Technology Adoption Orientation Amongst the Traditional SMEs of North East India: A Case Study of Bell Metal Industry

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Abstract

In the present time, technology has been a "panacea" for all types of firms, especially for the SMEs. The present paper explores the different benefits that technology- adoption provides to the SMEs. It also examines the level of "technology adoption" orientation of the Bell Metal Industry which is one of the traditional MSME Cluster of North–East India as recognized by the Government of India. The study uses both primary and secondary data. Primary data were collected from the owners of Bell Metal Units situated in Sarthebari through the help of a structured interview schedule. An index is constructed to measure their level of "technology-adoption "orientation. The findings reveal that "technology adoption" provides multi-fold benefits to the SMEs in creating a niche for them. However, in the context of the Bell Metal industry, the majority of the artisans portray a low level of orientation in technology adoption. The suggestion is made for a holistic approach on the part of different stakeholders to ensure that proper training can be provided to the artisans to make them capable of adopting technology in their business operations.

1. Introduction

In a developing country like India, which aspires to be a developed nation (Viksit Bharat) by 2047, SMEs act as the catalyst of its economic growth by contributing towards balanced regional development, poverty reduction, economic empowerment, social upliftment of the marginalized class, mobilization of resources and skill development? Furthermore, this sector is also credited with being the second largest contributor to employment, after agriculture. Spreading across multiple domains from manufacturing to service-based firms and catering to the varied needs of both the domestic and global markets, this sector has been fruitful in bringing about an inclusive development of the entrepreneurial landscape of the country. As of 27th May 2025, there are a total of 640.61 lakhs enterprises in the MSME sector, of which the micro and the small sector (SMEs) contribute around 99.95 % to the overall figure (MSME Dashboard, Ministry of Micro, Small and Medium Enterprises, Government of India).

