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Technology Espousal and Intervention Strategy for Small Rural Manufacturing Firms

Vipul Chalotra*, Rachita Sambyal**

Abstract

ICT has revolutionised the economics of the manufacturing sector, resulting in enhanced production capabilities, profitability, market share, employee welfare and competitiveness. The paper focuses on ICT adaptation, usage, moderating role of Govt. in enhancing ICT usage and challenges encountered in the use of ICT in small rural manufacturing firms. Data were collected from 44 managers of small rural manufacturing firms located in the industrial estate of district Udhampur, UT of J&K. After data purification; responses were analysed using descriptive analysis, multiple regression, and moderation given by Andrew F. Hayes. The study confirmed the use of ICT as a tool for enhanced communication, improves information sharing and communication with internal & external stakeholders and has a low moderating role of Govt. in the relationship between ICT-induced information sharing with internal and external stakeholders and a firm's competitive strength. High cost of ICT equipment, lack of supporting infrastructure, erratic power supply, absence of trained manpower, limited incentives from public agencies etc., are reported constraints in the use of ICT in small manufacturing firms. Since ICT usage significantly influences differentiation, Govt organisations should actively come forward and demonstrate ICT usage in varied areas like the development of new products, quality control, customer relationship management, gathering market intelligence, training etc., in small rural manufacturing firms.

Keywords: ICT, Small Firms, Moderation

Introduction

The role of ICT in enhancing a firm's competitive advantage has remained a focal issue for academicians and researchers. Hitt and Brynjolfsson (1996) found that ICT helps in improving productivity and value creation for consumers. Soh and Markus (1995) opined that ICT impacts BPR, profitability, coordination, adaptability and decision-making. However, the competitive structure determines the magnitude & usage of ICT by a firm. Essentially, in a competitive environment, synergy among business resources, human capabilities, and ICT pays the way for enhanced organisational performance (Teo & Ranganathan, 2003). The impact of ICT mechanism affecting competitive advantage has been viewed from the perspective of organisational learning, information dissemination, knowledge management and core capabilities (Huang et al., 2009; Tippins & Sohi, 2003). ICT usage is common in tourism, retail, textiles, automobiles, banking, insurance, and the target range is B2B transactions and B2C transactions. Some travel agents, hotel & resort owners, restaurants, and wellness centres are intensively using ICT in promoting travel recommendations, local tourism information, personalised services, booking airline tickets and travel packages, and selling leisure products, art and culture.

Empirically, the usage of the internet in the small retail sector is found to be high due to the need for reliable delivery and customer preferences for specialised products and customised services. Textile products, along with books, videos, music and software, are increasingly being sold on the internet. However, for fear of copying designs, SMEs do not post detailed information. B2B transactions are common in the automobile industry, and many small manufacturers have yet to install EDI due to high costs. Whereas large manufacturers use EDI to meet the changing demand for just-in-time delivery, eliminating errors associated with the re-entry of the order information and reducing lead time inventory. Barriers to internet commerce vary among sectors ranging from the dominance of relatively small agents (Tourism), the problems of confidence building (Retail), the high

* Assistant Professor in Commerce, Govt. Degree College (Boys), Udhampur, J&K, India. Email: vipulchalotra@gmail.com
** Assistant Professor (IT & Telecom), UIAMS, Panjab University, Chandigarh, India. Email: rachitasambyal@gmail.com

cost of installation of EDI (Textile & automobile) etc. The bulk of empirical researches are based on large & medium companies and ignoring SMEs and the value that ICT could add to their businesses (King, 1994; Palvia, 1994). The Atmanirbhar Bharat campaign of the Govt. is aimed at reviving & boosting manufacturing, especially in rural areas, for the creation of employment, equity & social justice, regional development and above all self-sustaining & self-generating economy.

The present study focuses on ICT adaptation, usage, moderating role of Govt. in enhancing ICT and challenges in ICT usage in small rural manufacturing firms for competitive advantage.

