

**University  
of  
Göttingen**

Dietrich Müller-Falcke

**Adoption of Information and  
Communication Technologies  
by Small-scale Enterprises in  
Developing Countries**

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International Department  
Institute of Small Business  
University of Goettingen  
Kaete-Hamburger-Weg 1  
37073 Goettingen  
Germany  
Phone: +49-551-394882, Fax: +49-551-399553

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Göttingen 2001

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edited by:  
International Department  
Institute of Small Business  
Director: Prof. Dr. Wolfgang König

ISSN 1432-9751

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## 1. Introduction

Information and knowledge are considered important issues for developing countries since the cost of information is influencing institutions and development perspectives (World Bank 1998). However, information systems in developing countries often function in a way that makes the acquisition and distribution of information difficult and costly. Especially entrepreneurship and innovation are constrained by these information problems (Leibenstein 1968; Stiglitz 1988).

The major tools to acquire, store, process and disseminate information and to generate knowledge from information are modern information and communication technologies (ICTs). In recent years, almost every international organisation has stressed the importance of ICTs for sustainable economic development. Especially small businesses in developing countries are expected to benefit from access to ICTs. Players in small and remote markets can significantly reduce information costs. They have the opportunity to widen their markets and to become less dependent on middlemen for their businesses (Barten / Bear 1999). Evidence of ICT use by small-scale enterprises in developing countries is, however, still scarce. It is the objective of this paper to describe in detail the mechanisms through which ICTs may become beneficial to developing countries' small-scale businesses and to review existing evidence of ICT adoption.

The next section elaborates on the characteristics of ICTs and their impact on business development and markets in general. Section 3 is concerned with the problems of small-scale enterprises in developing countries and the impact of ICTs on their operations. Section 4 finally reviews empirical evidence of ICT adoption by small-scale enterprises in developing countries. Section 5 concludes.

## 2. The impact of ICTs on business development

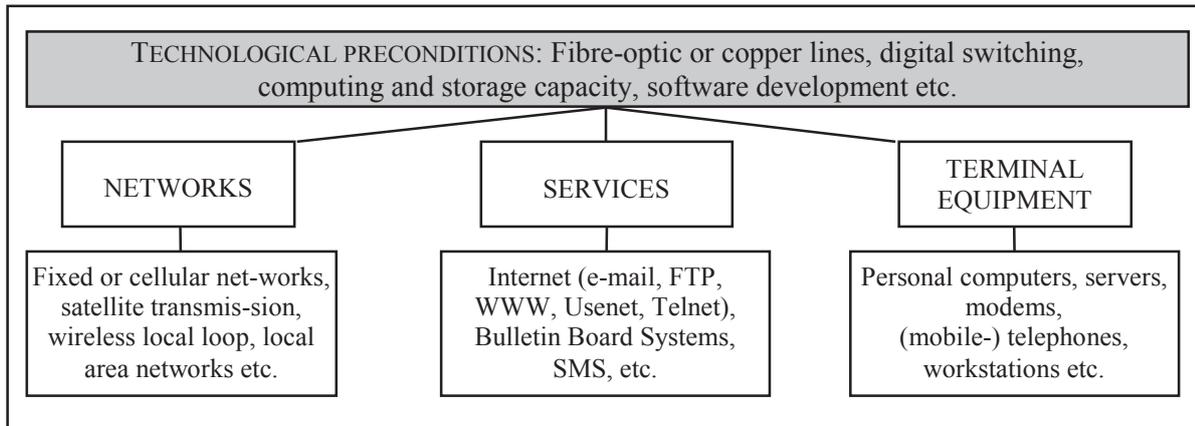
### 2.1. Definition and characteristics of ICTs

Information and communication technologies are defined as "*electronic means of capturing, processing, storing and communicating information*" (Heeks 1999:3). The common feature of all ICTs is their electronic character and the "digitisation" of information, i.e. the reduction of information to ones and zeros.<sup>1</sup> ICTs comprise different components, i.e. networks, services and terminal equipment (See Figure 1):

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<sup>1</sup> In fixed-line telecommunication, transmission can still be analogue but the trend to digital switches and transmission technologies is strong all over the world.

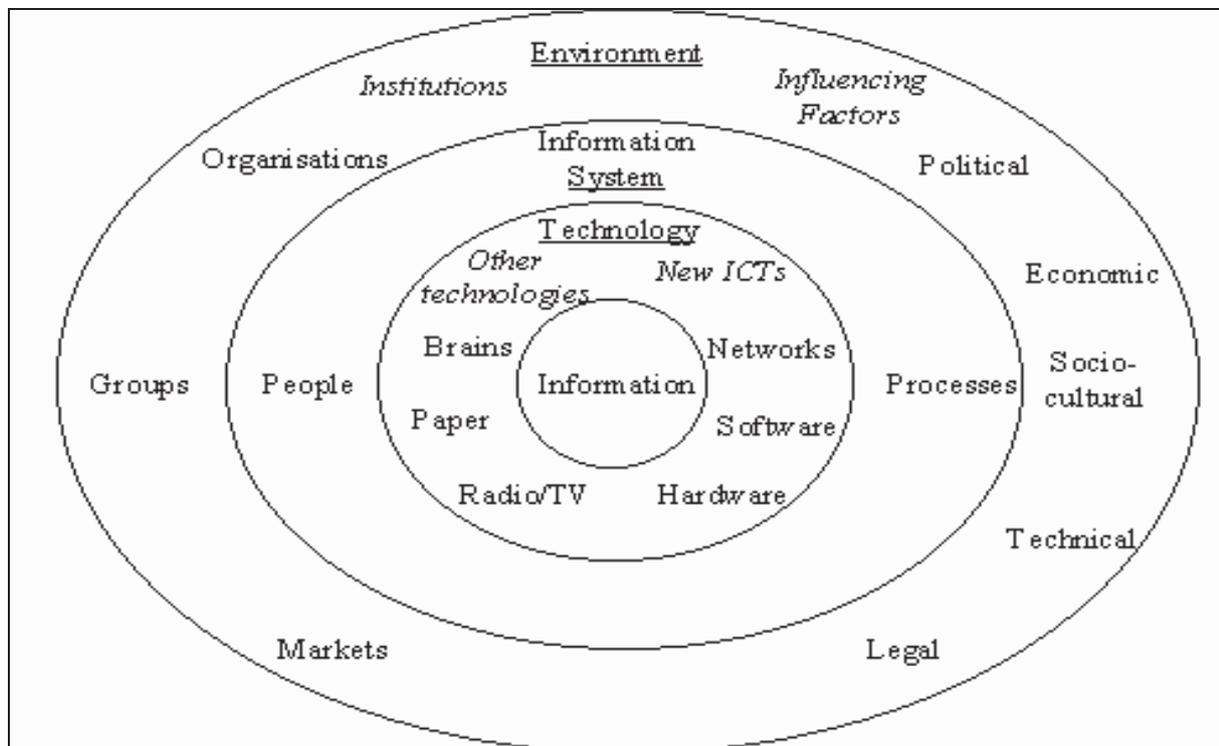
**Figure 1: Components of information and communication technologies**



Source: Seibel / Müller-Falcke / Bertolini (1999:6).