Extant literature has mentioned that several SMEs in developing countries have closed down within a few years of their commencement. Low level of technological adoption emerged as one of the major issues confronting the SMEs to cope with the market demands and face competition from their larger counterparts (Prasanna *et.al*, 2019; Ahmedova, 2015; Das *et.al*, 2020; Kumar & Ayedee, 2021). In the study of Prasanna *et.al*, (2019), by synergizing the reports of different committees like BCG, IBRD, Economic Committee, etc. it has been found that technology adoption is one of the strategic thrust areas for the growth of SMEs. Survival of the SMEs in the globalized era depends to a large extent on the technological progress made in it (Segarra & Callejón, 2002). Technological adoption refers to making improvements in the products offered to the market through the application of improved methods and techniques of production (Prasanna *et.al*, 2019), thereby saving time and labor for the enterprises concerned. It is particularly important for SMEs who have to always be on the lookout for opportunities, utilize their available resources, work with its semi-skilled base of workers and exploit those opportunities to create a niche for them. However, for SMEs which are mostly traditional industries, adoption of technology is not a one-shot activity. The process of technology adoption undergoes a series of steps namely: Knowledge- Persuasion- Decision- Implementation- Confirmation or Rejection. A wrong decision in any of these stages would not only add to the financial burden of an SME. It would also demoralize its workers limiting its orientation of technology adoption in the later course of time. A brief overview of the stages in technology adoption among SMEs is discussed in the figure below:
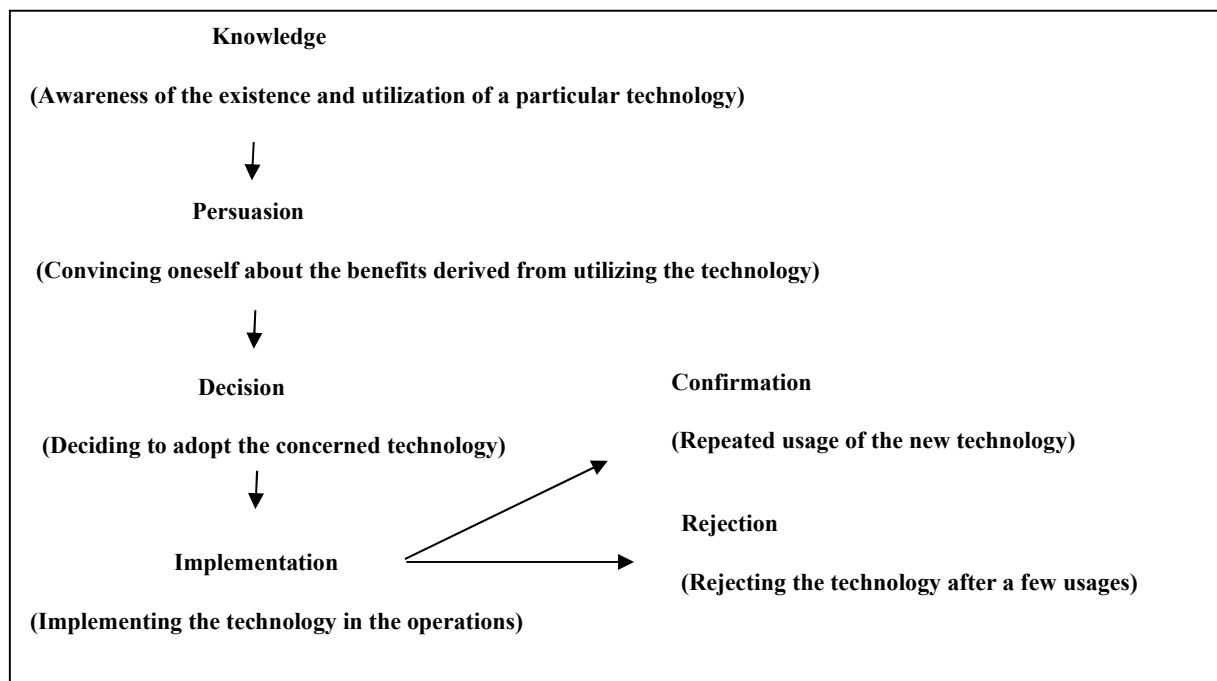

Fig.1 Diffusion process of technology among SMEs Source: (Rogers, 1962) in (Darbanhosseiniamirkhiz et.al, Sep-oct 2011)

The term "orientation" is defined as the pre-disposition of a business to act based on its area of interest (Varadarajan, 2010). "Technology-adoption" orientation refers to the willingness and ability of an organization to adopt a strong technological background to offer improved products and services (Gatignon & Xuereb, February 1997). Numerous studies have found a positive association between the technological orientation (attitude, sophistication, etc.) of SME owners on their performance particularly their survival amid the ever-growing competitive intensity (Ogbonna & Harris, 2005; Gunasekaran *et. al*,2011 Fadahunsi, 2012; Das *et.al*, 2020).

2. Statement of the Problem

Technology adoption by SMEs is an effective measure to solve multiple problems brought about by the dynamic market environment (Singh, 2019). Over the years, there has been a greater usage of technology in optimizing operations in the SME sector in India (Kumar & Ayedee, 2021). Why is it so? What benefits does technology adoption offer to the SMEs leading to its increased usage? In line with this, the North –East India has also witnessed a surge in the number of SMEs. As of 27th May 2025, the North Eastern States of the country have a cumulative total of 17.35 lakhs MSMEs, out of which Assam occupies 66% of the total MSMEs of the NER (MSME Dashboard, Ministry of Micro, Small and Medium Enterprises, Government of India). Irrespective of this feat, there is also geographical dispersion of the SMEs within the State of Assam, with the majority of the SMEs being concentrated near the capital city (Hazarika & Barua, 2024). Bell Metal Industry which is one of the traditional artisan-based industries of Assam is situated in the small town of Sarthebari of Bajali District. It is located at a distance of about 70 km from Guwahati, the capital city of Assam. Even being located in a distant place and in the era of the technological revolution, this industry has been able to survive over many decades by practicing the craft form with the techniques learnt through heredity. How has this been possible? Are the present artisans oriented towards technology- adoption to ensure its sustenance? If so, what is their level of technology adoption orientation? Also, the bell metal artisans belong to different age groups and educational qualifications (Bhuyan & Singha, July 2023). Is there any significant relationship between the age group and educational qualification of the artisans and their level of technology-adoption orientation?
The present study is an attempt to answer these questions.