Review of Literature

Van der Wieleal (2004) found that ICT by restructuring organisations, production processes, product development etc., in Germany and the Netherlands has led to capital deepening resulting in increased labour productivity in services firms. An innovative business environment is needed to lay the fundamentals for the efficient use of ICT and stimulating productivity growth. Ozturan (2008) found that SMEs are using accounting and office software for administrative purposes. Owners and managers with a positive attitude and inclination towards IT adaptation are more successful in implementing new technology. Drivers of IT adoption and implantation are found to be a desire for accurate information and its processing and comfort level with technology. Jamal et al. (2013) analysed the impact of information technology on 185 Malaysian manufacturing firms between 2000-2006. The results revealed that IT expenditure positively effect the growth of the firm apart from other factors like the year of establishment, productivity, number of employment and capital-labour ratio. Chi and Sun (2015) suggested that a firm desire to compete should not only digitise its operations but accurately perceive customer needs and identification of internal and external constraints. Other suggestions included are a motivational-based performance system for employees to enhance decision-making and creativity. Nwankpa and Roumani (2015) investigated mediating effects of digitisation between IT capability and firm performance based on data collected from 167 CIOs from US firms. The study found that digital technologies provide unprecedented convergence of people, businesses and things, leading to improved customer experience and performance. Digital transformation at the firm level is also influenced by IT capabilities and firms' financial resources.

Kurkoon et al. (2016) investigated the relationship between purchasing & adopting green IT behaviour and supporting green-imaged businesses. It was found that the usage of eco-friendly IT products is influenced by the perception, both physically and psychologically, of positive benefits than the usage of non-green products, green indicators on product packaging etc. Consumers are motivated by peers, such as friends, family, colleagues and the culture of the workplace for ICT usage. Consumer demography and educational experience influence consumer intention to purchase or use eco-friendly IT products. Babalola and Soyemi (2021) investigated ICT usage behaviour in consumer goods manufacturing companies in Nigeria. Primary data were collected through a survey of 19 manufacturing companies, and the sample consisted of 394 respondents. The results suggested that to design & produce quality products, share information with customers & suppliers, market share and ICT usage be enhanced across departments and social media platforms. Malone and Rockart (1922) found that information technology reduces coordination costs which in turn leads to the substitution of machines labour, optimum usage of resources and emergence of more coordination-intensive structures. Moravian Geographical Reports (2021) examined a sample of 26 rural manufacturing small/medium-sized enterprises of the Czech Republic to elicit their economic linkages and the factors affecting the nature of local/regional sourcing and purchasing. Statistically, it was revealed that small companies find difficulties in selling due to small and insufficiently diversified markets. Kutlu et al. (2021) identified and summarised the effects of incentives on the adoption of new technologies by firms. Data were collected electronically and manually from 80 studies, and over 1108 regression coefficients were used to draw inferences. The study concluded that new technologies helped to increase productivity, exports & output and increase survival probability. The intervention identified ranged from direct to indirect, depending on the nature of the industry. It included agricultural microcredit, input vouchers, input subsidies, vouchers to finance improved technology and access to crop insurance.

For manufacturing and service sectors, technology incentives, production & management consultancy and skill upgradation through corporate training are preferred.

