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Adoption of Improved Technology in India's Small-scale Industries: Evidences from a Field Survey

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Institute for Studies in Industrial Development
4, Institutional Area, Vasant Kunj, New Delhi - 110 070
Phone/Fax: +91 11 2689 1111; E-mail: info@vidur.delhi.nic.in
Website: http://isid.org.in

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Abstract

[Based on a field investigation of 399 small-scale industries in three Indian states, i.e. West Bengal, Haryana and Maharashtra, collected during April-June 2000, the present paper analyses the pattern of awareness, acquisition and adoption of technological changes in small-scale industries. It also examines possible constraints of non-adoption of improved technologies. The pattern of use of various components of Information Technology (IT) by small entrepreneurs is also discussed.

Following a broader definition of technological changes, the paper identifies major causes that are inhibiting the adoption of improved technologies and examines the role of existing policies and programmes in overcoming them; it also analyzes the present procedure for availability of finance to SSI units for upgrading and modernizing their technologies and suggest measures for facilitating such services to small-scale entrepreneurs; further it evaluates the requirements of improvements in skills, education and training both of entrepreneurs and workers among the SSI units to absorb and implement technologies in their diverse manifestations. Rural-urban contrasts are brought out markedly while discussing these issues.

The paper finds a better performance by the urban located units in terms of rate of adoption of all types of improved technology. Thus, locational attributes are clearly at work for different types of technological innovation and adoption. It also finds 'shortage of funds', *inter alia*, to be the most crucial factor for non-adoption of improved technology, which clearly implies an inadequacy of institutional support for these industries as a whole and rural units in particular. The paper concludes with many feasible and robust suggestions towards removal of all types of barriers for the adoption of improved technologies, which is vital for the long term growth of the SSI sector.]

JEL Classification

O31, L11

Keywords

Small Scale Industry; Improved Technology; Technological Innovation.

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Partha Pratim Sahu[♣]

1. Introduction

Growing concern for employment generation has created renewed interest in small-scale industries (SSI) in all developing countries. Studies show that these industries are not only labour-intensive, but also use capital more efficiently (World Bank, 1987; Vani, 1997). Besides SSI relies on local resources; contributes to regional dispersal of industries; adapts technology and labour market flexibility as well as an ability to spread the linkage effects of large-scale industries. But unfortunately, of late there has been less emphasis on technology, which seems to have inflicted a cascading impact on their competitiveness. As small enterprises realize the need to link up with large ones, they are having a relook at technology options, which would improve productivity, effectiveness and competitiveness.

The spread between the share of SSI in manufacturing employment and value added is indicative of low productivity in SSI compared with medium and large industry. For instance, in 2000-01, within manufacturing, the unorganized segment, which is largely a house of small and tiny enterprises, constitutes 83.0 per cent of employment but only one-fourth of gross value added. This, in turn, is a clear reflection of different types of technologies used by industry along the size continuum. While the low productivity associated with labour-intensive technologies should not necessarily be regarded as an indicator of inefficiency, nonetheless, empirical studies do confirm that there is a high correlation between labour productivity and the level of technology that is used (Islam, 1992; Chadha and Sahu, 2003). It has important implication for the employment generating capacity of SSI if the objective is to improve the productivity of labour engaged in them along with an expansion of employment. It is thus obvious that for policies that aim at the expansion of productive employment, i.e. employment expansion

♣ Assistant Professor, Institute for Studies in Industrial Development, New Delhi. E-mail: ppsahu@vidur.delhi.nic.in.

at a rising level of productivity, through the promotion of SSI, the question of technology assumes the foremost importance.

While there exists vast literature on technological innovation, bulk of which relates either to large industries or to post-green revolution in agriculture, it is not easy to find much in the specific context of SSI. Although some discussion can be found on indigenous development and diffusion of new technologies for SSI, especially on the supply side of dissemination effort, very little work appears to have been done on the vital issue of adoption of technology by a SSI entrepreneur.

Ramasatry and Krishnaswamy (1979) made perhaps a maiden attempt to understand the innovative behaviour of small enterprises with reference to 20 engineering firms in Bangalore. They found that the enterprises were innovative in different ways relating to technology though they did not observe any significant R&D taking place in small enterprises. The general level of technological infrastructure in the country prevailing then being rather low and, along with the limited investment capacity and low demand conditions prevailing around the time, the overall environment was not conducive to technological innovation in small enterprises.

Desai and Taneja (1993), based on a survey of 185 SMEs (comprising electronics in Ahmedabad, apparel in Bangalore, food products in Goa, vehicle ancillaries in Madras, and metal products and engineering in Calcutta, Hyderabad and Pune) found that a considerable number of small enterprises (about 40 per cent) got technology support from large enterprises/plant suppliers while among the rest, a majority developed technology on their own or by imitating others. A decade later, another comprehensive attempt to understand the Research and Development (R&D) and technological innovation in small enterprise sector in Karnataka was undertaken by Bala Subrahmanya, et. al. (2002). The study found that nearly 49 per cent (of the 2006 small enterprises in Karnataka) were engaged in technological innovations, mostly informally. These innovations were primarily 'incremental' in nature and product-oriented. Self-effort is the major source of innovation and the role of external agencies, particularly government agencies was found to be insignificant. External factors, particularly competition and customer needs were the major motivating factors for small enterprises to engage in innovation to achieve the objective of enhancement of competitiveness through quality improvement, cost reduction and meeting the market needs. However, there is hardly any literature that discusses the pattern of awareness, acquisition and financing of new and improved technologies in small-scale industries. Moreover, we have not come across any study, which comparatively analyzes technological innovations of small enterprises located in rural and urban areas. It is in this context the

present study assumes significance.