The handling of information, and the technologies available for this task are embedded in information systems made up of people and processes, which are set in a wider environment of institutions. This systemic view of information and information technologies is visualised in Figure 2.

**Figure 2: Systemic view of information and communication technologies**



Source: Heeks (1999:4).

ICTs have a couple of inherent properties that influence their impact and use in the handling of information. These properties are decoupling, the generation of content-related as well as network externalities and pervasiveness. Decoupling means that ICTs have the ability to separate information from its physical repository. Large volumes of information can be transmitted immediately without the physical movement of information storage, i.e. individuals or objects (Bedi 1999). The decoupling property allows for content-related externalities. Access to information becomes non-rival if it is possible to transfer it at low cost without any movement of the information source.<sup>2</sup>

Another specific feature of ICTs is the existence of network externalities, i.e. with each additional user the utility of a network increases. For present users these externalities are direct network effects, generated on the demand side of communication networks. On the supply side indirect network effects are generated if the expansion of the network leads to economies of scale in provision and lowers the price of using the network (Schoder 2000). Network externalities constitute an advantage of large networks over small ones. A network has to reach a “critical mass” in order to become sustainable. Existing networks therefore have a decisive advantage over contenders planning to set-up a similar network. Network development becomes path dependent as issues such as compatibility and standards gain importance in network development (Antonelli 1992).

The last specific property is pervasiveness. ICTs are not restricted to specific sectors of the economy. They can be applied and used for a wide range of purposes and tasks as well as tailored for specific needs (Bedi 1999). Such general purpose technologies will generate economic benefits beyond the actual investment, because they will facilitate complementary technical and organisational innovations (Avgerou 1998; Brynjolfsson / Hitt 2000). Owing to these properties, ICTs are assigned a positive influence on the whole economy as well as on the functioning of organisations.

## 2.2. ICTs and economic development

Countering the neo-classical assumption of frictionless markets, Stiglitz (1988) advocates an information-theoretic approach to economic development. He stresses the costliness of information and changes in behaviour of individuals in the presence of imperfect information. In this thinking institutions become endogenous since they adapt to information costs. However, in the presence of imperfect information the economy will not be in a Pareto-efficient state, even if rationality of individuals and the adaptability of institutions is assumed. Thus, information and the handling of information by individuals will have a decisive impact on the

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<sup>2</sup> One should, however, be aware that content-related externalities occur only in the transmission of information. To interpret and apply information specific knowledge is needed. If knowledge is tacit, i.e. it is embedded in the information source, information cannot be used effectively and the role of content-related externalities diminishes.

development of the economy by influencing the functioning of markets, institutions and organisations (Bedi 1999).

ICTs' main impact on **markets** is generated by lowering the costs of gathering, storing, processing and transmitting information, i.e. transaction costs. The gap between net prices realised by the buyer and the seller of a good decreases, bringing markets closer to Pareto-optimal levels. Applying ICTs, therefore, has the potential to enhance existing market activities and to establish new markets, for they lower the threshold for the emergence of markets (Bedi 1999). Consequently, overall allocative efficiency increases.

Decreases in transaction costs through ICTs can be significant. This is shown, for example, by Bayes et al. (1999) for the implementation of mobile phones in Bangladesh villages. The introduction of telephone services to previously unserved villages has risen consumer surplus in two ways. Firstly by saving the cost and travelling time required to gather market related information, and secondly by achieving higher product prices and lower factor prices through faster and more precise information. Referring to similar examples, the World Bank (1998) sees ICTs as a powerful instrument to mitigate information deficiencies on prices, market opportunities, best practices and financial systems.

Applying ICTs will not only change market outcomes but may also change the **institutions** that govern markets. Changes in the transaction cost structure will change incentives through changes in consumer and producer surpluses. The position of middlemen is believed to weaken when producer and final consumer are better informed about the other side of the market. Outside the economic realm ICTs are expected to empower people and foster participation by providing access to a greater variety of information sources (World Bank 1998). The set of institutional choices increases through the provision of easy accessible information on alternatives.

Special attention is often given to the potential for improved governance and delivery of government services through ICTs. The World Bank's Global Information and Communication Technologies Department (2000), for example, sees opportunities for greater participation in decision-making and enhanced opportunities to give voice to marginalised groups through the help of non-governmental organisations (NGOs). Moreover, ICTs can reduce administrative and service provision costs and can open government to more transparency and accountability.

All these aspects indicate the potentially stimulating effect of ICTs on economic activity and efficiency, and hence their potential to lead to increased economic growth. To some extent empirical evidence supports this claim.<sup>3</sup> However, it seems that a certain threshold in telecommunication infrastructure has to be reached before significant growth effects can be generated, i.e. substantial investments are required

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<sup>3</sup> In a cross-country study on 47 countries in the period between 1957 and 1977 Norton (1992) finds a strong relation between telecommunication infrastructure and economic growth.

(Bedi 1999).<sup>4</sup> But applications for enhancing administration, such as those described in the previous section, are to a large extent out of reach for poor developing countries.<sup>5</sup> Avgerou (1998:24) argues that ICTs can unfold their potential only when institutions are adapted (to the pressure for readjusting) in a favourable way through changing incentives and relative costs. She concludes that in developing countries *"efforts to spread information and communication technologies are necessary in order to participate in the emerging global economy, but not adequate to create economic growth."*

## 2.3. ICTs and business performance

### 2.3.1. *The impact of ICTs on organisations' productivity, flexibility and scale*

Applying ICTs has an impact on organisations' operations, because it changes the cost of handling information, and information is considered a prime factor to determine competitive advantages. Through lowering information costs, ICTs enable the transmission of information to increase, and with this increase the quality of information available rises. The speed of communication and information exchange is enhanced, uncertainty is reduced. Decision making will become improved and better-informed. The application of ICTs affects the competitive position of enterprises by changing industry structure, by giving companies new ways to outperform their rivals, and by creating new businesses. ICTs will channel these impacts through lower costs, enhanced differentiation and changed competitive scope (Porter / Millar 1985).