Conceptual Analysis and Framework

Empirically, ICT act as a driver and enabler for the advancement of the business sector to obtain sustainable competitive advantages (Francoand Garcia, 2017). It integrates departments, facilitates outside collaboration, seeks economies of scale and acquires new business opportunities. It contributes to output through capital deepening and the emergence of more coordination-intensive structures. Studies by Melville et al. (2004), Kohli and Devaraj (2003), Dedrick et al. (2003), Bartelsman and Doms (2000), Brynjolfsson and Yang (1996) confirmed the positive effect of ICT on firm performance in terms of market share, production capacity, profitability and value addition. The other performance measure includes service quality, process efficiency, cost reduction, process flexibility and customer engagement. The secondary literature provided a number of benefits of ICT adaptation - improved competitiveness (Giovanni & Mario, 2003), increase in speed & reliability of transactions (OECD, 2004), close relations with business partners and customers, overall long-term growth of the business (Prem Kumar & Roberts, 1998), cost reduction (Lymer et al., 1997), more effective marketing, new product development & better access to information & training (Lauder & Westall, 1997) and enhanced business performance (Barua, 1995). The reasons obstructing ICT adaptation are cost (Ernst & Young, 2001), inadequate financial resources (Poon & Swatman, 1996; Reynolds, 1994), lack of skill (Duncombe & Heeks, 2001) etc. Competitive advantage is measured through productivity & sales growth (Claud, 2018), product innovation, quality products, market share, customers' satisfaction, innovation, cost savings, flexibility and delivery (Kotane & Kuzmina-Merlino, 2015; Salah, 2014), cost leadership and differentiation (Helms, 2016), business competitiveness (Alberto & Fernando 2007). ICT adoption is constraint by numerous variables-high cost & supporting infrastructure (Eze & Chinedu-Eze, 2018), lack of access to modern ICT devices & inadequate institutional financing (Mwantimwa's, 2019), unfamiliarity with technology (Reynolds et al., 1994), lack of skill among employees (Mehrtens et al.,2001) etc.

Fig 1 shows the conceptual framework of the study.

On the basis aforesaid literature review, the following four hypotheses have been formulated:

Hyp[1]: ICT act as a tool for a firm's competitive advantage.

Hyp[2]: ICT improves information sharing with internal and external stakeholders and significantly impacts a firm's competitive strength.

Hyp[3]: Govt. support moderates the relationship between ICT-induced information sharing with internal and external stakeholders and the firm's competitive strength.

Hyp[4]: ICT adoption among rural manufacturing firms is constraint by multiple variables.