The thrust of the present paper is to address the question of adoption of improved technology in SSI. More expressly, the idea is to i) identify the nature of technological changes that have come up in recent years in SSI sector; ii) work out the pattern of adoption of known technological changes in SSI; and iii) find out possible constraints of non-adoption of improved technologies. It also discusses the pattern of use of various components of Information Technology (IT) by rural and urban small entrepreneurs. The paper is based on primary data that we collected during April-June 2000 through a survey of an assorted mix of 399 tiny and small enterprises (engaging 3060 workers) in rural and urban areas of three Indian states (West Bengal, Haryana and Maharashtra)1.

2. Nature and Dimensions of Technological Changes

In recent years there has been a growing concern on the role of technology in the process of economic development. The gaps in the levels of development between the developed and the developing countries can very well be explained by the existence of 'technological gaps' between them. Even within the sectors of an economy, there exists substantial technological gap. The SSI sector, which accounts for a considerable share of value added and most employment in the industrial sector is characterized by relatively low levels of technology in most developing countries, and it is in this sector that the largest technological gap exists between developed and developing countries. Needless to emphasize that in the Indian context, big technological gaps also exist between the rural and urban located units.

New technology can be conceptualized in a narrow as well as broader sense. In a *narrow sense*, it implies installation of new machines, tools and equipments, while in the *wider sense,* it covers new products and designs, and use of new raw materials, production and management techniques. Technology can be defined as a package of technical information required to set up, operate and improve upon productive facilities required in the production of a good and service. In a *broader sense*, it can also include the

[1] While selecting manufacturing units for enumeration, purposive sampling was resorted to so that units of different size classes, belonging to different organization and having varied access to markets for credit, raw materials, output, etc. get duly represented in the sample. Attempts were also made to choose varied product groups, which display contrasting features among them in terms of technology, production and its growth and trading organization. Manufacturing units where the number of workers is 10 or less were surveyed. Information was collected from the entrepreneurs for the reference year 1999-2000 by using a structured questionnaire (Sahu, 2005).

procedural and organizational information required in the process of production. The ability to perform the tasks of setting up a unit, operating it, improving upon it on a continuous basis, etc. may be termed as '*technical capability*'. Although technology is commonly perceived as a physical tool used for any resource transformation, it is in fact a combination of four basic components all of which dynamically interact and together accomplish any transformation operation. The components are facilities (*technoware*); abilities (*humanware*); facts (*infoware*) and frameworks (*orgaware*). *Technoware* or object-embodied form of technology includes all physical facilities such as instruments, equipments, machinery, devices, structures and factories. *Humanware* or person-embodied form of technology includes all acquired abilities such as expertise, proficiency, dexterity, creativity, perseverance, diligence and ingenuity. *Inforware* or document-embodied form of technology includes all facts and figures such as designs, accounts, specifications, observations, relations, equations, charts, and theories. *Orgaware* or the institution-embodied form of technology includes the frameworks such as groupings, allocations, systemization, organizations, networks, managements and marketing. When all these basic components of a technology attain desired levels of development, efficiency level of a technology can be maximized. The present study follows a broader definition of technological changes (Masum, 1992).

However, some enterprises may not undertake any technological innovation and may continue to produce the same product, in the same way year after year. While new product development is considered a substantial and weighty innovation, substitution of raw materials to improve durability of product or to reduce costs; changes in product designs due to self-initiative or self-effort or guided by customers, etc. represent incremental innovation. *It is worth investigating whether small enterprises are engaged in both type of innovation and whether locational attributes are at work for a specific type of innovation.*

3. Institutions and Institutional Changes

While SSIs are being assigned a key role in the development policy in India, there is a growing concern to upgrade technologies that are used in such industries. As a result of this consciousness, a number of organizations are engaged in the work of identifying/developing technologies for SSI and transferring them to actual users. There is, however, a substantial difference in the perception about the need for the improved technologies between the organizations with that of the actual users. It is therefore important to examine the organizational framework within which such work is being undertaken and assess the effectiveness of the mechanisms used for this purpose, especially from the point of view of narrowing down the gap between perception of development organization and potential users of improved technologies.

