# PRODUCT DESIGN IN THE CONTEXT OF THE SOCIAL NEEDS IN LESS INDUSTRIALISED ECONOMIES

Luiz Eduardo Cid Guimarães

Doctor of Philosophy

The University of Aston in Birmingham

November 1995

The University of Aston in Birmingham

**PRODUCT DESIGN IN THE CONTEXT OF THE SOCIAL NEEDS IN LESS INDUSTRIALISED ECONOMIES**

by

LUIZ EDUARDO CID GUIMARÃES

Thesis submitted for the degree of Doctor of Philosophy. 1995.

SUMMARY

This thesis is related to the subject of technical innovation, specifically to the activity of design in microenterprises operating in less industrialised economies. Design here is understood as a process, which is not the sole domain of formally trained categories such as engineers, architects or industrial designers. The 'professional boundary' discussion in this investigation is perceived as secondary as, in this context, products are designed, copied or adapted by workers, entrepreneurs themselves, or directly by the poor community. Design capacity at this level is considered to be important both in relation to the conception of capital and consumer goods and to the building up of technical knowledge. Although professional design emerged in Latin America little over three decades ago, this activity has remained marginalised throughout industry. Design activity tends to be concentrated in some product categories in the formalised industrial sector. For microenterprises operating informally, industrial design appears to be unknown. The existing literature pays little attention to 'informal design' capacity. Other areas of knowledge, such as development economics, recognise the importance of microenterprises and technological capability but neglects the potential role of industrial design in small manufacturing units. The management literature, though it focus on technical innovation and design, has also paid little attention to 'informal design'. In less industrialised economies this neglect is felt by the lack of programmes specifically tailored to create or stimulate 'informal design'. There is a need for recognition of 'informal design' capacity and for the implementation of programmes which specifically target design as a central activity in the manufacturing firm, independent of their size and technological capability. Addressing 'design by the poor for the poor', requires a down-to-earth approach. This entails liaising with different spheres of society, e.g. grass-roots self-help programmes to support the creation and development of informal microenterprises, and support for small business which, though operating formally, suffer from many of the constraints affecting informal microenterprises.

This investigation is based on a survey and case studies conducted in Paraíba state, in the North-eastern region of Brazil. The field work entailed structured interviews with entrepreneurs engaged in the manufacture of metal products, a case study based on the design and introduction of a product aimed at the low income population, and training sessions involving the participation of the low income population in the manufacture of a product to fulfil local needs. The findings revealed the true nature of informal design in the North-eastern region of Brazil (and other less industrialised economies). Design activity is conducted mainly by non-professionals. The field study revealed the need to introduce design into the tailor-made support programmes for microenterprises. The field study also revealed the potential of working with the community in generating and manufacturing products to fulfil local needs. The study has identified a potential for further research which would yield appropriate training programmes.

Industrial design, engineering design, microenterprises, informal sector, Latin America, Brazil

DEDICATION

Dedicated to my wife and daughter, Erika and Paloma

## ACKNOWLEDGEMENTS

I would like to thank my supervisor Dr John Penny and my second supervisor Dr Stanley Moody for their sound supervision. I am particularly indebted to Dr Pauline Madge from the University of Central England for her constant help during the all the steps of this investigation. Her constructive criticism and practical help was crucial for the completion of this investigation. I am also indebted to Dr. Fred Steward for his comments on my work and moral support at a crucial stage of this thesis. I extend my gratitude to Dr. David Poston for his useful comments and for his help in obtaining important material for this thesis.

I would also like to record my sincere thanks to my friends Dr. Demóstenes and Dr. Olívia Azevedo for their essential help and support during my field study in Brazil. My special thanks to my research assistant Claudia Guerrero for her help during the field study, and her perseverance in difficult moments of this research. My thanks to Dr. Guislaine Duqué and Marilda Menezes for the help related to the methodology used in the field study. My thanks also to Dr. Claudia Galvão for the useful comments on my research proposal, to Reverend Denis Saunders for his advice on matters related to communications and the community.

My special thanks to Dr. Wanjau Kabecha for discussing my work and allowing me access to important material related to this investigation. I am particularly indebted to all entrepreneurs, washerwomen at the Santo Antonio Municipal Wash House and the participants at the workshop at the Monte Santo Neighbourhood Association for their vital help in obtaining the empirical evidence.

My thanks also to my colleague Francisco Barbosa for his comments on chapters of this thesis, and to Allan Evitts and Tom Horton for their help in the Laboratory of the Mechanical and Electrical Engineering Department at Aston University.

# Product Design in the Context of the Social Needs in Less Industrialised Economies

**Contents** **Page**

# List of Tables

**Tables**

**Pages**

## List of Figures

## Abbreviations

| | |
|---|---|
| AID | Agency for International Development, US |
| ATI | Appropriate Technology International |
| CAD | Computer Aided Design |
| CIDI | Industrial Design Research Centre, Argentina |
| DTI | Department of Trade and Industry |
| ESDI | Escola Superior de Desenho Industrial |
| FETEC | Feira de Tecnologia de Campina Grande |
| FIEP | Federação das Indústrias do Estado da Paríba |
| FIESP | Federação das Indústrias do Estado de SãoPaulo |
| GNP | Gross National Product |
| ILO | International Labour Office |
| ID | Industrial Design |
| IDB | Interamerican Development Bank |
| ITDG | Intermediate Technology Development Group |
| LBDI | Laborátorio Brasileiro de Desenho Industrial |
| LIEs | Less Industrialised Economies |
| MIEs | More Industrialised Economies |
| DGIS | Netherlands Directorate General for International Co-operation |
| NMFA | Netherlands Ministry of Foreign Affairs. |
| NID | National Institute of Design, India |
| NIT | Núcleo de Inovação Tecnológica |
| NICs | Newly Industrialised Countries |
| ICSID | International Council of Societies of Industrial Design |
| OECD | Organization for Economic Co-operation and Development |
| PD | Product Development |
| PTD | Participatory Technology Development |
| PVC | Polyvinyl chloride |
| SETRABES | Secretaria de Trabalho e Bem Estar Social |
| SUDENE | Superintendência do Desenvolvimento do Nordeste |
| UFPB | Universidade Federal da Paraíba |
| UNDP | United Nations Development Programme |
| UNIDO | United Nations Industrial Development Organisation |
| VITA | Volunteers in Technical Assistance |
| WB | World Bank |

# CHAPTER I

# Background for the Investigation

## 1.1. Introduction

This investigation is concerned with the subject of product design (PD). It focuses on the activity of industrial design (ID) and on the possible role it might play in the development or improvement of manufactured goods produced in microenterprises and consumed by the poor population in less industrialised economies (LIEs)[1]. The role of industrial design in microenterprises, particularly those operating in the so-called informal sector, appears to be *terra incognita.*

It is important at the outset to clarify what is understood by PD in this study. Addressing 'design by the poor for the poor' requires a down-to-earth approach and a wider definition of design. Product design in this investigation is understood as an activity related to the identification, analysis and solution of problems and to the materialisation of these solutions into a piece of hardware. It is regarded as an activity related to manufacturing enterprises, but not exclusively to mass production. Product design is perceived as a process which is not the sole domain of professionals, such as engineers, architects or professional industrial designers. The 'professional boundary' debate, in the context of the needs of the poor in LIEs is secondary, as products produced and consumed by the socially vulnerable groups are designed, copied or adapted by workers, microentrepreneurs themselves or directly by the poor community.

In this thesis the term informal sector refers to small manufacturing units with little capital available, employing few workers, if any, depending mainly on family members. In general the units are managed by the owners/entrepreneurs themselves who also work in them. Often they depend exclusively on the business for personal survival (Levitski 1989:xviii).

The main objectives of this research were:

- To find out if there was product design capacity at the level of microenterprises;
- To understand the reasons for the existence or not of such capacity;
- To propose interventions to create or improve product design capacity

---

[1] The terms less and more industrialised economies are employed here because they are more precise than other terms commonly used. They are not loaded with political connotations like Third World or are pejorative like less developed countries. See Chapter II pp. 32,33 for further discussion of the terminology and what it implies.

This investigation attempts to bring together two separate areas of study, Design and Innovation and Development Economics, which so far appear to have been largely disassociated.

The proposal for this research has in fact originated out of a dissatisfaction with both these areas and the apparent neglect of the design innovation/management literature to seriously address the problems of Development Economics (or at least the product design capability of small manufacturing industrial units run by and manufacturing products for the poor in LIEs countries) and conversely, the apparent failure of the development literature to take industrial design/innovation seriously. In spite of the recent emergence of industrial design in some LIEs, most of the literature related to design concentrates on firms operating in the formal sector of more industrialised economies (MIEs) and, when it address the developing countries, the focus is on formal industries of the so-called newly industrialising countries (NICs), particularly in South-east Asia and in some countries of Latin America. However, there is relatively little written about industrial design in NICs. Early texts on the subject were mainly related to the role of design in development. In recent years a number of studies on the subject emerged, but the role of industrial design in microenterprises, particularly ones operating in the so-called informal sector has been neglected (Harper 1995). There is a lack of research particularly related to industrial design at the level of the firm. Thus, to collect data related to local innovative capability is important in understanding how firms operate, the constraints on them and existing capacity. This is the first stage in any intervention (Gamser et al. 1990: xvii).

Addressing the issue of industrial design in the context of the LIEs involves the consideration of different spheres of society. At the emergency level there are the needs of the destitute, composed of the marginalised population which need to generate income and employment and lack even the very basic products. There are also the low income communities who are poor but, as my case study (cf. 6.8.) conducted in one of the neighbourhood associations in NE Brazil revealed, can do much for themselves. Another level encompasses the small manufacturing units run by the poor which are linked to family and personal survival. There are also the small manufacturing firms which operate in the formal sector and which supply most of the goods consumed by the poor. Many of these firms, in spite of being legalised, suffer similar constraints as their informal counterparts.

## 1.2. The need for research on industrial design

Industrial design in this study is regarded as part of the technological capacity of the small firm, and an essential tool in helping it to compete successfully in the market place. Existing studies on design have concentrated on technology choice and only peripherally address the problem of industrial design capability at the level of the firm. Product design as the activity which enables the innovating firm or individual to materialise abstract concepts and embody them in a piece of hardware which is marketable, is thus a crucial activity to any manufacturing enterprise, independent of its size. This capacity is important because it determines the characteristics of both capital and consumer goods. Within the range of activities involved in product design, industrial design is of particular importance as it matches market and user requirements with production capabilities. Among the wide spectrum of design activities, industrial design therefore occupies a crucial place in manufacturing. As Moody (1984:7) points out

> [...] the place given to industrial design and concern for human values in manufacture has a bearing on industrial (and therefore national) prosperity; that industrial design is a factor in the development of a successful manufacturing capability; that to deny industrial design a place in manufacture is to retard industrial progress. The quest, it seems, has been to discover a means of achieving good design in new products of industrial manufacture so that their quality and value may be enhanced.

Thus, design capacity is a strategic tool that can give a competitive advantage to manufacturing firms, and in particular firms operating in saturated markets.

The importance of the role of technology as a strategic variable in the process of development is widely recognised. It directly affects, *inter alia*, the balance of payments, investment, employment, the distribution of income and as a result of that, the 'level of social well-being' (Maldonado and Sethuraman 1992:3-24). As pointed out by Maldonado and Sethuraman (1992:3-24), autochthonous technological capacity effects both the speed and the nature of the industrial activity and in the long run influences the possibility of self-sustained economic development.

Technology encompasses both hardware — equipment, tools, infrastructure, etc. — and software aspects such as product design capacity. According to Appleton (1994:4-12), people's capacity to recognise, modify and develop the technology in use or which they intend to employ, is founded on the software elements of production, the 'know why' instead of the 'know how'. Yet, despite the importance of such elements, which includes knowledge and skills, crucial to technical innovation capacity, little support for them is  ound in microenterprise technical assistance programmes. The 'know-why' is extremely important because of its role in conceiving or improving products which are: 'the result of the combination of knowledge, organisation and technique' (van Dijk 1987:51-68).

In recent years there has been a world-wide interest in research related to small enterprises. The focus of research has been on areas such as: the characteristics and dynamics of small firms; the social and economic issues; the mechanisms of support such as credit and technical training and ways of improving and extending assistance. Few attempts have been made to understand a firm's technological capacity, especially the role played by industrial design in microenterprises in developing countries. This is confirmed by Haan who calls attention to the paucity of research on areas such as product design, quality control and packaging (Haan 1989:39-46). He suggests that there is a need to focus research and development schemes with the objective of widening the availability of appropriate techniques which can be used by small producers and increase the manufacture of improved and varied products and services. Such views are shared by authors like Zoomers (1994:1-20), who argues that the focus should be shifted from 'choice of technology' to 'choice of product' giving priority to the manufacture of 'appropriate goods'.

To Bhalla (1989:M2-7), our understanding of technological capacity in small firms, operating both in rural and peri-urban areas of the Third World, is still limited. Most studies on capacity building and technical change have focused on large and medium enterprises. The possible role of microenterprises in accumulation and capacity have been under researched. However, this capacity is crucial to the operation and survival of small enterprises as this can contribute to the reduction of production costs, improve the overall quality of their products and help them to face the fierce competition from large and medium firms. According to Bhalla, there are some reasons for this neglect; the assumption that they are not capable of making a contribution or that there is no need for internal capacity of innovation in these small units. Some suggest that what is needed is access to more sophisticated technology which has been created somewhere else. However, access to more developed technology might involve it's adaptation to fulfil local requirements (Bhalla 1989:M2-7). Technology adaptation is related to the indigenous ability to innovate. To adapt technology developed elsewhere allows learning-by-doing and the build-up of knowledge, which are crucial elements of innovative ability, at the same time creating the necessary knowledge base that will allow enterprises better choice for more technologies suitable to their needs. There is considerable variation in relation to the needs of large, medium and small firms concerning technology. The small units use, in general, '*traditional*' technologies which need updating. One important difference is the degree of specialisation. For example, small businesses tend to concentrate all management functions on the same person. These are important considerations when studying innovation in different firms (Bhalla 1989:M2-7).

## 1.3. The Context

What has been said above is particularly relevant to the development of design and industry in Brazil. Brazil has experienced major changes in the past three decades. Although standards of living have improved in a number of ways, this country of 160 million people, 80 per cent of which live in urban areas, still holds one of the greatest income disparities in the world. Industry plays a major role in the Brazilian economy, accounting for 39 per cent of the Gross National Product (GNP) as against 21 per cent of agriculture's contribution. The output of the Brazilian steel industry was in 1994 about 50 per cent higher than Great Britain, and car production was approximately the same (The Economist 1995:21). However, this recent industrialisation has been concentrated in some parts of the country, mainly the Southeast and South regions.

The figures above contrast with the harsh reality of millions of people for whom even the most basic services are not provided. For example, 30 per cent of Brazilian households do not have piped water and only a third have access to sewerage systems (The Economist 1995:24). Chronic malnutrition affects at least 32 million people in the country and, in the North-eastern region, whole populations have been undersized because of hunger (Shankland 1995:29-30).

The idea for this investigation emerged against this scenario. The immense disparity which exists between rich and poor in Brazil and which means that the majority of the population is excluded from access to basic products, poses questions to any conscious professional. As an industrial designer I was provoked by the question of how the majority of the population, who is poor and are not sharing the benefits accrued from recent development, are able to fulfil their material needs? Observing the streets of major Brazilian cities provided me with some answers to this question. Simple observation shows the struggle of the low income population to survive, and of the creative solutions achieved by them in this process. The existence of a so-called *informal sector* is evidence of such attempts. This sector, which is composed of a plethora of activities, ranging from simple shoe repairs to small scale industrial production, has grown rapidly in recent years, not only in Brazil but all over the developing world. Around 30 million Brazilians work in microenterprises which employ less than 5 people. These enterprises represent 49.5 per cent of the total workforce (Rodrigues 1994:21-3).

As a designer I was particularly keen to understand what these people, who decided to be involved in manufacturing, were producing, and where did they get the ideas for the products they manufactured. The markets of Northeast Brazil open a window, simultaneously, to the world of the poor entrepreneurs and of the poor consumers, and it was by walking through some of these markets and appreciating the variety and quality of the products made and consumed by the poor population, that the main question I have attempted to answer in this investigation emerged.

**Has industrial design a role to play in the context of the social needs of less industrialised economies?**

## 1.4. Research and Development in More Industrialised Economies

To understand the present role of industrial design in LIEs it is considered important to have an overview of innovation activity in MIEs, as the emergence of ID in LIEs is directly related to industrial design in MIEs. Although in most LIEs industrial design has not emerged as an established activity, there are important lessons to be drawn from the literature of innovation in more industrialised economies. In recent years technology has become a central issue in the debate about economic growth and international competition. As mentioned previously, technology encompasses both hardware - e.g. capital goods, consumer goods - which embodies it, and software, the knowledge necessary to create, develop and operate it - e.g. education, research, management and methods of organisation in enterprises. The importance of technology, especially the production and dissemination of knowledge, has been recognised in recent years by economists, as the crucial factor in the process of economic growth. According to Freeman (1982:4)

> [...] it would not be unreasonable to regard education, research and experimental development as the basic factors in the process of growth, relegating capital investment to the role of an intermediate factor.
>
> Looked at in this way, the investment process is as much one of the production and distribution of *knowledge* as the production and use of capital goods, which merely embody the advance of science and technology. 'Intangible' investment in new knowledge and its dissemination are the critical elements, rather than 'tangible' investment in bricks and machines.

The process of generating and developing modern technology has become increasingly science-based, requiring considerable human, physical and financial resources. The major sources of finance are the private sector and governments in a process which involves substantial sums of money. For example, in 1993 a group of 166 biotechnology firms in the UK alone spent over £130 million in R&D and are expected to spend £200 million by 1996 (DTI 1994:71).

According to the Organization For Economic Co-operation and Development (OECD) there has been a rapid growth in R&D activities by member countries (DTI 1994:1). There has also been a considerable growth in the number of researchers in relation to the labour force. The United States and Japan have approximately 65 researchers per 10 000 labour force and the majority of other industrialised countries between 35-45 research workers per 10 000 labour force. However, most R&D activity is concentrated in a few industrial sectors. The most research-intensive industries in the majority of MIEs are 'in descending order of intensity: aerospace, computers and office machinery, electronics and components, drugs, scientific instruments, and electrical machinery' (OECD 1992:123). Research and Development activity is conducted by different bodies in government, universities, individual firms and by amateurs. This activity includes; a) basic or pure research in which the purpose is to broaden knowledge without targeting any specific application. b) applied research targeted at a specific objective. c) experimental or development work targeted at doing further research on new inventions, to create new products or to improve already existing products or processes (Bannock 1992: 367).

## 1.5. Product Design and Innovation in More Industrialised Economies

Although R&D is important to the process of innovation, it is only one among a number other activities within the innovation chain. In this thesis, innovation is understood as it was defined by Freeman,

> Technical innovation, or simply 'innovation', is used to describe the introduction of new and improved products and processes in the economy, 'technological innovation' to describe advances in knowledge (Freeman 1974:18).

There are a large number of innovation definitions (Freeman 1982, Burns and Stalker 1990), however, most of them recognise that innovative activity is crucial for the survival of the firm in a dynamic environment, with constantly changing technology and fierce international competition. In MIEs, success in the market place depends on the firm's innovative competence, the capability to recognise technological opportunities and its capacity to detect and predict consumer needs and expectations: in other words, its competence to develop and introduce novel or improved products or processes into the competitive environment. Success is by no means guaranteed, relying as it does upon different factors related to: the type of organisation; its strategy; and the proper management of human, financial and physical resources allocated to the innovation process. Depending on the degree of novelty, the process of innovation will involve considerable risk (Table 1.1). The more radical the process, the higher the level of risk (Walsh et al. 1992:90).

**Table 1.. Degree of uncertainty associated with various types of innovation**



*Source:* Freeman 1982:150.

It is important, at this stage, to make a distinction between innovation and invention. In this thesis the term invention is understood in the sense defined by Schumpeter, as a preliminary idea, a rough draft either to develop a novel product or to improve an existing product, device, system or process. Most inventions do not result in technical innovations and the ones which are patented might never be developed. Thus,

> An innovation in the economic sense is accomplished only with the first commercial transaction involving the new device, product, process, or system, although the term is also used to describe the whole process (Schumpeter 1961).

Innovation is crucial to most economic systems, fundamental to wealth generation and as a weapon in international competition. As Braun points out

> [...]innovation is an essential part of the competitive life of firms and economies in any economic system which contains competitive elements, and therefore in virtually all systems

> in operation today. We must accept that technological innovation is closely associated with economic growth - for better or for worse (Braun 1984:46).

Innovation is crucial to both advocates of accelerated economic growth and to its critics. In a world dominated by technology and rampant environmental destruction, innovation is of fundamental importance in preventing and providing solutions for these problems (Freeman 1982:3).

The initial stimulus for innovation can be a recognition of a market with potential to be fulfilled by a new process or product (market pull theories), or the result of an existing new technological capability (technology push theory). Despite controversy in the innovation literature about the importance of each theory, in practice few successful innovations are the result solely of technology push or market pull alone. The process of innovation is basically a 'coupling' activity. Developing, designing and marketing products or processes requires a course of action which involves combining the new technological capabilities to the market (Freeman 1982:109). It is of little importance if the initial thrust emerges from the acknowledgement of a potential need to be fulfilled or from the existence of a new technology. The crucial thing is that the innovative enterprise makes the proper link combining the two (Gardiner and Rothwell 1985:1).

Among the stages of the innovation chain is the role of product design. The term design can be used to mean different things. Its etymology derives from the French *désigner*, appoint and the Latin *designare*, designate (OUP 1993). It can be used as a noun or a verb to indicate an initial idea, or a rough drawing for something to be produced, but can also be used to indicate the skills necessary to produce them. Alternately it can mean patterns for decoration or just a plan or an intention to do something. It can be used to describe a single product or, as it is used in Theological circles, to describe the design of the universe by God. With so many possible uses no wonder the term is being constantly misinterpreted.

A more down to earth use of the term refers to a broad spectrum of different activities linked to manufacturing, from design of sophisticated heavy engineering machinery and processes, to the generation of consumer goods. The activity of design in MIEs involves a number of occupations covering the wide range of engineering specialities, from electronics to mechanical design, and professionals like industrial designers, visual communicators, and architectural designers. The common denominators among these activities are creative behaviour to generate ideas and the translation of these preliminary concepts into visual form, using two and three dimensional representation techniques e.g. roughs, models, prototypes. The aim is to create new or improved products that can range from an aeroplane to a logotype (Walsh 1993: 78-86).

It was not until recently that design has been recognised as an important factor in economic growth. In the 19th century, economic thought on international trade was dominated by neo-classical theories like the 'theory of comparative advantage', sometimes called the 'theory of comparative cost'. This theory was developed by the followers of the Scottish economist Adam Smith such as David Ricardo (Samuelson 1982:626). The theory implied that some countries were able to produce cheaper products than others because they have certain endowments such as capital, natural resources, availability of labour, technical knowledge and know-how and thus would have a comparative advantage over other countries. Although still accepted in a modified form, new theories of trade are challenging this theory. These new theories argue that a large part of foreign trade depends on a monopoly a country will have if it launches a new commodity in the international market, at least until other companies start copying it. The original manufacturers could then maintain a 'technological gap' if they continue to innovate the product. Authors such as Dosi (1984) and Freeman (1982) have examined the comparative advantage that allows the production of commodities that were qualitatively more technically advanced, had a better design etc. This comparative advantage was not a consequence of an endowment but of what is basically a process of learning. The advantages are 'established by the gradual accumulation of capital and technology, which are not freely available but firm specific, and are both the result and cause of technological specialisation in certain areas' (Walsh et. al. 1992:62-63)

As an activity which involves financial, physical and human resources, design has to be managed. Although a relatively new activity, the management of design in industrial economies has grown in importance throughout industry. Fierce pressure from the competitive environment has emphasised the importance of design in the survival of a company and compelled an increasing number of managers to get involved in this activity. These activities are independent of the size of the firm, in a one-person business or a large company, the key tasks necessary to control the process of design are the same (Oakley 1990:3-14). Determining the characteristics and assembling the product or service will affect a firm's entrance into the market and it's profitable operation in a specific context. The crucial factor is the way design is commissioned and managed. Design is an essential aspect of any enterprise and has to be controlled in a satisfactory manner just like any other business activity (Oakley 1990:3-14).

Being the first to introduce the right product into the market is invaluable to the success of manufacturing companies. The need for good quality products and fast new product development emanates from: the escalation of international competition at a global level; the rapid development and utilisation of new technologies; reduction in product life cycles; the provision of more options for customers and the development of products according to individual requirements; and a wider variety of multi-technology goods (DTI 1994:2). In recent years design has been recognised as a strategic tool, crucial for competitiveness:

> For the commercial enterprise, design is an integrating process that results in goods and services that can be supplied efficiently and that appeal to customers in their intended markets in terms of performance, appearance and value for money (Design Council/DTI 1988:2).

Global market changes have meant that businesses have to deliver products move quickly and cost-effectively, and have to provide goods which are different from, and superior to, the existing products in the market. To achieve this it is necessary to have a management strategy which recognises the importance of the development of new products and the improvement of existing products (Design Council 1988:2). Such a strategic approach would allow for the identification of market opportunities and thus the introduction of the product into the market at the appropriate time. For the strategy to work, the first stage is an evaluation of the firm's capacity to benefit from market opportunities. This step includes identifying the position of design within the organisation, marketing, production, finance and human resources in relation to the proposed strategy. It is also important to gather market intelligence to situate the firm in relation to competition and to customers aspirations, taking a

> [...] dynamic view by judging whether any new product is likely to be competitive by the time it reaches the market rather than at the point of its conception (Design Council 1988:6).

The strategy might also involve organisational innovations and the involvement of specialists from a number of backgrounds in the design team. The main point is that the participants in the team should be involved since the beginning. These changes in project organisation will depend on the type of project and capabilities of the firm. However there is no easy formula or specific technique guaranteed to achieve success in the market. The activity of developing products is intricate and requires an interactive process in relation to a number of aspects, among them: functional requirements or number of attributes of the product; cost of manufacturing; cost of product development; time of introduction of the product in the market place; product life cycle and after sales support and service costs; situation of the product in relation to the firm's other investments (Design Council 1994:3). Thus, design is crucial to the survival of any manufacturing firm as it can cut-down costs, enhance profit margins and expand the firm's share of the market, and provide the most profitable return on investment.

In contrast to the situation in MIEs, the R&D and innovation system in LIEs is underdeveloped. Although there are pockets of R&D and innovation in NICs, this is not the norm in most less industrialised countries. The innovation system in LIEs is in general concentrated in urban areas, and caters mainly for the needs of industries operating in the formal industrial sector. Even within the formal sector there is a bias in favour of the larger and economically powerful companies. In the following chapter a more detailed account of the innovation system in LIEs will be given.

## 1.6. The Reasons for Choosing Metal Manufacturing Light Engineering Enterprises

One of the factors which influences the process of industrial development and which has been neglected in the development literature, is the role of light engineering in developing countries (Smillie 1991:165). The importance of firms operating in the light engineering sector cannot be underestimated. Metal working and mechanical industries play a crucial role in the development of manufacturing industries and are vital to any country. These industries provide the necessary infrastructure for repair and maintenance of machinery and equipment produced by the capital goods sector. They provide a variety of consumer durables and intermediate goods. Its main importance however, is related to the production of capital goods which are vital to industrial productivity and technology. As pointed out by Maldonado (1992: 25-46).

