chose the "Very confident" option and an additional 6.7% who chose the "Extremely confident" option. A total of 33.3% responded with the "Somewhat confident" choice. Only a small number of respondents expressed a lower level of confidence with a total of 3.3% choosing the "Not confident" statement and 13.3% choosing the "Slightly confident" statement.

9. How challenging do you find the process of shifting from traditional methods to digital systems?

Level of Challenge	No of Respondents	Percentage%
Not challenging	0	0
Slightly challenging	2	6.7
Moderately challenging	18	60
very challenging	5	16.7
Extremely challenging	5	16.7

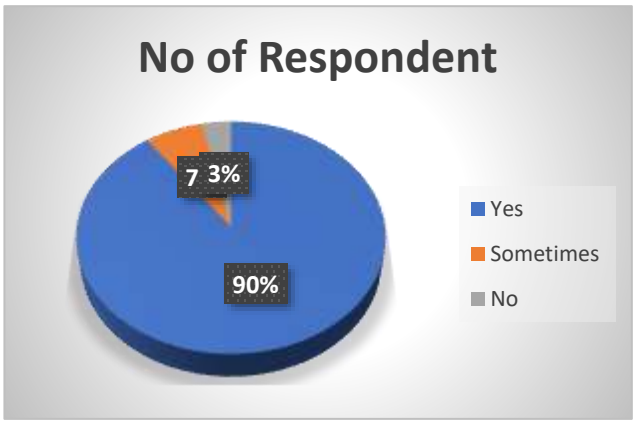


Interpretation:

The data obtained reveals that 60% of respondents find transitioning from traditional approaches to digital technology moderately difficult, while 16.7% find the process very difficult, and 16.7% find it extremely difficult too. Only 6.7% of them found it slightly difficult, while none of them found it not a challenge at all, which is an important indicator that transitioning from traditional approaches to digital technology is a challenge for them too.

10. Does shortage of financial resources affect the execution of organizational plans?

Affect	No of Respondent	Percentage %
Yes	27	90
Sometimes	2	7
No	1	3

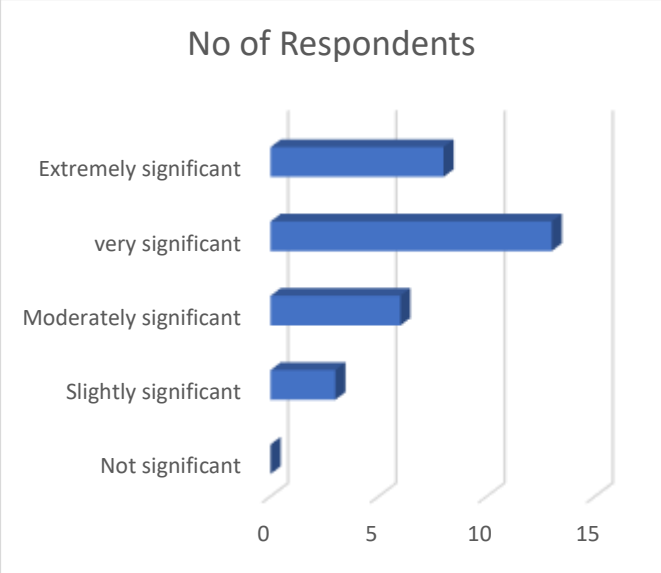


Interpretation:

Results show that 90% of the respondents reported that a shortage of financial resources affects the execution of organizational plans, 6.7% said it sometimes does, and only 3.3% reported no effect. This indicates that financial constraints may remain one of the major barriers towards effective plan execution in most businesses.

11.How significant is financial constraint as a challenge in effective execution?

Level of Challenge	No of Respondents	Percentage%
Not significant	0	0
Slightly significant	3	10
Moderately significant	6	20
very significant	13	43.3
Extremely significant	8	26.7

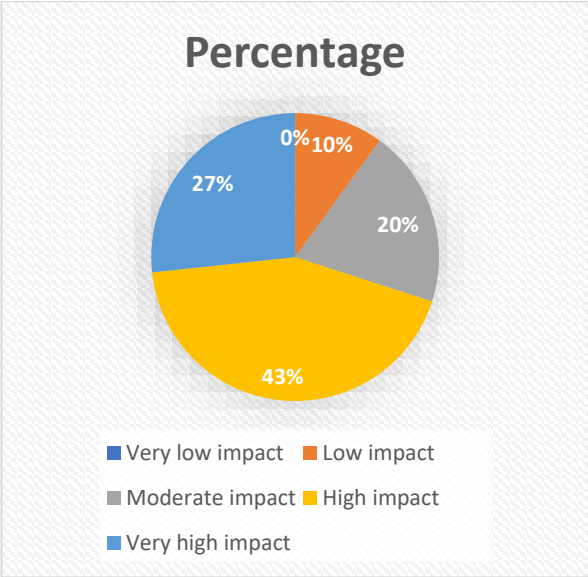


Interpretation:

Financial constraint has been found as a highly significant challenge facing effective implementation, as 43.3% and 26.7% viewed it as very significant and extremely significant, respectively. In addition, 20% viewed it as moderately significant, and only 10% and none viewed it as slightly significant and not significant, respectively, as shown above. This clearly indicates that financial factors have significant impacts on implementation effectiveness.