The *organizational framework* working on upgrading technology for SSI can be divided into three broad groups. The first category consists of *technology developers,* which are basically R&D institutions having research and experiment facilities. These include CSIR, NISTADS, TIFAC[2] etc. The second group comprising *financial institutions* includes agencies providing credit to SSI in India, IDBI, SIDBI, NABARD[3] etc., are such institutions that operate different schemes for promoting the adoption of improved technologies. These agencies provide financial support to organize suitable training programme for entrepreneurs, including the artisans, so as to facilitate switching over to improved technologies. The third group consists of *technology disseminators* who develop as well as disseminate improved technology. The government departments, autonomous bodies and corporations responsible for SSI, often engage themselves in development and dissemination of improved technologies. There is a multiplicity of agencies each concentrating on a specific group of industries. For example, Khadi and Village Industries Commission (KVIC), State Handicraft Corporation, Development Commissioner of Handloom, State Handloom Agencies, etc. each with its own respective jurisdictions, of course, with some overlap between the state level and national level agencies, are working in the same field. Apart from government or government-sponsored agencies, NGOs and even private individuals are also active in India in the field of upgrading technologies for SSI. Thus, it is obvious that there is a multitude of agencies engaged in the field of technology up-gradation for SSI. Admittedly, there is a great deal of variation in their size, technical capability and mode of operation.

A variety of means (i.e. field level demonstration, skill training, etc.) are employed to disseminate improved technologies, to actual users. Training for skill development is the most common mechanism to transfer newly developed processes, products and technologies to SSI. Formal financial institutions provide credit to entrepreneurs to acquire necessary equipments and machinery and help them in disseminating improved technologies. There are also evidences of disseminating technology through a 'package approach'- the package consisting of elements such as information about the availability, source and effectiveness of new technology, provision of credit, assistance in procuring and installing the needed machines, skill training in their use and support services for their smooth operations and even marketing of the products.

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[2] Council of Scientific and Industrial Research (CSIR), National Institute of Science, Technology and Development Studies (NISTADS), Technology Information Forecasting and Assessment Council (TIFAC).

[3] Industrial Development Bank of India (IDBI), Small Industry Development Bank of India (SIDBI), National Bank of Agriculture and Rural Development (NABARD).

The national policy making institutions do not seem to concern themselves specifically with problems of individual sectors, especially SSI. There is lack of guidelines to provide a direction to R&D work for SSI. There is gap between R&D work and the actual need of the SSI. The link between the users of technology and the R&D institutions is rather weak because of highly centralized structure of such organizations (technology developers). Therefore, much of the work of R&D institutions is directed towards large and medium industries. Even technologies developed for SSI are found to be rather general and often are not suitable for commercial application. Secondly, these agencies have a fairly decentralized structure with representation at lower level administrative units. Even here the performance varies – those having links closer to the grassroots level are obviously more capable of getting feedback about actual requirements and are thereby able to work, which is more effective in matters of technological switc-hover. Indeed the field structure of many of the public sector institutions is found to be inadequate compared to what is required for reaching the far flung rural areas. In respect of the link between technology developers and users, special mention must be made of the role of NGOs. These organizations are very closely involved in work of rural development and have good representation at the grassroots level. As such, they are in a good position to identify the need for improved technology in various processes and also channel back the available ones to the actual users.

4. Components of Improved Technology

Conventionally, a technological change may involve any of the following developments: introduction of new tools/equipment/machinery used in production, use of new raw materials, introduction of new products or new designs of existing product varieties, more efficient methods of work, and so on. While the last category of change emanates primarily from individual producer's own initiative, commitment to work, and the degree of skill acquired, the first two types of changes have largely to do with institutional efforts towards technological up-gradation. The introduction of new products or new designs of existing products could come about either through institutional prop or through commercial vision of the individual producer, or through a combination of the two.

In addition to the four conventional technology components listed above, a few others such as the availability of a telephone, photocopier, fax machine, e-mail support, computer, etc. are tending to become essential I.T. components of progressive industrial enterprises. In the context of small enterprises in rural and urban India, perhaps the accessibility of a computer is the highest point on the I.T. continuum.

4.1 Awareness and Adoption of Technology Components

Technology adoption is viewed as a course that starts with a choice of technology and ends when a technology potential is fully utilized. It is a complex behavioural performance that depends upon organisational learning, orientation and absorptive capacity, conditioned by deeply held cultural perspectives and presumptions. Adoption of new technology, therefore, depends on a range of firm specific variables, such as economic variables like firm size, perceived profitability from adoption, constraints on credit and raw materials availability, size of investment required in case of lumpy investment, marketing linkages, technological specificity of the innovation, as well as socio-demographic and psychological factors like age, education, motivation and attitude towards risk.

The first and foremost step in adoption of any technology is the existence of awareness, information and knowledge about the technology itself. Our survey revealed some interesting results in this regard (Table 1). First, the degree of awareness is very high for improved machinery and new designs both in rural and urban areas; while for new raw material it is as low as 17.5 per cent. In rural areas, nearly one-half of entrpreneurs were aware of the existence of improved machinery, nearly 40 per cent knew about the existence of new product designs, about one-fourth were aware of new products that had come into the market during the past five years, and finally, just about 12 per cent of the rural entrepreneurs had knowledge about new raw material that could be adopted by them. In total terms, therefore, the awareness about the new technology components presents a mixed picture; but, there is still much more scope for increasing their awareness about new technological innovations pertaining to their craft or line of manufacturing, and in this regard, the important role that public agencies, including training institutions, can play needs hardly to be underlined.