An extensive discussion has evolved around the relationship between investment in ICTs and its effects on **productivity**. The ever increasing investment in ICTs has failed to show positive effects in aggregate output statistics, indeed productivity growth has slowed down since the early 1970s. Additionally, empirical studies on U.S. economy showed no or negative impacts of ICT investments until the early 1990.<sup>6</sup> This "productivity paradox" has been explained in a variety of ways (Lefebvre / Lefebvre 1996). First, conventional measuring methods might have been wrong, for example not accounting for product quality. Second, ICT adoption requires extensive learning and adjustment, since their effect is subject to a time lag.<sup>7</sup>

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<sup>4</sup> This claim is reaffirmed through a study by Wang (1999) on ICT and economic growth in Taiwan who finds that IT investments in the economy only lead to economic growth if they are supported by a "robust information infrastructure that supports IT adoption and application."

<sup>5</sup> ICT infrastructure in developing countries is much less developed than in high income countries. Especially with regard to the Internet a wide gap has been created. The "digital divide" is manifested in regulatory deficiencies, in imbalances in infrastructure development - may it qualitatively or quantitatively, in deficiencies in human capital and in a lack of appropriate technological solutions and applications.

<sup>6</sup> See Bedi (1999) for a brief review of these studies.

<sup>7</sup> Brynjolfsson and Hitt (2000) indicate that evidence of productivity gains rises if longer periods are considered. Productivity increases if investment in IT is combined with organisational change.

Third, ICT adoption only achieves the desired outcomes if it is managed well.<sup>8</sup> Fourth, if not all enterprises benefit from the adoption, the enterprises that do not manage will fall back. The observed net-effect of ICT adoption on industry level will therefore be much lower than expected from evidence by success stories.

Notwithstanding the problems of measuring productivity on the macro level, recent studies that focus on the firm level show positive productivity effects. For a data set of 300 large U.S. enterprises Brynjolfsson and Hitt (2000) report a "*clear positive relationship but also a great deal of individual variation in firms' success with information technology.*" There are, however, severe problems in determining causality. For ICT investments Brynjolfsson and Hitt manage to show that attempts to control for causality lead to even higher returns of these investments. But they still conclude that "*there appears to be a fair amount of causality in both directions – certain organizational characteristics make information technology adoption more likely and vice versa*" (Brynjolfsson / Hitt 2000:33). With the described evidence the "productivity paradox" seems to be solved. The statistical problems that still exist call for an examination of ICTs' influence on other areas, e.g. quality, flexibility, enterprise structure etc., that are not measured by productivity statistics.

**Flexibility** is considered to be a source of competitive advantage. The capacity to adapt quickly to changing circumstances will give enterprises an edge over their slower adapting rivals. ICTs are assigned the ability to enhance flexibility. First, ICTs enable the creation of more flexible links with trading partners through their property of speeding up information exchange. Second, ICTs enhance organisational flexibility when they are adapted to speed up internal processes, or when they allow enterprises to adapt their information systems to changing environments.<sup>9</sup> Flexibility is considered a special advantage of small enterprises. Whether small enterprise will benefit depends, however, on their effectiveness in adopting and adapting ICTs in a way that enhances flexibility. ICTs will improve competitiveness of small enterprises by strengthening one of their core competencies – flexibility -, but they can enhance competitiveness of large enterprises, too, by mitigating one of the weaknesses of large enterprises, i.e. the slow adaptation to changing conditions.

Considering the last argument, it becomes clear that ICTs have an influence on optimal business **scale**. Alcorta (1994) examines the scale effects for new, ICT-based production technologies, such as CNC machines, which are considered to increase flexibility in production. He stresses that scale is not uni-dimensional but can be measured on the product (batch size) level, on the plant (plant output) level and on the firm (total firm production) level. New flexible production technologies will only have negative scale effects at the product level because it is easier and less

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<sup>8</sup> To develop the full positive potential of ICTs businesses have to change their strategic orientation. If these changes are not actively promoted by the management, or resistance to them cannot be overcome, ICT investments fail to generate favourable results (Dos Santos / Sussman 2000).

<sup>9</sup> As for productivity, positive effects from applying ICTs depend on the way they are embedded in the organisation. There is evidence that ICTs might also be a source of inflexibility when they change slower than the competitive environment of the enterprise (Golden / Powell 2000).

costly to produce different products with the same equipment. Enhanced flexibility will increase the ability to produce more with the same equipment leading to increased optimal scale at plant level. Since modern ICT-based equipment is in general capital intensive optimal scale in terms of employment on plant level might decrease. Owing to higher fixed costs on the firm level optimal scale tends to rise in the presence of economies of scale in marketing and distribution.

If office automation tools are considered similar results emerge. Hitt (1999) explores the impact of ICTs on firm boundaries, i.e. firm size. Analysing a data set of more than 500 large U.S. enterprises he finds that ICTs are associated with a decline in vertical integration as well as with an increase in diversification. The first result indicates that ICTs are especially beneficial in external co-ordination. Internal, often inherited, communication structures in large, vertically integrated enterprises are not that much affected. This result is in line with other studies which show that ICT and firm size are negatively related at the industry level (Hitt 1999). The second result indicates an increase in flexibility through ICTs that enhances possibilities of diversification. Therefore, again, scale effects are not clear-cut although there seems to be a tendency for a decrease in optimal scale with rising ICT investment.

### *2.3.2. Evidence from developing countries*

While most large-sample studies on the impact of ICTs on business performance have been done with U.S. data, there is only limited evidence on developing countries (Tam 1998). The diffusion of ICTs in developing countries is relatively low. Therefore, many entrepreneurs, especially from small-scale or micro enterprises, have to rely on informal information systems to a much larger extent than their high-income country colleagues (Heeks 1999). ICTs, where available, potentially enable enterprises to participate in local, national and global markets due to their properties of reducing information cost and increasing information quality (Mansell 1999). Reducing scale at the product level might offer opportunities for local production in places where aggregate demand from local sources and exports has been previously insufficient (Alcorta 1994).

Based on the work of Brynjolfsson and Hitt, Tam (1998) investigates the impact of ICT investments on performance indicators, e.g. return on equity, return on asset and return of sales, for enterprises from Hong Kong, Singapore, Malaysia and Taiwan. As for other studies, results are mixed showing positive, negative or no correlation for different indicators and countries. Therefore he discusses the probability that impact of ICTs on performance indicators is to a large extent determined by different institutions and societal factors. The situation in low-income countries is marked by an even poorer physical infrastructure than those of the NIC. If sufficient infrastructure, especially adequate electricity supply, is provided Cane (1992) sees potentials for the integration of developing country businesses in global production chains. Elliot (1995) is more sceptical, identifying three very basic factors as obstacle to more ICT-based businesses. Firstly, high prices for ICT solutions. Secondly, wage differentials between high-income and low-income countries, that call for

more labour-intensive operations in the latter. Lastly, the lack of ICT systems suitable for a developing country context.

The scarce evidence discussed suggests that in principle impact of ICTs for business development will not be different in developing countries. However, since the decisive effect of computerisation will be on the cost of co-ordination rather than on the cost of production one can expect effects especially in the area of market development and reach.