3. Revirew of Literature

The study of Mosbah, (2024) provides an overview of the trends, impacts, and benefits received by SMEs in their process of technology adoption. The findings of the study reveal that: (i) the rate of technological spending by SMEs vary across regions with developing countries showing a lower level of technological implementation. (ii)The most used technological platforms among SMEs are: delivery applications, digital advertising, and business software and social media platforms like Facebook, Twitter and Instagram. (ii) Technology adoption has a direct effect on the performance of SMEs as it provides them solutions to improve their performance and face the ever-increasing competition.

Rashed *et.al*, (2023) have examined the current scenario of technology and innovation management adaptation and have also discussed the challenges impeding technological adaptation in the manufacturing sector. Based on data collected from manufacturing organizations in Bangladesh through the help of interviews and structured questionnaires, the study found that most of the sampled firms are in the process of the planning stage for technological adaptation, however, the firms also feel that technological adaptation can reap benefits for their firms. The challenges that hinder the firm's technological adaptation include: expensive installation of technology, lack of technological know-how, lack of adequate resources, lack of adequate capital, availability of cheaper labor, lack of government support and limited access to credits.

Das *et.al*, (2020) have explored the important factors responsible for technological development that positively influence the performance of SMEs in developing countries. The study which is based on secondary data reveals that two factors namely: Institutional capabilities measured in terms of Availability of the latest technology: firm-level technology absorption, FDI and technology transfer, individuals using the internet, fixed broadband internet subscription and external capabilities measured in terms of international internet bandwidth are mainly responsible for technological developments in the SMEs. Through regression analysis, the study also reveals that institutional capabilities have a stronger impact on the sustainability of SMEs than external capabilities. Further, both factors become significant only when "time" is taken as a selection variable indicating the dynamism in the technological environment.

Through a review of the extant literature, Prasanna *et.al*, (2019) have identified six driving factors behind the technological upgradation of SMEs namely: social capital, link with MNCs and TNCs, innovation, sharing and networking, information technology, and adoption of productivity-enhancing technology. The study also highlighted three essential conditions behind technology adoption in SMEs: availability of a technologically skilled workforce, identification of opportunities for new technologies in the competition, and supporting working and policy culture.

Atalay *et.al*, (2013) have examined the relationship between innovation and firm performance of the automobile supplier industry in Turkey. Primary data are collected from the top managers of 113 automobile supplier firms through the help of a questionnaire. Through hierarchical regression analysis, the study reveals that technological innovation (product and process innovation) has a positive significant impact on the firm's performance. On the other hand, non-technological innovation (organizational and marketing innovation) has no significant effect on the firm performance.

Darbanhosseiniamirkhiz et.al (Sep-oct 2011) have discussed the technological adoption in the Persian Carpet industry of Iran. Through a case study of a famous carpet-making company "Alinasab Carpet Company", the authors found that innovative strategies implemented by the traditional industries have a positive impact on the

industry structure as well as a company's core competence, its competitive advantage and subsequently its market share.