The picture on the sources through which information on new technology components is obtained clearly shows that public institutions such as government agencies and training institutes have not played any role in the dissemination of the same. Perhaps, such institutions are not attuned to perform this responsibility. It is, therefore, the mixture of open market, fellow entrepreneurs and employees themselves that stand out to be the

main sources for such precious information; of all these, open market is the channel most intensively drawn upon by the entrepreneurs. Moreover, it is interesting to highlight that it is equally playing an important role both for the rural and urban entrepreneurs. We also observed that a fairly high proportion of the rural enterprises working under the sub-contracting system in one of the survey areas, i.e. Haryana, information about new products, new designs and new raw material, comes readily from their respective parent companies.

Mere availability of information does not necessarily mean that it will be equally and uniformly perceived. Information about an improved technology is just a spread of new idea from its source, while adoption can be defined as the actual act of putting it into practice. Let us now see the pattern of adoption of the new technology components side by side with knowledge about them, which is presented in Table 2. Rural entrepreneurs are doing pretty well for all components, except new machineries. For example, 49.8 per cent of rural entrepreneurs had known of the existence of improved machinery during the preceding five years but only 50.5 per cent of them actually adopted the same; nearly one-fourth were aware of new products and 40.0 per cent of new product designs, and most of them switched over to them. The rate of adoption among rural entrepreneurs who had known of the new product and new designs, was as high as 96.0 and 98.0 per cent, respectively. It is highly disappointing that in the present age of revolution in information technology, not more than 25.0 per cent of rural industries knew of new products in their own specific trade, not more than 12.0 per cent of them knew of the new raw materials commonly used elsewhere, and just about 39.0 per cent of them were aware of new designs in respect of the products being turned out by them.

The overall picture is fairly clear. The rate of awareness is not very high in respect of each of the four components of improved technology, except for improved machinery. But then, having known about an improved technological component, the rate of adoption is remarkably high for each category of component, except for improved machinery, both in rural and urban areas. As pointed out earlier, improved machinery may have no appeal to the family skill-based tiny enterprises; in fact, improved machinery may be an unwise economic proposition for the type of production activities that many of them carry out. It may look puzzling that while the rate of awareness is very low for new raw material, and not very high for new product designs, among rural enterprises, but every one knowing about either, staged a cent per cent switch-over. It is primarily because the new raw material and designs are assigned to them by specified urban units or trading enterprises, under a kind of 'forward contract' which, in the healthy conventional sense, cannot be construed to be a sub-contract. It is, at best, a reflection of contrived trade, which lends the benefits of higher value-adding, due to new raw material or improved

designs, disproportionately more to the urban trader or industrial unit. It is absolutely clear that the urban units are doing much better for each of the specified technology components. *In urban areas, not only is the rate of awareness high, but also the rate of adoption out of the total units is higher for each of the components, compared with rural areas.*

4.2 Sources of Acquisition of Technology Components

The small-scale industry in India shows a vastly differing, and a highly mixed pattern of acquisition of the technology components. It is evident from Table 3 that 'open market' purchase is the most dominant source for improved machinery and new raw material; that parent companies are the source of supply of designs of new products, or new designs of the existing products. Government agencies and public training institutes have practically nothing to contribute towards the supply of technology components; that even in small and tiny enterprises of the kind we are dealing with, many employees are at work in evolving new products or new designs of the existing products; for 45 per cent of the enterprises, new designs are crafted by such employees themselves.

In brief, the small-scale industry is surging ahead with technology improvements, which vary markedly in form and content, and for this purpose, all possible sources are used for actual acquisition of individual technology components. Our survey data discredit the usual perception that public agencies play a leading role in the actual supply of technology components; we discover that it is the market which is being relied upon, by a fairly big percentage of enterprises, for one or the other component. The era of public sector being the answer to every problem seems to be over; markets are now at the centre stage, and it is time that all segments of the economy, including the small and tiny rural enterprises, become market-savvy and learn to absorb the usual in-built market ups and downs, including technology stakes and their commercial fall-out.

4.3 Finances for Effecting Technological Improvements:

There are formidable constraints, which restrict the adoption of improved technologies. Some of the major constraints relate to finance, training and skill, institutional arrangements and flow of information. Adoption of improved technology is not a cost free exercise. Unfortunately, our survey does not contain information on costs incurred by the entrepreneurs to acquire improved technologies. Table 4 gives some evidence about the sources of finance to effect various components of improved technologies. For example, family's own savings is the only source of finance for new products, new raw materials and new designs, and a dominant source for improved machinery both in rural and urban areas, and it is the varying combination of own savings and bank loans that has facilitated the process of technological switch-over; that loans from government

agencies are reported only by a handful of enterprises, for one or the other technology component; that informal sources such as friends/relatives and village money lenders are of no help in effectuating technological improvements, except marginally *a la* improved machinery in some rural pockets of one of the survey region, i.e. West Bengal; that the position is qualitatively the same in urban, as in the rural, areas, and so on.