### **3. ICTs and small-scale enterprise development**

#### **3.1. The role of the entrepreneur and informational problems in small-scale enterprises**

The entrepreneur is a difficult figure in neo-classical economic theory. Analysing the adoption new technologies the definition by Casson (1982:23) is useful. He considers an entrepreneur as *"someone who specialized in taking judgmental decisions about the coordination of scarce resources."* In the real world the entrepreneur needs to employ resources in order to arrive at decisions. Gathering and processing information in order to get to an informed decision is not costless and the personal resources of the entrepreneur, who is running a small-scale enterprise, are restricted.

Information, i.e. the ability to gather, select, process and evaluate data, is considered to have become even more important with the development of new ICTs that enhance the quality and quantity of communication. Therefore, information becomes an important determinant in shaping competitive advantages. It will add to the strategies and objectives of small firms and affect their relative competencies in competition, which is trapped between cost leadership and product differentiation disadvantages (Porter / Millar 1985).

The task of information management in an enterprise is pervasive and requires a great deal of resources.<sup>10</sup> In small enterprises this task lies, to a large extent, with the entrepreneur. Larger businesses are characterised by a sophisticated division of labour, i.e. they are capable of gathering, evaluating and processing a greater quantity, as well as more specific information, whereas small enterprises are restricted by the cognitive abilities of the entrepreneur, whose *"strategic position serves as a 'focal' point, around which all business activities are centralized"* (Lybaert 1998:188). Scanning for information in small-scale enterprises therefore often needs to be of informal nature. Acknowledging that dealing with information incurs costs, it is even rational for the entrepreneur not to deal with all the information poten-

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<sup>10</sup> Information is needed in a variety of categories in an enterprise. Pleitner (1995) divides the information problem into two dimensions, content and technology. The former one is concerned with information content, which might be internal or external. Internal information comprises, on the one hand, information on management and on the other information on all other functional parts of the enterprise. External information is needed on supply markets, markets for sales and the general business environment. The technological dimension of information comprises the way information is handled, i.e. how it is gathered, selected, processed and evaluated.

tially available to conduct his business (i.e. he is exposed to bounded rationality).<sup>11</sup> In general, the information base of a small enterprise is more limited than the one of large enterprises, since the latter can rely on a sophisticated division of labour in information gathering and processing. Decisions in small-scale enterprises are thus taken rather intuitively and under more severe uncertainty, leading to increased general business risks. This disadvantages small enterprises compared to larger businesses. However, small enterprises still have the advantage of smaller internal co-ordination costs, including the costs of monitoring and steering internal information flows. The entrepreneur has much more control of the operations within his enterprise than the CEO of a large business. Nevertheless, many small entrepreneurs lead their businesses intuitively, based on prior experience (Pleitner 1995).

Referring back to the transaction cost argument, the mix of internal and external information costs influences the optimal scale of enterprises. The governance structure will be chosen in a way that minimises the sum of mainly co-ordinational internal and external transaction costs. Internal information costs constitute, besides costs to set-up, maintain and change organisations, a major part of internal transaction costs. Internal information costs consist of cost of the decision process, cost of monitoring, cost of assessing the activities undertaken, management costs and information processing costs (Richter / Furubotn 1996). External transaction costs occur in the initiation, negotiation and enforcement of contracts. Significant information costs occur *ex ante* in the initiation phase in the form of search and information costs and *ex post* in the enforcement phase as monitoring costs (Richter / Furubotn 1996). External information costs will be relatively more important in small-scale enterprises as internal information costs are relatively low. Internal information costs are of higher relative importance in large-scale enterprises.

Modern ICTs also enhance the quantity and quality of information that can be transferred, stored and processed. Thereby the capability to screen the enterprises' environment for relevant information as well as to co-ordinate internal information flows is increased. The latter aspect will be especially rewarding for large enterprises since costs of co-ordinating internal information flows rise disproportionately with increasing enterprise size. This offsets the potential relative gains that will occur through lowering the costs of generating external information. Due to these two counteracting effects it will depend on the specific technologies, organisational characteristics, market conditions and the character of transactions (i.e. specificity, frequency and uncertainty) whether new ICTs could increase or reduce optimal scale.

### 3.2. Resource problems of small-scale enterprises

The previous section showed the importance of the entrepreneur for small-scale business and the related informational problems. However, it is not only in the field

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<sup>11</sup> Studies on the behaviour of small entrepreneurs show that their decision-making process is intuitive and pragmatic rather than being based on formalised methods and models (e.g. Rice / Hamilton 1979).

of information that small-scale enterprises face different prospects than large-scale enterprises. Due to their size small businesses are considered resource poor, which makes them more vulnerable to fluctuations in business and framework conditions (Welsh / White 1981). This limited resource base restricts operations of small-scale enterprises in factor and product markets. Most of these restrictions are due to high fixed costs and a certain risk involved in participating in these markets.

In factor markets small-scale enterprises have only restricted access to capital, i.e. no access to the anonymous capital market. Bank lending might also be difficult for several reasons. First, lending to small-scale enterprises is more risky since the probability of exit is larger. Second, lending to small-scale enterprises incurs relatively high costs per unit. Therefore, credit might only be available at higher rates or not at all for small-scale enterprises (Tybout 1998). As a consequence, small-scale enterprises often rely on family resources to finance their operations (Casson 1999). Labour use may be constrained in smaller units due to a lesser division of labour. Small-scale enterprises tend to employ generalists rather than specialists. If there is a scope for specialised functions, these enterprises can offer only limited career paths.

Owing to a lack of resources, small firms face obstacles in their output market as well. Developing products requires information about markets, and entering new markets is risky. As these costs are fixed, a low financial and personnel resource base will restrict market entry. When operating in foreign markets in particular small-scale enterprises face higher transaction costs due to a lack of resources (e.g. for sales promotion or branding) which cannot be offset by lower co-ordination cost and higher flexibility (Schmidt 1996).

### **3.3. Small-scale enterprises in developing countries**

The growth of small-scale enterprises in developing countries is assigned much importance as the small-scale sector is, in general, much larger than in high-income countries. Businesses with less than 20 employees can employ up to 70 percent of the labour force. However, despite the importance of the small-scale sector in many developing countries the institutional framework is often unfavourable for them (Schneider-Barthold 1998). Tybout (1998:4) describes the situation as follows: *"Typically, product markets are small, access to manufactured inputs is limited, human capital is scarce, infrastructure is poor, financial markets are thin, macro volatility is high, the legal system functions poorly, and corruption and property crimes are relatively common."*

Profit-oriented small-scale enterprises are confronted with these typical problems, too. The small size of most developing countries' economies constrains the production of specialised goods which only have a small home market. With no domestic base, the cost of entering foreign markets is even higher. Operating on international markets bears higher transaction costs per se. Moreover, small and underdeveloped domestic markets make it necessary to import factors. In many countries small-scale enterprises still face restrictions to access foreign currencies due to an unfavourable

currency regime and banking systems. In addition to these factors, inadequate physical infrastructure increases the cost of serving and using distant markets, leading to a lower market reach in product and in supply markets. Reliance on foreign markets and small domestic markets will make small-scale enterprises face more relative price volatility, increasing the risk of business and straining the limited enterprise resources.