> There can be no national technological capability unless these basic industries are previously or concurrently developed

Metal working and mechanical industries are crucial in building up and strengthening technological capability and are also responsible for a considerable number of consumer goods used by the low income population, as most of the firms operating in this industrial sector are small or micro enterprises. In recent years there has been an expansion of metal industries due to urbanisation in LIEs. Such urbanisation has led to the demand for a wider variety of products and some small enterprises have invested in machinery and equipment to improve production, although this has happened in a relatively small numbers of firms. The majority of the firms still rely on basic technology and suffer a number of constraints.

The decision to study the metal manufacturing sector in Paraíba was taken because of the number of such enterprises operating in the state; the potential for their technological adaptation; their utilisation of a variety of new and old technologies, and the level of sophistication in the linkages within, and between, the informal sector and the formal sector. Metalworking activities involve the manufacturing of consumer goods and capital goods and the knowledge of a number of skills which can be used in other industrial sectors of the economy. The manufacturing of consumer goods is particularly important in a country like Brazil and this is an area of the private sector where Brazilian industries in general might have an advantage over transnational companies.

As Night (1981:59) points out

> [...] Food, shoes, clothing, bicycles, furniture and building materials for the domestic market do not require large-scale production, international trade networks or secret technologies. These are industries characterized by competition, rather than monopoly or oligopoly. And basic consumer goods can be, and are, exported.

These remarks are particularly relevant to design because of its crucial role in incremental innovation and as an activity which can enhance the value of products through non-price factors. Thus metal trades can benefit from industrial design.

## 1.7. Main Assumptions

The point of departure for this investigation were a number of assumptions related to product design in the context of Northeast Brazil. The first assumption was that there existed a certain level of design activity — both engineering and industrial design — being conducted by small manufacturing units and that they differ from the generation of artisanal products, and that this activity encompass both the conception and adaptation of production and consumers goods. The second assumption was that the programmes aimed at helping to develop microenterprises have an elitist view of design and do not take design capability at this level seriously enough to invest in it. The third assumption was that design might play a role in creating and improving the overall quality of products produced and consumed by socially vulnerable groups, and that enhancing design capability would accrue benefits for both low income producers and consumers alike.

## 1.8. Structure of the Report

This thesis is composed of seven chapters. Chapter I, introduces the thesis and clarifies the reasons that made me choose the subject of the investigation. Chapter II, attempts to pinpoint where, in the body of literature, are the lacunae concerning to the subject of this research.

Chapter III examines the issues related to product design in microenterprises in developing countries. Chapter IV presents the methodology used in the collection of evidence and the reason for using such methods. Chapters V and VI present evidence collected in Northeast Brazil and the evaluation of this evidence. Chapter VII presents the conclusions and recommendations for further research.

# Chapter II

# Technical Innovation and Design in Less Industrialised Economies

## 2.1. Introduction

The present chapter aims to introduce the subject of technical innovation in less industrialised economies and situate design within this subject. The first two sections provide an introduction to the process of industrialisation in LIEs and information on the professional Research & Development system within them. Sections 2.4. to 2.6 situate the emergence of professional industrial design within the LIEs, focusing on the countries of Latin America, particularly Brazil. Sections 2.7. and 2.8. introduce the design of socially useful products, both in MIEs and LIEs and focus on the relationship between industrial design and appropriate technology in LIEs.

## 2.2. Economic Development and Less Industrialised Economies

Despite considerable technical progress in the past hundred years, the majority of the world's population has not benefited from the results which accrued from it. Basic needs such as sanitation, housing and education have not yet been fulfilled for most of the world's population, who are continually fighting for survival. In recent years poverty has increased to worrying levels. According to the World Bank Report 1990

> [...] By 1990, between one and one and half billion people, twenty per cent of those on the planet, were living in absolute poverty - spending most of what they earned on food, and yet still eating less than enough to remain healthy (Smillie 1991:12).

Approximately two-thirds of the world's population live in the countries of the so-called Third World, most of them located in Africa, Asia and Latin America. For example, in the 1980s, these millions of people have access only to 10 per cent of the world's wealth, while North America which encompass only 6 per cent of the planet's population, use 40 per cent of the world's natural resources (Turner 1980:1). Some of these poor countries have gradually improved their conditions and have achieved a certain level of economic development since the last World War, while others have stagnated.

There are a number of terms employed to identify these poor countries, the most common: underdeveloped countries, non-industrialised countries, less industrialised countries, The South, the Periphery and Third World. The concept of a Third World emerged after the Second World

War and was related to a political idea. It was seen as an alternative to the First and Second Worlds, represented respectively by the ideas of Capitalism and Socialism (Harris 1990:7). The concept appeared in France and was used by the independent Left in an attempt to find a form of democratic participation which did not have the influence of Moscow or Washington (Allen and Thomas 1992:3). The Suez crisis and the Soviet invasion of Hungary in 1956 brought disillusion with both blocks. Leaders such as Nehru (India) Sukarno (Indonesia) Nasser (Egypt) Sékou Touré (Guinea) and Tito (Yugoslavia) formed the non-aligned movement. According to Peter Worlsey

> What the Third World originally was, then, is clear: it was the non-aligned world. It was also a world of poor countries. Their poverty was the outcome of a more fundamental identity: that they all being colonised (Worsley 1979:100-8).

This movement was by no means neutral and their members wanted to have 'an active participation in international affairs and judgements of issues on their merits rather than from predetermined positions' (Barzanti 1994). However, the original combination of interests of these non-aligned countries did not last long, and distinctions among the different nations of the Third World culminated in disunion, widening the gap between the NICs[1] and other countries in Africa and Asia. Thus, Third World implies a notion of superiority and is usually applied to those poor countries which, compared with the rich 'developed' countries lag behind in the modernisation and industrialisation process.

Development is thus crucial to poor countries to improve living standards and a key element in the process of development is industrialisation. There is a consensus that

> ...(i) countries cannot achieve high per capita incomes and living standards without industrialisation, (ii) rising incomes in turn lead to increasing demands (income elasticity demand) for industrial goods which soon outstrip those for non-industrial goods, and (iii) countries cannot become wealthy and independent even in the long run without first becoming substantially industrialised (Bhagavan, 1979:7).

Technology and technological innovation play an important role in the process of industrialisation and, as demands grow, in the production of industrial goods. However, to be able to create products, a crucial activity is product design and, among the many professions involved with this activity is industrial design. Professional industrial design activity is a relatively new phenomenon in less industrialised economies. In most of these countries, particularly in Latin America, the emergence of design dates back only thirty years and is mainly associated with the 'modernist development paradigm', which appeared in the fifties and sixties (Er and Langrish 1992:2). This paradigm of modernisation was sometimes called the 'diffusion theory', as it was expected to

[1] The Newly Industrialised Countries - NICs encompass countries such as the Asian 'Tigers', Singapore, Taiwan, Hong Kong, and South Korea as well as some Latin American countries such as Argentina, Mexico and Brazil.

'trickle down' the benefits of development to the majority (Desrochors 1976:25). It emerged from the optimism which followed the post World War II period, the so called 'Golden Years'. This period, which lasted two decades (1950-1970), was one of intense economic development in the industrial market economies, mainly in Europe and the United States. The theory implied that less developed economies should follow similar stages of development to the industrial powers, until they finally reached 'modernity'. As Toye puts it,

> The process of development consisted [...] of moving from *traditional* society, which was taken as the polar opposite of the modern type, through a series of stages of development derived essentially from the history of Europe, North America and Japan - to *modernity*, that is, approximately the United States of the 1950s (Toye 1987:11; emphasis added).

A country would reach modernity once it achieved, by various means, 'a certain critical rate of growth' which would be followed by positive benefits to the general population (Hewitt 1992:221-237). Or, according to Hettne

> Development was seen in an evolutionary perspective, and the state of underdevelopment defined in terms of observable economic, political, social and cultural differences between rich and poor nations. Development implied the bridging of these gaps by means of an imitative process, in which the less-developed countries gradually assumed the qualities of the industrialized nations. (Hettne 1992:60)

It was during the 'Golden Years' that a rapid expansion of industry occurred in many less industrialised economies, particularly in Latin America. One of the paths for this industrialisation process was the import substitution strategy. This strategy targeted internal markets, which were supplied with imported commodities, and was often followed by protectionist measures. The aim was to move gradually from the substitution of consumer goods to the production of capital goods. This process of industrialisation was not homogeneous. For example, in nations such as Brazil and Mexico, it started in the 1930s and by the 1960s these countries had a considerable industrial infrastructure. In Taiwan, South Korea, Singapore and Hong-Kong the development of industry followed a model based on the production of consumer goods on a large scale, aiming at overseas markets (Hewitt 1992:226). It was in such a context that industrial design activity would be established once industry in these economies developed (Er and Langrish 1992:2).

Few of the less industrialised economies have achieved a reasonable industrial infrastructure, the most industrialised countries, the NICs, have achieved a certain level of economic development but some, such as Brazil and other Latin American countries, are still highly dependent on exports of raw materials and cash crops. Others, such as the Asian Tigers (i.e. Taiwan, South Korea, Singapore, Hong Kong) are mainly exporters of some categories of industrialised goods.

However most NICs lag behind MIEs in a fundamental aspect of industrialisation, the existence of a strong research and development system.

## 2.3. Research and Development Activity in Less Industrialised Economies

In recent years, 'non-material' investment, which includes the acquisition, production and diffusion of technology, has overweighed the importance of factors of production like labour, capital goods, raw materials and energy. This 'non-material' investment requires, as in more industrialised economies, a sophisticated research and development system. However, not all industries have access to such system. It is concentrated in specific industrial sectors. In LIEs, very few countries have R&D institutions which can compete with the system in MIEs. Research and development is not only concentrated in some industrial sectors but in some areas of these countries.

A crucial factor which accounts for the technological backwardness of most of LIEs is scant industrial development. The LIEs, 'with 80% of the population of the capitalist countries, barely accounts for 10% of the world's industrial production' (Third World Editors 1988:56). A basic characteristic of industrialisation in LIEs is concentration. For example, Brazil alone is responsible for one-fourth of LIEs' industrial output. LIEs are composed of over 100 nations but 73.2 per cent of industrial output was, in 1988, responsibility of only 10 countries. This pattern of industrialisation also brings concentration of regional production. This is the case of states like Rio de Janeiro and São Paulo which are responsible for 60% of Brazilian industrial output. Thus, industrialisation in LIEs

> [...] tends to produce privileged poles in a few countries while, in general, it is limited to the implementation of a small capacity for agro-industrial transformation or the assembly of durable consumer goods. This is not the kind of industrialisation — specifically in the Brazilian case — that will permit a take-off and self-sustained industrial development (Third World Editors 1988:57).

R&D capacity is crucial to the development of industry. However, as Freeman (1982:184) points out, the world research and development system is highly unbalanced

> [...] the bias in the world research innovation system is so great as to constitute a danger to the future of human society. [...] over 90% of the world's R&D is conducted in the industrialized countries, and that is overwhelmingly and quite naturally directed towards satisfying demands in those countries. [...] This means that very little of world's R&D is in fact directly concerned with the elementary needs of the majority of the world's inhabitants. And here the bias in the *capital* goods sector is often of the greatest importance. The need for innovations in both capital goods and consumer goods designed specifically for the needs of the developing countries is very great; yet the innovation mechanism of the world market is biased overwhelming towards the high income countries.

The less industrialised economies are responsible for a minute part of world R&D and for only 6 per cent of production of technology (Table 2.1.). Twenty four countries in the North conduct 96 per cent of R&D activity as against 4 per cent of LIEs. Another important indicator is the quantity of gross national product which is spent on R&D by individual nations, and the amount invested per worker by each country. For example North America spends yearly U$331 per worker to increase productivity while developing countries spend US$3 per worker. The disparity can also be felt in the number of scientists working in industrialised countries, including the East European countries, and the developing countries. The former employ approximately 2 million scientists and the latter 300,000 (Third World Editors 1988:59). It is also worth noting that the production of capital goods, which is one of the fundamental aspects of self-sufficiency is very small in LIEs. A study conducted by Tiberghien (1981) showed that LIEs are responsible for only 3 to 4 per cent of the world's manufacturing of capital goods. Thus the acquisition of 'a capacity for economic self-transformation — on one hand research and development, on the other, basic machinery — is linked to other forms of economic exchange'. This involves the payment of know-how, patents, licenses, trade marks etc. which can be substantial. For example in 1976 Brazil made US$272 million on such payments (Third World Editors 1988:62).

**Table. 2.1. The Technological gap in numbers**

**Indicators (1978-82) averages** **Developing Countries**

Aston University

Illustration removed for copyright restrictions

Source UNCTAD (Third World Editors 1988:57)

However, R&D alone is not sufficient to materialise applied research into products which are commercially viable. The key activity within the innovation chain which links R&D and the market is product design. Design is in a unique position within the innovation system because of its integrative role between the requirements of producers and users. Although this activity has been used in some industrial sectors in some LIEs, particularly Asian NICs, in others it has not made any substantial impact over manufacturing firms, particularly microenterprises.

It is unlikely that design as a professional activity will be able to fulfil the needs of small firms in less industrialised economies. Bodies like universities and research institutes, even though some have design teams and could design products for small firms, have done little in this direction. There is a considerable distance between the formalised R&D system and the small and medium production units in less industrialised economies. As mentioned previously (Freeman 1982:184), the need for innovation in both capital and consumer goods specifically for less industrialised economies is very great, yet the innovation mechanism is biased heavily towards the high income countries. The bulk of research conducted by research institutes and universities is concerned with pure or basic research at the expense of applied research, and concentrates on problems debated in the scientific literature which are mainly related to the MIEs (Hekland 1992:101-108). Such bias within countries appears to be a reflection of the international R&D system where the majority of research is conducted in MIEs and when it exists in LIEs benefits mainly high income groups.

As in MIEs, most formal R&D in the LIEs is directed to more technologically advanced firms, leaving the great majority of firms, which are small, to fend for themselves. This is also true about product design. Institutions which recognise the role of design in manufacturing treat it as an activity which is only conducted by formally trained professionals working in research institutes or consultancies. To consider only professional designers, is to limit the potential of design in such a context. To invoke an historical example, many technological developments in 19th century England stemmed from small entrepreneurs or people working on the shop floor (Heckland 1992:101-108). Paraphrasing Adam Smith, many machines were originally the inventions of common workmen. Technical advance was rapid but the state of the techniques allowed people with experience and inventiveness to improve upon them by observing and conducting simple experiments. The majority of patents were granted to 'mechanics' or 'engineers' who developed their ideas while at work or at home (Freeman 1982:10). Practical experience of workers was responsible for a number of inventions and innovations in industries such as railway, metal-working and textiles (Freeman 1990:29). In a similar manner to-day, in developing countries much design is executed within an informal innovation system.

Although few patents are granted to microenterprises in LIEs, particularly firms run by the poor, such historical examples throw light on what is occurring in many millions of micro-production units, where innovation emerges from the need to survive. However, professional industrial design has been perceived by some LIEs as an important activity in the process of industrialisation and, since the end of the last great war, some governments in LIEs have shown concern for the inclusion of this activity in their industrialisation process, although this varies from country to country. The following section provides an insight into the emergence of professional industrial design in some LIEs which have been chosen because of their level of industrialisation and their attempts to introduce industrial design into the production system.

## 2.4. Professional Industrial Design in Less Industrialised Economies

Concern about product design in developing countries was expressed for the first time by the US government, in 1955 (Er and Langrish 1992:2). This concern was translated into a programme, supported by the US State Department, through the International Co-operation Administration. The Administration asked five design consultancies to carry out a survey of craft based industries in several developing countries, with the objective of improving product quality and making them more acceptable in the market place, especially in the United States (Heskett 1991:204). Governments in developing countries were also becoming aware of the importance of design. In 1958, the Government of India requested the American designer Charles Eames (1991:63-75) to produce recommendations for an educational programme in the field of design, aimed at aiding small businesses and at withstanding the fast decay in quality and design of consumer products. From the recommendations of the Eames Report emerged the National Institute of Design - NID - at Ahmedabad and the Industrial Design Centre - IDC - (1969) at the Indian Institute of Technology in Bombay (Bonsiepe 1990:252-267).

In the 1960s and 1970s international agencies such as the United Nations became interested in design as a tool in the development process and the discipline was included in projects of technical co-operation. According to Bonsiepe (1990), the first time design policy was debated at a UN agency was in 1973. A document entitled *Development Through Design* was produced by Gui Bonsiepe for the United Nations Industrial Development Organisation - (UNIDO), at the request of the International Council of Societies of Industrial Design - (ICSID). Design in this report was seen as a crucial tool in the industrialisation process and in the overall effort of development. Bonsiepe (1973:9-11) listed nine main problems which design in developing countries could help to solve:

(1) Alleviate the balance of payments by saving currency which otherwise would be used to import manufactured goods. This currency could be used in a more productive way.

(2) Products designed locally would meet needs which are specific to developing countries, which were not being met by imported goods. Such products would fit in with the local manufacturing infrastructure and less capital intensive technology.

(3) Job creation through the design of products using labour intensive technology. This would help to absorb abundant non-skilled labour.

(4) Full utilisation of local manufacturing capability through the diversification of production.

(5) Help to create products aimed at export markets.

(6) Design can develop products with a strong cultural identity.

(7) Design can minimise environmental damage by stimulating "...the development of alternative environmentally compatible technologies".

(8) Design can minimise the impact of unjust income distribution through the creation of accessible products to the poor population. **'...Industrial design could find one of its noblest aims, and one of its very few really worthwhile justifications, in developing products for the needs of the poor majorities.'** (emphasis added)

(9) Rationalise and establish priorities in product design policies, according to the country's existing resources, is one the most important areas for industrial design.

In relation to these countries, it was argued that design was crucial to the development process particularly in relation to industrialisation. Design would *inter alia* allow the poor masses access to products that, up to that moment, they had not. Based on the potential developmental role of design, a number of missions sponsored by UNIDO in conjunction with ICSID were prepared (Auböck 1974, Reid 1978, Mullin 1978). The main purpose of these missions was to obtain overviews of developing countries' design activity and recommend how to improve it. There were also other joint interventions supported by governments of developed and developing countries (Cressonnieres 1975, 1976).

These missions, in spite of the short time to undertake them, provided a snapshot of design activity in the countries surveyed. One of the most important of these missions was undertaken by the British designer John Reid. Reid, in 1978 produced a report called *The State of Industrial Design in Developing Countries: A Report on the Pilot Mission to India, Pakistan, Egypt and Turkey*. The mission's terms of reference were to visit these countries, clarify UNIDO/ICSID intentions to government officials, private sector and other bodies involved, or which potentially could be involved, in industrial design and have an overview of the state of local industrial design, its needs and then recommend possible interventions to fulfil such needs by the scheme

UNIDO/ICSID (Reid 1978:ii). Reid, who saw design as an art 'concerned with people - their hopes, needs and aspirations', was optimist about the potential role design could play in those countries where the majority of needs were similar (Reid 1978:iii). Among his recommendations was support for design in small scale industries. He argued that in India design could provide quicker beneficial effects if the more perceptive small scale entrepreneurs were selected and a design consultancy service accessible to them, particularly in financial terms, was set up. The author condemned the sort of aid programmes which brought in foreign designers who were involved in quick projects and then returned to their countries without leaving anything behind. What was needed, he argued, was design capability to train local designers (Reid 1978:20). The preoccupation with design for small industries emerges in different parts of the report. In New Delhi he suggests that labour intensive activities should be encouraged and that this is a crucial point in the development of Indian design (Reid 1978:38). He recognises the existing creativity and skills in very small firms and that visiting experts should have a 'down-to-earth practical and common sense approach to design problems and a true appreciation of peoples needs' (Reid 1978: 143).

Although he acknowledges informal design produced by the poor population and recognises the creative capacity involved in the conception of some products sold in popular markets, his approach is mainly related to intervention by formally trained designers, being expatriates or local (Reid 1978:28). He also acknowledges that some of the products of intermediate technology might be useful in this context and that at the time, there was important work being carried out in this area in developed countries. He suggested that an abstract or digest on IT products should be considered (Reid 1978: 33). However, later in the report Reid does not seem so enthusiastic about intermediate technology. As he point out

> We are concerned with industrial development, not intermediate technology. Our problem is not to find ways of recycling used Coca-Cola tines to make ingenious hydraulic pumps for village irrigation schemes, but to provide the design expertise that will assist in the development of indigenous industries and skills (Reid 1978: 232).

At a later section in the report, Reid gives an interesting account which exemplifies the different perceptions of people involved in appropriate technology to matters related to industrial design. In discussion with the Deputy Director of the Appropriate Technology Development Organisation in Pakistan, he pointed out that the director was surprised when asked about the choice of product to be made using the appropriate technology. The director seemed not to realise the relationship between the design of the products and the technology which is going to produce it (Reid 1978:128).

Reid advocates the need for 'socially necessary design'. He describes self-help schemes in slums, mainly related to architecture, in Pakistan and suggests that design can be used in similar schemes. Such schemes involve the marginalised population in the solution of their own problems, creating self-respect, group work, independence and immediately improving living standards (Reid 1978:141). He is also openly critical of the fashion within the design establishment for Third World issues which emerged during the 1960s and 1970s and, condemns, what he calls, the fruitless talking of seminars like *Design for Need*. According to him

> [...] in spite of the fact that much is said, there appears to be little in the way of tangible results [...] One successful case history is worth a hundred seminars [...] One adequately trained competent designer can make a greater impact on the industrial development of his country than a thousand seminars and exhibitions (Reid 1978: 233).

Professor Reid stresses the importance of design for small enterprises in LIEs and suggests that designers in such contexts should be more generalist and might have to be involved in production as well as in the design of products. The designer should identify problems related to products but also have to take into consideration all the managerial aspects related to product design. He suggests the establishment of a kind of clinic where small enterprises could draw upon a number of specialities of design. Designers would work as part of a wider team of experts from different disciplines and address problems in their entirety. He differentiates the work of the designer working in clinics aimed at small and medium firms from the practice of the designer in a large organisation. In the large organisation they work in a more isolated form. These clinics could be set up in design institutions and be subsidised by government and international agencies (Reid 1978:247).

Another Pilot Survey commissioned by UNIDO/ICSID was called *Industrial Design in Mexico, Colombia, Brazil and Argentina* and was conducted in 1978 by Mary V. Mullin (Mullin 1978). The aims of the mission were the same as Reid's: to report on the state of industrial design in the countries covered; to consult designer associations, universities, industrialists etc.; to recommend actions related to industrial design. Among her recommendations were (Mullin 1978:86)

- definition by international organisations of the areas and the kind of assistance they could provide to local societies;
- Compilation by UNDP of a directory containing all institutions which are involved with, or can have some positive contribution to make to, the development of industrial design in the countries visited;
- Organisation of short term courses aimed at the personnel in these organisations to provide and exchange information on industrial design;
- Setting up of a special mission to study the best way to use UNIDO/ICSID resources to **'improve the living, working, health and social conditions prevailing in so**

**much of Latin America.**' (emphasis added) She recommends the involvement of other agencies such as the World Health Organisation, UNESCO, etc.;

- Development of a Designer Placement Scheme which would provide designers from LIEs with specialised training;
- Recommendations of the this first visit should be immediately be acted upon.

Victor Papanek and Gui Bonsiepe, the two main designers who have addressed the needs of the poor and the potential role of design in improving their living conditions in developing countries, published their major books in the 1970s although they first discussed the theme in the 1960s. Both wrote about design in LIEs, but from fundamentally different perspectives. Papanek (1985), the author of the most popular book on design, *Design for the Real World*, caused considerable controversy in the 1970s with his strong attack on the profession of industrial design in industrial market economies. His book focused on a wide range of ethical issues concerning design, and included material on design in developing countries but, the main theme was the 'social responsibility of the designer and the role of the industrial design profession in the creation of forced obsolescence and the design of socially irresponsible products' (Madge 1993: 149-166). In the 1971 edition, Papanek proposed that designers from MIEs should design for LIEs. He was criticised for these proposals, particularly by Bonsiepe who described Papanek as an ingenuous person lacking a political perspective (Bonsiepe 1974:42-4). Bonsiepe also criticised Papanek's proposal that students from industrialised economies should design for the Third World, because he felt that this would bring no real benefits to LIEs (Bonsiepe 1974:42-4). Papanek in the 1985 revised edition, recognised that much of his writings on peripheral countries were out of context and to a certain extent naïve (Papanek 1985:xvii,xviii). He acknowledged a

> [...] somewhat patronizing viewpoint many of us had about the poorer countries more than a decade ago [...] I and others failed to appreciate how much we could *learn* in the places we set out to teach. [...] The road between the rich nations of the North and the poor southern half of the globe is a two-way street. It is reassuring to understand that designers in the Third World can solve their own problems free from interference by "experts" imported for two weeks.

Papanek now suggests that what is required is a more just relationship between North and South and he recognises that aid and charity have limited effects on the wide range of needs in LIEs. In his view, dependence can only be overcame by mutual co-operation (Papanek 1985:xx). He proposes that co-operation between North and South should combine small-scale and new technology which, he believes, will 'for the first time make decentralised and human scale feasible' (Papanek 1985:xxi). The role of the designer, in his opinion, is that of a synthesiser, bridging the gaps between disciplines and designing products which range from simple village level goods to products for export (Papanek 1985:37). Of particular interest to this thesis are the points made by Papanek (1983:30) about participatory design. He points out that the industrial design profession has been relatively slow to respond to consumer demands, and that consumers have not forced this participation either. In his opinion this occurs because the design profession is unknown to the majority of people, who are unaware that design can have any influence over their lives. This ignorance about design varies according to country. However, this can create problems for the process of participation in design, as people will not be able to be involved in something which they do not know about. He suggests that one of the forms of bringing people and design closer together is by creating products in which the involvement of the end users is crucial to the design process. Doing so means that architects and designers must be more reachable to people. This is the only way which allows people to have some influence upon the products they will use (Papanek 1983:31). He argues that the complexity of the design process requires that designers work in teams which involve non-designers, but that democratising the design process is difficult and slow. It involves, among other things, overcoming communication problems, and getting deeper involvement with the end user. Similarly to Bonsiepe (1992:110) he also considers the involvement of workers in the process of design important. Papanek cites an example of Bepla/Planet Products in Australia as a model of workers participation in decision making and design. Suggestions by workers were frequently requested by management and modifications related to production, design or working practices also came from workers. Not only were workers stimulated to initiate the design of lamps, but also to design capital goods. According to Papanek, this process of consultation has brought positive results for the firm (Papanek 1983:34, 35).

In another attempt to involve users in the process of design he describes a failure in the design of a chair intended to be built by the residents of a low income housing estate. The users said the chairs were comfortable and functional, but they did not like them. They found the chairs designed by students, 'ugly'. Residents considered that the chairs resembled 'third rate do-it-yourself furniture, not like what they thought "normal" chairs should look like.' Thus, a basic human requirement, the aesthetic perception of that group was ignored. As Papanek points out,

> Participation in design is based on trust. Although most people are inexperienced in design and are not used to working with designers, the design profession must reach out and ease the way for dialogue. The task is difficult, but it is absolutely essential if design is not to bankrupt itself morally. Only this way will the designer become a tool in the hands of the people (Papanek 1983:43).