One of the important insights that deserve to be underlined is that whosoever among the rural entrepreneurs makes bold to adopt an improved technology component, has to rule out financial support from friends/relatives, presumably because the latter themselves are usually the people with limited means who can ill afford to put their resources at risk; lending to relatives/friends in India, especially in rural areas, is a double-risk proposition. Borrowing from formal financial institutions too seems to be on its way out, possibly because the attractive element of subsidy that was the hallmark of rural entrepreneurial development programmes, during the later half of 1970s and 1980s, had come nearly to a naught by the close of 1990s. Bank loans were availed of by a large number of the technology-improving rural and urban enterprises only in case of improved machineries.

4.4 Reasons for Non-Adoption of Improved Technology

One can visualize a number of obstacles in the adoption of improved technology. The most commonly reported are shortage of funds, lack of skill/training with the entrepreneur, lack of suitable manpower in the labour market, shortage of power, insufficient demand, and so on. In our survey, we enquired about the possible reasons for not adopting different components of improved technologies. The sample response in our case is highly surprising, which is presented in Table 5. Due to very small number of valid responses for new product and raw material, it has not been reported in Table 5. Firstly, seeing through the total sample position, not more than 14 per cent of the rural units could put their finger on one or the other obstacle in the introduction of improved machinery. Out of these, to a preponderant majority, shortage of funds stands in the way; other obstacles are hardly operative. A miniscule proportion reported any kind of obstacle in respect of other technology components. A similar position is reported by the urban units also. Perhaps, it looks too good to believe that no major obstacle comes in the way of an overwhelming majority of tiny and small enterprises, both in rural and urban areas, when a technological switch-over is sought to be effected. But then, the respondents' perception about each obstacle need not be questioned by us, especially in terms of lack of skill and training.

5. Use of I.T. Components

Information Technology (IT) can play a leading role in developing SSI sector in India, along with other tools. Because IT is changing the way business operates, offering new opportunities as well as new challenges. Although large enterprises seem to be in a better position to adopt IT, but its adoption will benefit SSI sector to a greater extent for their survival in the market. To be able to endure the surrounding environment, SSI sector has to adopt IT, which would keep them competitive in the market, as they already suffer from different obstacles (i.e. marketing, trade, technical skills, etc.). The benefits of IT use by SSI can be grouped under two aspects; operation and management, as the perceived benefits from SSI themselves pertain to saving time, improving quality, reducing manpower requirements, increasing cost effectiveness, sharing of information, improving general skills of employees, improving communication with company and with the world outside, and facilitating access to trade information.

An overwhelmingly large proportion of rural entrepreneurs are aware of the importance of information technology, especially the remarkable contribution that a computer can possibly make, in keeping track of market trends, developing new designs, maintaining accounts, etc. But then, being aware of the possible contribution of a computer is quite different from the actual possession of the same, or even a plan to buy one. For example, in rural area, nearly 82 per cent of the entrepreneurs are aware of information technology, and more than 72 per cent of them did have some kind of computer training, but only 19 per cent have actually bought one although 20 per cent of those without it, at the moment, do plan to buy it. In overall terms, it is obvious that in certain parts of rural India, many among the tiny and small enterprises have already become I.T.-savvy, and many more would like to follow suit. If one were to generalize the latent demand for I.T. gadgets, most ostensibly the computers, on the basis of unit-level desires or plans, the figure can swell into a few million pieces. Perhaps, a big part of rural India is poised to witness I.T. expansion, on an extraordinary fast pace; who could imagine, say, ten years back, that even the lowliest of the rural industrial enterprises would enjoy market linkages through the benevolence of a small machine?

Nearly 55 per cent of rural industrial units and 84 per cent of those in urban located units did have a telephone. As a matter of fact, the real revolution in the area of communications has been the phenomenal expansion of telephone facilities all over the country; clearly, rural India too seems to have had its share in the remarkable expansion of this crucial item of industrial infrastructure. It is nevertheless important to note that because of the limited scale of their production and market operations, the rural enterprises cannot justify a telephone exclusively for their business purposes.

Accordingly, rural enterprises have a telephone in premises, which serve as a residence-cum-office.

A much higher proportion of urban units operate with the telephone facility, primarily because 'urban distances' make it highly essential, even if the scale of operation is small. Moreover, access to telephone connectivity is better in urban areas. That is partly the reason that a slightly higher proportion of urban units, compared with their rural counterparts, have the telephone installed expressly in their offices. But then, the logic of scale economies does come in; like their rural counterparts, a preponderant majority of the urban units too have the facility installed in a common place and use the same for business-cum-personal purposes. The fax is also showing itself up among the rural units, *albeit* to a limited extent. Compared to 20 per cent of urban units, only 8 per cent of rural units have possessed fax machines. Thus the rural units are undoubtedly behind their urban counterparts.

Table 6 also informs us about the variety of uses to which the computer is put by the computer-owing units. For example, 94 per cent of the computer-owning rural units are using them for maintaining accounts, 52 per cent for maintaining production and quality control, nearly 55 per cent for developing product designs and so on; 39 per cent of such units have e-mail and internet facilities as well. The urban units are doing slightly better in that 32.2 per cent of such units are using their computers for acquiring market intelligence as against 15.2 per cent of their rural counterparts.