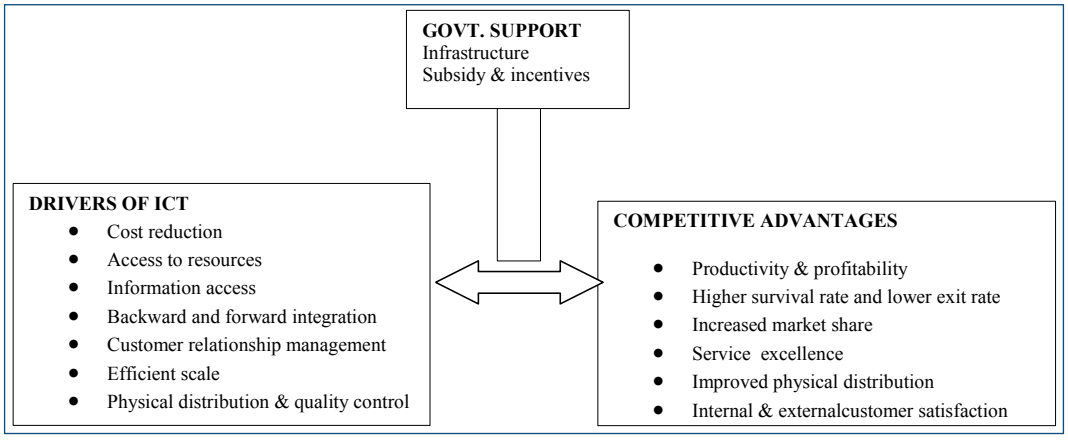

Fig. 1: ICT and Competitive Advantage

Sample Profile and Industrial Structure of District Udhampur

District Udhampur is one of the 20 districts of UT J&K with an area of 2380 sq. Km. The district area falls between the latitude of 32°-34' to 39°-30' North Longitude of 74°-16' to 75°-38' East and is bounded by Anantnag in the north, Rajouri in the west, Jammu in the southwest, Doda in the east, and Kathua in the southeast. The temperature ranges from 42 degrees in summer to 1.5 degrees in winter. It is drained by the Chenab and Tawi rivers. Of the district population of 557689, the percentage of rural and urban is 80.60 & 19.40, respectively. The majority population is Hindus (73%), followed by Muslims (26.23%), Sikhs (1.27%), Christians (0.28%) and others 0.02%. The literacy rate is 58.49%. Administratively, the district is divided into 4 subdivisions, 8 tehsils and 17 blocks. Of the total working population, the percentage distribution among cultivators, agricultural labourers, household industry workers and other services are 23.67,1.58,0.5 and 74.24, respectively. 24.78% of the area is under cultivation, and major crops grown are rice, corn (maise), jowar (sorghum) and barley. Livestock hides, raw wool, dried milk etc., are local trade items. To accelerate the process of industrial development in UT of J&K, the organisation involved are- DIC Kashmir & Jammu (Directorate of Industries, SIDCO (J&K State Industrial Development Corporation), SICOP (Small Scale Industries Cooperative), Directorate of Handicrafts, Directorate of Handloom, Handicraft Development Corporation, Handloom Development Corporation, JK Cements Pvt. Ltd., JK Industries, JK Minerals and Entrepreneurial Development Institute.

The bulk of Industrial activities in district Udhampur is unorganised and in a small-scale sector. At present, there are two Industrial Estates, namely, Thanda Paddar and IID Centre Battle Ballian. The total land acquired, land developed, the number of plots allotted, number of units in production and units registered are 11004 ha, 573.40 ha, 208 number, 70 number and 1368 units. The industrial units registered with the Directorate of Industries, Udhampur during 2015-2020 are 3938(2015-2016), 3963(2016-2017), 3966(2017-2018), 2541(2018-2019) and 2550 (2019-2020), respectively. Units registered with District Industrial Centre during 2012-2013 are 13(2012-2013), 8(2013-14), 5(2014-15), 5(2015-16), 25(2016-17), 3(2017- 18), 8(2018-19). The nature of units operating is agro-based, ready-made garments & embroidery, woollen, silk & artificial thread-based clothes, chemical, rubber, plastic & petro, mineral-based product, wood/ wooden based furniture, transport equipment, paper & paper products, repairing & servicing, metal-based (steel fab.), electrical machinery etc. Janglegali and Sukhalgati areas are rich in coal, bauxite, magnetite and limestone deposits. Lain Thakkar Sui area is known for Palegozoic/ China clay deposits.

The study is based on 47 SSIs operating under SIDCO and SICPO in District Udhampur of J&K State. To begin with, a list was obtained from the Directorate of Industries & Commerce (DIC) for managers of 47 functional units. The Census method was used in collecting responses from the managers through a self-developed pretested schedule prepared after consulting experts and an extensive review of the literature. The actual response was obtained from 44 managers after visiting their respective firms 3-4 times. The units contacted were 34 located in SIDCO and 10 in SICOP industrial estate. The schedule for managers was subdivided into general information and information about ICT usage based on ranking and ordinal scale (5<-->1) ranging from 'strongly disagree' (1) to 'strongly agree' (5). After the pilot study, the schedule was refined after the addition and deletion of several ambiguous & erroneous items. The raw data so obtained was subjected to the multivariate data reduction technique of factor analysis through SPSS (15.0 version). The principal axis procedure of factor analysis, along with the varimax rotation procedure with the needed series of iterations, was applied to arrive at a stable factorial design and enhancing the interpretability of the factor. For the purpose of describing the underlying factor structure, the eigen value-one criterion, KMO as a measure of sampling adequacy and Bartlett's test of sphericity were used. The reliability of the findings was statistically tested with the help of Cronbach's Alpha method. Interactions with experts led to the establishment of face & content validity of the ICT usage construct. Further, construct validity was tested using the KMO measure of sampling adequacy. The secondary information was collected from various sources, namely, bulletins, the digest of statistics, books, magazines, online journals & hard copies of journals, annual action plans etc.