Gui Bonsiepe, is an ex-graduate and lecturer from the Hochschule für Gestaltung in Ulm, has had a wide experience as a consultant for international organisations (UNESCO, ILO, OECD, ICSID) and has published a number of books on industrial design (Bonsiepe 1975, 1978, 1983, 1992). He was vice-president of ICSID from 1973-1975 and has lived in Latin America for a number of years, working in several countries in the region. Bonsiepe approaches the subject of industrial design from a neo-marxist perspective, and was originally influenced by the Latin American 'Dependence Theory'.[2]

However, in recent years he has become disillusioned with this school of thought. Bonsiepe now feels that this is a limited discourse as it over-emphasises the role of exogenous actors in the economic system of peripheral countries and does not really explain the failure of design in that context (Bonsiepe 1991:17-24). Although he rejects the explanations of dependency theory, Bonsiepe still places considerable emphasis on the role design can play in developing countries. According to him, design is

> [...] one way for countries on the periphery to come to terms with modernity, with the modern project, and not only and predominantly in the realm of industry, but also in that of social organization (Bonsiepe 1990:252-259).

He argues that there is an absolute distinction between design in the more industrialised economies and the less industrialised economies, the '*dissimilarity of context'*. The disparity in wealth distribution, which is especially serious in Latin America, with its consequences for the majority of the population, highlights the ethical aspects of design. The effects of foreign debt and of the constant outflow of capital from less developed nations and its implications for future developments raise the question of the role design can play in minimising the effects of this disproportionate relationship (Bonsiepe 1990:252-269). According to this author, the main impediment to the progress of industrial design in developing countries is the absence of a '...discourse on design to form the background to the daily life of a culture' (Naylor 1990:71-2).

In Bonsiepe's opinion, design in industrialised countries has been approached from a different perspective, as a tool used to differentiate, or stimulate, the consumption of products in the market. This is due to the fact that production problems are already resolved and there is a capacity for overproduction. The designer works within a much higher level of technological development, with sources of technical information and specialist know-how in all steps of production (Borges and Carrascosa 1988:55-59).

---

[2] '...In the literature on development and underdevelopment published in the 1970s there was one dominant perspective: the dependency approach. It originated in the extensive Latin American debate on the problems of underdevelopment, and became a significant contribution to modern social science. Not only did it contain a devastating criticism of the Eurocentric modernization paradigm, it also provided an alternative intellectual perspective, rooted in the Third World, and it also functioned as a catalyst in the subsequent development of development theory. This new perspective went beyond the problem of structural dependency; it implied a self-reliant approach to development theory....' Hettne, B. *Development theory and the three worlds*. Longman. Harlow. 1992. pp 81,82.

In LIEs the situation is the reverse, with 'sub-consumption', 'deficit in the productive sector', lack of qualified labour and of technological information. Because of these opposite contexts, the role and attributions of the designer are quite different in LIEs, states Bonsiepe. In his opinion, the designer in LIEs has to undertake a wider range of functions than designers in developed countries: for example, the designer has often to be involved in the production stage. These limitations have a direct influence over his work, restricting the quality of the design output. Bonsiepe is suspicious of designers from industrialised countries designing <u>for</u> the Third World. This he describes as the *'continuity of cultural domination'*. He does not deny that it is important to exchange information with developed countries but one should not use this as a model. In his view it is not possible to adopt an universal concept of design which can be applied in both industrial market economies and developing countries (Naylor 1990:71-2), but he acknowledges that his ideas are frequently unacceptable to Europeans and Americans who still maintain a 'universalist' vision

> [...] what they do is only to extrapolate their limited and eurocentrist vision, inflating it and trying to give it a universal value it does not have. There is no universal model valid to all (Borges and Carrascosa 1988:55-9).

Bonsiepe recognises the hegemony of the 'Centre'. It controls the world, it's design scene dictates the kind of products and the *'physiognomies'* of manufactured products, the speed of change and output of new theories. By contrast design in peripheral countries is only embryonic, but nevertheless has a potentially new, "emancipatory" role, which is emerging in the particular context of the developing countries. The issue of design in developing countries is related to the 'problem of technological dependence'. To Bonsiepe design is a 'technological variable'. Design and technology go beyond the aesthetics of goods. They 'touch the nerve centre of the material culture - with proper characteristics not simply of form, but of structure as well" (Naylor 1990:71-2).

In relation to the level of design in LIEs Bonsiepe (1990:252-269) suggests some indicators which could serve for the development of design in a specific context, and which could help to identify the areas of competence of industrial design. These indicators

> [...] serve as guiding principles and instruments for ascertaining the status that industrial design has achieved within a society on the periphery, and can be used to reveal the background to particular local histories of the discipline.

Design management in state and private sectors

Design management is translated into products aimed at consumers in a specific context. This management is evident in three aspects which cannot be separated a) Generation of the commodity. What the product does for the consumer. Requirements of the user covered by the product, including cultural aspects etc. b) control of product quality during production. c) Built in aesthetic quality.

The exercise of professional activity

Related to the fact that more designers are working in manufacturing firms and that professional bodies and design consultancies are being established.

State Policies

Government support at various levels e.g. inclusion of design in industrial policies, implementation of institutions for the practice of design.

Education and training

Structuring programs and curricula for this new discipline in educational establishments.

Research

To produce a body of knowledge that professional practice could contribute, and to create a theoretical critical body of knowledge to change the present situation in which design is understood in a narrow sense, associated only with skills.

Debate on design

To generate a debate on design through journals and other means. Table 2.2. below was based on these six criteria (Bonsiepe 1990:252-269)

**Table 2.2. Stages of the History of Design**
**Matrix of domains of design (columns) and stages of development (rows)**



Source: BONSIEPE, G. "Developing Countries: Awareness of Design and the Peripheral Condition." *History of Industrial Design.* Electa. 1990. Volume 3, 1919-1990 The Dominion of Design. pp.252-269.

According to Bonsiepe, the most industrially advanced countries in the developing world reached level three in a period of thirty years (1960-1990). The main periods are:

- "Proto-design" period - independence to II World War. The previous existing industrial infrastructure developed with the cessation of exports from the industrial countries involved in the war.
- 1950s **"**Gestation**"** period. Avant-garde movements brought the subject of design into the spotlight. Design was seen as crucial to modernity.
- 1960s and 1970s "Period of incipient institutionalisation" - establishment of educational institutions.
- 1980s "Period of expansion and incipient consolidation"
  "Sovereignty phase" not achieved in any country in the developing world.

## 2.5. Professional Industrial Design in Latin America

Industrial design is a recent phenomena in Latin America. This activity emerged in some countries in the region approximately 30 years ago and is closely linked with the industrialisation process. Government institutions were the main force behind the introduction of design. It was introduced also by international programmes aimed at supporting small and medium enterprises development, with the objective of improving the quality of goods produced for local and for export markets (Bonsiepe 1991:17-24).

The main countries which have developed some level of design capacity have been Brazil, Mexico and Argentina although others, like Cuba and Chile, have also attempted to introduce design into local industry. Although there were some local peculiarities in the development of design, in most of these countries it emerged as part of the import substitution strategies aimed at stimulating the process of modernisation and industrialisation. However, in spite of some positive aspects of such policies, protectionist measures also brought negative consequences. As Er (1994:61) points out, economic growth brought also an

> [...] inegaliterian consumption structure as a result of the efforts for creating a large enough domestic market to stimulate the consumer durable industries protected by high import tariffs. The distribution of the national income is heavily distorted in favour of the upper income groups.

Thus, although in some countries industrial design has addressed, to a certain extent, some of the needs of the upper and middle classes, it has neglected the needs of the majority of the population.

In most Latin American countries, design activity has not become integrated into the production system. Bonsiepe suggests that there are number of reasons for this. The first one is related to the *theory of dependence*. According to the advocates of this theory, the multinational corporations had excessive power in the region and obstructed the development of local design capacity. However, Bonsiepe points out that the fact that transnational corporations operate locally provides no explanation to the lack of attempts by local firms to use design. The second cause is related to financial constraints. Local firms are not willing to invest in an activity which is a long term venture and which has no guarantee of success. There are alternatives which will provide a much quicker return on investment. The third cause, lack of integration with management, is related to the fact that it is less expensive to reproduce foreign concepts than to hire designers to generate new ones. Finally there is the gulf between higher level design education and the needs of the industrial enterprises. This is a considerable obstacle to the dissemination of design into the industrial milieu (Bonsiepe 1991:17-24).

However, design has achieved a level of dissemination in some countries. For example, in Argentina there was a certain level of design activity before the war, which was reduced considerably when protectionist measures were brought in. However, there were some positive consequences of these measures, particularly for light manufacturing industries. Argentina, for example, had an advanced level of design in the 1960s, and in 1962 set up the Industrial Design Research Centre (Centro de Investigación de Diseño Industrial - CIDI) which was influenced by the 'Good Form' movement. The CIDI was supported by industrialists mainly from the furnishing, fabric and lighting sectors. Gradually entrepreneurs started paying closer attention to design and played a key role in its development. Important publications and the first university level courses appeared in the 1960s. However, according to Bonsiepe, the emergence of design courses in Argentina differed from Brazil and Mexico, in the sense that they were not linked to the demographic explosion phenomenon but were based on academic experiences in the teaching of design from abroad. Gradually other sectors of industry such as transport and agricultural machinery received the attention of designers. (Bonsiepe 1990:252-269)

According to Margain (1994:1-16) the evolution of industrial and graphic design in Mexico has occurred in four successive stages which coincide with four decades. In the 1950s the first courses in universities appeared. It was during this period that the National Design School of the National Institute of Fine Arts (Escuela Nacional de Diseño del Instituto Nacional de Belas Artes) was founded. In 1959 the Iberoamerican University (Universidad Iberoamericana) created the Industrial Design School (Escuela de Diseño Industrial) to provide technical training. The 1960s witnessed the organisation of designer's associations and the creation of other design courses such as that in the School of Architecture at the National Autonomous University of Mexico (Universidad Autonoma de México - UNAM). In 1969 the first design student graduated from the

Iberoamerican University. It was during the 1970s that the public and private sector focused attention on design and started hiring the services of designers. Public sector recognition materialised in the creation of the Design Centre of the Mexican Institute of External Trade (Centro de Diseño del Instituto Mexicano de Comercio Exterior). It was in the early 1970s that the first professional associations and a number of design schools were established. The design related activities in the decade culminated with the 1979 ICSID Congress. In the fourth stage a Master degree course at UNAM was established and in 1981 the Mexican Academy of Design was created.

Mexico has a total of 70 design schools, 18 of which are industrial design schools, with two postgraduate courses. However, it remains to be seen which direction Mexican design will follow after the North America Free Trade Agreement - NAFTA. Margain (1994:1-16) explains that attempts have been made to work together with American and Canadian design associations and that the Mexican Government has taken the decision to create a number of institutions aimed at reinforcing the present infrastructure for industrial development. Among these are the National Centre of Metrology (Centro Nacional de Metrologia), the Mexican Institute of Industrial Property (Instituto Mexicano de la Propriedad Industrial) and the Mexican Institute of Standards and Certification (Instituto Mexicano de Normalizacion y Certificacion).

Although Cuban industrial production is insignificant, attempts have been made by the socialist government towards the establishment of design. According to Guillois (1988:10), founder of the National Industrial Design Office (Oficina Nacional de Diseño Industrial - ONDI), the need to support Cuban design is related to '...the needs of an underdeveloped country in the direction of the construction of socialism'. These needs include not only consumer goods but also capital goods. The development of capital goods is in his view, a strategic point, because they are crucial in the development of local technology. For example, having such capacity could open a market of over three billion people in the LIEs which has been neglected by the MIEs. He states that in Cuba the need for designers is related to the need to materialise the existing development of scientific research. This structure was set up in the early days of the revolution. He mentioned a study conducted by soviets which found out that 'for each researcher in advanced pure science, ten industrial designers are needed to convert the results of this research into new products.' This has to be done quickly because of existing international competition.

In Chile, industrial design training was practised as a craft-based activity linked to interior design. By 1968 a reform at university level changed the position of design and it became one of six design specialities. At the end of the 1960s the Technological Research Institute (Comité de

Investigaciones Tecnólgicas - INTEC) was created by the socialist government. INTEC designed a number of products ranging from simple toys to capital goods. In recent years, design has mainly developed in the light engineering metal manufacturing industries (Bonsiepe 1990:252-269).

## 2.6. Professional Industrial Design in Brazil

The history of design in Brazil is relatively recent. In the twenties and thirties, some architects and artists used product design, mainly in their own architectural projects, but those initiatives were mostly on a semi-artisanal basis. Artists such as Regina and John Graz and Antonio Gomide, influenced by the European vanguard and the art déco movement, translated the main artistic tendencies of the period, such as cubism, futurism and construtivism, into products used in interior design projects. They were influenced also by the philosophy of the Bauhaus.

Because of the Second World War, substitution of imports was necessary and prepared the ground for industrialisation in the fifties. In 1947, the Museum of Art of São Paulo (Museu de Arte de São Paulo - MASP) was created and became a breeding ground for design as it turned into a meeting point for architects and other professionals involved with design. The first design course was established in São Paulo in 1951 at MASP. The Museum opened a number of schools which taught design as part of a variety of subjects, ranging from music, ceramics, and history of art to advertising. The school of design was called the Institute of Contemporary Arts (Instituto de Artes Contemporâneas - IAC) and a two year course aimed at giving practical and theoretical training. The Institute was run by Lazar Segall, Pietro Maria Bardi, Roberto Burle Marx and Lina Bo Bardi (painter, art critic, landscape designer, architect respectively), among others, and the students came from a number of different backgrounds. For the first time the importance of industrial design was diffused among painters and other professionals. The didactic methods were considered advanced for their time, as they were based on the teaching methods used at the Bauhaus and were influenced by the Hochschule für Gestaltung in Ulm. Ludovico Martin, one of the most respected designers in the country, considers IAC as a milestone in the history of design in Brazil, because as well as initiating the teaching of design it emphasised the integration of graphic design and industrial design as did the Hochschule für Gestaltung in Ulm. IAC, according to Maurício Nogueira Lima, tried to approach industry without success and concentrated its activities mainly on graphic design aspects.

The economic development of the fifties modified the economic and social conditions of some parts of the country, especially the South-eastern and Southern regions. The plan for the modernisation of Brazil clearly aimed at rapid industrialisation. Juscelino Kubitschek, the president at the time, made clear his vision of industrialisation.

> To industrialise the country at an accelerated pace; to transfer the basis of autonomous development to our country; to make manufacturing industry the dynamic centre of national economic activity - this resumes my aims and options. (Niemeyer 1993:64-67)

Population growth in urban centres and rapid economic development led to the construction of factories and offices and gradually design activity was introduced in the furniture and building industries. The first publications on design also appeared in this period and by the end of the decade the debate about design was stirred up by the presence of foreign lecturers and professional designers who visited Brazil. In 1956 the Rio de Janeiro Museum of Modern Art was created. Its director intended to set-up a Technical Creation School (Escola Técnica de Criação) to be housed in the Museum and asked Tomás Maldonado from the Hochschule für Gestaltung in Ulm to prepare the curriculum. The original plans for the school were later adapted by Carmem Portinho to the Brazilian context (ABDI 1977:2). The school was opened by the Brazilian President in 1958 but, it never worked satisfactorily. As the industrialisation process increased, the authorities in Rio de Janeiro felt the need to create a new design school. Tomás Maldonado, Max Bill, Misha Black, Umberto Eco and others were asked for advice and in 25 December 1962 the Advanced School of Industrial Design (Escola Superior de Desenho Industrial - ESDI), the first graduate level university design course, was created in Rio. The school was influenced by the principles of the Bauhaus and the Hochschule für Gestaltung in Ulm, and in turn served as a model for later design schools in Brazil. The school was influenced by both American and European design practice and started to operate in July 1963 with the aim of:

> [...] training, through technical, scientific, artistic and cultural education, professionals at university level who would be able to fulfil to the two demands of our industrial society: planning of industrial products, and planning of means of visual communication (ABDI 1977:2).

To the creators of the school, ESDI would not only provide specialised designers for the incipient industry in Brazil but would be a way of reducing the payment of royalties to foreign designers and giving the population wider access to products. Surprisingly, as pointed out by Niemeyer (1993: 64-8), there is no indication of attempts by ESDI to make contact with industry. In the late 1960s ESDI started to question the imported Ulmian model which was distant from the Brazilian reality and the role of design in the Brazilian industrialisation model (ABDI 1977:1).

By the end of the 1960s and early 1970s, design in Brazil was beginning to consolidate. An important step forward was achieved with the creation of the Industrial Design Institute - IDI (Instituto de Desenho Industrial) at the Rio de Janeiro Museum of Modern Art (Museu de Arte Moderna do Rio de Janeiro - MAM) in 1968. The Institute was involved in four main areas: project development, exhibitions, information and advisory services. It operated within a context dominated by external technological, economic and cultural factors. From the beginning IDI was involved in the discussion of the creation of a model for design in Brazil. It was critical of the import substitution policy because, according to IDI, this was developed with the short-term aim of quick profits. There was a lack of long-term planning of production or the market, and this made it difficult to implement a design policy (IDI 1978). In 1968 IDI mounted an exhibition called "Industrial Design 68 - International Biennial Exhibition of Rio de Janeiro" involving six important agencies in Brazil; Ministry of Exterior Relations, MAM, ESDI, Brazilian Association of Industrial Design, São Paulo Biennial Foundation and Confederation of National Industry. The USA, United Kingdom, and Canada participated in this exhibition. There were subsequent Biennial exhibitions and others related to specific areas of design such as Corporate Identity and Contemporary Silverware. The exhibitions were also intended to contribute to the proper formulation of concepts and 'to find the right professional criteria of action' (IDI 1978).

In 1973 the Federal Government through the Ministry of Industry and Commerce/Secretary of Industrial Technology, structured a programme of support for industrial design aimed at the export markets. IDI developed a project about packaging which resulted in the *Handbook on Package Planning*. The objective was the systematisation of information and the identification of the three major activities included in packaging planning - engineering, marketing and design. The Handbook was followed by an implementation stage which was composed of a mobile exhibition and courses aimed at professionals in the packaging industry. One of the most important aspects of the project was the standardisation of cargo units.

Also worth mentioning was IDI's project for school furniture. This project was supported by two institutions responsible for building and equipment in schools, the Brazilian Centre for the School Buildings and Equipment - (Centro Brasileiro de Construções e Equipamentos Escolares - CEBRACE) and São Paulo Company for School Building (Companhia de Construções do Estado de São Paulo - CONESP). This was an interdisciplinary project and according to the Institute,

> [...] has reinforced a point of view held by the IDI since its inception in 1968: that design in countries such as Brazil can and should be oriented towards objectives other than immediate profit which sees in the industrial product only the trade value contained therein (IDI 1978).

The project's objective was to guide institutions involved in purchasing, using and producing school equipment, defining adequate criteria for all possible requirements.

Concurrently, there were some initial attempts to introduce design in state policies for science and technology and in government institutions. In 1973 the Ministry of Industry and Commerce (Ministério da Indústria e Comércio - MIC) through the Secretary of Industrial Technology

(Secretaria de Tecnologia Industrial - STI) created the Programme 06: Industrial Design (Programa 06: Desenho Industrial) which aimed at establishing priorities in product development and finding institutions with the technical resources to design them. The major activity of the Programme was to choose, control and provide technical advice on, projects supported by the STI through agreements with a range of research bodies. The aim was to develop industrial products to improve the competitiveness of Brazilian goods in the international markets. In 1975 this industrial design group was officially recognised and named Industrial Design Advising. This was an important breakthrough because for the first time an industrial design unit was operating in a federal government institution. Its function was to analyse and follow up projects financed by STI which had strong industrial design content. The STI was also given the task of structuring a National Centre for Industrial Design (Centro Nacional de Desenho Industrial), although the Centre was never established. Gradually the group also began to design products for public agencies and it published a number of case studies of products and set up the first ergonomics laboratory in the country. Latter the name changed to Industrial Design Programmes Unit (Unidade de Programas de Desenho Industrial - UPDI). The historical significance of the STI/UPDI was to gain recognition for design within the public administration as a discipline with a defined function in innovation and production (Naveiro 1994:35-46).

In São Paulo, the most industrialised state in Brazil, a Centre of Industrial Design (Núcleo de Desenho Industrial - NDI/FIESP/CIESP) was set up by the State Industries Federation in 1979. The aim of the Centre, now called the Department of Technology (Departamento de Tecnologia - DETEC), was to diffuse the activity of design within industry and government institutions. This institution began with the purchasing of an itinerary product exhibition from the Museum of Art in New York and then established a Design Award, in conjunction with the National Research Council and the Governor of the State Award, where products considered as 'Good Design', received an NDI label and were allowed to enter a competition. The NDI organised important seminars such as the Design Seminar on Quality Control and Packaging (Seminário de Design, Controle de Qualidade e Embalagem) in 1981, in conjunction with the Federal Government. It also organised a series of exhibitions and lectures by foreign designers. The support from the Federal Government's STI with the Programme of Support to Scientific and Technological Development (Programa de Apoio ao Desenvolvimento Científico e Tecnológico do Ministério da Indústria e Comércio - PADCT) was also important. Its objective was:

> ...the systematisation of information in the area of industrial design, aiming at the integration between the knowledge stock from teaching, research and development institutions and the demand from industry (Design & Interiores 1987:174).

This programme culminated in a database of services, materials and the first image bank of Brazilian products. DETEC today work in five major areas: automation, informatics, training, quality and standardisation, and industrial design. This period coincided with the establishment of a considerable number of design schools all over the country. Today there are over 90 schools providing courses linked to design.

It was only in the eighties, on the initiative of the National Council of Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq), that industrial design was included in official scientific and technological policy. This was during the presidency of Lynaldo Cavalcanty de Albuquerque of CNPq. He continued the policy which had started in 1973, with the establishment of a programme of industrial design by the Federal Government, which then expanded in 1975 (Bonsiepe 1990:252-269). CNPq recognises, through the Programme of Product Development - Industrial Design (Programa de Desenvolvimento de Produtos - Desenho Industrial) created in 1981, the importance of industrial design activity for developing countries. The programme was included as one of its priority actions, to strengthen, diffuse and promote industrial design. Innovation was seen as a tool of liberation from techno-economic and cultural dependency from the industrialised countries. Industrial design was considered as the crucial ingredient for integrating technological innovation to industrial practice (Barroso 1983:55-6). The objectives of the Programme were

- to contribute to the processes of creation, adaptation and diffusion of technologies, by promoting the insertion of the activity of industrial design into the productive sector and into the technology and research centres;

- to support actions aimed at improving the formation of human resources in project areas, emphasising industrial design, product engineering design and mechanical engineering

The structure of the programme included a variety of activities divided into two major groups:

- to increase the industrial demand for techno-projectual services related to the activity of industrial design (diffusion and promotion)
- improvement in the human resources training (professionals and lecturers specially)

These two groups were to be supported by other actions of five groups of sub-activities:

- Diffusion and Promotion
- Human resources Training
- Infrastructure
- Support for Technological Innovation
- Institutional Support

There was considerable financial support and projects were commissioned from public research institutes. CNPq also supported a number of awards e.g. “First Award for Agricultural Equipment

Appropriate to the Small Rural Producer" (I Concurso Equipamentos Agrícolas Apropriados ao Pequeno Produtor Rural -1983), which reflected the preoccupation of the institution with socially useful projects. Albuquerque recognises the importance of capacitation and technological modernisation but also the need to take into consideration the variety of the Brazilian productive system and its physical and socio-cultural differences. These technologies had to be economically viable but also socially appropriate to suit the variety of situations in which the population lives and work. Acknowledging that it is crucial to support research on high technology he also argues that the state should promote technologies accessible to small and medium producers and which take into consideration available factors such as labour (Barroso 1983:3).

In the 1980s important publications such as *Industrial Design: Professional's National Directory*, (*Desenho Industrial: Cadastro Nacional de Profissionais* -1984) were published and research institutions, such as the Brazilian Laboratory of Industrial Design (Laboratório Brasileiro de Desenho Industrial - LBDI) were established. LBDI, formerly called Product Development Associate Laboratory/Industrial Design - Santa Catarina (Laboratório Associado de Desenvolvimento de Produto/Desenho Industrial de Santa Catarina - LADP/DI-SC) is the most active of all the 'Laboratórios'. It was created in 1984 as part of an agreement between CNPq, FINEP and Federal University of Santa Catarina (Universidade Federal de Santa Catarina - UFSC). It's aims were to meet the increasing needs of small and medium industries located in the Southern region of Brazil using the existing technologically advanced infrastructure of UFSC. The LBDI develops products for local industries and promotes conferences, seminars and short courses aimed at 'recycling' professionals and lecturers in industrial design and has produced a series of publications on design (Design & Interiores 1987:119).

Although concentrated mainly in the Southeast and South regions of the country, design has to a limited extent penetrated some segments of industry. Its presence can be felt especially in the furniture, electrical and electronic consumer goods, and fashion industries. But despite the undeniable development of industrial design as a professional activity in the past thirty years, design has not managed to fully establish itself within Brazilian industry. There are different reasons for this, but two are particularly important. On the one hand, there is the lack of ability by designers, as a professional body, to present in a convincing manner to businessmen, the advantages of hiring professional designers. On the other hand, most entrepreneurs and managers appear to consider design as an unimportant activity for their businesses (Bonsiepe 1991:17-24).

According to the São Paulo State Industries Federation (FIESP/DETEC/NSDI 1991:58-67), at least 30 higher education design schools are in operation in Brazil today. Most of these institutions were established in the past thirty years, are modelled on American and European universities, and train designers along First World lines. The quality of the schools, it's teaching and infra-structure, varies considerably and the communication between them is superficial. Interaction with industry is also poor and there appears to be a significant mismatch between what is taught at the universities and the needs of industry. There are also problems related to the lack of professional industrial experience by lecturers. This problem is made worse by the fact that full-time teachers are not allowed to work outside the university, which makes it difficult for them to update their teaching. Another important aspect which needs to be addressed, is the strengthening, in the university curricula, of project work and of disciplines related to business and management. These are subjects which are normally neglected, placing the recently graduated design students in a vulnerable and disadvantageous position in a business environment.

To complicate this situation, professional books on design are hardly available in Portuguese. Designers depend almost exclusively on foreign publications, which are expensive and difficult to acquire. Very few are translated into Portuguese and research papers and publications in this language covering the social role of design are rare. In spite of these problems, educational institutions in Brazil may still have an important role to play in improving relations between design activity and society. As Bonsiepe (1979:45-50) has suggested

> [...] Universities, have the opportunity for experimentation. They can explore forms of co-operation when providing their extension services to clients who do not normally use them, such as, industrial parks, co-operatives, rural communities, governmental departments. This contributes to the diffusion and access to products by the low income population.

However, he said this 16 years ago and, there is little evidence yet of such noble aims materialising. Despite some isolated efforts to design socially useful products, it appears from the existing design literature in Latin America and in Brazil, that products for the low income population are not top on the agenda in the design establishment. Nevertheless, the needs of the poor communities are ever increasing and it would be extremely healthy if designers gave them some attention.

There are a number of programmes supporting microenterpises that draw from industrial design expertise. The main programme providing support for micro and small enterprises is run by the Brazilian Micro and Small Companies Support Service (Serviço Brasileiro de Apoio às Micros e Pequenas Empresas - SEBRAE). This institution was created in 1972 by the Brazilian Federal Government and it was privatised in 1990. Today it is a non-profit organisation providing a wide range of services, supported by a well established infrastructure. The programme is one of the largest of its kind in the world having at its disposal an annual budget of over US$250 million. It operates in 27 states of Brazil and deals with 20.000 requests from enterprises per day. It is also involved in providing training and in the organisation of two thousand exhibitions per year (Jornal do Brasil 1994). SEBRAE target the 4 million micro and small companies operating in the country today. The situation of these firms varies widely but, as a survey of 992 firms conducted in 1990 revealed, they all experience a number of difficulties such as lack of planning and lack of control methods. In critical areas such as marketing, 85 per cent of firms do not utilise any marketing techniques. In relation to production, 65 per cent do not use productivity evaluation systems and 60 per cent have no quality control techniques (SEBRAE 1990). The survey classified the enterprises into two different groups in relation to the way they operate in the market and revealed that they react differently to policies aimed at opening up the Brazilian economy to international competition. The first group encompass enterprises which operate in localised markets and have a restricted geographic dimension. These are little affected by the policies. These enterprises are more dependent on the level of income of the population and are to a certain extent remote from decisions concerning export markets due to the customs and level of consumption of customers. Demands are satisfied to a certain extent by present production. This group encompass the majority of microenterprises or 65 per cent of the total. The other group is composed of enterprises which supply the market at national and international level. This is the segment which will benefit most from the new economic policies but such exporting enterprises represent only 6 per cent of the total.