Undoubtedly, the urban units in our sample are a step ahead of their rural counterparts, practically in each aspect of I.T. up-datedness, be it the proportion of the computer-owning units, or the variety of uses to which the computer is put. Nevertheless, it bears substantial emphasis that the rural-urban gaps are not as daunting as one would have ordinarily expected them to be, especially in terms of the pattern and the intensity of the computer use. Guided by the steadily increasing presence of the computer, and the variegated uses to which it is put, we are persuaded to believe that even the rural units are emerging as modern business entities; it seems, I.T. revolution is penetrating rural India too. It can perhaps be emphasized all the more for more recent years since IT revolution has assumed extraordinary pace of expansion during the post-2000 years. Further, it needs to be appreciated that the unmistakable strides that the I.T. sector has registered in the domestic and international arenas, could not have penetrated into the country-side within the domestic economy, without a facilitating institutional mechanism.

Many among the rural industrial units, which do not have a computer at the moment do wish to go in for one (Table 6). For example, the percentage of such enterprises is 28 and 20 for urban and rural enterprises, respectively. Each one of the units that intends to have a computer would like to use it for maintaining accounts, 53 per cent for maintaining production and quality control, 50 per cent for developing product designs; market intelligence is the least important priority after a computer comes in. It is redeeming, once again, that from amongst the units not having a computer at the moment, the percentage of those, which do want to acquire is slightly higher in the urban compared with rural areas. Urban units also wish to use it much more intensively for development of product design and maintaining quality control.

Table 6 also takes us closer to the analytical explanations offered by the units that wish to install a computer, as also the difficulties they anticipate to face in putting their plan into operation. Out of the 20 per cent of the rural units that wish to have a machine, 60 per cent of the entrepreneurs anticipate shortage of funds to be one of the important constraints of installing a computer. Power shortage and lack of skilled manpower was also reported by good a number of entrepreneurs as anticipated difficulties for going in for a computer, both in rural and urban areas.

In totality the SSI sector has failed to capture the potential benefits of IT, which may largely be attributed to lack of awareness and the perceived high cost of operating with IT. In such a situation, the role of govt. is deemed highly essential, if not inescapable. The role of government is to set a strategic vision that would create a favourable environment for IT development. At least three main areas of interventions are urgently called for: i) Public awareness and education and skill, ii) IT infrastructure, and iii) Regulatory framework.

6. Concluding Remarks

The present paper, exclusively based on primary data, seeks to assess the problems being faced by small-scale industries especially those in respect of adoption of improved technologies. More expressly, we venture to identify major causes that are inhibiting the adoption of improved technologies and to assess the role of existing policies and programmes in overcoming them; it also analyzes the present procedure for availability of finance to SSI units for upgrading and modernization of their technologies and suggest measures for facilitating such services to small-scale entrepreneurs; further it evaluates the requirements of improvements in skills, education and training, both of entrepreneurs and workers among the SSI units to absorb and implement technologies in their diverse manifestations. *Attempts were also made to bring out the rural-urban contrasts while discussing these issues.*

Technological changes of small-scale industries may take different forms depending upon various factors, internal as well as external to an enterprise but the sources and dimensions of technological changes in SSI appear to be similar in rural and urban areas. But the nature and magnitude of technological constraints are markedly different for rural located units as compared to their urban counterpart. Unfortunately, there are no differences in the policy support extended to technological innovations in rural and urban areas. Further, the special handicaps of the rural enterprises do not figure anywhere in the policy documents (Chadha and Sahu, 2005).

From every conceivable angle, the rate of adoption is relatively poorer in rural areas for each component of improved technology. For example, hardly 25.1 per cent of sample units have adopted new machinery although 50 per cent of them were aware of it. The adoption of new products is reported by 24 per cent, while the adoption of new raw material is far more depressing since only 11 per cent of them adopted it. Moreover, the rate of adoption varied significantly between the production locales. The urban sample units have put up a better showing for all types of technological changes. Nonetheless, for introduction of new products, the rate of adoption is the same, both in rural and urban areas. Thus, the locational advantages including easy access to outside market seems to have promoted quite a few rural units to invest in launching new products. We also found out that a preponderant majority of rural units are working under sub-contracting arrangements (Sahu, 2005). Thus in totality the message is clear, i.e. a recommended technological change can succeed only if certain technical, locational, investment and marketing pre-requisites are fulfilled. Since urban located units meet these pre-requisites more satisfactorily, and perhaps more easily, compared to their rural counterparts, hence a better performance in terms of adoption of improved technology.