Varukolu & Park-Poaps (2009) have examined the status of technology adoption in Indian apparel manufacturing firms and the organizational factors that affect the level of technology adoption. Primary data were collected from 108 apparel manufacturing firms located in Tirupur town, Coimbatore district, Tamil Nadu State. The study revealed that the production process in the apparel industry is mostly carried on traditionally through manual operations of machines and materials. However, in order to meet the fast-changing customer fashion trends, the firms are in the process of adopting technology into their operational domain. The four most adopted technologies by the firms are: the internet, High-speed sewing machines (HSSM) Modern fusing and pressing machine (MFPM) and Computers. The study also found that firm size, competitive advantage, technical skills and top-management support are important factors that affect the level of technology adoption in apparel manufacturing firms.

4. Research Gap

The works reviewed have explained the factors responsible for technology adoption in SMEs (Das *et.al*, 2020; Prasanna *et.al*, 2019 and Varukolu & Park-Poaps 2009); trends in technology adoption among SMEs (Mosbah, 2024); the positive impact of technology adoption and innovation strategies (Rashed *et.al*, 2023 Atalay *et.al*, 2013; Darbanhosseiniamirkhiz et.al Sep-oct 2011; Varukolu & Park-Poaps 2009); the different technologies used by SMEs (Mosbah, 2024; Varukolu & Park-Poaps 2009) and the challenges hindering technology adoption Rashed *et.al*, (2023). No study has been encountered that has described the benefits provided by technology adoption to the SMEs. Further, no study has also attempted to examine the level of technology-adoption orientation of the artisans in the Bell Metal industry of Assam, which is one of the MSME Clusters recognized by the Government of India.

The present study is an attempt to fill these gaps.

5. Objectives of the Study

The present study intends to achieve the following objectives:
a. To explore the different benefits provided by technology –adoption to the SMEs.
b. To examine the level of technology-adoption orientation amongst the bell metal artisans.
c. To check the nature of relationship between (i) the age - group of the artisans and their level of technology-adoption orientation and (ii) the educational qualification of the artisans and their level of technology-adoption orientation.

6. Hypothesis

(A) Ho1: There is no positive relationship between the age - group of the artisans and their level of technology-adoption orientation.
(B) Ho2: There is no positive relationship between the educational qualification of the artisans and their level of technology-adoption orientation.
(C) Ho3: There is no significant difference in the level of technology-adoption orientation amongst the artisans in terms of their age – group.
(D) Ho4: There is no significant difference in the level of technology-adoption orientation amongst the artisans in terms of their educational qualification.

7. Research Methodology

The present study is descriptive and empirical. It is based on both primary and secondary data. Secondary data were accessed from articles from different journals and Government Reports. Primary data were collected from 50 master bell metal artisans of Sarthebari through the help of a structured interview schedule. The convenience sampling method was used to select those 50 samples. Both descriptive and inferential statistics were used to analyze data. An index was also constructed to measure the level of technology adoption orientation of the bell metal artisans.

The total number of variables for measuring Technology- Adoption Orientation = 12 adopted from (Gatignon & Xuereb, February 1997).

8. Resutls and Discussions

8.1 Benefits Provided by Technology-Adoption to the SMEs

Technological development is indispensable for SMEs to become competitive, thereby leading to sustained growth (Das *et.al*, 2020). A study by (Pylaeva *et.al*, 2022) reveals that since SMEs suffer from resource constraints and a higher degree of vulnerability, their technological development is subjected to higher instability. However, prolonged use of worn-out equipment cannot bring technological innovation. So, technology adoption in SMEs provides a number of benefits such as a decrease in the use of resources, a decrease in the cost of production, flexibility in asset management and higher gross profit. (Estrada *et.al*, 2019)

have revealed that in terms of technology adoption, SMEs mostly operate with modern machinery and equipment with its acquisition mainly determined by the technical-economic criteria. The benefits offered by technology adoption among the SMEs include: productivity, process improvement, lower costs of production and efficiency.