In the microenterprise segment, defined by the survey as enterprises with up to 20 employees, the situation is critical. Only 23 per cent use any technical specification, 19 per cent follow technical standards, 20 per cent have trade mark register or patent, and only 13 percent have some contact with technology centres. The survey confirmed that microenterprises, particularly in the Northern, North-eastern and Centre-west regions, have the worst performance in the management, technology and production and have serious market limitations. The conclusion makes it clear that there is a huge task to be tackled, particularly in the small industries, in relation to

> [...] information dissemination, human resource training, management capacity, support for technological and market development, aiming at a change in mentality, consolidation of a group conscience and better professional qualification which allows the entrepreneur to formulate his strategy in a modern Brazil, mature and ready for international competition, which the External Commercial and Industrial Policy aims to affect (SEBRAE 1990).

To tackle the needs related to product design, SEBRAE has a programme called Micro and Small Enterprises Technological Support Programme which provides technological assistance to micro and small firms producing goods or providing services. Its aims are the stimulation of new technological developments, the improvement of quality and the increase of productivity and competitiveness. The programme is divided into two types; Type “A”: Optimisation and Rationalisation of Processes and Products and Type “B” Development and Technological Innovation. In relation to product design, Type “A” provides, among other things, support for improvements in products and in production equipment; product, technical or economic feasibility studies; and human resources training. Type “B” is an exclusive programme aimed at the development of new products and processes. The actual service is provided by a number of institutions such as technology centres, universities, research institutes, technical schools, and other non-profit making bodies. One problem with this programme is on one hand, the limited amount of funds available for enterprises operating with more sophisticated technology, and on the other hand the fact microenterprises run by very poor people do not have the resources to contribute the minimum of 30 per cent of the project’s value which is required from the enterprise. The maximum resources available for Type “A” are approximately US$6.250 and for Type “B” US$12.500. SEBRAE also runs a programme called SEBRAETEC which is a consultancy service aimed at providing tailor-made consultancy for short term projects. Its objective is to establish a mechanism for the transfer of knowledge from Technology Centres through the use of their human resources to solve micro and small enterprises technological problems. It is directed at industry, commerce and the services sector. One peculiarity is that the project is allowed to work with informal enterprises which are in the process of legalisation. It operates by solving specific technical problems of processes and products and analysing the technical feasibility of potential technological innovations. The costs of the service are met by SEBRAE for consultancies of up to two hours and for over two hours there is a financial contribution made by the enterprises themselves. The programme also uses student labour as consultants with a fee of 50 per cent of the usual cost. There is no provision for training on product development.

Another institution providing credit and management training is the Centre for Small Business Support of Paraiba (Centro de Apoio aos Pequenos Empreendimentos da Paraíba) which is part of a national network co-ordinated by the National Federation for Small Business Support (Federação Nacional de Apoio aos Pequenos Empreendimentos - FENAPE). FENAPE is a non-profit private organisation concerned with the socio-economic development of the low income population. It provides financial support to small family undertakings in manufacturing, commerce and the service sector. Besides financial and technical support it provides other services such as management training and business consultancy. I had contacted CEAP representatives in Paraíba and Rio Grande do Norte in 1994 and had proposed an experimental training module which was to be tested in November 1994. Unfortunately I had to return to the UK and could not participate in the tests. I had tried to obtain feedback from CEAPE but this was in vain. The module *Product Design* was based on CEAPE's existing modules which include, the areas of production, entrepreneurial personal characteristics, and production and costs. The idea was, through an exercise called 'The Generation and Development of Products', to make small producers aware of the potential role of industrial design and the benefits of its use; to introduce the idea that the process of design is manageable like any other activity in the firm; to show the interrelation between design, production sales, and the consumer; and the importance of these three aspects in the creation of new products.

The training was intended to participants go through some stages of the design process and learn to present and evaluate new ideas, thus minimising risks. The module was divided into three phases: (1) Identifying and Structuring the Problem; (2) Generation of Alternatives; (3) Presentation. In the first stage participants would be divided into groups and a fictitious market situation introduced, where competition between products was rife. Discussions would then be started with the aim of finding solutions to such competition. From the answers other concepts would be introduced. The second phase would be the design of a simple product, and the third phase the presentation of alternatives, explanation of the choice of product and calculations for production. This preliminary module was to be used as an exploratory method and from the information emerging the module would be improved.

There is also a programme supported by the Federal Government called Promotional Programme for the Generation of Employment and Income in Northeast Brazil. (Programa de Fomento à Geração de Emprego e Renda no Nordeste do Brasil). This programme is co-ordinated by the Bank of the North East of Brazil (Banco do Nordeste do Brasil - BNB) and involves both Federal and State government and other institutions in the region. The budget for the programme is U$150 million, to be spent on training, technical assistance, infra-structure etc. The actions are divided into six strategies, the most relevant to this study being: 4. Strategy of support for small Agro-industry in the North East; 5. Strategy of promotion for industrial and artisanal small and microenterprises; 6. Strategy of access to the productive process for families in condition of total poverty. The bank finances the implementation of enterprises, construction of physical infrastructure and training linked to the implementation of the programme (BNB 1993:10).

An important programme in Paraíba state is the *Projeto Meio de Vida*, a programme created in 1992, by the Paraíba State Government through the Community Action Foundation (Fundação de Ação Comunitária - FAC). This programme provides finance at subsidised interest rates for the creation, or strengthening, of existing manufacturing/commercial microenterprises operating both in urban and rural areas. The money is lent against transfer of ownership of the machine to the creditor. The funds available derive from the Small Business Support Programme (Programa de Apoio aos Pequenos Negócios - PROPENE) and are aimed specifically at the low income population. In its first stage no training was available. The project has been particularly important because it provides access to credit for people who previously had no access to conventional credit mechanisms. Providing credit allows poor people to set up or improve their microproduction units and consequently provides the market with low cost products and services which are accessible to low income users (Governo do Estado da Paraíba/FAC 1993:1).

The project proved to be of interest to the population. FAC was open for application during 15 working days and during this time received 10.000 applications. In the first stage of the project, applications could be made in two geo-administrative microregions, corresponding to 33 per cent of the municipalities of the state: João Pessoa (capital of the state) with 18 municipalities, and Campina Grande with 38 municipalities. Selection of the beneficiaries was made after a visit to the applicants home where the socio-economic aspects of applicants and the techno-economic feasibility of the proposal was assessed (Governo do Estado da Paraíba/FAC 1993:2-3).

In 1993, 250 projects in João Pessoa and 128 in Campina Grande were accepted, directly benefiting 378 families and approximately 1890 people. FAC also financed 15 micro-production units of the 'group mode', benefiting 154 families and 770 people directly. The projects are varied and cover a number of activities in commerce, services and manufacturing. In both 'group mode' and 'individual project' modes, the most sought after support was for the garment industry. The second area was artisanal fishing. Other activities in manufacturing included; broom manufacturing, disposable nappies, crafts, school equipment, jewellery, lady bags, sweets, furniture, tinsmiths, metal working, physiotherapy equipment, shoes, dolls, truck bodies, and soap. Among the beneficiaries were disabled people, ex-convicts, ex-young offenders, unemployed, migrants etc. (Governo do Estado da Paraíba/FAC 1993:4-12).

An evaluation of the project conducted in 1993 points to some positive results, particularly in relation to employment generation. There were also negative points mainly related to misuse of resources (FAC 1993). In May 1994 a decree by the State Governor created the Feira Meio de Vida - FEMEV (Meio de Vida Open Market) with the aim of establishing an outlet for the products manufactured by micro-producers supported by the project. FEMEV provides space for 400 producers, 200 in João Pessoa and 200 in Campina Grande (FAC 1994).

Observation of FEMEV provided evidence and reinforced the need for product design in micro-production manufacturing units supported by the project. Although there were a large number of products being sold at FEMEV there was a saturation of products. For example, a number of entrepreneurs were reusing plastic bottles first used as drink packaging. They developed interesting solutions but did not use the material to create new products, but made products, easily found in other outlets (Figures 1-7). The products made were chairs for dolls, boxes for a variety of uses such as keeping cotton or thread or toys. There were also decorative objects such as flowers constructed with dried and tinted leaves (Figure 5) An amazing technique is used to make products such as animal toys, bags and purses (Figure 6.). There were also producers manufacturing teaching resources. Figure 4.).

Figure 1. Two litre PVC bottles are recycled into a number of products.

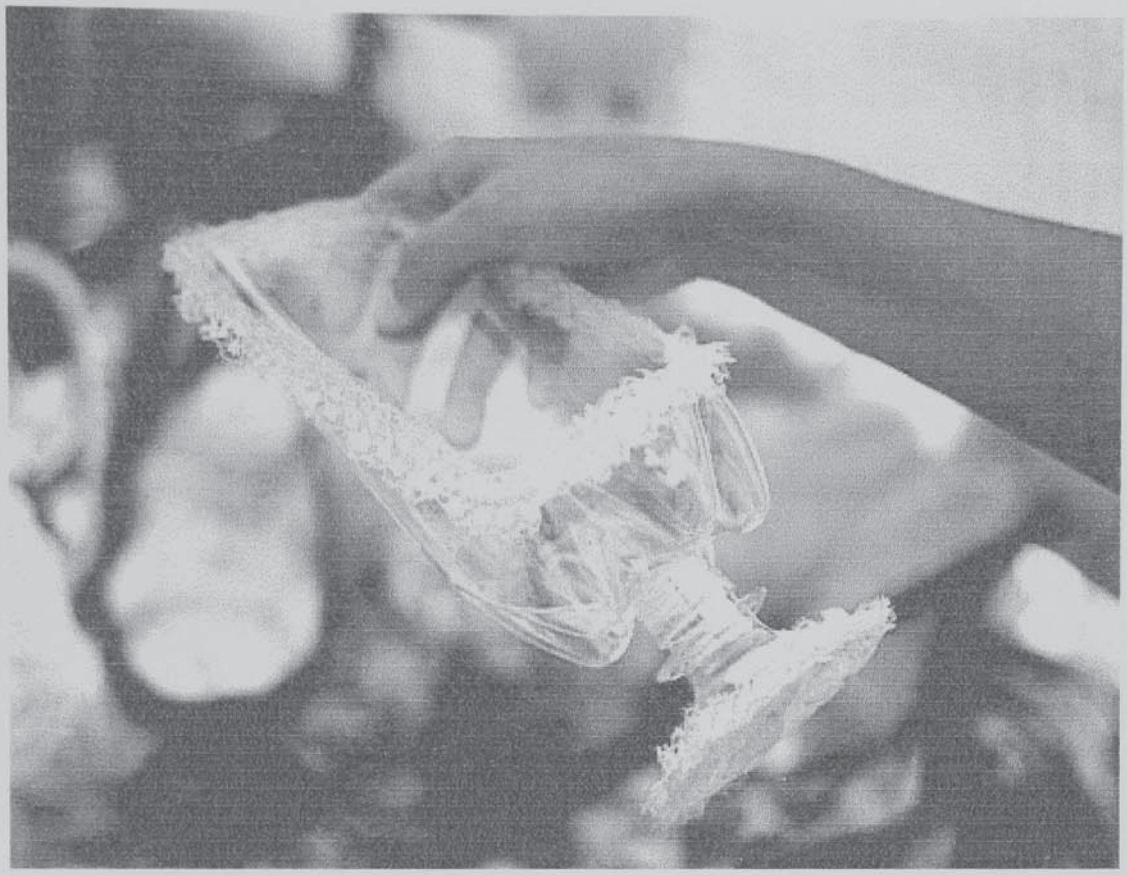

Figure 2.. The top of the bottle is cut and glued to the bottom to make the chair's leg.

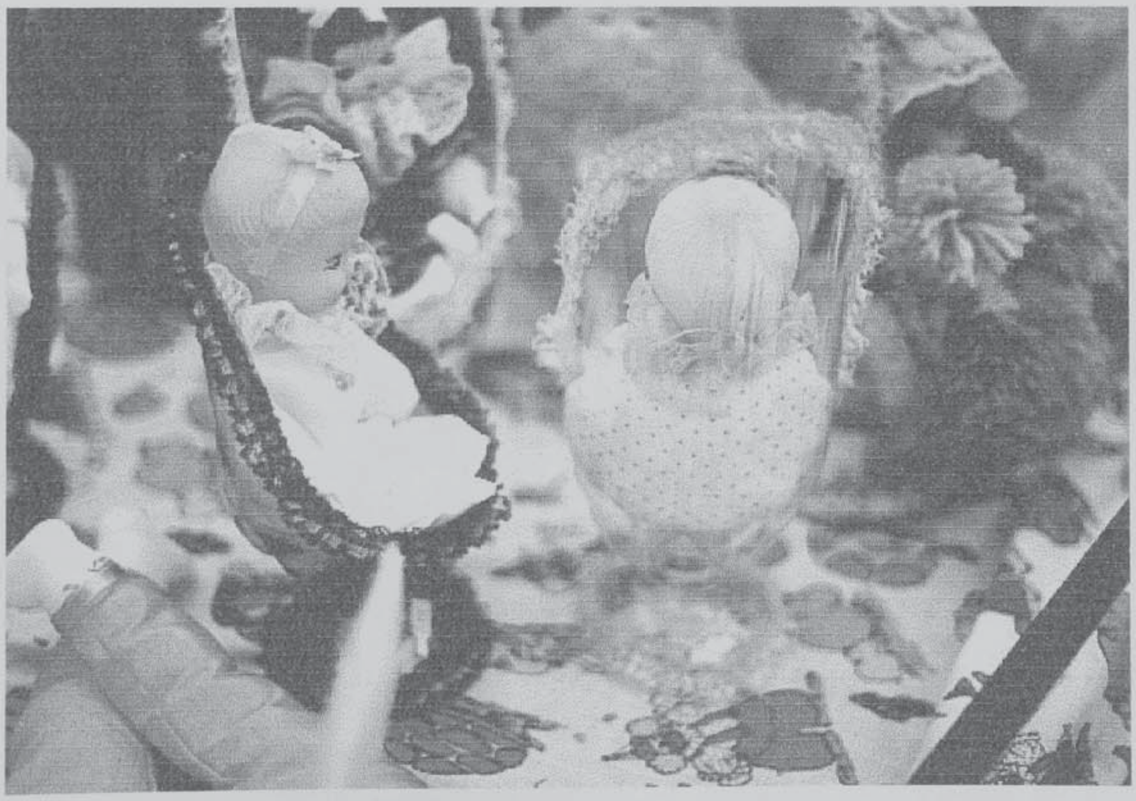

Figure 3. The chair is used as a child's toy.

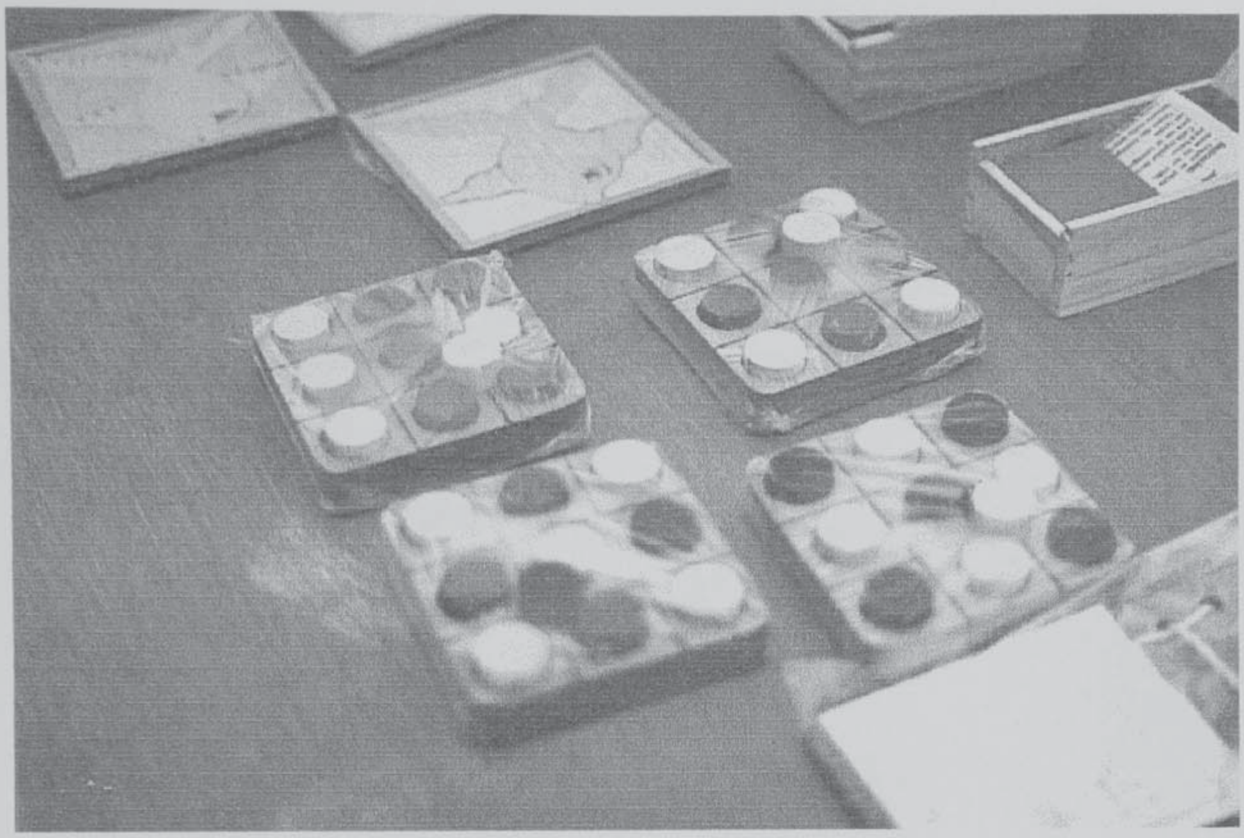

Figure 4. Teaching resources made by a woodworker.

Figure 5. Flower assembled used tinted dryed leaves.

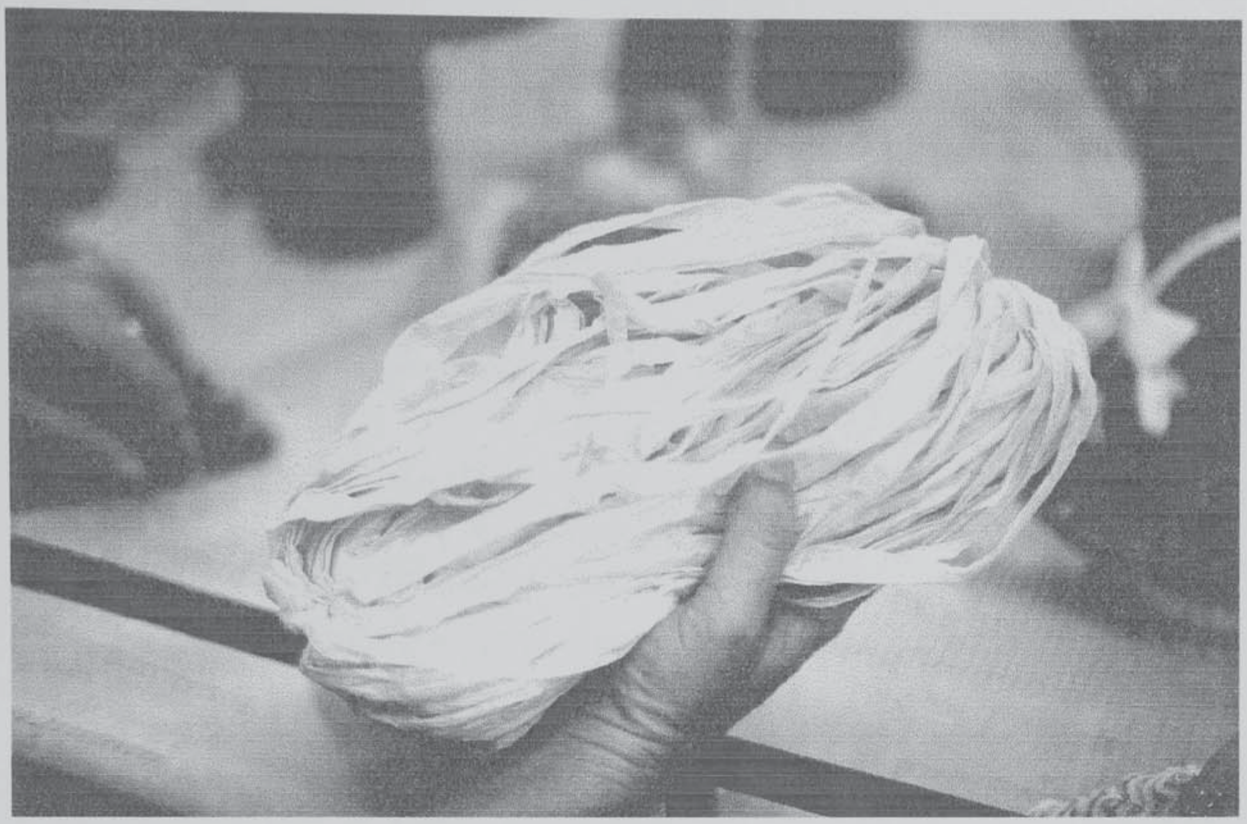

Figure 6. From this plastic string called 'Ráfia' a number purses, toys and other products are made.

Figure 7.Toy made from 'Rafia'.

I had two meetings with the programme co-ordinators and suggested that attention should be paid to product design in the programme and that training should be aiming at creating or enhancing existing capability. They were very interested and explained that in recent months, they had made contact with other support institutions to set up a management training programme for the small producers. We agreed that when I returned to Brazil a training programme similar to CEAP's would be introduced. However, there are obstacles to be overcome. They estimated that by 1995, the programme would be covering more then 4000 beneficiaries both in João Pessoa and Campina Grande. Thus depending on the approach to training, there will be considerable logistical problems to overcame.

Another important programme is the *Programme of Support for Appropriate Technologies* (Programa de Apoio às Tecnologia Apropriadas - PTA), under the responsibility of the Ministry of Science and Technology. The Programme recognises the importance of appropriate technology in the development process for the fulfilment of basic needs, and that it can offer improvement in living conditions, increase in productivity and as a consequence, of income to large part of the population (MCT/CNPq/IBICT 1993:13). PTA could play a particularly important role in the introduction of design to the low income population because among its objectives are the implementation of 'School Factories' (Fábricas Escolas) in urban periphery and rural areas, Lycées of Arts and Crafts (Liceus de Artes e Oficios) in shanty tows in cities and rural areas, to structure Technological Video Libraries and Publications (Vídeotecas Tecnologicas e Publicações). Moreover among the specific objectives of PTA, is stimulation for the preparation of small business leaders and the organisation of micro and small enterprises in technological innovation institutions. Its aims for 1993/4 were are quite ambitious. It intended to implement 'School Factories' and/or Lycées of Arts and Crafts in 1000 municipalities; to train 1000 monitors and organisers of Factories and Lycées; to reach a target population of one million people; to produce 100 Video Technology Libraries and 500 teaching texts.; to implement the National Network for Transfer and Diffusion of Appropriate Technologies (Rede Nacional de Transferência e Difusão de Tecnologias Apropriadas). I have contacted the MCT asking to what extent they achieved such aims but have received no reply. The following sectors are part of the programme priority: agriculture and cattle breeding; health and nutrition; housing; sanitation and environment; transport; energy; education; and small scale production (MCT/CNPq/IBICT 1993:16-25). In small scale production a range of products and processes are considered from leather tanning to household utensils. However, there is no mention of the possible role of industrial design in such a programme.

## 2.7. Socially Useful Design

In the late 1960s and 1970s the design of socially useful products was *en vogue* in Europe and America. These concerns culminated in a Symposium held at the Royal College of Art in London, called *Design for Need: The Social Contribution of Design*. The Symposium brought together a number of different designers with quite different views on design, such as Victor Papanek and Gui Bonsiepe. It appears that at this time, some sectors of the design community had reached a certain level of political awareness and, judging by the rather pompous closing remarks of the conference, delivered by Sir Misha Black, socially useful design would be here to stay. He stated that

> We have two things to offer the emergent world: our technology - a power for good as well as evil - and the frail but real advantages of democracy. But if the rest of the world is to learn from us, we must prove ourselves worthy of the role of teacher. This is not the task for the weak - for those who would opt out of society. It is simultaneously a political, economic and social task which needs a toughness equal to that of those who care only for the satisfying of their own gluttony (Bicknell and McQuiston 1977).

The idea of socially useful design is not new and can be found, for example, in the work of Buckminster Fuller. Fuller's utopian ideas influenced the 1960s and 1970s design establishment both in Europe and in the U.S.A.

From the agitation of the 1960s a number of lines of thought appeared. Whitely (1993:96) identifies 3 main movements: a) alternative/appropriate technology movement; b) concern for designing shelter for Third World disaster victims; and c) complete denouncement of design and architectural practice (e.g. the group Architectural Radicals, Students and Educators - ARSE). It was during this period that Victor Papanek became very influential. He argued that designers should be concerned with fulfilling the real needs of the majority. Among Papanek's priorities were design for the Third World; teaching and training materials for disabled people; medical equipment; equipment for research laboratories; equipment to be used in inhospitable environments; and 'systems for breakthrough concepts' (Papanek 1985).

The design of socially useful products has been executed by a number of groups both in MIEs (e.g. Alternative Product Working Group in Germany, the Unit for the Development of Alternative Products at Coventry and The Sheffield Centre for Products Development and Technological Resources) and the in the LIEs (e.g. National Institute of Design, India and Pontifícia Universidade Católica do Rio de Janeiro - PUC/RJ, Social Design Sector/ Industrial Design Laboratory of the Federal University of Paraíba)

However, there were earlier experiences which are worthy of note. One of them, involving workers, was conducted by Gui Bonsiepe and a group of designers in Chile from the beginning of 1971 to the end of 1973. The Chilean experience, which occurred under a socialist government, had the objective of attempting to overcome technological dependence in the transformation industry. The objective was to systematically design products with the following partial aims: save foreign exchange through the reduction of imports and thus reduce the negative trade balance; save foreign exchange in the payment of royalties, patents, and trade marks; to satisfy the real needs of the majority through the design of goods with a relatively high use value and a low exchange value; use in a rational manner the existing industrial infrastructure to enhance productivity, standardisation of products aiming at simplifying production, improve tecno-functional aspects of products and reduce costs; to rationalise the variety of goods; and to create the conditions for a local material culture. According to the socio-political programme the following product sectors would be prioritised: agriculture machinery and equipment; basic consumer products, sanitary and medical equipment; production machinery and equipment for the light engineering industry; building components; transportation; industrial and consumer packaging (Bonsiepe 1992:106).