Limitations in human capital are generally a constraint for enterprises in developing countries. Small-scale enterprises, in particular, have difficulties in employing specialised labour. Low rates of secondary education and scarcity of technicians in developing countries make it difficult to absorb, adapt or develop new technologies. Wage rates in large enterprises tend to be higher, making it more difficult for smaller enterprises to employ qualified personnel.

In addition, access to capital for small-scale enterprises is more limited in developing countries than in high income countries. In developing countries, the banking system mostly does not specifically cater for small-scale business needs. Financial markets abstain from serving small enterprises because of high service per unit costs. This lack of access to credit in particular constrains the growth of dynamic, potentially fast-growing enterprises.<sup>12</sup> Only specialised programmes and institutes may lessen this bias.

However, the most important constraint for the development of small-scale enterprises is a deficient institutional infrastructure. Governance problems, reaching from imbalances in the legal system over corruption to inappropriate laws and regulations, lead to higher transaction costs. Access and efficient use of markets are constrained for business in these environments. Inefficient (and often also corrupt) legal systems makes enforcement of property rights difficult or costly (Schneider-Barthold 1998). If entering relations with unknown business partners becomes risky small enterprises will retreat to personal relations, or to an environment characterized by social enforcement mechanisms. But this again leads to smaller potential markets for these enterprises (Müller-Falcke 1997). That laws and regulations might push businesses to operate illegally was most prominently shown by de Soto (1989) for the case of Peru. Other studies have also shown that the costs of registering and running a business are very high, in some cases even prohibitive, for small-scale enterprises (Lagos 1994).

The discussion of the framework conditions in developing countries shows that these conditions raise the costs of participating in domestic and foreign markets. These conditions also hold for large-scale enterprises. However, due to their poor resource base small-scale enterprises will, in general, be more severely affected. By inhibiting the operation and development of a major part of economic activities the overall potential for economic growth is reduced.

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<sup>12</sup> This is reported by Goedhuys and Sleuwaegen (1999) from a survey in Burundi. Dynamic and young small enterprises feel most constrained by the lack of access to credit, followed by over-regulation and general market conditions.

### 3.4. The impact of ICTs on small-scale enterprises

The impact of ICTs can be discussed for small enterprises development prospective, and their prime characteristic, i.e. flexibility. Blili and Raymond (1993) examine in detail how the characteristics of small-scale enterprises influence the impact of ICTs on their **development prospects**. They identify five specific areas. **First**, small-scale enterprises face a more uncertain environment which makes it more difficult to identify appropriate technological options. Furthermore this makes them more likely to become dependent on large customers and suppliers through demand for specific technological options. **Second**, small-scale enterprises do not have the resources to develop their own information systems. Therefore, they have to rely on third parties for these products. This increases risk because of a lack of control. **Third**, because of a lack of cognitive resources the time-horizon in small-scale enterprises is often short-term. Therefore, the implementation of ICT systems is often not a strategic decision but based on the entrepreneur's intuition. **Fourth**, the entrepreneur plays a dominant role in the enterprise. ICT introduction depends on his perception. Moreover, diffusion of ICTs through small-scale enterprises is constrained by deficient training experience. **Fifth**, information systems in small enterprises in general are rather simple. Applications are usually subordinated to accounting rather than to enterprise planning, thus they are often under-utilised in small-scale enterprises.

Blili and Raymond (1993:448) conclude that *"despite the sophistication of technology and the investment required in both financial and human terms, it is already within the grasp of some innovative small firms. For these firms, it has become a strategic opportunity to be seized."* Enterprises that are not proactive in applying ICTs are threatened to become more dominated by their (large) business partners that apply these technologies.

ICTs can help to strengthen **flexibility**, which is one of the core characteristics of small-scale enterprises. However, large, formerly slow-moving enterprises can also gain flexibility from the adoption of ICTs, rendering small-scale enterprises less competitive. Flexibility gains do not come automatically. This holds true especially for small-scale enterprises. ICTs as such can contribute to organisational flexibility because they are more adaptable than previously used technologies. However, they age rapidly calling for continuous investment in order to maintain flexibility. In the presence of indivisibilities this is more difficult for small-scale enterprises that can rely on limited financial resources only.

The issue of scale effects, induced by ICTs, has been already discussed in section 2.3.1. The evidence is by no means clear. Considering the arguments reviewed in this section one can conclude that only by proactively adopting and using ICTs small-scale enterprises can gain a competitive edge. Otherwise they are threatened to be left behind. This proactive and bold behaviour will be more difficult to achieve for enterprises operating in an adverse institutional environment, which, unfortunately, is the case in many developing countries.

## 4. Evidence of ICT adoption in small-scale enterprises

### 4.1. Adoption of innovations in small-scale enterprises

Empirical evidence indicates that small enterprises lag behind in the adoption of innovations (Nooteboom 1994). A classical study which supports the argument of a higher speed of technology adoption in larger enterprises is conducted by Mansfield (1963). He gives three reasons for this phenomenon. First, larger firms face relatively smaller costs and risks involved with innovation. Second, larger firms have a wider range of “operating conditions”, therefore the likelihood that conditions favourable for the particular innovation are among these is greater. Third, large firms have more units of a particular type of equipment, which increases the chance of an early replacement.<sup>13</sup>

In the area of new ICTs it is also well established that small-scale enterprises lag behind large firms in adoption (la Rovere 1998). This may be because these technologies are not appropriate, i.e. their profitability is too low for a small-scale enterprise, or because of a lack of resources to screen viable technological options. The resource argument is not shared by all authors. Meeus and Oerlemans (2000) explore empirically the validity of the evolutionary adaptationist perspective on innovation and the epidemical selection perspective.<sup>14</sup> Analysing data from the Dutch manufacturing sector, they claim that adaptation is of importance, i.e. even with a limited resource base small enterprises can find appropriate technological solutions when they efficiently exploit their potential flexibility.

Whether this is possible is, however, questionable. The fewer resources of small enterprises lead to weaknesses in finance, training, planning, organisation as well as to a more informal structure which leads to an intuitive and reactive decision making process (Blili / Raymond 1993). Thus, small-scale enterprises will only innovate if clear business opportunities are realised or if strong outside pressure – from customers or suppliers – forces them to do so (la Rovere 1998). In these cases environmental uncertainty is reduced.