Darbanhosseiniamirkhiz et.al (Sep-oct 2011) opine that only through technological adoption a traditional industry can be made into a productive one resulting in its sustainability. Two key benefits offered by technological adoption to an SME are: an increase in profit (by reducing defects, repeated work, scrap and waste, inspection cost and inconsistent results) and an increase in revenue (by increasing throughput, capacity, quality, customer satisfaction and efficiency). The study (Thomas *et.al*, 2008) has highlighted that the benefits derived by the manufacturing SMEs through technology adoption include: Increased customer base, reduced product cost through optimum exploitation of resources, Minimisation of inspection cost, improved process control and improved delivery performance through greater integration of operational processes and manufacturing tasks. (Swamidass & Winch, 2002) have revealed that Focused production, progress towards zero defects, extension of product line and progress towards zero inventories are some benefits that technology adoption can reap for firms in the manufacturing sector.

Figure 2 describes the benefits offered by technology adoption in SMEs as evident from the literature. Profit maximization is the primary objective of any type of business. However, for SMEs which operate with minimal capital investment, profit becomes the only means for its sustenance. SMEs derive profit through an increase in their revenue which is possible through the:

(i) **Increase in Productivity**: With the aid of technology the manufacturing tasks are integrated, process control is ensured and mistakes that were committed manually are avoided. So, the time and effort required to produce a product is decreased resulting in increased productivity.

(ii) **Reduction in cost of Production**: Technology adoption results in optimum utilization of resources, and curtails many costs associated with work done manually such as inspection cost, cost of repeat work, cost of waste and scraps, etc. This helps in lowering the cost of production of the products.

(iii) **Increase in Customer Base:** SMEs that adopt technology streamline their business processes resulting in efficiency, improved product quality, improved delivery performance and better customer satisfaction. This in turn boosts the morale of the SMEs and they look to extend their product line resulting in an increase in their customer base.

Fig. 2 Diagrammatic Representation of the Benefits of Technology Adoption in SMEs.
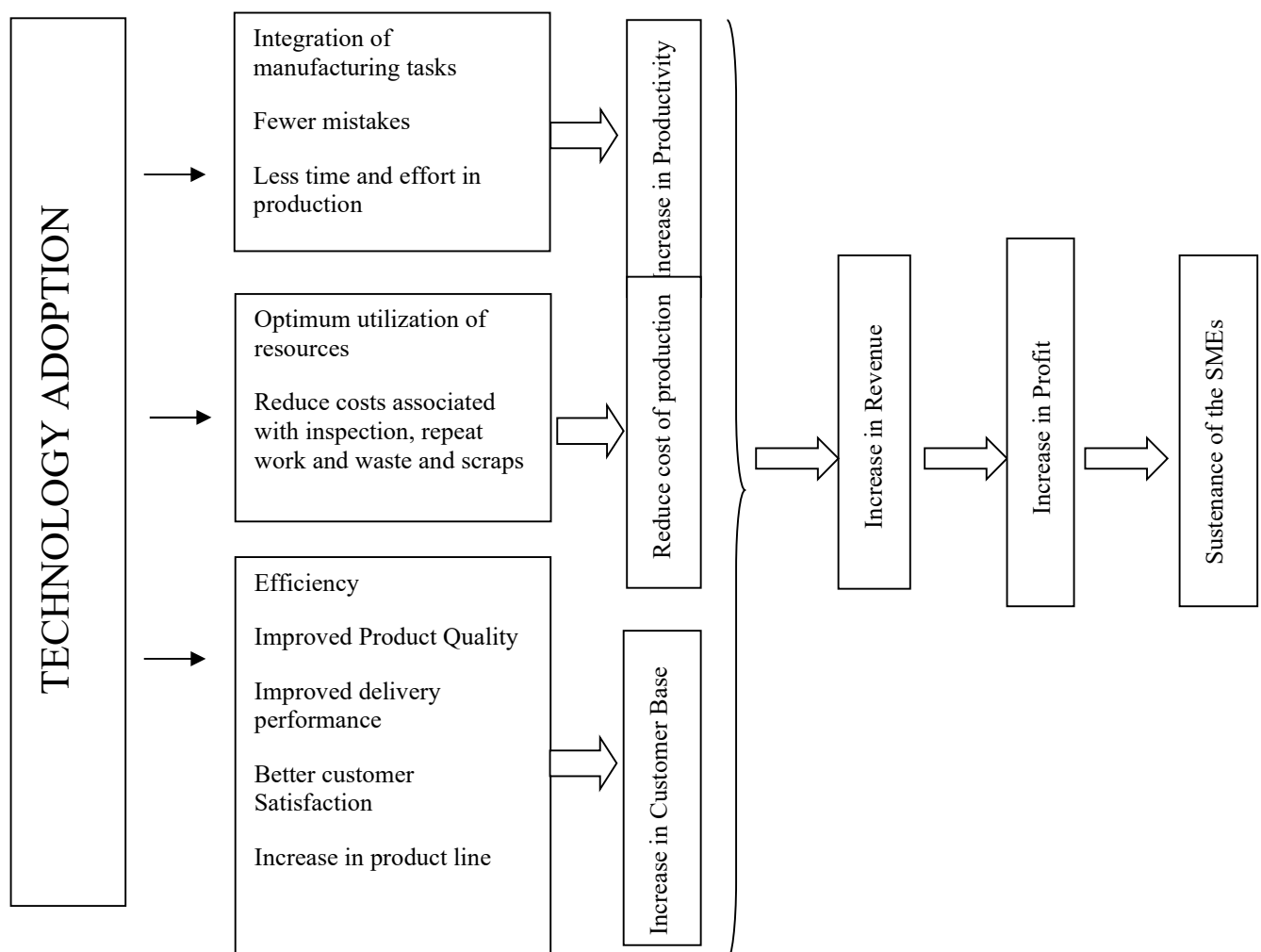
8.2 Level of Technology-Adoption Orientation Among the Bell Metal Artisans