The possibility of a socialisation of the design process was considered and justified by the government. According to Bonsiepe, the workers retain a latent technical knowledge which is not used, partly because of the 'hierarchy of the division of labour' which makes it difficult for them to systematise and formalise their innovative knowledge.. As a result, the workers have difficulties in communicating verbally (Bonsiepe 1992:110-1). Bonsiepe's new form of participation was intended to facilitate the conception of products which would suit the existing production facilities and reduce the time of product development. This effort was determined by the theorems of Marxist alienation theory or

> [...] self-determination and transparency in production instead of heterodetermination and obscurantism; the workers not as an object but as the subject of history. (Bonsiepe 1992:111)

The design process was conducted in committees (Comité de Diseño) composed of a small number of members which represented the different sectors of the factory. Outside designers had the role of catalysts and interventionists, bringing in a methodological participation. Proposals for new products were presented by the group to a general assembly and through discussion a selection of the alternatives to be produced was made. However, this experience was cut short by the counter revolution and thus no conclusions can be drawn on its feasibility. Nevertheless, Bonsiepe states that the early stages of this project demonstrated that good results could emerge (Bonsiepe 1992:112). Among the products designed by Bonsiepe's group were (Figures 8., 9.): standard furniture (1971); record player (1972).

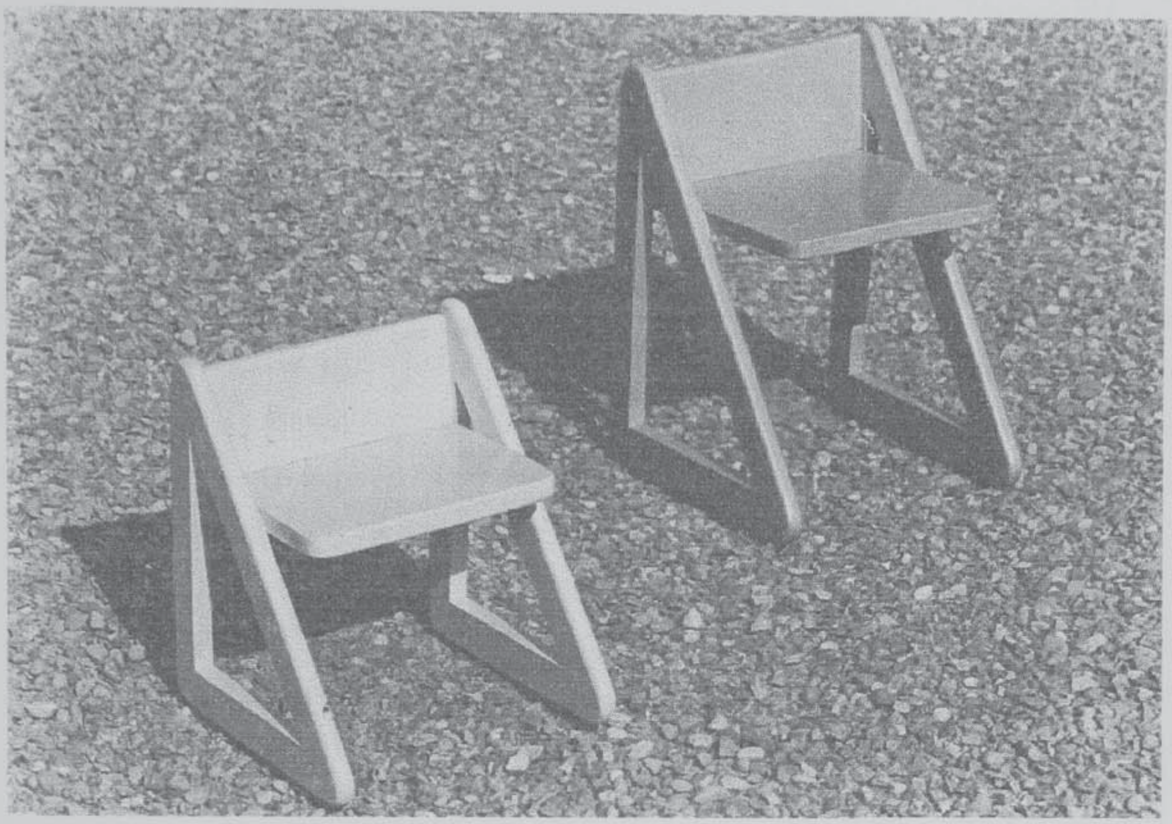

Figure 8. Low cost furniture system. Source, Figure 1 and 2, Bonsiepe, G. *Teoria e Prática do Desenho Industrial: Elementos para um Manual Crítico*. Centro Português de Design. Lisboa. 1992.


Figure 9. Product aimed at absorbing money from the local bourgeoisie

It is important to note that the revolutionary process allowed the practical implementation of a *projectual model* which contrasted with existing models from the MIEs (Bonsiepe 1992:149).

Bonsiepe suggests that the model from the Chilean experience could be used in other countries if some modifications were made. However, he stresses that the emancipatory intention has to be maintained. The main features of such model would be:

a) In relation to the content of the projectual tasks: development of existing local production means, possibly alternative ones (this does not imply a technological primitivism); agricultural and forestry implements and equipment for the transformation industry; development of packaging systems for agricultural products; building materials and components adjusted to the local needs; development of basic consumer products; development of safety equipment; development of products to generate energy locally (solar, eolic, etc.); development of products for collective use (schools, hospitals, etc.)

b) related to the design tasks: critical selection and use of methodology derived from the MIEs; to resist the implementation of schools or design centres based on the models of the MIEs; fight against elitist so-called *good design* which ignores the needs of the majority in LIEs.; reservation in relation to aesthetic factors.

c) institutional sphere: the design of a general industrialisation and technology policy in which industrial design is explicitly included as an innovative instrument to satisfy the needs of the majority of the population; consolidation of design activity in state research institutions (Bonsiepe 1992:150-1).

The experience of the Lucas Aero Space Combine Committee Plan in the United Kingdom was similar. Faced with the prospect of unemployment and the fear of war, shop stewards at Lucas Aerospace, a company manufacturing weapons systems, proposed a plan for the production of socially useful products and for alternative modes of employee development. The workers were organised in a combine committee representing stewards from seventeen Lucas Aerospace plants (Wainwright, and Elliott 1983:1). The Plan, publicly launched in January 1976, proposed the production of 150 socially useful products which could be designed and produced at Lucas. It was divided into two parts. One part outlined of a number of socially useful products and the other suggested the use of new forms of technology to manufacture such products, which would not be human-diminishing and which valued the intelligence and creative potential of workers. The products (Figure 10.) included, equipment for disabled children, medical equipment, and alternative forms of transport (Cooley 1984:51-4).

Figure 10. The socially usefull products included,medical equipment, and alternative forms of transport. Source, Cooley, M. 'Socially useful design', in R. Langdon and N. Cross (eds.), *Design Policy*, Vol.1: Design and Society, Design Council, 1984, pp.51-4.

One important aspect was the fact that large number of workers, instead of a 'small technocratic elite', were engaged in the conception and development of a number of products (Cooley 1990:305-312). As Cooley points out

> [...] The tacit knowledge (in the Polanyi sense of the word) of the wide range of workers was used to the full. Thus no virtue was made of complexity, and the sense of touch and feel and shape and form of the workers was utilised to the full and resulted in a process in which it was possible to democratise decision-making processes in design involving masses of people. (Cooley, 1990:305-312)

Socially useful design thus challenges preconceived ideas about industrial relations in the sense that it values the potential of the human being in relation to the use and development of science and technology. It challenges also the role of the designer in industry, asking for whose benefit he/she is working. Cooley suggests, that 'the designer should cease to be the industrial Eichmann of a large corporation' (Cooley, 1990:305-312). In his view there must be a closer relationship between designers and the people who are suffering from the problems brought about by science and technology since science and technology are made by human beings, if they are not working for the benefit of people, there is a 'right and responsibility to change them'. His message is, that the future of technology is not pre-determined, it can be directed by ordinary people, and socially useful design is one of the alternatives (Cooley, 1990:305-312).

In the early eighties other unions were also concerned with socially useful production. In 1983 the Transport and General Workers Union produced a document called *A Better Future Strategy for Arms Conversions* (TGWU 1983). The document proposed to convert some sections of the weapon's industry into the manufacturing of products which were socially useful. It was argued that this would promote disarmament and diminish the possibility of a nuclear Armageddon. It would also bring about stability and increase job prospects for workers involved in arm's manufacturing and stimulate economic growth by re-channelling resources and R&D to manufacturing in the civil sector, simultaneously meeting urgent social needs. Alternative products would be based on a number of criteria. Among these would be the use of skills already possessed by the worforce and that production of products in the same location where the workforce were employed, using the existing infrastructure. The new products had to be viable, and needed, and the workforce did not have to be moved. This conversion process would be democratically planned and implemented (TGWU 1983).

Another initiative in a MIE worth mentioning is the Greater London Enterprise Board (GLEB) which was set up by the Greater London Council (GLC) in the 1980s. As in many other local authorities, this was an attempt not only to develop products to fulfil local needs but, also to create employment. This is an interesting case as it contrasts with innovation in the private sector where the main reason for investing in innovation is the possibility of profit. Local authorities have wider concerns involving the welfare of the community. GLEB attempted to bring expertise which existed in local innovation centres, to fulfil the needs of the community, or in the words of Eliott (1986b:80)

> [...] to create a new form of 'technology push' and 'need pull', by mobilising groups of producers and consumers. [....] a new mechanism of 'technology transfer'.

GLEB was trying to transfer academic resources and know-how to fulfil what it identified as social needs. Its most important technological intervention was related to investment in industrial sectors whose policy criteria identified them as particularly in need of development (Eliott 1986b:80). Participation of the community was important within this policy. The GLC established a Popular Planning Initiative (PPU) to help community groups to put their plans and initiatives forward. These initiatives were backed by a number of courses, delivered by agencies and associations. The main objective was to create a network involving local groups, to identify needs, and to take ideas forward and pass information on to the departments of the GLC which could finance these proposals (Eliott 1986b:85). Among the products developed with support by GLEB were a 100W wind turbine, and an electric bicycle. One important point in this experience was that GLC/PPU acknowledged that

> [...] most people experience technology as 'given'; something that is imposed on them from above, which they either have to accept or resist. The idea of positively participating in the decision-making about *how* the technology should be deployed, much less which technology should be developed, is almost unthinkable! (Eliott 1986b:109).

Some useful points can be deduced from the experiences described above. One of the most important is the possibility of involving users in the process of generating products, which is particularly pertinent to this investigation. However, although there have been interesting examples of attempts at institutional support for the design of socially useful products, these have been short lived.

## 2.8. Appropriate Technology and Industrial Design

Very little can be found in the existing body of literature on industrial design in LIEs about the design of socially useful products. Again, the main texts which demonstrate some concern for the poor have been written by Papanek or Bonsiepe. Most descriptions of interventions on socially useful products aimed at the poor, are found in the literature of development, particularly in the literature related to appropriate technology.

The appropriate technology (AT) movement emerged from the ideas of the economist Ernst Friedrich Schumacher. Schumacher, in his best known book *Small is Beautiful*, (Schumacher, 1986) first published in England in 1973, analysed the economic system from a new perspective. He was critical of the obstinate way humanity was searching for progress and growth and the consequences of this doctrine for the world, and he warned against the effects of specialisation and large organisations and proposed a new form of intermediate or appropriate technology which, as an alternative to both expensive, large scale capital intensive high technology, and primitive labour-intensive technology would help to solve the problems of underdevelopment in LIEs. AT made a new contribution to the development debate by presenting a complete solution to the problem of development rather than fragmented solutions (Dunn 1978:vii).

To Schumacher and the AT movement generally capital-intensive technology is considered inappropriate, because the need to import it causes collateral problems related, *inter alia,* to savings and foreign exchange. Such technology has to be located in urban areas and thus, in turn, concentrates investment in infrastructure and social services in tows and cities to the detriment of the rural areas (Kaplinsky 1990:28). Capital-intensive technology is also expensive in terms of cost per workplace, has negative effects on employment since it is labour-saving, requires high levels of production, and complex support systems, and presupposes the existence of large mass-consumption markets. Although the AT movement was mainly concerned with LIEs AT was also seen as relevant in MIEs. According to MacRobie and Carr, existing structures based on

> [...] large scale, capital and energy-intensive technology are increasingly unacceptable on social and human grounds; threatening our survival on ecological grounds; and increasingly insupportable on economic-resource and energy grounds;[...] In many of the industrialized countries there is a growing consciousness that our most urgent tasks are to find ways of humanising industry, protecting the physical environment and conserving non-renewable resources. To serve these ends, we need technologies that embody the humane application of knowledge - that are smaller, less rapacious, more capital and energy saving, and therefore more sustainable.' (McRobie, G. And Carr, M. 1982:1)

Particularly relevant to this thesis, capital intensive technology produces mostly sophisticated products which are neither accessible to nor fulfil the basic needs of, the poor population. Appropriate technology argues that, because LIEs have little capital available they require methods of manufacturing which are capital-saving and, as they lack specialised personnel and foreign exchange it is necessary to produce equipment which is easier to be manufactured, used and maintained utilising existing local, human resources and raw materials. They also argue for smaller and more flexible production units, as many of the existing markets are localised (McRobie, G. and Carr, M. 1982:1). However, despite awareness of AT by donors and receivers of aid, and their recognition that technology from the MIEs has to be more carefully considered, it is mostly this technology which continues to be transferred to LIEs. Such technology is transferred in a number of ways including investment from the foreign private sector, and trade between MIEs and LIEs, because for export less industrialised economies have to comply with rich countries quality standards. Two other means of technology transfer take place through capital aid and technical assistance programmes supported by MIEs, and by academic institutions such as universities and research centres which are structured along similar lines to MIEs (McRobie, G. and Carr, M. 1982:2). The consequences of capital intensive technologies can be felt in most of LIEs. Although gross national product (GNP) may improve, relatively few jobs are generated. Industrial concentration generate jobs in urban areas to the detriment of rural areas. Poverty in rural areas forces peasants to migrate to urban centres, thus swelling an already stretched infrastructure. As a result, in rural areas, there is a growth of unemployment and under-employment and little generation of jobs occurs, both in farm and non-farm occupations. The use of capital-intensive technology not only fails to create the number of jobs needed but in many cases destroys existing jobs (McRobie, G. and Carr, M. 1982:5).

Because technology is a social process and not neutral, it brings with it the values of the society in which it originated and, when it is transferred to a different environment, causes side effects. As an alternative, AT proposes the choice of small-scale technologies which are more labour intensive, providing more jobs at cheaper cost, prioritise the rural environment, and the manufacture of goods which fulfil basic needs. Such technology would also use local natural resources and would be in harmony with the ecological requirements of the environment. (Stewart 1985: xiii)

Another important aspect of AT is that it raises the issue of who controls the technology. The control of capital-intensive technology is exerted by a number of technical and non-technical people who influence its development, which reflects different political and social interests. AT argues for a technology which can be controlled at local level and which empowers people. Thus, AT can benefit the poor and is particularly relevant for poor women.

Many of the issues raised by the advocates of AT are still relevant to industrial design in the majority of LIEs. This is recognised by the authors currently writing about design in developing countries (Bonsiepe 1990, Er and Langrish 1992, Papanek 1985). The literature of design in the 1960s and 1970s had focused attention on the needs of the LIEs, and attributed some importance to appropriate technology. However, this debate has been marginal and in the 1980s the design establishment gradually lost interest in the subject, although in more recent years, issues raised by appropriate technology have occasionally emerged in the literature about 'sustainable growth' and 'environmental compatibility' (Bonsiepe 1992: xxv).

One crucial issue in the AT debate is the role of small scale-enterprises. It is argued by AT advocates that it is through these enterprises that appropriate technology can be disseminated in the most economic and rapid way. According to Harrison (1985:399-403), small-scale firms utilise capital in a more effective way in two vital areas of development: the generation of employment and the expansion of production. Another crucial aspect related to this thesis, is that these units are inclined to hire more unskilled workers, which means that they will employ more poor people in urban areas who have low educational levels. In recent years, more attention has been paid to small-scale industries by development agencies, and the potential role of such enterprises in rural and urban socio-economic development has been recognised. Although they are affected by factors such as market forces, business environment, government policies and so on, a key factor in their life cycle is technology (Trindade 1992:ix). As noted in Chapter I (cf. 1.2), technology includes not only hardware but, more importantly, the software elements of production such as, the capacity to design products. Such capacity is important to microenterprises because innovations at this level are rarely radical, but are the result of incremental improvements of existing technology.

In spite of the considerable body of literature about appropriate technology, texts on AT have rarely referred explicitly to industrial design. For example the journal *Appropriate Technology*, one of the major publications on AT, first published in August 1974, has included relatively few articles describing interventions by industrial designers. The other texts on the subject, also reveal that most of the hardware designed by AT practitioners has emphasised the techno-functional aspects of products and rarely addressed factors related to the human-product interface such as ergonomics or aesthetic factors. Interventions by industrial designers have been limited to isolated projects where designers from developed countries travel to a region to work for short periods. For example, the project developed by Andrew Pyne, a British furniture designer, is a good illustration. In this case the need for design was associated with the survival of the Katpadi Industrial Institute in India, as this school supports itself by selling products made in their workshop. Mister Pyne was contacted to design a chair where the requirements were the use of less wood, as raw materials were scarce and expensive, the need to have a product which looked more 'modern' and which could be produced at the Institute's workshop. The main objectives were to capture markets inside the country and 'a) to meet the needs of the ordinary Indian; b) to use the latest [process] development available in India; c) to use less timber and so be less expensive' (Pyne, A. 1988:24-5).

Interventions by industrial designers aimed at poor communities have particularly targeted the crafts sector. Design has been perceived by some support agencies as merely a marketing tool. Designers have been contacted to improve the quality of craft goods, targeting overseas or local high-income markets. This has been the case, in the case of both local and overseas support agencies. For example, Sri Lanka, a country which relies mainly on exports of raw materials and cash crops, has a National Design Centre, established since 1986 under the Ministry of Tourism and Rural Industrial Development, but design is perceived mainly as an artistic activity. The Centre provides services related to creative designs 'in the sphere of small industries and improving the artistic quality of one's diverse creations' (SLNDC 1993). International organisations such as the Inter-American Foundation (IAF) have supported projects involving the work of industrial designers. Since 1991 IAF has supported the 'Marketing and Development and Product Innovation Technical Support Unit' (Unidad Técnica de Apoio en Marketing y Desarollo e Innovación del Producto) in Uruguay. The objective of this project was to help microenterprises to develop into formal enterprises. To achieve these aims the project intended to provide microenterprises with the elements which they lacked in order to consolidate their business. These included support in design, marketing and technological change. The Foundation understands that, providing services in these areas will allow microenterprises 'the qualitative leap into the modern economy'. The project is mainly related to craft-based microenterprises (Ruétalo 1993).

British charities such as OXFAM have promoted workshops in different countries, like Bangladesh, where embroiders and designers were brought together. OXFAM also sponsored craft interventions by expatriate designers, in countries like India and Bolivia. In one of the Bolivian interventions, a group of women working in a co-operative was helped with the design of knitwear by a British designer who also had marketing experience. The president of the co-operative recognises that design was a real problem as competition among producers was rife. In her own word's 'We realised we needed to change but we didn't know how' (OXFAM 1992).

On the engineering side there have been important interventions by product designers both in consumer and capital goods. APT Design and Development in the U.K. has been involved in a number of these projects. The firm is composed of engineers with experience in the formal industrial sector and who have decided to design socially useful products. For example, Mike Walsby has 18 years experience with DeHavilland Aircraft Co., British Aerospace and Borg Warner. APT have been working for development agencies and non-governmental organisations in a number of countries (Mansfield, H. 1988:66-9) and the group has a realistic approach to design. They are conscious of the technological disparities between and within LIEs and are involved, among other things, in the design of simple production tools which can be made using available raw materials, in rural and peri-urban areas. For example, in some parts of Africa, blacksmithing still plays an important part in the production of agricultural tools such as hoes, machetes and chisels, and in the provision of replacement parts used in a number of products. Taking this into consideration the group has been training blacksmith apprentices from different parts of the world. Of particular importance to LIEs is their design of a range of tool-making machines. The designs are based on the constraints experienced by village workshops such as: lack of raw materials; variations in the existing raw materials and so on. To address these problems APT has designed a number of machines which are simple, can be built with new or old raw materials, either in the English or metric system. A high level of improvisation is a characteristic of APT's work. For example, their cutting shear's blade utilises truck's leaf springs which are made of high carbon steel. Hardwood bearings, which had been previously immersed in hot motor oil, are utilised in the sheet metal rolling machine as, in many LIEs, there is a scarcity of mass produced metal ball bearings. The wood bearing also has the advantage of working better when operating in dusty conditions. Another important tool is the lever-operated hole punch, which allows holes to be made without the use of expensive, and difficult to obtain, metal drills. Machines such as those described previously have allowed the manufacturing of socially useful goods such as the wheelchair produced by the Malawi Against Polio Charity (Mansfield 1988:66-9). However, there are some criticism of APT's work. Victor Papanek states that

> One of the difficulties I have with some of the thinking of the alternative technology group is that they really don't know where they fit in with technology right now (Mansfield 1988:66-9).

He uses as an example agricultural equipment which was well designed but where the users were not able to understand how it worked and argues that the solution to such a problem would be the use of a microchip

> It's absolutely possible for less then half a cent to include a series of chips in almost any Third World device — even if it's made there — that will tell the user in a tribal language how he's supposed to use the item. This then becomes a compromise between a centralized, high-tech item inserted in a decentralised local product (Mansfield 1988:66-9).

Other designers, although recognising that APT has done very innovative work, think they are too small scale. An important aspect of APT's work is the recognition of existing indigenous design capacity, which is not available in local formal research institutions but is the work of non-professional designers. Rob Hitchings gives an example from India, where the Institute of Technology in Delhi had designed a machine to produce charcoal briquettes from agricultural waste. Their design was large and complicated and only a wealthy person, interested in setting up a small factory, would be able to afford it. A floor sweeper who worked at the Institute came up with a much simpler idea. According to Hitchings

> He came up with a container that you could put the rice husks in, seal with clay, place over a fire, cook and then come up with charcoal dust. This you would mix with rice starch, press out into a mould and let dry in the sun. When paraffin became scarce, the sweeper's neighbours all came to buy his briquets, since they burned with a clean flame. We just tidied up his design to make it safer. (Mansfield 1988:68-9)

Hitchings acknowledges that there are many similar examples of non-professional design and that design problems in LIEs have to be solved in LIEs. He recognises that designers are keen to find problems to which they can provide a solution, but stresses that

> The idea that you can go out and find solutions already there, and somehow make them a bit better, a bit more available to more people — that takes quite a switch in thinking. To come up with something clever and new is an ego trip. But designers have to avoid ego trips in this business if they want to be useful (Mansfield 1988:66-9).

In more recent years, APT has been adopting a more comprehensive approach to their activities and is concentrating on the areas of enterprise, policy, technology and training. They have been involved in small enterprise development, in Africa, Asia and more recently in Romania, where the government is encouraging small business.

Their approach to small business development is as follows (APT 1944:4)

- Meeting needs, by listening to what people at the grass-roots say;
- Assessing local resources with local partners, to meet those needs;
- Providing skill, both technical and management;
- Providing information to partner organisations and small business;
- Encouraging effective use of finance and other resources;
- Promoting sustainable economic growth;
- Helping people to break out of the poverty trap.

Their present projects range from assisting vocational training centres in Vietnam and Zimbabwe to setting up an Appropriate Technology Unit in Kenya.

Another group involved in AT is the Development Technology Unit (DTU) at the Engineering Department of University of Warwick in the UK. The Department has one of the few courses specialising in appropriate technology. The DTU has been involved in the provision of engineering support for the development of rural and small firms in LIEs and works at different levels, ranging from the provision of technical information, feasibility or design studies related to rural products, short term consultancy to, at the highest level, R&D programmes to develop specific products or processes. The Unit has been involved, among other things, in the design of pumps, ice making equipment, communication systems and animal powered equipment (DTU 1988).

An important and well established engineering institution is the Technology Consultancy Centre (TCC) in Kumasy, Ghana. The TCC was established in 1972 with the objective of providing a channel for consultancy work related to appropriate technology for small industries. It makes the expertise and infrastructure of the University of Science and Technology at Kumasi, available to people interested in setting up an enterprise, or who have a technical problem. Although the Centre has been involved in larger consultancy contracts, over 80 per cent of its activities are concerned with small informal industries and farm enterprises, to whom they provide a free service. They have been involved, among others activities, in industries producing soap, caustic soda, steel nuts and bolts, glass beads, vehicle and machinery spare parts (Powell 1980:12-4).

In recent years there has been a recognition, by some writers on AT, that technology alone is no guarantee of success. In a recent article called, *Product Development for the Informal Sector in Kenya*, Masera (1994:34-5), Co-ordinator of the Undugu Society of Kenya's Design Unit, emphasises the importance of design for informal sector enterprises. Design capacity would, among other things, enhance the possibility of job creation, make available good quality, locally produced goods, and enable better use and development of appropriate production technology.

He points out that, as well as such factors as inadequate access to capital, lack of entrepreneurial skills, and inappropriate policy environment, what also prevents the development of the Kenyan informal sector is the lack of product variety. According to the author, product development is much more than the cosmetic styling of products: it is the methodical and creative conception of goods which address the physical and psychological requirements of people. It is related to the techno-functional and aesthetic factors of products and to the man made environment. In the systematic and creative generation of products there an the interaction between technology, creativity and the market. In his opinion, among the benefits of introducing product development to the informal sector are:

- Growth and generation of markets, both at national and international level. Product development is a tool to improve the quality of products, to make production process simpler, to shorten production times and reduce costs, designing new or redesigning existing products.
- To stimulate the substitution of imported products by locally produced, high quality products. The production of high quality goods can be accomplished by using or modifying existing low cost manufacturing technology. Nevertheless, to achieve such standards, the product must be conceived bearing in mind the local technological context. Informal sector associations have to structure marketing strategies to call attention to the goods which will challenge imported products. The aim of such strategies should be potential supporters of the sector such as: NGOs; government and international donor agencies.
- Creating products which are suited to the requirement of the country and customers.
- To promote the creation of jobs. A corollary of the expansion of the market for locally made products will be the entrance of more people into the sector requiring more apprentices and thus creating more jobs.
- New or redesigned products can lead to improvements in existing production technology

He proposes that product development should be promoted in collaboration with different organisations and involve other aspects of business such as the provision of credit and managerial training. In his opinion, research and training are the crucial aspects of product development promotion in the sector.

The importance of design in the Kenyan informal sector is also recognised by other authors. A survey conducted by Kabecha (1994:232-3), revealed that the sector's production is composed mainly of consumer goods and that

> ...These goods tend to lack attractive finish and are poorly constructed. They failed in their fulfilment of functional needs as well as non-functional needs, such as, aesthetics and features. The low quality could be attributed to inadequacies in design, raw materials and quality control and to the low level of technology prevalent in the sector.
>
> Design capability does exist in the sector. This capability tend to be largely used for finding ways to circumvent the lack of resources in order to maintain the enterprise rather than for the development of products and processes to improve competitiveness. Design is not practised a lot because it involves cost which the producer can not meet from his low level of resources, and uncertainty surrounds the marketability of the results. Increased accumulation is required to finance design and this may come from increased product quality or liberated time due to the use of high level of technology, rather than from increased production alone. Shortage or substitution of materials lead to changes in design and modifications of technology to fit the available materials. The inadequacies in design changes and technology modifications lead to poor quality.