Another very important factor for technology adoption in small-scale enterprises is the personality and the behaviour of the entrepreneur, which is at the centre of a study by Gagnon and Toulouse (1996). They model the decision-making process during technology adoption in smaller enterprises in the following way. Five dimensions of entrepreneurial behaviour are identified (see Table 1):

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<sup>13</sup> Testing for fourteen innovations in four industries Mansfield finds that size is the most important determinant for the speed of adoption, followed by the profitability of investment. Other factors, that were expected to have a positive effect on adoption speed, such as firm profitability, growth rate, liquidity, the age of the enterprise and its profit trend, emerged as not significant (Mansfield 1963).

<sup>14</sup> The adaptation perspective stresses the importance of flexibility, i.e. the propensity to adjust behaviour to environmental changes, for enterprise success (Meeus / Oerlemans 2000).

Table 1: **Model of entrepreneurial behaviour in technology adoption**

<b>Dimension</b>	<b>Behaviour</b>
Strategic orientation	Driven by perception of opportunity
Commitment to seize opportunities	Revolutionary, with short duration
Commitment of resources	Multi-staged with minimal exposure at each stage
Control of resources	Episodic use or rent of required resources
Management structure	Flat, with multiple informal networks

Source: Gagnon / Toulouse (1996 :61).

The strategic orientation of the entrepreneur is driven by the perception of opportunity. However, the commitment to seize opportunities is of short duration only. Resources are committed not at one, but at various stages of the process, whereby only a minimal exposure of resources in that stages is aimed at. As a consequence, resources are, ideally, rented during the adoption process. Thus, control of the resources is not total. Finally, entrepreneurial decision-making will depend on a flat structure of management in which informal networks are heavily used. This model indicates that the adoption of technologies, requiring many resources over a long period of time, will change the enterprise significantly. Therefore, there will be barriers to successful adoption.<sup>15</sup> The importance of the entrepreneur or the enterprise's CEO for technology adoption in small-scale enterprises' decisions is stressed by other studies as well (e.g. Fink 1998). This is especially the case if an innovation can be assigned strategic importance (Bili / Raymond 1993).

#### **4.2. Empirical evidence of ICT adoption in developing country small-scale enterprises**

Enterprises in developing countries face different economic framework conditions to similar enterprises in industrialised countries and should therefore show a different innovation performance. However, the framework used for analysing determinants of ICT adoption is often the same and also generate similar results (Dasgupta et al. 1999). There is a difference in the penetration of ICTs among and within developing countries' small-scale enterprises. The focus of most studies is, therefore, not on e-business but on the use and adoption of basic ICT technologies.<sup>16</sup> This is especially the case for studies on low-income countries.

There are only a limited number of studies on the adoption of ICTs in small industry and service enterprises in developing countries. Out of these studies only few em-

<sup>15</sup> Gagnon and Toulouse (1996) corroborate these presumptions with a case study on the adoption of new technologies in eleven small and medium-sized Canadian enterprises.

<sup>16</sup> Studies on the basic uses of ICT were undertaken in industrialised countries in the 1980s and before. At this time new communication technologies, e. g. fax and first data exchange applications (e.g. BTX), as well as microcomputers and PCs came into wide use in small enterprises.

ploy quantitative techniques to analyse the adoption process (e.g. Lal 1999, Lal 1999a, Müller-Falcke 2001, Seyal et al. 2000, Thong 1999, Thong / Yap 1995).<sup>17</sup> Other empirical works conduct case studies (e.g. Khan 1998, Lal 1998) or simply use descriptive analysis (e.g. Duncombe 1999, Duncombe / Heeks 1999, la Rovere 1998). Descriptive studies mainly explore the extent to which ICTs are used. Surveys that employ more formal methods try to analyse the determinants of the reported use. Again, individual results vary from study to study. This may be due to different objectives, different environments and different survey set-ups.

Although providing some conceptualisation of developing country small-scale enterprises' information needs, Duncombe reports only basic descriptive results from a survey undertaken on Botswanian small-scale enterprises (Duncombe 1999; Duncombe / Heeks 1999 and 2001). 61 formal enterprises from manufacturing and service responded to a mailed survey, hardly making it representative.<sup>18</sup> It turned out that ICTs were more widely used in the service sector, especially in tourism, technical services and IT. Duncombe (1999) divides the enterprises into five groups: non-ICT users (no immediate access to ICTs), non-IT users (access to telephone, fax within the enterprise but no computer use), non-networked IT users (computers but no network connection), networked IT users (external data connection) and intensive IT users (external and internal network connection). The survey shows that the intensity of IT use (i.e. belonging to a group with more advanced ICT and IT use) is positively related to size, affiliation to the service sector, being an exporting manufacturer and being owned by a foreigner.

La Rovere (1998) concentrates on the barriers to use ICTs in developing countries. She cites a study on ICT use of Brazilian SMEs in 1997 by a Brazilian SME promotion organisation, which reported that 57 percent of the respondent SMEs owned computer equipment in 1997 whereof 22 percent used the Internet. The main reason for not using computers was found in factors inherent to the enterprises, i.e. a lack of resources and a lack of systematic information gathering and processing in the enterprises. To apply computers efficiently Brazilian SMEs face additional difficulties due to the fact that few adequate software exists for SMEs in Portuguese. Moreover, SMEs have difficulties in choosing and evaluating adequate technological solutions.

A more specific account is given by Khan (1998) who conducted a detailed case study on eight innovating SMEs in Pakistan. His investigation is based on a qualitative framework of technological innovation in SMEs which contains, on the one hand, environmental factors (i.e. various variables belonging to the general business framework conditions, "enabling and disabling environment", and specific market conditions), and on the other, driving factors for innovation (i.e. various variables characterising the entrepreneur, motivation, opportunity recognition and evaluation

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<sup>17</sup> Thong (1999), whose work is reviewed later in this section, claims that he was the first to apply a quantitative model to analyse IT adoption and intensity of adoption in small enterprises.

<sup>18</sup> About 50 percent of the enterprises were e-mail users, 60 percent were using a mobile phone. This clearly indicates a pro-technology bias within the sample.

and technology assessment). Implementation of the innovation is influenced by finance, technical expertise, time, networks and problems. Interviewing eight SMEs that recently introduced an innovation and had some record of innovation Khan (1998:308) concluded that environmental factors, especially on the policy side, are rather disabling. The entrepreneurs need *"a high degree of determination and commitment to operate within a weak supporting infrastructure of technological innovation, and to tolerate a high degree of ambiguity and uncertainty in the hope of achieving a challenge of making profits."* In such an environment innovators act demand-led, satisfying a clearly identified product need and aiming at reachable customers. At all stages of the innovation process the enterprises' own informal networks were used to help. However, innovative success was often constrained, besides the already mentioned adverse general environment, by the general technological lag in a developing country and by a lack of managerial skills. With these results Khan stresses the importance of the entrepreneur's perception of opportunities for technological innovation especially in an unfriendly environment.