A number of factors are at work for non-adoption of different technology components. Nearly the whole lot of sample units, both in rural and urban areas, reported 'shortage of funds' as constraint number one for not switching over to an improved technology. This is indeed a bold confirmation of the lopsided functioning of credit institutions especially in rural areas. Diverse problems connected with training and skill, raw material, non-suitability of technological changes, etc. were also expressed by many entrepreneurs. Thus, adequate institutional support is not forthcoming for these enterprises to adopt improved technology components. The other barriers observed are lack of awareness or lack of knowledge and information about the availability of requisite technology, desire to avoid risk in adoption of improved technology, low level of indigenous R&D, inadequate management skills and non-availability of technically qualified persons to understand the complexities of and operate with the new technology.

It comes out clearly that public policy and institutions have not played any decisive role; a very sizeable proportion of small enterprises, especially located in rural areas, have remained nearly completely bereft of one or the other type of institutional support. In spite of wide claims, the state's contribution to technology promotion among the small-scale industries cannot be termed as satisfying. First, government agencies and formal training institutions are nearly completely absent from dissemination of information on new technology components such as improved machinery, new products, new designs and new raw materials. Most of the entrepreneurs strive to procure such information from open market sources, and to a limited extent, through fellow entrepreneurs. Not only that the economic cost of getting information through non-institutional sources is high, but the involved process of trial and error often discourages many a prospective innovator to attempt the swith-over, most significantly because the subsequent means needed for technological switch-over is also not forthcoming through public institutions. Perhaps, it is the sheer absence of the state or its lackadaisical approach at crucial stages of technology promotion that a fairly substantial proportion of the rural enterprises do not venture to switch over to new technology components, and prefer to stay back with the on-going but 'trusted' technology irrespective of the opportunity cost of staying back with what they have in hand. Our survey data also clearly testify that we have still miles to go in the 'diffusion of IT innovations'.

Concerted effort is needed, both from government and small industry itself, for lending technological dynamism to this sector. Technological up-gradation and in-house technological innovation and promotion of inter-firm linkages need to be encouraged consciously and consistently by government or public institutions. Also, the financial infrastructure needs to be broadened and adequate inflow of credit to this sector is to be ensured, taking into consideration the growing investment demand, including the demand of technological transformation.

Given the high degree of heterogeneity of the SSI sector, location specific and product specific policies need to be devised. Special attention for rural areas is called for while dealing with numerous problems connected with production technology, marketing strategies, workers' skill and training and so on. The adoption of new and improved technologies is vital for the growth of this sector and the removal of all types of barriers for the adoption of such technologies must be taken up in all earnestness by the Government, financial institutions, and research and development agencies and also by the private sectors. All stakeholders should act together with a sense of mission.

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Table 1
Degree and Sources of Awareness of Different Components of Improved Technology by Rural-Urban Location of the Enterprise

Components of Improved Technology	*Locale*	*Percentage of Units Which Knew*	*Percentage of Units Getting Information from*				
			Own Employees	*Fellow Entrepreneur*	*Open Market*	*Govt. Agency & Training Institute*	*Parent Co(s)*
1	*2*	*3*	*4*	*5*	*6*	*7*	*9*
Improved	Rural	49.8	10.3	9.4	72.9	4.7	2.8
Machinery	Urban	64.1	13.6	9.3	77.1	0.0	0.0
	Total	56.4	12.0	9.3	75.1	2.2	1.3
New Product	Rural	25.1	16.7	3.7	42.6	0.0	37.0
	Urban	44.6	24.4	6.1	48.8	0.0	20.7
	Total	34.1	21.3	5.2	46.3	0.0	27.2
New	Rural	12.1	11.5	26.9	50.0	0.0	11.5
Raw Material	Urban	23.9	15.9	6.8	56.8	0.0	20.5
	Total	17.5	14.3	14.3	54.3	0.0	17.1
New Design	Rural	38.6	18.1	3.6	42.2	0.0	36.1
	Urban	39.1	20.8	5.6	44.4	0.0	29.2
	Total	38.9	19.4	4.5	43.2	0.0	32.9

Note: Reference period for each form of technology component is the preceding 5 years.
Source: Field Survey Data.

Table 2
Knowledge and Adoption of Different Components of Improved Technology by Rural-Urban Location of the Enterprise

Component of Improved Technology	*Percentage of Industrial Units Knowing and Adopting the Technology Component*								
	Rural			*Urban*			*Total*		
	Units Which Knew	*Units Which Knew and Adopted*	*Adopters out of Total Units*	*Units Which Knew*	*Units Which Knew and Adopted*	*Adopters out of Total Units*	*Units Which Knew*	*Units Which Knew and Adopted*	*Adopters out of Total Units*
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Improved Machinery	49.8	50.5	25.1	64.1	62.7	40.2	56.4	56.9	32.1
New Products	25.1	96.3	24.2	44.6	92.2	40.2	34.1	92.7	31.6
New Raw Material	12.1	92.3	11.2	23.9	93.2	22.3	17.5	92.9	16.3
New Design	38.6	97.6	37.6	39.1	94.4	37.0	38.9	96.1	37.3

Source: The same as in Table 1.