The categorization of the level of technology-adoption orientation is based on the mean and standard deviation. The mean of the technology-adoption orientation is 0.760 and the standard deviation is 1.041. The high level of technology-adoption orientation is 0.760+ 1.041 = 1.801 (2 approx.) and above while the low level of technology-adoption orientation is 0.760- 1.041= -0.281 (assumed to be 0).

Table 1: Categorization of the Level of Technology- Adoption Orientation. Source: Computed by the Authors

S. No.	Level of Technology-Adoption Orientation	Score
1	High	Above 2
2	Medium	Up to 2
3	Low	0

Table 2: Level of Technology- Adoption Orientation of the Bell Metal Artisans. Source: Field Survey

Sl. No.	Level of Technology-Adoption Orientation	Count	%
1	High	5	10
2	Medium	18	36
3	Low	27	54
	Total	50	100

Table 2 reveals that the majority (54 per cent) of the artisans have a low level of technology-adoption orientation, followed by artisans who have a medium level of technology-adoption orientation. Only 10 per cent of the artisans have a high level of orientation in the dimension of technology adoption. So, the findings reveal that there is scepticism amongst the artisans in technology adoption. They mostly prefer to carry on their operations using the traditional methods and the traditional tools which they have observed being utilized by their ancestors. However, the result also reveals a positivity among the artisans who have already or are in the process of adopting technology in their daily operations indicating their willingness to go as per the needs of the market.

8.3 Nature of Relationship Between The (i) The Age - Group of The Artisans and Their Level of Technology-Adoption Orientation and (ii) The Educational Qualification of the Artisans and Their Level of Technology-Adoption Orientation

The correlation analysis result as shown in Table 3 reveals that in the case of (i), the correlation value is -0.019 which is negative and also insignificant (*p-value>0.0.5)*. Since the present study considers a 5 % level of significance. So, Ho1: *There is no positive relationship between the age - group of the artisans and their level of technology-adoption orientation* is accepted which means that there is a negative insignificant relationship between the age group of the artisans and their level of technology-adoption orientation. Also, in the case of (ii) the correlation value is -0.023 which is also negative and insignificant (*p-value>0.0.5)*. So, Ho2: *There is no positive relationship between the educational qualification of the artisans and their level of technology-adoption orientation* is accepted which means that there is a negative insignificant relationship between the educational qualification of the artisans and their level of technology-adoption orientation. Thus, it can be inferred that in the bell metal industry of Assam, the traditional educational system has no positive bearing on the level of technology adoption orientation among the artisans.