Product-wise distribution of units is- Cement (8), Battery/ Lead/Alloy (5), Pesticides/Insecticides (3), Conduit pipes (2), Menthol (2), Guns (2), Steel(3), Gates/Grills/Varnish/ Paint (5) and others (11). Number of units with initial investment are-16(Rs.1-25Lakhs), 8(Rs.25-50Lakhs),

3(Rs.50-75Lakhs), 2(Rs.75-1 crore) and 15(above Rs. 1 crore). Age-wise distribution of managers is 20 – 30 years (4), 30 – 40 years(10), 40 – 50 years(20) and 50 – 60 years (10). Qualification-wise number of managers are 8 (Metric),13 (Higher secondary),18 (Graduation), 9 (Post graduation) and 1 (Others). On prior work experience-wise, the classification of managers is 1 – 5 years (8), 5–10 years (25), 10 – 15 years(5), 15 – 20 years (2) Above 20 years (4). Annual turnover-wise units with Rs.1 – 25 lakhs, Rs.25 – 50 lakhs, Rs.50 – 75 lakhs, Rs.75 – 1 crore and above Rs.1 crore are 21, 6, 1, 2, 14, respectively.

Data Analysis and Interpretation

The responses collected from 44 managers through questionnaires are tabulated, purified, and analysed using SPSS. The hypotheses-wise testing and results are as under.

Hyp[1]: ICT act as a tool for a firm's competitive advantage

Descriptive statistics reveal that 100% of managers opined ICT as a tool for a firm's competitive advantage. The ICT tools used are reported to be Telephone, Fax, E-mail, and Internet. Based on the responses of managers, the range has been evolved as low (≤ 3), medium ((≤ 4) and high(=5) on five points Likert scale. Table 1 & Fig. 2 display the mean response of managers that ICT act as a tool for a firm's competitive advantage.

Table 1: Managers Perception about ICT as a Tool for a Firm's Competitive Advantage

Range	*Frequency*	*Percentage*	*Cumulative Percentage*
Low	1	2.3	2.3
Medium	35	79.5	81.8
High	8	18.2	100

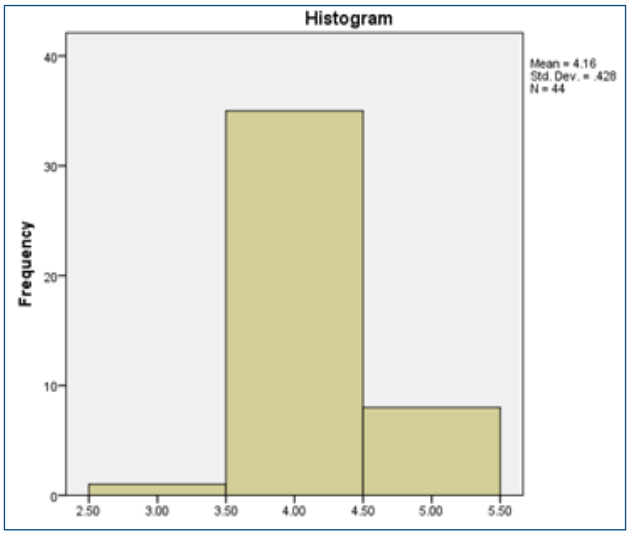

Fig 2: Mean Response for ICT as a Tool for a Firm's Competitive Advantage

Accordingly, 2.3% of managers fall in the range of low, 79.5% in medium, and 18.2 in the high range of perception. This is supported by values shown in histogram. Thus, the hypothesis `*ICT act as a tool for a firm's competitive advantage'* holds true.

Hyp[2]: ICT improves information sharing with internal and external stakeholders and significantly impacts a firm's competitive advantage.

Tables 2, 2(a), and 2(b) shows the relationship between the dependent variable(Organisational competitive advantage) and independent variable (ICT improves information sharing with internal and external stakeholders) given a set of data obtained from 44 managers of rural SSIs. The assumption of homoscedasticity and normal distribution of data was checked by graphic plotting of predicted values against the residuals and correlation matrix. 68.4% variation in organisational competitive advantage is explained by independent factors.