Table 3
Sources of Acquisition of Different Components Improved Technology by Rural-Urban Location of the Enterprise

	Percentage of Units Reporting Acquisition Through				
Component of Improved Technology / Locale	*Own Employees*	*Fellow Entrepreneur*	*Open Market*	*Govt. Agency & Training Institute*	*Parent Co(s)*
1	*2*	*3*	*4*	*5*	*7*
Improved Machinery					
Rural	5.6	0.0	90.7	1.9	1.9
Urban	13.5	2.7	82.4	1.4	0.0
Total	10.2	1.6	85.9	1.6	0.8
New Products					
Rural	42.3	0.0	19.2	0.0	38.5
Urban	37.8	5.4	36.5	0.0	20.3
Total	39.7	3.2	29.4	0.0	27.8
New Raw Material					
Rural	8.3	0.0	79.2	0.0	12.5
Urban	24.4	2.4	53.7	0.0	19.5
Total	18.5	1.5	63.1	0.0	16.9
New Designs					
Rural	53.1	0.0	18.5	0.0	28.4
Urban	35.3	4.4	33.8	1.5	25.0
Total	45.0	2.0	25.5	0.7	26.9
Source: The same as in Table 1.					

Table 4
Source of Finance for Adopting Different Components of Improved Technology by Rural-Urban Location of the Enterprise

	Percentage of Units Availing Finance from				
Component of Improved Technology/Locale	*Own Savings*	*Borrowings from Friends / Relatives*	*Loan from Govt. Agency*	*Loan From Bank*	*Others**
1	*2*	*3*	*4*	*5*	*6*
Improved Machinery					
Rural	40.7	5.6	9.3	40.7	3.7
Urban	59.5	0.0	5.4	33.8	1.4
Total	51.6	2.3	7.0	36.7	2.3
New Products					
Rural	80.8	1.9	1.9	15.4	0.0
Urban	77.0	0.0	2.7	17.6	2.7
Total	78.6	0.8	2.4	16.7	1.6
New Raw Material					
Rural	79.2	0.0	4.2	16.7	0.0
Urban	63.4	0.0	19.5	17.1	0.0
Total	69.2	0.0	13.9	16.9	0.0
New Designs					
Rural	91.4	0.0	0.0	8.6	0.0
Urban	82.4	0.0	4.4	11.8	1.5
Total	87.3	0.0	2.0	10.1	0.7

Note: * = Village moneylenders, Cooperative society, Parent Cos. etc.
Source: The same as in Table 1.

Table 5
Obstacles for the Non- adoption of Improved Technological Components

	Rural		*Urban*		*Total*	
Component of Improved Technology	*No of Units*	*% age*	*No of Units*	*% age*	*No of Units*	*% age*
1	*2*	*3*	*4*	*5*	*6*	*7*
Improved Machinery						
i) Shortage of Fund	47	83.9	32	66.7	79	76.0
ii) Lack of Skill / Training	1	1.8	0	0.0	1	1.0
iii) Lack of Manpower	0	0.0	0	0.0	0	0.0
iv) Not Suitable	6	10.7	14	29.2	20	19.2
v) Others	3	5.4	2	4.2	5	4.8
Total	56	100.0	48	100.0	104	100.0
New Designs						
i) Shortage of Fund	7	53.9	10	45.5	17	48.6
ii) Lack of Skill / Training	3	23.1	3	13.6	6	17.1
iii) Lack of Manpower	0	0.0	3	13.6	3	8.6
iv) Not Suitable	2	15.4	5	22.7	7	20.0
v) Others	1	7.7	1	4.6	2	5.7
Total	13	100.0	22	100.0	35	100.0

Note: Others include marketing problems, shortage of power, order-based work.
Source: The same as in Table 1.

Table 6
Pattern of Use of Information Technology

	Rural	*Urban*	*Total*
1	*2*	*3*	*4*
A. % of Unit Aware of IT	82.3	95.1	88.2
B. % of Units with			
Computer	18.6	33.7	26.14
Telephone	55.4	84.2	68.7
Fax	7.4	20.1	13.3
C. Purpose of Use			
Accounting	93.9	96.6	95.7
Maintaining Production & Quality	51.5	49.2	50.0
Product Designing	54.6	55.9	55.4
Marketing Intelligence	15.2	32.2	26.1
Internet/ E-mail	39.4	39.0	39.1
D. % of Entrepreneur with Computer Training	72.7	72.9	72.8
E. % of Units Who Plan to Buy Computer	20.3	28.0	24.2
F. Purpose of Use for Prospective Buyer of Computer (%)			
Accounting	100.0	98.0	98.8
Maintaining Production & Quality	52.8	40.8	45.9
Product Designing	50.0	63.3	57.7
Marketing Intelligence	8.3	14.3	11.8
Internet/ E-mail	13.9	16.3	15.3
G. Anticipated Difficulties for Prospective Buyer of Computer (%)			
Power Shortage	22.2	30.0	26.9
Shortage of Fund	59.3	52.5	55.2
Lack of Skilled Manpower	18.5	17.5	17.9
Source: The same as in Table 1			

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Institute for Studies in Industrial Development
4, Institutional Area, Vasant Kunj, New Delhi - 110 070, INDIA
Phone/Fax: +91 11 2689 1111; E-mail: info@vidur.delhi.nic.in
Website: http://isid.org.in

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