Table 3: Result of Correlation Analysis

Age - group of the artisans and their level of technology-adoption orientation				
	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Pearson's R	-.019	.108	-.135	.894[c]
Spearman Correlation	-.035	.118	-.243	.809[c]
N of Valid Cases	50			
Educational qualification of the artisans and their level of technology-adoption orientation				
Pearson's R	-.023	.169	-.161	.872[c]
Spearman Correlation	.041	.142	.284	.777[c]
N of Valid Cases	50			
a. Not assuming the null hypothesis.				
b. Using the asymptotic standard error assuming the null hypothesis.				
c. Based on normal approximation.				

9. Hypothesis Testing Result

Normality tests were conducted on both the parameters of the age-group and the educational qualification of the artisans. The result of the normality tests as shown in Table 4 reveals that the data are not normally distributed.

Table 4: Normality tests Results

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Age	.338	50	.000	.750	50	.000
Education	.321	50	.000	.766	50	.000
a. Lilliefors Significance Correction						

The Kruskal Wallis test result which is shown in Table 5 reveals that, in the case of Ho3, the p-value is 0.415 which is above 0.05. So, the null hypothesis *Ho3: there is no significant difference in the level of technology adoption orientation amongst the different groups of Bell Metal artisans (in terms of their age groups)* is accepted. It indicates that there is no difference in the level of technology adoption orientation of the artisans in terms of the different age groups to which they belong. In the case of Ho4, the p-value is 0.044 which is less than 0.05 so, the null hypothesis *Ho4: There is no significant difference in the level of technology adoption amongst the different groups of Bell Metal artisans (in terms of educational qualification)* is rejected. It indicates that there are differences in the level of technology adoption orientation of the artisans based on their educational qualifications.

Table 5: Kruskal Wallis Test Result

Age- Group	
	Technology –Adoption Orientation
Chi-Square	1.760
df	2
Asymp. Sig.	.415
Educational Qualification	
	Technology –Adoption Orientation
Chi-Square	8.122
df	3
Asymp. Sig.	.044
a. Kruskal Wallis Test	
b. Grouping Variable: Age	
c. Grouping Variable: Educational Qualification	

10. Conclusion

The technological revolution has exposed firms to new ways of doing business. The SMEs are not lagging in this regard. Technology has become one of the vital components in the daily operations of the SMEs. However, its adoption is not consistent in the SMEs of different regions. Irrespective of this, SMEs which foster technology adoption reap multiple benefits from it. The study reveals that technology- adoption enables SMEs to earn more profits through an increase in revenue which is again facilitated by an increase in productivity, reduction in cost of production and increase in customer base. Also, by examining the level of "technology adoption" orientation of the artisans in the Bell Metal Industry of Assam, the study found that the majority of the artisans portray a low level of "technology adoption" orientation which indicates their conservative way of performing their operations. Further, the study also found a negative and insignificant relationship between the two demographic characteristics i.e. age- group and educational qualification of the artisans and their level of "technology adoption" orientation. So, the suggestion is made to implement skill-based courses where dimensions of technology usage are integrated into the course curriculum. This would make the children of the artisan community not only aware of the technology inputs but they can also learn how to apply different technology inputs. This way, there is likelihood that future generation of the artisan community to be more technology-adoption-oriented. This is only possible with the combined effort of different stakeholders like: the Government, academic institutions and industry partners.

Conflict of Interest

The authors declare no conflict of interest.

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