A more formal approach is applied by Seyal et al. (2000). Investigating the degree of IT usage in 54 SMEs from different sectors in Brunei, they concentrate on internal determinants of technology adoption, i.e. CEO and organisational characteristics. Seyal et al. examine the influence of four CEO parameters (ownership of a PC at home, educational level, computer literacy and computer experience) and organisational parameters (size of organisation, type of business and sales of business) on IT usage. After controlling for the multicollinearity, Seyal et al. regress the variables on IT usage which was measured on a five point scale from "not at all" to "all of the time". Only the influence of businesses' sales, the type of business and the occurrence of in-house training are significant. Size of business, ownership of a PC, outside training, self-taught training, CEO's educational level and CEO's total experience do not turn out to be significant.

A similar study was undertaken by Lal (1999 and 2000) for the adoption of IT in 59 Indian electronic goods manufacturers. Since all enterprises are located in the same industrial area he only pays attention to factors within the companies, i.e. entrepreneurial characteristics, international orientation, workforce and size of the enterprise. Lal divides the enterprises into four categories: non-IT firms (no use of IT-tools); low level IT firms (use of management information systems - MIS); moderate level IT users (use of CAD/CAM in addition to MIS) and high level IT firms (use of flexible manufacturing systems in addition to CAD/CAM and MIS). Using descriptive and univariate techniques Lal denies any influence of export activity and the importance given to product quality on ICT adoption. The perception of R&D spending level, the importance given to market share as well as the entrepreneurs' education, size and skill intensity of the enterprise are tested in a variety of ordered Probit models, in which only skill intensity does not prove to be significant. Thus, Lal concludes, that the entrepreneur and his perception are most important for technology adoption.

Lal (1999a and 2000) also conducted a survey on Indian garment manufacturers with a slightly different focus. The question was whether IT use influences export

performance, i.e. ICT adoption is not the dependent variable in this study. 74 enterprises in a Delhi industrial estate, which is one of India's garment centres, were interviewed. IT adoption is again categorised into non-IT firms, firms that use IT in office automation and firms that use IT in manufacturing activities (mainly integrated CAD applications). As there were almost no non-IT using enterprises, the degree of IT-adoption is reformulated as a dummy variable, which indicates whether IT was used in manufacturing. Using a Tobit regression model on the intensity of exports, the IT-dummy turns out to be a significantly positive determinant.<sup>19</sup> Lal concludes that the advanced use of IT tools is crucial for garment companies to remain internationally competitive.

The most structured and comprehensive model of IT adoption and intensity of use in small enterprises is probably that developed by Thong (1999). A predecessor of this work, with the same data set of 166 Singaporean small businesses, is Thong and Yap (1995) which concentrates on CEO and organisational characteristics as determinants of IT adoption. Thong and Yap focus especially on the characteristics of the CEO, which is usually the owner of a small business, because he plays the major role in these businesses. Characteristics of the CEO and the organisation are represented by a number of variables. Thong and Yap assume that adoption of IT in a small business depends on the CEO's innovativeness, the CEO's attitude towards adoption of IT, the CEO's IT knowledge, business size, competitiveness of the environment and information intensity of the business. Data is used from interviews of small companies (below 100 employees and less than S\$15 million sales) from manufacturing, trade and service sectors. The independent variable is a dichotomous variable, indicating whether the enterprise is computerised (defined by specific software applications). Bivariate testing and discriminant analysis for the multivariate analysis show a significant positive effect of the three CEO characteristics and business size of IT adoption.

Thong (1999) develops this model further, including environmental characteristics as well as technological characteristics, and extends the model to cater for the intensity of IT use.<sup>20</sup> He identifies different parameters for the four influencing dimensions. In this study, CEO characteristics comprise indices of the CEO's innovativeness and the CEO's IT knowledge. Organisational characteristics are business size, the information intensity of the business, and in this case, indices for the employees' IT knowledge. The IT characteristics are indices of the relative advantage of the particular IT, its compatibility and complexity.<sup>21</sup> Environmental characteristics are reduced to an index of competition intensity. Since the last factor was counted as an

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<sup>19</sup> Other significant variables are the quality of raw material used, the perceived importance of flexibility in design and the wage rate.

<sup>20</sup> The likelihood of IT adoption is again a dichotomous variable, whether the enterprise is computerised or not. An enterprise is considered computerised if it has a computer and uses it beyond word processing. The extent of IT adoption is operationalised by the number of computers.

<sup>21</sup> A principal component analysis of the survey data groups the variables representing relative advantage and compatibility together. Both characteristics are therefore analysed together (Thong 1999).

organisational characteristics in Thong and Yap (1995) the innovation of this model lies in the inclusion of technological influences.

The models are tested with the same data set as in Thong and Yap (1995). The results of a discriminant analysis show that the likelihood of IT adoption is significantly influenced by CEO's innovativeness and IT knowledge, by relative advantage, compatibility and complexity, as well as by business size and employees' knowledge. Information intensity and environmental characteristics, i.e. competition intensity turns out not to be significant. These results are similar to Thong and Yap (1995) but add for technology characteristics. For the extent of IT adoption only organisational characteristics (business size, employees' IT knowledge and information intensity) show a significant influence. CEO and technological characteristics show no effect.

Thong (1999:208) concludes firstly that the study highlights the importance of having "*innovative and IS-knowledgeable CEOs*" for IT adoption. Secondly, ITs are only adopted when they offer a better alternative to existing business practices. Thirdly, the presence of sufficient financial resources and IT-knowledgeable employees is crucial for successful IT adoption (i.e. understanding size as a proxy of financial power). Finally, the information needs of a business will be the main trigger for the extent of IT adoption. He admits, however, that more research on the specific determining factors is needed to understand the adoption of IT and especially the extent to which they are used.

Building on the conceptual framework of Thong, Müller-Falcke (2001) is providing a comprehensive account of ICT adoption in small enterprises. Similar to Lal, he provides evidence from the Indian small-scale industry examining the use of fax machines, pagers, cellular phones, computers and e-mail by small manufacturing enterprises in an Indian industrial estate. A survey, carried out in mid 1999, revealed a widespread use of ICTs by the 300 interviewed enterprises. All enterprises owned a telephone, 55 percent owned a fax machine, about 35 percent used pagers and/or cellular phones. Nearly two thirds of the small-scale enterprises were using computers and about one third had already access to e-mail. The last result was especially surprising since by the time of the survey the total number of Internet subscribers in India was about 300,000.

To analyse the motivations of technology use, Müller-Falcke develops an empirical model comprising personal, organisational, environmental and technological dimensions of the adoption decision. The technological dimension is tested indirectly by referring to differences in the adoption patterns between different technologies. He examines adoption determinants at the time of the survey for each technology first with Probit regression models. Subsequently, the determinants for the time of adoption are analysed using Tobit censored regression models.