Non-technical aspects of products appear to be important for products manufactured by microenterprises. However, AT practitioners have paid little attention to such aspects. Both Masera and Kabecha recognise the importance of non-price factors such as aesthetics and ergonomics which enhance product quality. However, as Bonsiepe (1980:13-26) points out, aesthetic factors have been neglected in AT products. He calls attention to the neglect of formal-aesthetic quality, suggesting that this might be related to the fact that the industrial designer has not been involved in the development of the products. Another reason could be the perception of people who make decisions in this sphere, they give aesthetic quality a low priority and might even see it as something superfluous. He questions this indifference by appropriate technologists in relation to 'consumers' and users' aesthetic needs' and suggests that such views are related to a discrimination against the aesthetic phenomenon or as a manifestation of 'perceptive insensitivity'. The author condemns the view that the aesthetics of such products express 'local vernacular codes' suggesting that such statements denote lack of design capacity or suggest that they are just bad projects. In his opinion, 'the visual codes of poverty do not necessarily have to be bad' (Bonsiepe 1980: 13-26).

Although a considerable number of products generated by AT practitioners are directly related to industrial design, Madge (1993:149-166) suggests that the neglect of design is partly related to a problem of definition

> [...] of identifying the precise dividing line between design and engineering; of defining the role of the designer in pre-industrial as opposed to industrial contexts; and deciding whether design is an activity confined to professional designers or is an everyday act of every body.

Pacey (1992:217-225) has addressed the relationship between professional and non-professional designers. He argues for a recognition of non-professional design and for a closer relationship between professional and non-professional designers, and declares that recognising lay people's design capacity is a form of empowering people. He points out that,

> Where design professions have emerged within developing countries, they have generally done so in response to Western influence, and professional designers have found themselves designing Western-styled products for an affluent élite rather than serving the more urgent needs of people at large; needs which might best be served by reviving and developing indigenous craft and other practices which were undermined by colonialism, and by regarding people themselves, their culture, and their identity, as a resource.

Bonsiepe identifies a clash of interests between professions in the debate about AT which has implications for industrial design. He notes that interest in appropriate technology emanates, both from the technological disciplines and the social sciences. The latter perceive this technology as an instrument of liberation of the oppressed and emphasise the questions related to what he calls the 'software of the social system'. However, he warns about the dangers of making generalisations which would limit the potential of the AT and would transform it into an academic preoccupation. In his view this would mean the neutralisation of AT. He also condemns an 'idealisation of popular knowledge' arguing that this could lead to obsolete solutions which would be against the interests of the population. According to him, the non-technological disciplines have a certain reticence against the *hardware*, and the technological disciplines neglect extra-technological factors. Such a 'territorial dispute' he states, disregards the fact that AT tries to go beyond 'the limits of specialisation and academic classifications' (Bonsiepe 1983:123-186).

AT advocates argue that the differences in the context and resources of developing countries are so different from the central economies, that a new kind of technology has to be considered: a technology created in the developing countries and involving the participation of users in this process. He points out that a crucial criteria in the assessment of AT is its generation in the developing countries, 'the rest is paternalistic mystification with re-colonisation intentions' (Bonsiepe 1983:123-186).

Bonsiepe recognises the importance of AT but is sceptical about appropriate technology proposals. In his view, appropriate technology was a movement which emerged from the questioning of society in the 1960s and is related to the crisis in the environment and to the rebellion opposing the 'alienation of industrial advanced society' (Bonsiepe 1992:80). The critical voices against central technology, according to him, use the following arguments

1. Central technologies are biased in favour of local urban groups which are economically better off and neglected the rural areas;
2. Central technology is highly capital intensive and absorbs little of the labour force;
3. The high cost of creating a job using central technology makes it not feasible for developing countries;
4. Needs in developing countries are so distinct from the centre that technology developed in the centre, in its existing form, will not be able to fulfil those needs. (Bonsiepe 1979b)

Bonsiepe points out that the arguments above are related to industrial design. This means that the designer must design products which use more labour in their production, use locally available materials, and 'respect local cultural traditions'. However, in his opinion, such proposals have not been implemented by any government in Latin America for enough time to 'prove the hypothesis of a self-centred development without depending on the centre.' Moreover, the debate on other possible forms of technology has been restricted to academia, and a few projects supported by international agencies: there has been no substantial impact on industry. He criticises IT saying that the concept has 'pejorative connotations but also suffers from inherent programmatic limitations', and he points out that there are also economic/political criticism to be made of intermediate technology since it represents a pastoral/populist posture which is a negative view of the marginalised population.

In his view, the alternativist movement is a 'compensatory movement' which has had negligible economic importance. He considers as symptomatic the fact that such movements have proliferated in the industrialised countries and points out that 'alternativism' in the South is essentially different from that in the North (Bonsiepe 1980b:91-8). As a matter of fact, intermediate technology was not immediately accepted in the South because many people associated such technology with a second-rate alternative. People did not widely welcome the introduction of alternative technologies because they had originated in the more advanced and it was thought that the countries from the North did not want to allow developing countries to access new technology and design. Bonsiepe however dismisses this idea of a conspiracy, arguing that this is a limited view which considers technology as 'objects - not as activities' and thus does not address the real issue (Bonsiepe 1990: 252-269).

He argues that the alternative proposals will maintain the current imbalance, or 'technological asymmetry', but will maintain the existent dependence relationship in a more 'benevolent' style. Such proposals would allow industry, in MIEs to export more products, and would maintain the countries in the South technologically dependent (Bonsiepe 1980a:13-26). In his view AT would hardly be able to compete with the dominant currents of industrial and technological development in Latin America, and it's only possible impact would be in attempting to counterbalance the prevailing tendencies. He argues that the existing production infrastructure in Latin America has to be taken into consideration when formulating policies of industrial design, and that failing to do this would make such alternative policies to be mere rhetoric, and would lead to a self-marginalisation of the industrial designer from industry (Bonsiepe 1980a:13-26). Another criticism Bonsiepe makes to alternativism is related to its lack of political perspective and its concern with utopian life styles. He suggests that

> It should pass from the arbitrary creation of individual products to a planned design strategy intended to limit the nature and variety of products which follow social requisites. This way, the designer will enter the nevralgic zone which is the political zone, in which we should ask ourselves which products society has more need of, and what priorities are needed to establish their production (Bonsiepe,. 1992: 81).

To Bonsiepe there are direct implications of AT on industrial design, including:

1. Design of alternative products. More useful products. Instead of alienating products, the design of 'convivial products';
2. A different perspective of the natural world. Preservation of environment, pollution reduction. 'Pre-rural focus, anti-urban'. More durable products. Less products;
3. Factors of production: design more labour intensive products, which can be made using locally available raw materials, and de-centralised manufacturing;
4. Alternative forms of production: 'de-centralised production by co-operative or communities for self-use';
5. A new attitude towards consumption and production which seeks to keep them in balance and maintain independence in the supply of products and services;
6. A different attitude to 'presenting and articulating needs'. A smaller scale where groups and individuals participate more in the determination and fulfilment of their needs;
7. A more just industrial design which reduce economic disparities, as opposed to the design of products which stimulate differences within society;
8. A non-professional industrial design, where the users have a say. The industrial designer would act as a facilitator (Bonsiepe 1979c:51-58).

These are the main characteristics of a possible alternative industrial design methodology. The products should fulfil basic needs. They can vary from household appliances to agricultural machinery and should be different from the products which are normally associated with the work of professional industrial designers in MIEs such as, stereo systems or ski boots (Bonsiepe 1990: 252-269).

Bonsiepe recognises that, in contrast to the markets in the Periphery which follow the principles of industrial design from the industrialised market economies, there is the question of **industrial design for most of the population**, who have particular requirements, very different from the needs of the global markets and the local higher income markets. What would be appropriate would be technology generated locally by local design capacity and which fulfilled local needs (Bonsiepe 1980a:13-26). In Bonsiepe's view, an alternative industrial design depends on the adoption of this activity throughout local industry and would lead to the generation of local projects. An alternative industrial design in Latin America would have to be **technologically pluralist**. It would have to encompass both professional practice in the conventional sense and another practice which considers alternative concepts (Bonsiepe 1980a:13-26). A renewed programme of the objectives of production should include:

- an emphasis on the conservation of the natural and social environment adequate to people;
- the intention of creating working conditions which allow people the full development of their creative capability;
- the manufacture of products which are useful, durable, easy to repair, and "emancipatory";
- the economic utilisation of necessary resources to obtain these objectives. (Bonsiepe 1981)

This implies a re-orientation of the concept of "efficiency", which must aim at the needs, and not the factors of production. "Emancipatory" or "convivial" products are objects designed and conceived in such a way to work as instruments to acquire more liberty and self-determination. "Emancipatory" objects would not stimulate new needs and dependencies (Bonsiepe 1981). However, he states, such products do not have to be technologically primitive. To him AT is '...sometimes a cocktail of various components of different technological levels'. To illustrate that he uses an example of a harvester developed in Argentina in which the majority of the parts were produced in the country (Bonsiepe 1983:123-186).

To make design viable in this context, Bonsiepe, suggests that an alternative design proposal would require a different organisational framework for the production of innovations. Local innovation is problematic and, because of the high risks involved in such activity, particularly so in the case of small and medium sized enterprises. To solve this problem he proposes the implementation of 'industrial design factories or workshops' which could operate within a certain industrial sector, or be thematic, for example, comestibles. Another alternative would be 'non-specialised factories which, according to the circumstances, could have a regional character, fulfilling needs beyond the geographic boundaries.'

Another important point addressed by this author is design for popular taste. He condemns the idea of popular taste as something non-contaminated, or pure and argues that 'popular taste' is part of, and not immune to, the cultural dynamic. As such, it is powerfully affected by a number of extra-popular factors, a combination of different 'formal codes' influenced by other classes. He questions the idea that the designer can create products according to popular taste. The designer should consider peoples' preferences but has to be critical and not limit him/herself to allegedly uncontaminated standards. He argues that the industrial designer has to be critical and this would include challenging popular taste (Santos 1980:27-50).

On the question of the development of products by the people, he states that the term 'people' is not clear. There could be a relationship between artisan industry and design by the people. He recognises that

> **[...] design is not an exclusive privilege of designers. Many more people could design, and it would be a healthy phenomenon if the activity of design was spread** (Santos 1980:27-50). (emphasis added)

But in his opinion design is an activity which demands proper training, and there are a number of operational difficulties which prevent people designing within an industrial milieu. One of the main difficulties would be the control of the means of production. The 'people', to him a synonym of 'users', posses the potential to design their own products but would find difficult to manufacture them because they do not control the means of production. He identifies two major alternatives among the different currents which aim at the socialisation of the projectual process:

1. A more radical method which exterminate the professional and glorifies the 'people'. This alternative emphasises the political aspect to the detriment of technical work, and ignores the political significance of technical activity;

2. This current perceives the professional as a catalyst and attempts to take the mystery out of design activity. Bonsiepe appears more sympathetic to this second current and states that the **'de-mystification of the professional would be welcomed.'** (emphasis added).

In this respect he recognises the positive influence of intermediate technology (IT) on industrial design because it questioned technological relationships within MIEs and because IT is sensitive to the social problems of LIEs (Bonsiepe 1992:124). However he emphasises the fact that IT advocates may have identified the problem but they have not provided the solution (Bonsiepe 1979b).

By stating that design is not the exclusive privilege of designers, he comes closer to Papanek's approach. Papanek suggests that there is room for appropriate technology and for co-operation between the North and the South. This co-operation can occur at different levels, for example, research on alternative sources of energy carried in the South but which could be funded by the North (Papanek 1985:36). Papanek also argues that industrial designers are in a privileged position and might play an important role in the Third World. Because of the characteristics of their training, industrial designers can act as synthesisers, crossing disciplines and could work at different levels at a very small scale in rural areas, or on a larger scale on products for the export markets.

## 2.9. Commentary

A number of important points have emerged from the review of the literature related to industrial design. The first point is the almost complete absence of studies related to the role of industrial design in microenterprises. Actually, most of the literature on design focuses on the industrialised economies and, when it addresses the less industrialised economies it concentrates on more sophisticated enterprises in the newly industrialised countries. In general design in defined narrowly, leaving little scope for non-professional design. It is also clear that, in spite of the emergence of design as an important strategic tool in some newly industrialised countries, design is not widespread in all NICs. Another point is that the social role of industrial design has also been the subject of little research, and most of the authors who have written about this role in LIEs have ignored the informal sector. The portion of the development literature which is related to the technological needs of the poor population in LIEs, although it includes a widespread discussion of technology choice, has paid little attention to product choice, and in particular to product design capacity in microenterprises operating in the informal sector.

It emerged from the review that there are two major authors who have discussed the role of industrial design in relation to the needs of the poor majorities in LIEs: Victor Papanek and Gui Bonsiepe. Although Bonsiepe's (1973) UNIDO report was written over twenty years ago, many of the issues he addressed at the time are still relevant today. Some of them, such as design for export markets, have been addressed to varying degrees. However, other important issues, such as the role of design in income redistribution and the fulfilment of the needs of the majority of the population, have seldom been addressed in the recent design literature. In Brazil, for example, the design of socially useful products very rarely attracts sympathy from the design community. This appears to be true both in the literature, and in practical projects, in other countries of Latin America too. As José Korn, Director of the School of Design of the Instituto Profissional do Pacífico (Chile) points out

> [...] some dynamic sectors awoke to the need of design to compete in the internal or external markets, or to promote their identity. But the other face of this coin, in the whole of Latin America, is that the social area is totally neglected (Leon 1991: 45-48).

It is clear that the private sector is very rarely involved in any intervention related to meeting the needs of the poor in LIEs. The few existing interventions are undertaken by some governmental institutions, international donor agencies, and by non-governmental organisations working in the area of development. However, these interventions are relatively small in relation to the overwhelming needs. In reality most of the material needs of the poor are satisfied by small producers who design and manufacture the products, or by the poor themselves.

Papanek suggested that in the developing world, 'design is a luxury enjoyed by a small clique who form the technological, moneyed, and cultural 'elite' of each nation' (Papanek 1985:61), while the majority of the population does not have even their basic needs fulfilled. Although in recent years design activity in the newly industrialised countries of Latin America has been able to establish itself in some industrial sectors, Papapek's comment, in spite of Bonsiepe's (1991:252-269) criticism that he lacks evidence, is still true. Design may perhaps be more than the privilege of a small élite, but it is still a long way from becoming a reality for the mass of the South American poor.

Actually design has barely touched the formal industrial structure of Latin America. Most discussions occur at academic level, rarely affecting the formal industrial sector, much less microenterprises run by the poor. In the development debate there are different perceptions in relation to the role of AT which have implications for design. Social scientists have, in general, little knowledge about the practicalities of technology and emphasise aspects which might conflict with people concerned with hardware, such as engineers. These differences in the perception of priorities can have a negative effect on to the expansion of industrial design at grass-roots level. For example the IAF project mentioned in section 2.8., encountered a number of problems which occurred at managerial level and were concerned with the perception of people in charge, related to what the priorities in support programmes should be. In practice this might mean allocating funds and human resources in areas which are not priorities, thus increasing the risk of wasting resources or even failing in the intervention. It appears that a more conciliatory relationship between professional categories, which recognise each others' strengths and weaknesses would be desirable. It might be useful to pay attention to the literature of innovation in MIEs which has pointed to the importance of team work in more innovative and successful firms. There is a case for some institutions and AT groups to emphasise interdisciplinary co-operation. It might also be useful to look at the co-operative schemes set up by the poor themselves which occur frequently in LIEs. For example, the construction of houses in many locations of Latin America involves communities working together to achieve common objectives. Such schemes might provide clues to possible alternatives which will allow the poor wider access to products they lack.

It is worth noting that the most important writers on design in the LIEs, and who have expressed concern for the lack of access to products by the poor, have remained silent about the potential role of design in the informal sector. Bonsiepe states that the only reason for the existence of design would be the fulfilling of the needs of the majority of the population (cf. 2.4.) and criticises the appropriate technology movement for being utopic. However, his own proposals to provide the poor with access to socially useful products, appear to be utopic since they rely mainly on state interventions. His short lived experience in Chile, is a good example. In spite of relative success it was only a demonstration of what could be done.

It is difficult to see how governments in Latin America, particularly after the implementation of neo-liberal polices, will provide conditions for the development of socially useful products. A closer look at the Brazilian socio-economic situation provides evidence of the potential obstacles faced by any state policy which intends to include industrial design. Programmes still at the design stage, such as the *Brazilian Design Programme*, might have a impact on more modern, large and medium sized formal enterprises. However, even formal small enterprises will hardly be touched by such a programme. There is over 3.5 million small enterprises will in Brazil (SEBRAE 1992), it is questionable whether such a programme will have any substantial impact on these microenterprises or on the informal sector, whether it will address them at all.

As microenterprises in less industrialised economies are responsible for most products consumed by the poor, it appears reasonable that a design which aims to benefit the majority of the population should pay attention to manufacturing microenterprises. However, Bonsiepe does not address the problems of design in this sector. This maybe because his view of design does not encompass non-professional designers. Actually most of the literature on design concerned with LIEs has neglected non-professional design. More recent works have concentrated on the formal industries within NICs (Er 1994). Bonsiepe, in some of his texts, suggests that a de-mystification of design would be healthy, a de-professionalisation of design, with more people involved in designing products. However, he does not show how this could be achieved.

The industrial design establishment has shown little interest in participating in AT projects and AT practitioners have little concern for industrial design and human factors such as ergonomics. These are limited approaches which diminish the potential for a more just industrial design. For example, it is very rare to find any account of appropriate technology projects which takes into consideration the anthropometric measures of the target population, and in fact anthropometric surveys are almost non-existent in most LIEs, although this should be considered as a primary step for any discipline concerned with the design of products. Ignoring such basic data may cause a number of problems, not only related to the operation of the product, but also to aspects related to safety, and could reduce the chances of success in the market place. Thus, although industrial design has recently been acknowledged as a crucial aspect of the innovation process by the engineering profession in MIEs, such views have not spilled over to the AT movement.

From the literature review it is clear that most institutions involved with technology for poor communities in LIEs are engineering-based institutions, or are managed by people with a social science background who have little contact, if any, with industrial designers. Although there have been some interventions involving industrial designers, there appears to be a bias towards engineering and thus a certain prejudice against industrial design. This is also true of organisations supporting small businesses.

In relation to hardware, the engineer's view of industrial design tends to predominate. Moody (1984:318), referring to U.K. firms, points out that, in general, design is under the control of the engineering functionaries who regard design as an activity supportive of engineering and thus,

> [...] since the preoccupation in engineering - in theory, practice and education- is with technical function and performance, the approach to design is typically dominated by considerations of this nature.

This might reflect a view of industrial design as an activity concerned with the 'cosmetic' treatment of products and thus irrelevant to products aimed at the poor.

However, some authors on design have been sympathetic to appropriate technology. Papanek's pragmatic approach to design is more closely related to the work of appropriate technology practitioners. In contrast to Bonsiepe, Papanek does not put such emphasis on state and government intervention in design. Although he does not address some important political issues, his proposals are pertinent and can be related to what is happening today in the informal sector and many of the examples cited in his books can be related to the needs of poor communities. He considers one of the best designs for developing countries a brick making machine which has allowed people in need to make their own bricks. This he considers 'socially conscious design, relevant to the needs of people in the world today'. He also gives an example of a pipe making machine which, according to him,

> [...] can be built in Africa by Africans and used for the common good. A machine (or tool) that will bypass private profit, corporate structures, exploitation, and neocolonialism. (Papanek 1985:79)

This example is interesting because it touches a crucial point in the question of socially useful products: profitability. This is were Papanek's proposal might be interpreted as naïve. Although I also advocate the production of socially useful products, I would argue that it is important not to ignore the private sector and its potential to diffuse technology. This pipe machine is a product which could be made the microenterprises operating in the informal sector. However, microenterprises will not construct such a product merely for philanthropic purposes. Small entrepreneurs suffer many constraints and have to be very careful when choosing which products to manufacture. The State could set up schemes which could produce such a machine, but then there are vested interests and a bureaucratic structure to deal with, in LIEs. There is also the danger that the product would become an electoral tool, used by opportunist politicians.

Nevertheless, there are examples of successful firms which have produced socially useful products. Parry Associates in Birmingham UK provides us with a good example of the design and production of socially useful capital goods by the private sector. They design and manufacture construction equipment for fibre concrete roofing (FCR), which is of very good quality and extremely simple to operate. Parry Associates demonstrates that appropriate technology is feasible and can be profitable. The development of one of his products and its consequent diffusion, derived from co-operation between non-governmental organisations (NGOs) and private sector enterprises in Britain and in developing countries. Parry Associates sells today at least 500 manufacturing units per year in 60 countries. It is a good illustration of an appropriate technology, encompassing most the criteria of appropriateness such as: small scale, low cost, easy to operate and maintain, controllable and ownable by the community etc. However the development of this product was quite complex (Smillie 1991:158).

An important aspect of the development and diffusion of this technology was related to management, which in the end caused serious disagreements between the partners involved in the project. Parry was critical of what he perceived as lack of professionalism on the part of the NGOs in relation to production and marketing. The problem was related to the kind of human resources used in production and, in the end, the failure was blamed on the technology. Some NGOs also argued that the equipment should be made in the South rather than in England. Equipment was copied from Parry and workshops subsidised by NGOs established in the South. Parry accused the NGOs of a lack of business vision, because problems occurred with the equipment due to the poor quality of the machine copied and low out put. The lack of entrepreneurial capability of the tile manufacturers therefore hindered success and the technology only took off when genuine entrepreneurs took over (Smillie 1991:160). According to Smillie, (1991:162) there are few companies in the North working according to Parry's philosophy. His firm is successful because it is highly innovative and realistic and has a workforce committed to what it does. They survive because they are continuously innovating, have good management and financial discipline.

Another crucial aspect related to this investigation is design by non-professional designers. This is another area which has seldom been addressed in the design literature. Papanek cites examples of participatory design and praises some of the objects made from recycled materials in LIEs, but he has not addressed design capacity in microenterprises. Bonsiepe is sympathetic to non-professional design and allow room for participation by workers in the Chilean experience. However surprisingly he still neglects the informal sector. He states that '**design is not an exclusive privilege of designers. Many more people could design, and it would be a healthy phenomenon if the activity of design was spread**' (emphasis added) (Santos 1980) but fails to answer the question how do you materialise it? His view is very similar to the prevailing view in the literature of design and innovation, which consider industrial design as the domain of a professional category which needs specific training and is thus inaccessible to lay people. This contrasts with some of the points he makes about the design for the majority of the population since he does not propose any realistic means for achieving that.

What emerges from his texts is that a series of structural modifications in the political system would be necessary for the production of socially useful products. This appears utopic in the sense that industrialists who own the means of production are not keen to produce socially useful products, in LIEs or MIEs, if they do not see a prospect of making a profit. The same is true of the State, as it stands today. He himself has experienced the problems of working within state institutions, where the budget in many occasions is defined according to the vested interests of politicians and professional categories. This means institutions which depend on these budgets are always on the verge of disappearing. My personal experience of working as a teacher at a Federal University, makes me question the validity of depending exclusively on state support. In Bonsiepe's views, an alternative industrial design depends on the adoption of this activity throughout local industry and the consequent generation of local projects. This argument leads us to the question of which local industry we are addressing, what industrial production units are expected to be concerned with design <u>with</u> socially vulnerable groups? A number of questions come to mind when thinking of local industry. Would local industry be interested in the production of socially useful products?; will the microentrepreneur be willing to make socially useful products?; how are the priorities related to products aimed at the poor established, and by whom? Because the poor have no alternative, they are doing things for themselves. This is clear in the case of the informal sector, where people survive on very little. Thus it appears that, for the sake of coherence, if the poor are the aim, the focus should be sharpened on the small production units run by the poor.

There thus appears to be a case for intervention by both the state and support agencies to introduce basic industrial design at microenterprise level, and an activity as important as design should be introduced in primary schools, since many people working in microenterprises have low levels of schooling.

# Chapter III

# Microenterprises and Non-Professional Design in Less Industrialised Economies

## 3.1. Introduction

The present chapter introduces the concept of the informal sector and situates it in the world context. It points out its importance in relation to the needs of the poor population in less industrialised economies and attempts to show that design activity is being practised in microenterprises throughout the LIEs, although by non-professional designers. It pinpoints the main aspects related to design, which could hinder or develop this activity in micro-production units. Evidence that innovative activity, both in engineering and industrial design, occurs in microenterprises, and that informal methodologies for generating products are in place, is provided.

## 3.2. The Informal Sector

In the early 1970s, researchers created the term *urban informal sector* to describe economic activities and employment which did not occur in the formal sector. In 1972 a mission was undertaken in Kenya by the International Labour Office (ILO) and the concept developed. After this report, there were subsequent reports on the informal sector in a numbers of other countries. According to Haan (1989: 39-46), the idea of the informal sector originates

> from the fact that different combinations of labour and capital may be used to produce and sell goods and services. In theory, this should lead to an uninterrupted range of production modes. In practice, however, a dissimilar absorption of technological progress by different economic agents [...], together with an unequal distribution of income and the related structure of demand, have caused a productive structure in which two parallel sectors stand out. One is composed of economic units which operate with relatively advanced production methods and organisation techniques and the other sector uses simpler, more labour-intensive methods. The former consists mainly of "modern" medium-and large scale enterprises with relatively large number of wage-employees and high levels of productivity. The latter, that is the "informal" sector, is characterised by self-employment and family-based micro-enterprises which have only partially taken advantage of technological progress; they consequently reach only modest levels of productivity. [...]

Although standards of living in many developing countries have improved in the past three decades, reducing poverty is still one of the major challenges facing the world today, where over a billion people live in destitution. Over three quarters of the working population in the LIEs struggle to survive, excluded from the formalised sector without any form of protection from society (Blanchard 1989:ix). By the end of this century approximately 1400 million human beings will be entering the labour market. Of this total only 500 million will be able to get employment in present jobs. For the remaining, new employment will have to be generated (NMFA 1993:7). The needs of employment in developing countries are challenging. Every year there is a need to create 40 million jobs. For example, in India 10 million people enter the job market yearly. In China there are approximately 110 million under-employed. Unemployment will continue to grow and will be more acute among the poor (Smillie 1991:198).

To combat poverty a two-part strategy is suggested by the World Bank as a mean of achieving a rapid and sustainable development. Added to the provision of social services for the low income population, the creation of jobs and rise in incomes, by supporting the use of productive labour, is seen as a valuable tool. Such views are shared by agencies such as the United Nations Development Programme (UNDP) which emphasise, in the *Human Resource Development Report* of 1991, the need to fight poverty through the support of small scale-enterprises. Such needs are also recognised by governments. A recent Netherlands government policy document argues that

> [...] combating poverty through the development of small-scale enterprise provides a suitable framework within which to give concrete shape to the three other main points of Dutch policy: women and development, the environment and research (NMFA 1993:7).

The scale of poverty in most less industrialised economies is bringing massive problems, which are particularly acute in the large cities of the LIEs (Blanchard 1989:ix). A constant migration from rural areas, accompanied by a slow growth in wage-employment activities suggests that people are finding alternative ways of work. In many LIEs an ever growing number of people are entering the labour market with the intention of finding wage-employment in the formal sector of the economy but, this sector is not able to absorb them. Thus people are compelled to generate their own employment, working in the informal sector or as subsistence farmers (Fluitman 1989:xiii). Stewart (1978:34) points out that the modern sector provides employment only for a minority of the population in LIEs. As a result of the industrialisation process and subsequent growth in urbanisation, new modes of urban activities have emerged. This is the case with the informal sector in which the population are involved in a number of different activities ranging from manufacturing to services, providing for themselves and for the modern industrial sector.