Table 2: Model Summary from Multiple Regression

Model	*R Square*	*Adjusted R Square*	*Std. Error Estimate*	*Durbin-Watson*
1	.827[a]	.684	.20847	2.117

Predictor(Constant): Organisational competitive strength is Regression: ICT improves information sharing with internal and external stakeholders.

Table 2(a): Output from ANOVA

Model	*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Regression	6.776	1	6.776	155.916	.000[b]
Residual	3.129	43	.043		
Total	9.905	44			

Table 2(b): Coefficients[a]

Model	*Unstandarised Coefficients*		*Standardised Coefficients*	*t*	*Sig.*
	B	*Std.Error*	*Beta*		
(Constant)	.395	.229		23.654	.001
Regression	.894	.072	.827	12.487	.000

The ANOVA Table 3 indicates that the model, as a whole, is a significant fit to the data. The Durbin-Watson value is also close to the threshold level. The value of F in Table 2(a) and the value of `t'in Table 2(b) are also significant. Thus, the hypothesis` *ICT improves information sharing with internal and external stakeholders and significantly impacts organisational competitive advantage"* holds true.

Hyp[3]: Govt. support moderates the relationship between IC Tinduced information sharing with internal and external stakeholders and a firm's competitive strength.

The PROCESS developed by Andrew F. Hayes, which does the centring and interaction terms simultaneously, has been used to confirm the impact of moderators in the relationship between the independent and dependent variables (Table 3).

Table 3: Output from Moderation

Description	*R*	*R-sq*	*MSE*	*F*	*df1*	*Df2*	*p*
Model summary	.4828	.2331	1.0016	6.2305	2.0000	41.0000	.0043
Model Coefficient	Coefficient	SE	t	p	LICI	ULCI	
Constant	3.5083	.8480	4.1370	.0002	1.7957	5.2210	
Interaction	.3113	.1786	1.7428	.0889	.0494	.6721	
Direct effect of X on Y							
	Effect	SE	t	p	LICI	ULCI	
	.3113	.1786	1.7428	.0889	.0494	.6721	
Indirect effect of X on Y							
	Effect	Boot SE	BootLLCI	BootULCI			
	.1068	.0902	.0241	.3303			

Model = 4, Y = Information sharing, X = Competitive Advantage, M = Govt. Support, Sample size = 44 Number of bootstrap samples: 1000; Level of confidence interval: 95.00

Model 4 has been used along with X as independent (ICT-induced information sharing with internal and external stakeholders), Y as the dependent variable(Firm's competitive advantage), and M as moderating variable (Govt. support). The moderator provides a low response in the relationship between the independent and dependent variable as evident from Table 3, R2 23%, F(6.235), p<.05. The value of the direct effect of X on Y also lies between ±1 of LICI and ULCI. The indirect effect of X on Y is also significant. Thus, the hypothesis` *Govt. support moderates the relationship between ICT-induced information sharing with internal and external stakeholders and the firm's competitive advantage'* partially holds true.

Hyp[4]: ICT adoption among rural manufacturing firms is constraint by multiple variables.

Table 4 shows mean response and ranking of responses in adoption of ICT among rural manufacturing firms.

Table 4: Challenges in Adoption of ICT Usage in Rural Manufacturing Firms*

Sr. No.	*ICT Adoption Constraints*	*Mean Response*	*Ranking of ICT Constraints*
1.	Complexity of new technology	4.05	III
2.	Attitude towards risk and change	3.54	IX

Sr. No.	ICT Adoption Constraints	Mean Response	Ranking of ICT Constraints
3.	Inefficient and poor quality services	3.00	XII
4.	Poor connectivity	4.00	V
5.	Lack of relevant content	3.32	X
6.	Lack of ICT infrastructure skill	4.12	II
7.	High cost	3.96	VI
8.	Lack of ICT benefit awareness	4.14	1
9.	Paucity of time to spend on technology	3.22	XI
10.	Problem of system integration	3.86	VII
11.	Software availability	3.74	VIII
12.	Little support from Govt.	4.02	IV

Source: Survey.