The personal dimension, i.e. personal characteristics of the CEO, such as age and education, prove to be in general no determinant of technology adoption. This is explained mainly by deficiencies in the chosen variables that had to be rather simple. The organisational dimension proves to be a determinant for ICT adoption. Size

turns out to be the most significant single determining factor for all technologies. The importance of size results from some economies of scale in ICTs, generated by indivisibilities in acquiring and applying the technologies. It also reflects the increasing relative advantage of using ICTs with increasing enterprise size, triggered by the potential to lower co-ordination costs. Enterprise structure related variables, such as the use of advanced production technologies and line of production performed differently depending on the technology in question. The examined enterprises were probably too similar for significant differences to occur.

The importance of relative advantages for ICT adoption are clearly shown by the results in the environmental dimension, i.e. by market specific factors. The higher the number of business contacts, the more probable is ICT adoption. This holds for fax, pagers and e-mail. The insignificance of the effect in respect to computers points to the fact that they are mainly used in office automation rather than in communication. The influence of markets' location also reflects relative advantages. Operating in national and international markets will increase adoption of fax, computer and e-mail. For pagers the reverse holds true, indicating that it is basically a local communication tool. Cellular phone adoption is determined by international market participation. Explanations might be "cosmopolitanism" of the users and demonstration effects through international partners. The results within the market dimension show that location of markets is a stronger determinant for ICT adoption in small enterprises than other market specific characteristics. ICTs are adopted because of their relative advantage of reducing costs and increasing speed of communication. Strategic deliberations do not seem to play an important role.

The technological dimension was not measured directly. However, as it has been discussed for the other dimensions, it appears that the advantage of using an ICT over conventional technologies is one of the main triggers of adoption. Less obviously is the importance of availability. The extremely fast growth of e-mail usage, especially within exporting enterprises, indicates that there has been a potential demand for this technology even before it became available in 1995.

The model applied by Müller-Falcke (2001) has, however, some limitations since it is based on cross-sectional data. This makes it difficult to capture dynamic processes such as technology adoption. However, sophisticated and reliable time-series are very difficult to obtain from small-scale enterprises. Nevertheless, the results provide a comprehensive impression of the determining factor of ICT adoption and use in small-scale enterprises.

## **5. Summary and Conclusion**

This paper described the mechanisms through which small-scale enterprises from developing countries can benefit from the use of ICTs. Moreover it provided empirical evidence of ICT use by these enterprises. Small-scale enterprises face a number of inherent constraints in doing their business such as resource poverty and a lack of information processing capacity. In developing countries these problems are intensified by deficient information systems and a general adverse institutional

environment. ICTs have the potential to mitigate these problems. However, the infrastructural development in many developing countries constrains the beneficial use of ICTs in small-scale enterprises.

The review of empirical evidence of ICT adoption in developing countries' small businesses reveals mixed results of what determines the use of ICTs. Only size is with certainty a decisive factor, since almost all studies could establish the influence on size.<sup>22</sup> For all other variable groups records are less determined.

Differences might be due to different methods of designing dependent factors and variables. In most cases a number of dimensions is identified in which determinants can be found. These dimensions are, however, not used as variates in the analysis. They only structure the adoption decision. Normally a number of variates is subsumed under the dimensions. Either this is done for clarification purposes and each single variable is tested individually (e.g. Lal 1999, Lal 1999a, Müller-Falcke 2001) or variables are combined to a reduced number of factors (e.g. Thong 1999).

The explained variables differ as well. In most cases the use or non-use of a technology at a specified point in time is examined. Only a few authors try to explain the intensity of adoption either in categories of use (Lal 1999) or in continuous forms (Thong 1999, Müller-Falcke 2001). To identify the driving factors behind information technology adoption and to test the hypothesis single equation limited dependent regression models are normally used (Lal 1999 and 1999a, Müller-Falcke 2001, Seyal et al. 2000). An alternative is the use of discriminant analysis to identify differences between the users and non-users of the technology in question (Thong 1999, Thong / Yap 1995). Most importantly, the objects of research differ from study to study. In the survey of the adoption of ICT a wide range of technologies was presented. These variations in observed technologies should also lead to difference in the identified adoption factors.

Nevertheless, empirical evidence shows that, if available, ICTs are adopted by small-scale enterprises in developing countries to a wide extent. However, applications and intensity of use lag behind industrialised countries. Next to availability, adoption depends on other determinants as well. Some empirical studies provide evidence of the importance of entrepreneurs' characteristics such as innovativeness, education and ICT knowledge. But these attitudinal characteristics are rather difficult to capture. More obvious determinants for ICT adoption are structural parameters of the enterprise itself, such as size that turns out to be a significant variable in almost all empirical studies. The larger an enterprises, the more likely is the use of ICTs. Other important factors are the line of industry and the markets served. These determine the relative advantage of ICTs over conventional communication technologies. The more advantageous the use of ICTs, e.g. how much costs can be saved, the more likely and earlier will be the adoption.

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<sup>22</sup> Where this is not the case fallacies in the analysis can be assumed. Seyal et al. (2000), for example, should have controlled for the sector when examining IT usage because different sectors need different degrees of IT.

Thus, evidence calls on the one hand for an improvement of ICT infrastructure in order to make services available and less costly, and on the other hand for measures to raise the awareness among entrepreneurs about the properties and possibilities inherent to ICTs. By such measures, ICT adoption should be speeded up among small-scale enterprises.

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### **Institute of Small Business**

The Institute of Small Business at the University of Goettingen does research on microeconomic and macroeconomic issues concerning the development and growth of small and medium sized companies. There are close institutional links to the German small business community and its organizations. The two Directors of the Institute are professors of the Economics Department of the University of Goettingen.

The International Department of the Institute focusses on export behavior and other forms of internationalization of German small units. Research is also carried out on questions raised by the European Common Market and other international developments with an impact on the competitiveness of small and medium sized companies. Furthermore, the Institute is involved in projects of small business promotion in Third World countries.

### **Purpose of the Series**

The Series intends to promote the critical analysis and discussion of current issues concerning international small business developments. Topics relate to impacts stemming from global and regional economic expansion and to problems of entrepreneurship in developing economies.

### **Submission of manuscripts**

Manuscripts should represent the results of original work and not be submitted for publication elsewhere. Papers must be in English. An abstract of not more than 300 words should be enclosed.

Papers are accepted for publication on the understanding that they are subject to editorial revision. Two copies of the manuscript should be sent to:

International Department  
Institute of Small Business  
University of Goettingen  
Kaete-Hamburger-Weg 1  
37073 Goettingen  
Germany  
Phone: +49-551-394882, Fax: +49-551-399553