The situation described in the previous paragraphs is common in most countries of the developing world. In Latin America, the growth of the informal sector has been considerable and in most countries a significant part of the working population survive by working in this informal economy. Economic problems in the 1980s have stagnated the development process in the region, and for millions the standard of living has deteriorated, increasing the level of poverty in all countries (Stearns and Otero 1990:16). The promised growth which would accrue from the transnational economies did not occur and governments in the region are now looking inwards for alternatives to produce and generate economic growth. They perceive the informal sector's productive potential as something to be included in development policies. Another important reason for interest in the informal sector is related to demographic patterns. Rates of population growth are still high and the age composition of the population is of particular concern to governments, as well as the fact that much of the population is concentrated in urban areas. In the majority of Latin American countries more than half of the population are living in cities and consist basically of young people. Governments have interest in the sector because it creates jobs for the growing population at relatively low costs, 'reflects the skill and level of the majority of the labour force, and encourages the production of goods and services that supply the poor populations' (Stearns and Otero 1990:17).

Manufacturing industry in most LIEs, is either incipient or almost non-existent. The majority of the local population, to obtain manufactured basic products, rely on small manufacturing units and increasingly upon the informal sector. Small firms account for most registered firms in the majority of nations. They are extremely numerous in the manufacturing sector of LIEs, accounting to more than 95 per cent of all registered undertakings (International Labour Office 1982:4). Manufacturing microenterprises, particularly, are vital in the generation of employment and income, as capital intensive technology ignores and marginalises poor people who live in rural or peri-urban areas (ATI 1985:6). In Latin America, and the Caribbean the number of people relying on the informal sector to survive is increasing considerably. It is estimated that one third of the economically active population, approximately 30 million people, work in the informal sector. However, it has been recognised that, in practice, little attention has been given to this sector (Levitsky 1989:xiii). Despite it's economic problems, and it's lack of technology and disorganisation, the informal sector still creates more employment than any other sector. These small businesses operate both in urban and rural areas (Levitsky 1989:ix).

In recent years donor agencies and development banks have recognised the importance of the informal sector. Institutions like the Interamerican Development Bank (IDB) have strengthened co-operation with non-governmental organisations, and the IDB is determined to include discussion on the informal sector at policy level with governments (Levitsky 1989:xiii). It also recognises the role of NGOs in the Bank's Small Projects Programme. Other agencies like the US Agency for International Development (AID) also stress the importance of microenterprises in developing countries and their importance in relation to non-agricultural employment. It was pointed out during the international conference on microenterprises held in 1988 (Levitsky 1989) that, in some countries, microenterprise activity was generating more income to households than farming, and in some nations, where regulation and government policies compelled business to stay small and illegal:

> [...] the value added in the informal sector can exceed that created in the larger, more visible formal sector (Levitsky 1989: xiv).

However, AID recognises that appropriate policies and an environment that encourages business are crucial for the survival of microenterprises. In 1988 AID and the US Congress made a financial commitment of US$50m to microenterprises expansion. These resources were aimed at institutions in developing countries, involved in increasing income and creating employment via the development of microenterprises (Levitsky 1989:xv). The World Bank also recognises the importance of microenterprises as a 'subclass of the enterprise sector'. According to the Bank, at least a third of the population in LIEs provide their livelihood from the informal sector and if assistance is geared towards developing such a sector there is a great potential to contribute to economic growth (Levitsky 1989:xv). The World Bank also consider it important to include the informal sector in discussions related to 'policy reform and structural adjustment programmes' in an attempt to change policy and legislation which stifle the informal sector (Levitsky 1989:xvi). The importance of the informal sector should not be underestimated. In some countries a number of services that should be provided by government are provided by the informal sector. For example,

> In Lima alone, the black market (excluding manufacture) employs 439,000 people. Of the 331 markets in the city, 274 have been built by the black-marketeers (83 percent) [...] Half of the population of Lima lives in houses built by black-marketeers. Between 1960 and 1984, the state constructed low-income housing at a cost of $173.6 million. During the same period, the black-marketeers managed to construct housing valued at the incredible figure of $8,319.8 million (47 times what the state spent) (Llosa 1989:xv)

Although in the literature of development, defining the informal sector has proved controversial, the 1988 international conference on microenterprises reached some consensus. Most participants agreed that microenterprises referred to quite small income generating units, with very little capital available, which belong and are administered by entrepreneurs who get most of their income from the firm and who are directly involved in the work conducted. They, in general, employ small numbers of people, who are mainly family members. Although in most LIEs this is mainly the characteristic of the informal sector, in some instances it may encompass cottage industries, craftsman units and self-employed people (Levistski 1989:xviii).

The informal sector is heterogeneous, encompassing a variety of economic activities. These vary from agricultural activities such as post harvest operations e.g. rice de-husking; manufacturing products e.g. metal gates and doors; to providing services such as selling food or domestic work. One of the characteristics of the informal sector is the different types of labour it involves. Herschbach (1989:3-15) presents four categories of workers involved in informal sector activities which have important implications for training.

a) small entrepreneurs who own their means of production;
b) paid and unpaid establishment workers
c) independent workers
d) casual workers

a) entrepreneurs: are the best educated category. They are the main workers in the firm. If others are employed they generally are family members. They purchase raw materials locally, administer their own finance and sell in a localised market to a variety of buyers. Their constraints are related to lack of capital, difficulties of access to credit, and limitations in demand for their goods and services.

b) establishment workers: people who work for the entrepreneurs. In general there are three or four working in the firm. They can be people working for a salary, apprentices and unsalaried members of the family. They are normally full-time workers with a relatively high level of skills and have attended formal education. They are engaged in clerical, administrative or skilled work such as sales, repair and maintenance work, manufacturing etc.

c) Independent workers: This category include people who are mainly self employed. They provide a number of services varying from repair of equipment and household goods to selling food and other goods in the streets. They are limited by the low value of their work in the market. These are the 'smallest units in the category of establishments and are the simplest forms of production units in the informal sector' (Papola 1981);

d) casual workers: these are the most deprived, with very low incomes and constitute the largest category. The kind of work they are involved in requires little training and depends mostly on manual labour. They are involved mainly in household work such as gardening, cleaning, but also in construction work etc.

It is important to note that these are not fixed categories and that there is constant movement between them, and also that people go in and out of the informal sector (Herschbach 1989:3-15).

Although the importance of microenterprises has been recognised and a number of countries have set-up specialised institutions to support them, this help has been insufficient. Organisations in general have proved to be bureaucratic, and rarely reach the poorest is society, and in many cases are not allowed to work with informal sector enterprises. Such organisations mainly focus on credit aspects and occasionally give technical training. However there is relatively little support for such programmes. For example, in Peru, by the end of the 1980s only a third of one per cent of all credit was directed to the informal sector (de Soto 1989a:3-12).

In some cases resources and subsidised interest rates, which had the objective of benefiting socially vulnerable groups, attracted the better-off who thus also benefited from them. In many programmes the focus is biased in favour of enterprises involved in trade because of the profitability of this activity and quicker rate of repayment. This leaves little alternative for many microenterprises but to rely on family based finance. Studies have revealed that, for example in Nigeria, '98 per cent of finance for productive enterprise is family based. In Tanzania the figure is 93 per cent and in Bangladesh it is 75 per cent (Liedholm and Mead 1987).

In the literature on the informal sector there is some disagreement over the best form of help for microenterprises. Some authors favour a *minimalist model*. The term describes programmes which concentrate focus on the provision of credit only, and provide no other kind of assistance. The measure of success of this approach is shown by the record of repayment of loans. Other authors argue for an *integrated model*, meaning by that the provision of credit and technical assistance. Most Latin American participants and some NGOs in the 1988 Conference supported the latter approach. Some, like the Carvajal Foundation of Cali, argue that

> [...] Training and technical assistance are the main services needed and credit should be available only to those who have passed through training programmes on how to manage their enterprises (Levitsky 1989:xxviii).

Advocates of the *integrated model* maintain that the provision of credit with no training and guidance can be used improperly and lead to inadequate results in the development of microenterprise operations (Levitsky 1989:xxviii). The integrated model has been advocated for many years and is favoured mainly by NGOs while banks and other financial institutions appear to support the minimalist model (Levitsky 1989:xxix).

## 3.3. Training in the Informal Sector

Another crucial factor in microenterprise development, is the existing level of education and skills available. Primary education in particular has a crucial role to play in microenterprises, because having such training will enable people to understand written instructions, give them the ability to measure precisely and to comprehend the fundamentals of science and organisation. A study conducted on the relationship between education, poverty income distribution, and economic growth, concluded that education plays an important role in growth, and that returns on education are comparable to, or even surpass, returns on physical capital. The study also revealed that education promotes income distribution, has an important role to play in poverty reduction and that primary education has a much more important contribution to growth and income distribution than other levels of education (Tilak 1989).

Most people in the informal sector learn their skills through informal training. A newcomer learns by watching and helping others to performs specific tasks. According to Herschbach (1989:3-15) the character of informal sector training, which is mainly unplanned and unorganised, differentiates it from *formal* and *non-formal* training activities which are provided by governments and private agencies, and which are mainly planned and organised ways of training. He notes that apprenticeship is widespread in the labour market of West Africa and is composed of a large training 'system' 'through which critical economic and development needs are addressed'.

That is not to say that formal education is not important to the informal sector. Actually, formal training has a direct influence on the success and mobility of people within the informal sector. People with literacy and numeracy skills do better than people without them. Lacking such skills also denies access to existing training programmes and might be the most crucial problem impeding occupational progress. Thus, gaining access to higher levels of skill training is crucial to occupational mobility in the informal sector. Skills acquired by formal and non-formal training are constantly being transferred to the informal sector and this inflow of experience is responsible for technical improvement (Herschbach 1989:3-15). Research by the ILO in India and Thailand (Sethuraman 1992:49-79, Nurul Amin 1992:105-129) found that experience in the formal sector and the level of education of entrepreneurs and workers is one of the determinants of technological capability and change. As Sethuraman points out,

> The evidence on linking education and exposure to the modern sector, on the one hand, and technological capability measured in terms of adaptation, innovation and maintenance capacity, on the other, suggest a positive correlation as expected [...] findings support the hypothesis that schooling, experience and exposure to technologies in the modern sector on the part of entrepreneurs do play a significant role in technology adaptation. Their importance however, seem to vary because of the presence of other factors such as credit rationing (Sethuraman and Maldonado 1992:223-235).

Training in the informal sector is a delicate matter. It is not very clear how formal training should address the training needs of the informal sector. Blaug (1979:397), suggests that the informal education system should not be interfered with, as it seems to be accomplishing a variety educational aims more effectively than the formal system. There are a number of strengths in the informal sector which should be taken in to consideration. For example the fact that it is unstructured and improvised allows flexibility and adaptability which suits employers. Thus there is a risk that by 'formalising' informal training, this flexibility would disappear and the objective of the training be lost. Another aspect of this training is the financial support. Since most of the cost of informal education is paid for by the apprentice or his/her family, by paying fees, 'in this sense, informal sector training is self-supporting'. To intervene in a direct and organised way requires large sums of money which are not normally available. This intervention might also disrupt the existing system. The present system also provides education which is accessible to the educational levels of the workers who, in general, have no literacy or numeracy skills making it difficult for them to participate in formal training programmes (Herschbach 1989:3-15).

Cost is another barrier to the potential trainee. Fees, transportation and instructional material might account for 50 per cent of the trainee's monthly income. Added to that is the fact that employers might not be willing to permit employees to have time out for training. Such better qualification might be perceived as a threat, as there is no guarantee that by having better qualifications the employee will not demand a higher salary, apply for another job, or even try to set-up a competing business. These problems restrict the participation of informal sector employees, particularly the poorer ones, in programmes aimed at them. For example, research by the ILO (1977:217-229) revealed that programmes in Chile attracted wealthier workers. Poor workers did not even apply.

A peculiarity of most small business is that they are essentially pragmatic, and might not perceive that training, which does not have a practical application, should be a priority in their business. Thus to make change possible, the subject of training should be discussed with entrepreneurs and preliminary contact should include on training as well as guidance advice on matters such as the best way of getting financial help, marketing etc. (NMFA 1993:37).

Despite the existence of many support programmes for small business, in general they have not been very fruitful. They disregard the needs of small entrepreneurs and the research necessary to verify of the effectiveness programmes is lacking. Such problems have occurred in most regions of the world and in some countries the training programmes are too short and unsuitable for developing entrepreneurial ability. There are some exceptions to this but, in general traditional, small enterprise programmes have rarely resulted in sustainable development for the enterprises concerned. This lack of effectiveness has been confirmed by evaluation of formal training programmes which are maintained by agencies such as ILO, UNIDO, UNDP and the Netherlands Directorate General for International Co-operation (DGIS). Studies found that few of the people at which the programmes were aimed, were actually involved in the programme. There were better results with on-the-job and training in mobile training units but, such schemes are very costly (NMFA 1993:37).

There are however some successful projects such as the Technology Consultancy Centre in Ghana which support people already involved in a productive activity. These programmes are broader in scope and include access to credit, machinery, raw materials and business advice. Giving priority to people already operating in the market not only reduces technical training costs, but is also more likely to help people who are really entrepreneurs. Such programmes make sure that participants have the proper combination of stimulation, analytical abilities and problem solving skills (Smillie 1991:203). In King's (1990:105), opinion, reliance on traditional training methods has its limitations. He suggests that

> A really major set of changes in the enabling environment and in the financial support of microenterprise will be necessary to alter the dominance of education and training for employment towards some significant measure of education and training for *self*-employment.

According to the Netherlands Ministry of Foreign Affairs, the point of departure for training programmes aimed at small business should be 'action learning'. This means, among other things, very little use of conventional class work and constant feedback. It is preferable to choose more uniform groups regarding size, sector and level of development, and the solution of practical problems should be given priority. This method involves experimentation, simulation, case studies and role playing and, above all, students are taught to think in terms of 'what happens if I do this or that'. A crucial aspect of this approach is that people participating should share the costs of support although not necessarily with money. Contributing to the cost of training is an important way of stimulating participation and can verify the extent to which the agency's perception of needs is shared by participants (NMFA 1993:37,38).

The following approach to training for small enterprises is suggested by the NMFA (1993: 38)

- The target group is clearly defined
- A first inventory of the advice and training needs is drawn up with representatives of the target group.
- Priorities are then established in consultation with representatives of the target group.
- Advice sessions then begin.
- On the basis of the first discussions, needs and priorities are adjusted.
- On the basis of the adjusted needs, training programmes are organised, courses being held preferably near people's homes, in short sessions, at times when the business person or her/his staff are available, and geared to problems arising in day-to-day experience.
- The application of the material learned is followed up with visits to the participants at their places of work.
- Follow up advice and training programmes are improved and adjusted on the basis of experience in the first round.

The same Ministry also suggests that alongside more traditional teaching resources, audio-visual training materials, such as computer video training, should be used in training programmes because, in spite of the initial cost, the material can be copied and taken to remote areas (NMFA 1993:7). Another important aspect to be considered when designing support and training programmes in the informal sector is the role of women. They account for a considerable number of workers in the informal sector, particularly those involved in non-farm rural activities. For example in Bangladesh they account for 34 per cent of the labour in rural industrial units; and in Honduras they are proprietors of 61 per cent of small business (Carr 1989). Although, in general, microentrepreneurs operating in the informal sector suffer a number of difficulties, women are the most vulnerable group among them. In recent years, most donor agencies have recognised that little attention was given to gender issues in previous microenterprise support programmes. The situation is gradually changing and special programmes aimed at remedying this situation have been designed.

A number of reasons justify the focus of support on women. They are increasingly becoming the main providers in millions of households throughout the developing world. Not less than one third of households in the world depend on womens' gains (ITDG/IBT 1991). In sub-Saharan Africa they account for approximately 40 per cent of the total work force. Also in Africa more than 50 per cent of economically active women work for themselves, the majority working in the informal sector. Their tasks are varied, ranging from food selling in the market, servants doing domestic work, petty trade, washing clothes, to jobs in industry (INSTRAW 1991). Despite of the fact that their contribution to household incomes is considerable, they have little opportunities to access wage-employment. Employment in the formal sector presents problems because of womens' roles as producers, mothers and other responsibilities in the household (Male 1993: 35 and International Labour Office, 1990: 6).

From the previous sections it becomes clear that, when addressing support for the poor in less industrialised economies, one cannot ignore the role of the informal sector. In relation to the objective of this investigation, it emerges from the review of the literature related to this sector, that manufacturing plays a crucial role in the survival of the low income population. It is thus considered necessary to sharpen the focus on the micro-production units. As stated in Chapter I, the product design capacity at this level is considered fundamental to the development of microenterprises. The next section presents an overview of how small manufacturing units operate in relation to the design of products, and provides evidence of the existence of design capacity in microenterprises.

## 3.4. Product Design in the Informal Sector

The ability of small firms to adjust themselves when faced with competition is a valuable resource to them. They are able to assess the competitive environment and take advantage of commercial possibilities. Maldonado and Sethuraman (1992:3-24) suggest that they possibly use three 'technological responses' to do that; a) the exploration of new lines of production in market segments not explored before (specialisation or diversification); b) differentiating products or services available in the market and which are provided by formal or informal manufacturing units; c) substitution of high-price, domestic or imported products and services by more suitable, accessible and cheaper ones. Among a number of comparative advantages in relation to formal enterprises, there is the fact that the goods and services provided by them are appropriate to the customs, needs and financial availability of poor consumers. This advantage is related to the thorough utilisation of available raw materials, capital, etc. and of production techniques which value know-how and labour above capital. Thus, they are able to offer a variety of products or services ranging in price and quality.

Limiting factors include lack of access to capital, lack of management skills and a hostile policy environment, but there is also the lack of product variety, of demand and the difficulty of opening alternative markets. A study by King and Abuodha (1991), carried out in Kenya's metal manufacturing firms, points to the fact that small businesses are producing the same products, causing a market saturation and thus stagnation in the sector. It emerged from their study that a number of firms are producing windows grills, metal gates, doors and windows. The result is that,

> These saturate the market, resulting in dampened prices and low prices and low profits or losses. These further cause low investments, stagnation, or firm closure. ...There is therefore a need to enable and encourage product differentiation and product quality improvements, where inter- and intrasectoral competition is stiff, and to ensure that the product base is widened.

This is also the opinion of Gamser and Almond (1989:189-201), who state that one the most important reasons for failure of informal sector support programmes, aimed at manufacturing firms, is the total neglect of product design. This view is supported by Male (1993:35-42) who suggests that programmes should emphasise training in product marketing and product design.

Despite lack of support and many other constraints, informal innovators have considerable economic importance in many LIEs. For example, in Bangladesh blacksmiths are responsible for '5 per cent of total manufacturing GDP' (Gamser 1990: xii). As Gamser point out,

> About 10,000 blacksmithing enterprises are a major source of non-farm employment in a nation with an estimated 65 million landless poor. Blacksmiths also help in import substitution, producing spare parts for power tillers and tractors. Without the blacksmiths, these parts would have to be imported — at twice the cost! (Gamser, Appleton and Carter 1990:xii)

In the majority of less developed countries, the developing process has ignored poor peoples' innovative capacity and technical knowledge. Foreign machine and equipment imports dominate technological development in most countries and can discourage innovation conducted by the more vulnerable groups. There is a bias in the support innovation system, with priority being given to formally trained people to the detriment of the informal sector (Gamser, Appleton and Carter 1990:ix).

Technology developed by the poor is linked to their need for survival. It is developed and diffused gradually by a process of experimentation and is developed via direct consultation between manufacturers and consumers. These technologies are thus a reflection of the priorities of the local market and take into consideration local technical and socio-economic characteristics. The marginalisation of peoples' technology restricts informal innovators' access to information on technical issues, to credit and other resources which are available (Gamser, Appleton and Carter 1990:x).

Kabecha (1994) points out that this 'informal' innovation system, composed of individuals and workshops, has a crucial importance to the economic system. He calls attention to research undertaken by Kenneth King (1975) in the Kenyan context. To King there is a strain of innovation in the informal sector. His view is that even the simplest products in the sector have been modified and a variety of alternatives introduced into the market. The creativity and ability of blacksmiths is well developed, and their capacity to design and construct tools for self use, puts them into a *sui generis* position (Kabecha 1994). To acknowledge that peoples' technology has a value is the starting point for the encouragement and reinforcement of such technology. This acknowledgement questions existing relationships and calls for their re-evaluation. Informal innovation capacity should be more prominent and co-operation between the scientific community and local knowledge should be strengthened (Gamser, Appleton, and Carter 1990:xii).

However, there are substantial difficulties in innovating at this level. The entrepreneur/innovator has to fight against a variety of linked problems. These can be social, economic and technical. The problems are highlighted in the rural areas of the Third World where the majority of the population in these countries live, due to the lack of a proper infrastructure, e.g. lack of electrical power, irregular market structure and dispersion of the population. Among the most prominent constraints are: the lack of availability, and bad quality, of existing materials and the high price of raw materials, which compels entrepreneurs to recycle materials can lead to and poor quality; non-existence of locally produced machinery or equipment or the high prices of available hardware; the level of training and education of local business owners. The lack of education limits innovation and adaptation, producing low output; lack of market demand impedes accumulation and restrains investment in change; there are no specific facilities to test new products; there are weak links with the formal sector; and the entrepreneurs lack capital and formal credit is inaccessible to them.

In relation to technical innovation, requirements are related, to the development of existing techniques and adaptation of them to local circumstances. Innovators have to search for product solutions which are safe, simple, affordable by low income consumers, strong, easy to operate, repair and maintain and which can be mainly manufactured, in units operating near the areas where they are required. This demands financial and other resources, and time, as in the industrial economies but, due to the constraints mentioned above, much higher risks and lower returns are involved (Waldenström 1988:3).

Informal sector firms are reluctant to invest in research and design, because of the lack of patent protection, which does not occur in the case of large firms. In China for example, a few years ago this was not a problem because most R&D was sponsored by the state, so that small firms could use this research. This situation in changed and now firms which bought equipment privately were no longer willing to share it with competitors (Bhalla 1992:82-100).

Informal products, despite their apparent simplicity, have developed gradually and are well adapted for the context in which they are going to be used. They have, in general, emerged without any help from professionally trained designers and have not used design as an activity distinct from production. This is a process similar to the emergence of craft products in MIEs. As Jones observes,

> [...] The surprising thing to us is that the beautifully organised complexity of the farm wagon, the rowing boat, the violin and the axe, should be achieved without the help of trained designers and also without managers, salesmen, production engineers and the many other specialists upon whom modern industry depends (Jones 1970:15).

Jones points out that

> [...] neither the professional designer, nor the drawing board upon which the parts of a design can be adjusted relative to each other, are essential to the evolution of complex forms that are well fitted to the circumstances in which they are used (Jones 1970:20).

It is worth noting that, despite the emergence of design as a professional activity, non-professional design continues to be important in more industrialised economies. In the design management literature there are some recent examples of non-professional designers getting involved in the design process. Gorb and Dumas (1987:150-6) found out that in the late 1980's there were many firms in the UK where design activity was not interpreted as 'design' and was conducted by people with no background in design, working in other capacities within the firm. They call such process 'silent design' and argue that;

> The aims and intentions behind the design activity of an individual cannot simply be subsumed under 'design' if his job description, title and his own intentions are not perceived by him and others as having design as a central activity. To assume that if the job entails design, it should be undertaken by a professional designer is to adopt an over simplistic view. The individual undertaking the work, oblivious of its design content, may well be operating effectively. The 'design' part of his work will, in his terms, be classified differently and his motivation and approach toward the task is likely to be entirely different from that of the professional designer. Indeed within his particular business context his set of decisions might be more appropriate than those of the designers.
>
> The degree to which the 'silent designer' is aware of his design role needs to be understood better. It is also of great significance in the interaction between the 'silent designers' and the 'professional designers' [...]

This situation is similar to the innovation process occurring in small businesses in developing countries. Non-professional design activity appears to be widespread in these micro production units. Poston (1990:72) argues that design capacity is particularly important in contexts where less technical information and technological resources are available because to innovate, invent and improvise are the only alternatives when normal commercial resources are non-existent. Although Poston's research is concerned with the African context, parallels can be traced with Latin America, where design is mainly used in most microenterprises because of the scarcity of resources to ensure the survival of, rather than the development of the business. Thus, design capacity is required at all levels of development of the firm and should be considered a priority by development agencies. As Appleton argues;

> It is assumed that the process of innovation is as important as the output: the ways in which people use their knowledge and skills are as important, and may be more important, than actual technical changes. Any technical innovation results from a problem identification and problem solution. The ability to identify problems and provide solutions is thus a useful measure of people's technical capacity wherever it occurs (Appleton 1994:4-13).

There are a number of reasons why small firms have to design new, or adapt existing, products. Capital goods needed might not exist or might not be available in the market, in sizes appropriate for the small scale manufacturing and operations of microenterprises; the costs of existing capital goods are high; existing equipment and machinery is poor quality; consumer goods to fulfil local demand are either lacking or cost too much and government policies restrict the imports of foreign products.

However, some of these constraints can stimulate local small producers. Nkonoki (1990:6-20) describes a situation in Tanzania where foreign machinery was sold by co-operatives such as the Kilimanjara Native Co-operative Union. Most machines were bought by wealthy farmers. With the dissolution of co-operatives, imported coffee equipment and spare parts became scarce, and this compelled most coffee producers, including wealthy ones, to use machines manufactured in Tanzania. The manufacture of local pulpers was initiated by blacksmiths and carpenters and the machines have a high rate of diffusion. Approximately 50 per cent of small pulpers are produced indigenously, imported hardware being responsible for only 40-55 per cent of the total coffee produced by small coffee producers.

A certain level of isolation from exogenous technology may also stimulate innovative behaviour. Chukwujekwu (1992:175-181), describing a case study conducted of a Nigerian company, explains that the thrust for the innovation in this firm was the best possible use of existing raw materials. The design of machinery and equipment to process existing raw materials would benefit entrepreneurs, because it could reduce dependence on external sources of machinery and raw materials. It would also allow a permanent provision of necessary parts for maintenance and repair. Thus the company decided to rely on itself. Its method of building up its design and production capability was by adopting a method of learning-by-doing. The managing director believed that a good mechanical engineer would be able to design any mechanical system. He recognised that the efficiency of the system might be lower, and that it might take longer to produce the system than in the case of equipment designed by a specialist, but felt that the designs would work. There was also another reason for adopting this approach: the fact that foreign manufacturers have no interest in sharing their technology in the area of equipment.

The many reasons for the need to innovate are interrelated. For example, Jamil and Said (1992:167-173), in a study of small and medium enterprises in Malaysian industry, point out that firms' behaviour in the market ('competitive phenomenon') is influenced by a number of 'interrelated technological factors'. They suggest that a firm's incapacity to increment sales might be related to inadequate design ('product or process technology') and lack of after-sales support ('marketing management'). Inadequate product quality might result from lack of proper machinery or the lack of tolerance in manufacture or absence of trained personnel ('management or human resources'). Their study revealed that very few entrepreneurs are aware of this interrelation

> ...only about 19 percent of enterprises were engaged in developing new potential users or consulting the company's personnel for ideas about new products. Only an insignificant number of the surveyed enterprises relied on normal market research or available R&D institutions for the development of new products (Jamil and Said 1992:167-173).

This suggests that informal mechanisms for surveying the market, and seizing existing opportunities, are in place. This also suggests that there is a need to develop internal capacity to innovate. However, there are obstacles to be removed. In theory, the quest for enhancing competitiveness should encourage small and medium enterprises' innovative behaviour. However, there is a problem because these firms do not create technology in-house. The need for survival leaves little room for investment in R&D or product design. This compels them to rely on external sources of technology and on availability of financial resources to access it (Jamil and Said 1992:167-173).