12. Rate the impact of lack of skilled staff on effective implementation.

Level of Impact	No of Respondents	Percentage
Very low impact	0	0
Low impact	3	10
Moderate impact	6	20
High impact	13	43
Very high impact	8	27

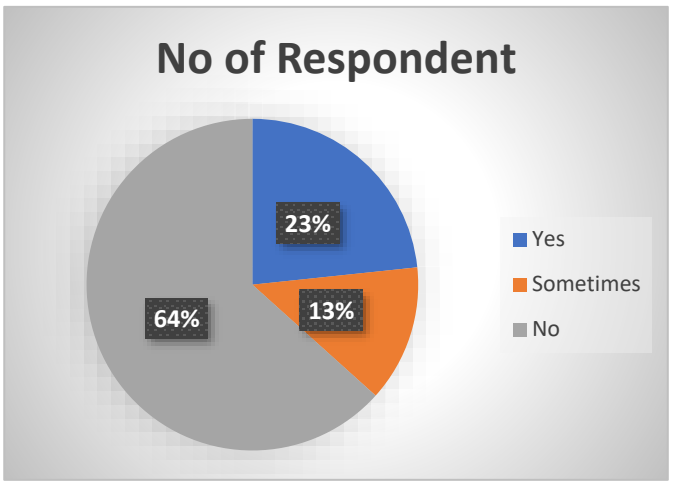


Interpretation:

The data shows that skill shortage is an issue that significantly affects implementation, with 43% having a high impact and 27% having a very high impact. Furthermore, 20% felt that there is a moderate impact, followed by 10% with a low impact, with no one having a very low impact. This indicates that skill shortage is a significant issue that inhibits successful implementation of these businesses.

13. Do employees show resistance towards organizational changes?

Employee resistance	No of Respondent	Percentage %
Yes	7	23
Sometimes	4	13
No	19	64

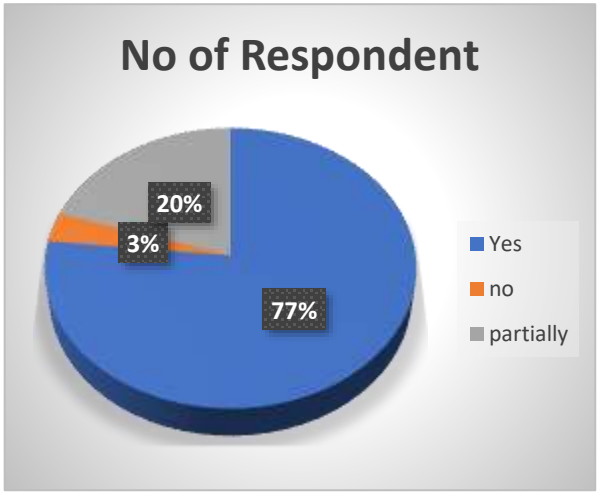


Interpretation:

The findings show that 64% of the respondents do not encounter employee resistance to organizational changes, which in most aspects reflects a good attitude on the part of the employees. However, 23% accept the presence of resistance, while 13% said that resistance occasionally occurs. This shows that even though resistance is not widely evident in many aspects, it is still a concern for one section of businesses while implementing change.

14. Is the available technology adequate to support organizational implementation efforts?

Employee resistance	No of Respondent	Percentage %
Yes	23	77
No	1	3
partially	6	20



Interpretation:

The data indicates that 77% of the respondents found the technology that is available adequate for implementation, while 20% found it partially adequate.

Only 3% found it inadequate; this seems to indicate that a majority of businesses have adequate technology available, although some are still hampered by such technology that may hinder implementation.

8. Findings of the study:

1. Technology Usage: Most businesses primarily use basic computers and accounting/ERP software, while adoption of advanced technologies like AI, IoT, robotics, and cloud tools remains limited.
2. Employee Skills: Two-thirds of organizations reported that their employees possess the required skills for Industry 4.0 implementation, though one-third feel additional skill development is needed.
3. Cost Sensitivity: The majority of respondents consider cost to be a critical factor in designing strategies for implementing Industry 4.0 technologies.
4. Government Support Awareness: Less than half of the businesses are aware of government schemes or support available for Industry 4.0 adoption.
5. Strategic Challenges: High implementation costs and lack of skilled workforce are identified as the most significant challenges at the strategic level.
6. Keeping Up with Emerging Technologies: Most businesses follow updates on emerging digital or smart technologies only occasionally, indicating limited proactive engagement.
7. Process Flexibility: A majority of organizations report moderate to high flexibility to modify processes when new technologies emerge.
8. Employee Adaptability: Businesses express moderate to high confidence in their employees' ability to adopt new digital tools if required.
9. Transition Challenges: Shifting from traditional methods to digital systems is perceived as moderately challenging by most respondents.
10. Financial Constraints: Shortage of financial resources is reported to affect the execution of organizational plans in a significant number of businesses.
11. Impact of Financial Limitations: Financial constraints are rated as a moderately to highly significant challenge in implementing Industry 4.0 initiatives.
12. Impact of Skill Shortage: Lack of skilled staff is considered a moderately impactful challenge in effective implementation.
13. Employee Resistance: Around half of the respondents report occasional resistance from employees toward organizational changes.
14. Adequacy of Available Technology: The current technology is seen as somewhat adequate to support implementation efforts, but there is scope for upgrades and integration of advanced tools.