The ranking of responses in descending order is lack of ICT benefit awareness, paucity of time to spend on technology, the complexity of new technology, little support from Govt., poor connectivity, high cost, the problem of system integration, software availability, attitude towards risk and change, lack of relevant content, paucity of time to spend on technology and inefficient and poor quality service. Thus, it can be inferred that challenges before ICT adoption are unawareness, lack of ICT skills, and complexity of new technology, which are managers related, whereas others are related to little support from the Govt.

Conclusion and Managerial Implications

The paper investigated the ICT impact on a firm's competitive advantage, its usage in information sharing with internal and external stakeholders, the moderating role of Govt. support in enhancing competitive advantage and challenges in the use of ICT in 44 small rural manufacturing firms in district Udhampur of UT J&K. The usage of desktops, laptops, mobile phones and emails are highly rated and used in sharing information about SCM relationships, inventory performance, service mix, warehousing, production capacity, systematic purchasing, material handling, diversified markets, promotional effectiveness and planning & improved implementation which eventually improves competitive strength of a firm. The results are supported by Grazzi and Jung (2015) & Eze and Chinedu-Eze (2018), who opined that ICT usage optimises the efficiency of internal processes, widens markets and increases firms' competitiveness. The support of Govt. in moderating the relationship between ICT-induced information sharing and competitive strength is found to be low. Keeping the future of ICT, small rural manufacturing firms should prioritise ICT applications and adopt them along the value chain. ICT-induced CAD and ERP brings production efficiency and organisation competitive advantage (Papa et al., 2018). Other application areas of ICT usage are computer-aided design in new product development, standardisation of product quality, customer engagement, CCTV to monitor employees' activities, resource optimising system and tracking the movement of the firm's resources through radio frequency identification. Robotics and artificial intelligence may be applied in production and management processes. Cost, access and usage are the prime constraints in ICT adoption by small rural manufacturing firms. To intensify the usage of ICT & to build confidence among manufacturers, the basic problems of small firm's such as low production capacity, low brand awareness, and limited markets through ICT be addressed first. ICT capabilities of personnel can be enhanced through organisational learning & training, and development by CII. Enhance collaboration and cooperation with institutes of higher learning for sharing problems and communicating solutions would be of immense usage. Public investment in improving basic infrastructure, such as uninterrupted power supply, improvement in telecommunications, roads connectivity, etc. be undertaken to support the growth of ICT by the rural manufacturing firms.

Besides these, there is huge potential for developing industries such as bakery products, lamination, cold storage, food processing, dairy and dairy products, silk weaving & reeling, extraction of oils, herbs and flowers, laundry soap etc. The promote extensive use of ICT in small manufacturing firms requires a multi-prolonged strategy. At the first step, simple, easy-to-use ICT tools be popularised through joint local government- university

projects, media mix and associations of small firms contact by technocrats. This will help to create awareness about the use of ICT in the operational-mix and reaching wide markets. Secondly, EDP programmes be recognised as an important driver of change. Through these programmes, young entrepreneurs can be taught the use of ICT as a key aspect of economic dynamism, exploiting opportunities and willingness to take risks. This will yield economic growth and competitiveness for small manufacturing firms. Thirdly, to sustain the use of ICT, skills need to be imparted to employees through training at ITIs and free professional assistance through camps organised near industrial clusters. The results will have a substantial policy in understanding the level of ICT penetration and its usage by small firms. Lastly, public institutions must devise some support mechanism to ensure the continuous use of ICT by small firms.

Though utmost care is taken to collect responses from managers, still respondent error cannot be wholly eliminated. The role of the external environment in the digital transformation of rural SMEs can also be taken for future research.

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