9.Managerial implication: -

The study indicates that business managers and entrepreneurs should take an orderly and financially prudent approach to the implementation of Industry 4.0. Based on the fact that financial issues and lack of skills represent the most emerging challenges, the managers should concentrate on strategic budgeting and skills improvement. Emphasis on increasing awareness of the government's aid schemes and cooperation between managers and technology companies to mitigate the cost implications and risks associated with the implementation of the new technologies is indicated by the results. In addition, the managers should improve the change management and digital planning processes to facilitate the shift to the new technologies and to facilitate the digital transformation.

10. Limitations of the Study:

The following are the key limitations of the present research:

1. Geographical Limitation:
The study is confined to small business units within a specific region (for example, Amravati District). Hence, the findings may not fully represent the challenges faced by small businesses in other regions or states.

2. Sample Size Limitation:
Due to time and resource constraints, the study is based on a sample of 50 respondents. A larger sample size might have provided more comprehensive and generalized results.

3. Respondent Bias:
The study depends on the responses provided by small business owners and managers. Some responses may be influenced by personal opinions, limited understanding, or hesitation to disclose complete information.

4. Time limitation:
the time limitation of the study restricted the ability to conduct a thorough and detailed analysis of the data.

5. Generalisability of finding:
The research findings are context specific to Indian small businesses, particularly those in semi urban and industrial region. Hence the result may not be directly applicable to large enterprises or businesses operating in technologically advance economy.

11. Recommendation:

- Gradually adopt advanced technologies like AI, IoT, robotics, and cloud tools.
- Provide training to employees to improve skills for Industry 4.0.
- Plan budgets carefully to manage implementation costs.
- Use government schemes and support for technology adoption.
- Allocate resources effectively for technology, training, and process updates.
- Stay updated on new digital and smart technologies**.**
- Make processes flexible to adapt quickly to new technologies.
- Encourage employees to learn and use new digital tools.
- Follow a step-by-step plan when shifting from traditional to digital systems.
- Find alternative funding to overcome financial constraints.
- Focus on skill development programs for key technical gaps.
- Reduce employee resistance through awareness and involvement.
- Upgrade and integrate technology to support operations better.
- Combine planning, training, and technology upgrades into one strategy.
- Regularly check readiness and improve skills, processes, and systems.

12. Scope of study:

In the context of the above, the topic of the current research work is centered at trying to unlock the key challenges faced by small businesses in adopting the concepts of Industry 4.0. The key objective of this research work would be to span the identified area of small and medium enterprises across the entire sector, be it the manufacturing, services, and retail industries, in a bid to present an overall analysis related to their preparedness in getting adapted to the digital ways.

This study also aims to evaluate the state of awareness and readiness among the current generation of small business owners regarding Industry 4.0 and examine the approaches and frameworks that would help these business owners adopt Industry 4.0. The results of the proposed research will be beneficial for entrepreneurs, the government, and the industrial sector as it will help them prepare efficient interventions and assistance for facilitating the digitalization process among the small business community.

13. Conclusion:

Objective 1: To study the strategic framework required for the implementation of Industry 4.0 technology.

Conclusion:

The findings indicate that while businesses recognize the importance of a strategic framework, high implementation costs and lack of skilled workforce are key strategic challenges. Organizations need to integrate financial planning, process flexibility, and employee adaptability into their strategies to successfully implement Industry 4.0 technologies.

Objective 2: To assess small business owners' awareness, preparedness, and flexibility with regard to Industry 4.0 adoption.

Conclusion:

Most businesses have a moderate level of preparedness, with employees being somewhat skilled and moderately adaptable. While process flexibility is present, awareness of government support and emerging technologies is limited, highlighting a need for improved knowledge and proactive engagement among small business owners.

Objective 3: To identify the challenges faced by small business in implementing effective strategies.

Conclusion:

Financial constraints, limited employee skills, occasional resistance to change, and partial adequacy of technology emerge as the main challenges. These factors affect both the planning and execution of Industry 4.0 strategies, making targeted interventions necessary to overcome adoption barriers.

Objective 4: To identify the most prominent challenge among all the challenges faced by the small businesses.

Conclusion:

The findings suggest that financial limitations and lack of skilled staff are the most prominent challenges hindering Industry 4.0 adoption. Addressing these challenges through focused training programs, investment planning, and strategic resource allocation is critical for successful implementation.

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