Nevertheless, in some contexts, small firms might not have alternatives and are compelled to innovate. For example, the excessive cost of foreign machines and raw materials forced small entrepreneurs in Nigeria to seek for technology and products made in the country. Among those products were agriculture machines for harvest and post-harvest operations. Although rustic in some aspects, these machines worked and could be refined. There is a great potential for such technologies. Producers of machinery emphasised the possibility of designing a much wider number of alternative products if they had proper manufacturing equipment (Adegboye and Akinwumi 1990:64-79).

Despite difficulties, there is growing evidence of microenterprises' ability to innovate. Sethuraman observes, in a study conducted in India, that the quality of the response of small enterprises varied and that some units were more creative than others. An important aspect in his study, was the fact that few firms had produced exact copies of existing machinery or equipment, and some claimed to have made an original model which was not available in the market. Concerning new products or services, 'in six out of 13 cases these were not available in the market before; in three cases they were new designs' (Sethuraman 1992:49-79).

Although there is evidence of both design of capital and consumer goods, existing data suggests that most innovations are related to consumer goods. In a study related to patterns of innovation in Africa (Sierra Leone) Chuta and Liedholm found that

> [...] at least 48 percent of the entrepreneurs surveyed had introduced some kind of technical change—new product or improvement of existing product's quality, new kind of machinery, etc. (Bhalla 1992:83-100).

The study found that

> Product changes were much more prevalent than changes in equipment. [...] An interesting feature of this survey was that it interviewed the same enterprises between two dates to review dynamics of technical change. About 39 per cent of the sample entrepreneurs whose enterprises were more than five years old reported product diversification and manufacture of new products [...] (Bhalla 1992:83-100).

**Table 3. Innovations introduced by small-scale enterprises of at least five-years standing (Sierra Leone, 1975-1980)**

| *Type of Innovation* | *Respondents (percentage)* |
|---|---|
| Restyled goods and services | 47.6 |
| Started making entirely new products | 38.5 |
| Transformed the workshop | 34.5 |
| Bought new machines | 22.5 |

Source: Enyinna Chuta and Carl Liedholm, *Employment and Growth in Small scale Industry: Empirical Evidence and Policy Assessment from Sierra Leone* (London, Macmillan, 1985), p. 83.
*Note*: The sum of the percentages exceeds 100 because each of the respondents had the opportunity to give more than one positive response. Source (Bhalla 1992:83-100).

This pattern also occurs in some other African countries. Kabecha, in an attempt to establish whether there was design capacity in the Kenyan 'Jua Kali'[1], found that one commonly manufactured product, a tin lamp, had been modified in many aspects since it was taken over from Indian craftsman in the past two decades. His research found that 33 per cent of respondents said they had changed the products they started with by adding a number of new characteristics (Kabecha 1994). Sethuraman found that in Bangalore (India)

> [...] 15 units (out of 80) reported having produced at least some new product or service - either it did not exist or it was a new 'design'. In Bangkok, for example, a much higher proportion of sample enterprises - 38 per cent - reported having introduced a new activity. (Sethuraman 1992:49-79)

The findings in Bangalore give the impression that there is low 'innovative ability' in this sector. This might be explained by the strong competition from the formal sector, allowing little room for niches in the market which could be fulfilled by small enterprises.

In China there is also a greater incidence of consumer goods in product development, in relation to capital goods. In Zheijang Province, firms were more interested in the manufacture of new products than of technology, because of the immediate economic benefits which accrued. Technology was something which they could acquire from external sources (Tianzu 1992:139-151).

Design in microenterprises is being executed mainly by producers, who have knowledge of production and marketing conditions in areas of low-income consumption. This design output is diverse, varying from 'traditional' to more elaborate new techniques developed in practical use. Knowledge of the socio-economic and technical context is crucial for the quality of product design. Entrepreneurs at this level are more vulnerable than larger firms which are protected by patents and copyrights. Surviving in such contexts is evidence of the appropriateness of their technologies (Mitchell 1980:103-111). As Harper (1984:13) points out, such innovations may not be patentable but create employment locally and economise foreign exchange. Firms operating with more sophisticated technology will, in general, depend on external sources of technology.

---

[1] Jua Kali means outside in the hot sun (Gamser and Almond 1989:189-201)

Design is important to any size of firm including microenterprises in LIEs. As Freeman (1983) points out, design plays a fundamental role in innovation, not only because it is the realm of creativity where concepts are generated but, also because it is there that a connection between technical opportunities and demands from the market occur. The integrative role of design also influences manufacturing techniques, as new products might require new manufacturing processes. Most of the design activity conducted by microenterprises appears to fall into two of the three categories defined by Freeman (i.e. *experimental design, routine design engineering, fashion design*). Design consists of either routine design engineering, applying known technology to specific products and conducting incremental modifications to improve performance; or fashion design, variation in the visual characteristics of a product without any technical change.

Observation of the kind of products aimed at the poor consumer reveals that these products differ completely from those designed and manufactured by large manufacturers for the middle and higher income groups. Although the products aimed at the low income consumer are not such good quality they have to be strong as well as low cost, because poor consumers cannot replace them often. Above all they must be functional to their use (Stewart 1978:79,80). Microenterprises manufacture basic consumer and capital goods which are required by the majority of the population in urban and rural areas. The techniques and equipment are, in general, less sophisticated than machinery and equipment used in the formal industrial sector. Small firms are also constrained in terms of opportunities to acquire better technologies (Carr 1989:165-176).

Manufacturing microenterprises have to be versatile in terms of the products they produce, to make better use of their capital equipment and to overcome market and production constraints. Thus, many produce a variety of products, sometimes peripheral to their main activity. This is the case of a machine shop in Indonesia, in which the main activity is the production of hydraulic ram pumps. However, they also produce a number of supplementary products — automobile and truck parts, pellet guns, seats, etc. — which are changed on a monthly base. Most raw materials come from scrap yards which are visited frequently by one of the workers. Figure 4 is a good example of the improvisation which occur in relation to capital goods. This lathe uses an automobile part as its body (Mitchell 1980:103-111). Other examples can be found all overs LIEs (Figure 11, 12).

Figure 11. Constraints in accessing capital goods compels microentrepreneurs to innovate. *Source*: Mitchell, R.J. (ed.) *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980.



Figure 12. Alternative forms of propulsion are common place in small workshops. *Source*: Mitchell, R.J. (ed.) *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980.

Kabecha (1994) points out that goods manufactured by the poor vary in kind. They substitute goods produced by the formal enterprises and are produced mostly by poor people for poor people. There is relatively little product diversification and the entrepreneur in general prefers to widen the variety of activities invested in so that she minimises risk. Thus, she will have alternatives in case something goes wrong. This leads to over competition and the manufacturing of simple products, suggesting that in the small firm there is little design and innovation capacity.

A crucial variable in microenterprises is capital/labour (K/L), as it determines the manufacturing capacity, the types of commodities to be produced, and the needs that firms operating in the same market aim to fulfil. As stated in section 3.2., capital for setting up business comes from a number of sources such as informal money lenders, family relatives or friends, personal savings and compensation from a previous job, and a small proportion from formal institutions providing credit. Due to lack of capital, an informal business develops in stages. Initially the firm is established as an adaptable manufacturing unit. This means it begins to produce with very simple equipment which will permit the production of different products. Nevertheless, as a matter of survival the firm regularly has to adapt itself to the requirements of the market. Thus, it is compelled to diversify production by making different quality products or by adapting different designs. Independently of which alternative is chosen, the manufacturer will have to buy more equipment and machines, depending on financial resources and availability of technology and so slowly increase the value of K/L (Farrel 1992:131-150).

## 3.5. Informal Design Methodology

Design capacity is crucial for small firms operating formally and informally as it determines the type and characteristics of the goods manufactured and the effectiveness of the products imitated and adapted from enterprises operating with higher technology. It is also fundamental in the translation of design ideas given by the customer. Many requirements for products in the informal sector are for one-off designs and thus the small entrepreneurs have to go through all the stages of design to be able to complete the order.

Independently of the size and the level of sophistication of the workshop, design input will always be required. What varies is the nature of such input. Poston (1990:78), referring to the Central African context, differentiates between *primary* and *secondary* workshops' design input. In his view, primary workshops require intensity of design as there must be flexibility to cope with a variety of requirements ranging from design, development and repairs of different products. Each job is almost individual and needs specific design input. So all the decisions involved in a design project have to be taken by the worker or entrepreneur, and this involves considerable process development and innovation to compensate for workshop inadequacies. As the workshop grows and becomes a secondary workshop, it becomes more production and process intensive, and the need for daily design input is reduced because production becomes more standardised. Thus,

> [...] more specialised long-term input is required for product design and development, and for the development of processes appropriate to the production of those products. Cosmetic design input is also required for consumer products, whereas the capital goods of the primary workshop will largely succeed or fail on function and the price alone at this level of market (Poston 1990:78).

In relation to rural small units, urban small firms have a relative advantage which directly affects the output of design activity, as some of the crucial factors of production such as raw materials, access to technology, access to credit and skilled labour are more available. For example, raw materials derived from larger firms and discarded mass-produced goods are available in scrap yards, although varying in kind and quality. There is also a better level of communication among microentrepreneurs and wider linkages between firms operating informally and in the formal sector. This can occur through subcontracting. There is also more general availability of information on the market particularly for products, by direct observation of existing products and by information in the media, both important sources of reference for potential products to be manufactured by informal firms. However, in spite of a comparative advantage over rural enterprises, urban and peri-urban small firms still struggle to survive. Limited access to credit due to lack of collateral appears to be a major problem as it influences all the activities in the firm. In manufacturing units this will affect the level of technology used by the enterprises and consequently the overall quality of the product. Although information is abundant in some countries, very small units have little access to it and operate in relative isolation. Such factors limit the horizons and ability of enterprises to operate in the market.

It is important to bear in mind the considerable differences in the infrastructure of industry between LIEs and that these differences affect the ability to innovate and the type of output of small enterprises. For example, in the newly industrialising countries of Latin America there is a considerable industrial infrastructure, although in most countries there are inter-regional disparities. Nevertheless, independent of the level of technological sophistication and size of firm, some method of designing products exists. In microenterprises this appears to be based mainly on common sense.

Adegboye and Akinwumi (1990-64-79), in a study related to cassava processing innovations, describe the process of design in metal manufacturing by blacksmiths and welders, as a process of trial-and-error method, where knowledge is acquired and added to existing experience. These innovators attempt to resolve practical problems, as bottlenecks in the processing operations emerge. Although not a recorded method, it is nevertheless a method where objectives are clearly established and the steps required to achieve them delineated. It is a process which also involves close feedback from users. Changes in equipment are made by the manufacturers, as new ideas emerge, by the apprentices themselves and sometimes by users. Users change their processing equipment when it breaks down or looses efficiency. When machines are taken in for repairs, incremental improvements are made by manufacturers, aimed at enhancing efficiency. Subsequent machines will incorporate the incremental modification.

Nevin (1982:10) describes the case study of Clafer Manufacturing, a small toy manufacturer operating in Latin America, where engineering and industrial design capacity proved crucial to the success of the firm. For example, tools and jigs made in-house reduced considerably the amount of time necessary to produce one toy. The owner admitted that her process of design was by trial-and-error and was a difficult process. She has no training in design or in sewing and explain the success of her product by her innate design capacity:

> [...] I can't really explain it, [...] except that I think my tastes are what every body else seems to like too. Also, the fact that I stress quality above everything else, and my workers know it. [...] It's hard to me to say where my designs come from. I never had stuffed animals or dolls as a child. I wasn't particularly fond of that kind of thing, but I do seem to be able to dream up some good designs. I look through lots of magazines and catalogues to see what bigger companies are making, not just stuffed animals but all kinds of toys, and I also look at children's clothes designs to get ideas. Then I just sit down with scissors and some cloth or even just a pencil and paper and little by little try to come with something I like. I also get a lot of good advice from my workers and family, and I experiment a lot before I begin making very many. It takes a bit of time to get the design right so it will balance properly or so that the pattern can be sewn easily. I usually do the designing after the big Christmas rush when I can have sometime for my self (Nevin 1982:11).

The owner has occasional meetings with workers to discuss new design proposals and has good feedback from them in relation to models and colours. According to her, the workers are keen to do that because it makes them feel part of the firm. She stresses that this relationship makes a dramatic difference for the firm (Nevin 1982:12).

Thus design and creativity are crucial factors in the success of Clafer Manufacturing. To maintain constant design output is the most difficult aspect of the business, the owner admits, but the one which satisfies her most. As orders grew, process innovation became important to accelerate production and improve working conditions. Her husband helped by using his design ability, to construct a machine using automobile parts and a scrap motor which produced more and wasted less raw material. With this he managed to increase production from 90 sets per day to 300 sets per day thus eliminating the most painstaking and expensive part of production (Nevin 1982:12).

Another important aspect related to the process of design in microenterprises is techniques of representation. Two dimensional techniques are not commonly used. For example, small producers very rarely use drawing as a tool in the design process. They rely mainly on their ability to work three-dimensionally in close contact with the user during the design process. On the one hand, being unable to draw may be a limitation because drawing could help to predict aspects of a product and thus the cost of development could be reduced and risk minimised. On the other hand, the ability of small entrepreneurs to work in three dimensions and the close contact with the user is an asset. As Jones (Cross 1990:36-47) comments, there are limitations in the use of design-by-drawing. Using scale drawing is limited because it is not a reliable model of the 'product-in-use situation'. Such a method, despite being advantageous to the manufacturer, can be problematic to the user because the product is being designed in isolation from its use. 'Incompatibilities' may emerge between different individual products which the user wants to use together or when products are utilised on a large-scale. He calls these the '*external* compatibilites of a product' and points out that scale drawing solves problems such as the dimensions, location of components, etc. of a product or its *internal* compatibilities, but that,

> When considering the external, as opposed to the internal, compatibility of a new product the designer gets no help from the drawing and has to rely, in the main, upon his experience and imagination.

He argues for an externalisation of the design process with more user participation, since this can bring to the project knowledge and experience which the designer does not possess (Cross 1990:36-47). This user participation process does often happen in small firms in developing countries where two dimensional means of representation are rarely used and the relationship with users is very close. The difficulty of understanding drawings and the facility for understanding three-dimensional representation techniques, was also found by Christensen (1980:27-34) when working with craftsman in a stove project in Afghanistan. Referring to the development of a stove he explained

> I had earlier mailed them some sectional views of an old Danish stove; however, the drawings I sent were difficult for them to understand. So I made a model out of cardboard; three months later I was informed by mail that the prototype was finished. .

Communication problems also emerged in an architectural workshop carried out in Iran (Williamson 1980:35-40). A cross-cultural problem occurred. People in the workshop had different backgrounds and had their own way of designing buildings. For example, some participants used no drawing at all while others used it to show details of the tiles and brickwork, but not the form of the building. Other people used normal architectural drafting. It was necessary thus to have some standard for communicating

> Modern techniques had to be adapted to local drawing skills and perceptions. The village builders were asked to draw their houses and they all produced the same sort of drawing (Figure 13. ), a combination of a building plan and elevations of doors, windows and trees, as if these were folded flat. There is much more emphasis on the main door, the courtyard space and trees than on the physical structure. One can view this drawing from any direction; there is no top or bottom. This drawing technique reflects the way in which buildings are designed in the project area: customer and builder walk around a building site, roughly sketching the form on the ground. Construction details are not drawn, they come out of the builders head. Likewise, the trainees could sit around a sketch and discuss it, unlike the modern draftsman's drawing which can be read from one side only. Development Workshop combined the local approach with more formal drawing techniques (Figure 14.) for a village bathhouse latter built by the workshop participants. Four sectional views are folded out from the plan drawing in the centre; like traditional drawings, it can be viewed from any side. The concept of sectional views was explained by cutting sections in cardboard models.

Figure 13.. Drawing as a means of communication is not a common practice among low income innovators. *Source*: Mitchell, R.J. (ed.) *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980.



Figure 14. Hybrid drawing incorporating local approach and more formal drawing techniques. *Source*: Mitchell, R.J. (ed.) *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980.

Thus, there are a number of peculiarities which have to be considered when addressing design by the poor for the poor. Added to constraints suffered by all small business, the small manufacturing firms have to struggle with one of the most uncertain activities in industry i.e. innovation. What emerges from the previous sections is that entrepreneurs are constantly finding ways to circumvent huge constraints, most of which they do not control. One important way to reduce uncertainty is by involving the user in the process of design. To a certain extent, in very small firms there already exist a close relationship with the user and enhancing this relationship might increase the chances of success of the product.

## 3.6. Designing with Users

There are a variety of types of knowledge and skills which are necessary for change to occur. The role played by the user in technical innovation increases if the demands on technology are 'more location specific' (Gamser 1988:1). A number of authors have stressed the crucial role played by users in the innovation process. Some, like von Hippel have interpreted user in a limited way to define only people who 'use or consume a product'. Others, like Rothwell and Gardiner have widened the definition to encompass all people who 'interact with a technology, its creators disseminators and consumers' (Gamser 1988:2).

Gamser uses a wide definition of 'user' and divides users into three types (Gamser 1988:2). These categories seem appropriate to this thesis as there are a number of similarities between the context he describes and Northeast Brazil. His user types are :

1. (Consumer) People who access a technology by buying it or using other ways to meet personal needs. These users range from women buying fuel to cook, to manufacturers buying equipment for a manufacturing process.
2. (Producer) People who produce the technology or use this technology in manufacturing. These encompass small stove manufacturers, workers in assembly lines, etc.
3. (Distributors) People who are involved in the dissemination and distribution of technology to others. This encompass traders, staff involved in marketing, teachers, extension agents and workers involved in development.

He excludes staff from universities and research institutions, with the exception of people who in their spare time 'and outside working duties consume, produce or distribute technology'. Gamser's central thesis is that

> [...] an *ex ante* commitment to greater user participation in technology development enhances the innovative propensity of a given firm or agency. Making use of this human resource, this 'people power', is an integral part of effective change management (Gamser 1988:3).

The importance of user participation is independent of the level of technology. This is not to say that all innovations where users are involved will be successful but that users have a crucial role to play in the process. He stresses the need for recognition and use by both industry and the development community, of this latent potential (Gamser 1988:3). He argues that important lessons can be extracted from the new reorganisation in R&D institutions in MIEs, that benefit can accrue from involving users in product design and development, and that R&D bodies, universities and support programmes in LIEs should use this user-interactive method.

An example of user participation worth noting is described by Wharton (1980:21-26) in the design process of a stove project in Guatemala involving users. Some prototypes were made based on design constraints such as: efficiency in the use of fuel, does not produce smoke, low cost and should use locally available technology and raw materials. These stoves were subsequently presented to a number of people who made observations. From these observations prototypes were improved and chosen for field trials. An interesting fact occurred in relation to one of the alternatives which was a low floor cooker. Local women did not show much interest in it. After a number of modifications one of the women questioned the positioning of the stove on the floor and said that normally a stove was higher than that. This was the necessary feedback. The designers took this suggestion into consideration and the women were more satisfied. The development of the project was based on practical experimentation in the real situation, instead of a more scientific testing which would need specific instruments and time. The flexibility of raw materials permitted the product to emerge from a block of mud and sand alloy and allow changes to be implemented fast, tested and compared to the previous test. The versatility of the mud/sand mixture allowed the designers to make the fire box and pot holes out of a block of this material instead of building up a structure around frames or form. Therefore, new models and design changes could be made quickly during the development stage and tested against each, other obtaining advice from the users. Experimentation with firebox shapes, flu sizing, and burning efficiency was done while cooking with the stove (Wharton, 1980:21-26).

Although the article on this stove project, is not explicit about it, most of the benefits of the new product were in fact related to industrial design because they focused on the human-product interface. It is interesting to note that the article did not mention ergonomics or function in relation to the products. The main benefits identified were:

1 Ease of cooking. Many people stated that the fire required much less attention than an open fire; for instance the fire would not go out easily and required little fanning. The raised Lorena stove also allowed the cook to get off her knees, handle the pots without risking burns from the flames, and place the pots without worrying about them falling over.

2 Decreased smoke. Smoke was greatly reduced or eliminated completely in all cases. Women often commented that they enjoyed cooking more without a constant haze of smoke and tears.

3 Hygiene. The raised platform kept dirt and animals from getting into the food.

4 Safety. Because the pots are almost completely enclosed by the stove body, there is little danger of small children spilling boiling food on themselves. Many people considered this a very important feature.

5 Cost. The low cost of building the stove made people feel confident about constructing them.

However, there were some disadvantages. Some users thought that the stove 'did not heat the house as much as the traditional open fire' and this was important because the weather is cold. Even with this disadvantage the other benefits were considered more important .

Although creative skills, means of representation and user's involvement in the design process are important for the innovation process, possessing and using them is no guarantee of success in the market. Other factors influence the commercial success of products. One crucial factor is the thorough knowledge of the market where the products are to be sold.

## 3.7. Marketing

For design to be effective in microenterprises it is necessary to understand the market and how to get the product to the consumer at a reasonable price, taking into account user requirements and presentation. This can be a concept difficult to communicate and grasp. Marketing products involves knowing the best way to 'deliver the goods' and includes consideration of: who will sell the product, the quality of the product, packaging, transportation, awareness of competition and of promoting the advantages of the product to potential consumers. The main challenge of marketing is the identification of a service or a product which can be manufactured, will be profitable and which will sell (Kindervater 1989:8-10).

Marketing products and services is an important aspect of any business and presents major constraints to microenterprises, the most important being: lack of demand; restricting government policies; difficulties in expanding markets; and difficulties in transporting goods to market. In relation to technology, microenterprises suffer constraints due to lack of production capacity, as they use outdated or inadequate machinery and equipment; problems related to innovation capability; difficulties in accessing raw materials (i.e. cannot maintain standards and quality of products), and added to that they operate in markets which might be saturated (Male 1993: 35-42).

Their products and services are aimed primarily at low-income customers with low purchasing power. This means that there might be a demand but, the potential customers are not able to satisfy their demand. Customers might be farmers or urban dwellers, although the urban poor do much of their buying from traders who also supply goods from larger enterprises. Most small enterprises producing consumer goods sell directly to the final consumer without using intermediaries. This is possible because of their size and location which allow them to sell to passers by. Most clients live close to the workshops. Selling this way is crucial for their survival because working capital for the next job depends on this direct relationship with the customers. Poor people buy their goods because the products are cheap, are suitable for their needs and, in many cases, will last longer than goods produced by the modern industrial sector. Another advantage of community links is that it allows the entrepreneurs to evaluate the possibility of giving credit to customers (Harper 1984: 118).

Linkages are another aspect which can play a crucial role in the development of microenterprises. For example in South Korea, the link between farms and small scale manufacturing firms were crucial for the development of the country. Good prices paid for agricultural produces allowed farmers to increase their incomes and thus they were able to invest in agricultural machinery and equipment, and to purchase consumer durables. As a consequence firms were established in rural localities. This also benefited former agricultural workers who had been dismissed because of the introduction of capital intensive techniques (Harper 1984:120).

However, despite the advantages, demand in geographically close markets is because the customers are poor, particularly in markets located in rural areas. There is also the problem of product saturation because of the lack of variety of raw materials and technical skills available. This is added to lack of product design capacity and knowledge of how to market a product. As a consequence there is a standardised output sold in 'slowing growing markets' (Okelo 1989:240-250).

The lack of technique and knowledge which would allow changes in the way firms operate, thus meeting local demands, is also pointed out by Gamser and Almond (1989:189-201), who call attention to the fact that this is not because microentrepreneurs have no skills but, because of the constraints in the context which they operate, where raw materials are scarce, and infrastructure is weak. They suggest it is necessary to identify a new way of working within such an environment, which allows the firm to continue the level of output and product quality which are needed to sell in localised markets. As microentrepreneurs are stimulated to expand and diversify their market, standards and uniformity in product will be necessary. They might suffer competition from modern sector manufacturers or have strict standards to meet.

## 3.8. Commentary

The information contained in this chapter provides evidence that product design activity in microenterprises in less developed economies does take place, although most of this design is executed by non-professional designers. This design capacity varies according to the type of firm, its technological level, the availability of financial resources, and the level of education and skills within the enterprise. Design at this level does not emerge from over-production like in MIEs or the need to create more superfluous products to fight international competition, but is mainly associated with the need for survival. Another aspect which emerged from the literature survey, is that there are informal design methodologies being used in the creation or adaptation of both capital goods and consumer goods. These methods are mainly based on common sense. It also became evident that there are a number of constraints impeding the development of informal design. One of the major constraints is the definition of design and the designer. If one uses the yard stick of professional design and compares the products designed by the poor with the glossy photographs of professional design magazines, then it will be clear that very little design exists at this level. However, in the case of millions of microenterprises in the informal sector, there is little time for such narcissistic formal delirium, although aesthetic factors must be considered, independently of the purse of the buyer. Thus, the first step to removing existing obstacles is the recognition of this innate capacity by support organisms.

However, this is no easy task, as most research in R&D bodies and universities are biased, and benefit producers with more resources or larger and technologically more advanced firms. In general the personnel working in such institutions come from the country's élite and mirror their values and practices. There have been some attempts in different countries to address innovation by the poor entrepreneur, but the scale of the problem casts doubt on the ability (or will) of existing design institutions, as they stand today, to tackle this task. In general, design teams working in state run bodies have addressed the problem from an outside perspective, products would be designed for 'them' (the poor) when the government institutions provide the finance. The impact of the work of such institutions on the poor has been minimal and has served mainly as an illustration of what could be done. Considering professional design as the only alternative will limit the potential of design interventions in such a context.

Product design capacity in microenterprises is related, among other things, to the intense competition they suffer, not only from enterprises within the informal sector, but also from larger firms operating in the formal industrial sector. Although creating new products or redesigning existing ones is part of their 'technological response' to a competitive environment, lack of product variety is still a major problem for microenterprises. This brings saturation and stagnation in a given market. Thus, there is a case for stimulating and supporting the development of this capacity (King and Abuodha 1991, Gamser and Almond 1989, Male 1993). Recognising informal innovators' design capacity will enhance their access to much needed technical information and other resources. (Gamser, Appleton and Carter 1990).

The constraints mentioned above (cf. 3.4.), can, on the one hand, limit the creation of new, or the redesign of existing, products because they have direct influence on their quality and marketability. However, on the other hand, these limitations can stimulate design activity as was shown by the case studies conducted in Tanzania, Nigeria, India and Kenya (Nkonoki 1990, Chukwujekwu 1992, Sethuraman 1992, Kabecha 1994). Such innovative activity is concentrated mainly on consumer goods. The explanation for this might be that, from a technological point of view, this is easier than the design or adaptation of capital goods. In addition, consumer goods are more marketable than machines and production equipment.

Non-professional design is carried out mainly by entrepreneurs, their workers and other isolated individuals. The type of design output is mainly related to incremental modifications on existing technology. However, depending on the context, these innovations might be quite radical. For example, in a situation where a hoe is the main implement used in agriculture, the introduction of animal drawn mechanised equipment might be seen as a revolutionary step, affecting not only agricultural output, but also social relations. Products aimed at the poor population are in general very different from the ones produced for higher income groups. Because they use simple technology and waste raw materials, their finish, compared to mass produced goods, is of a different quality. Although this makes them more accessible to the poor consumer, it is no justification for bad design. In fact, design can be a powerful tool for maximising the existing production infrastructure because it can provide alternative uses for otherwise idle equipment. Quality, as much of the recent innovation literature states, is not only related to the physical aspects of hardware and this is where design can make a difference.

Another pattern which emerged from the literature is that many microenterprises produce a variety of products which are not directly related to the main activity of the firm. Such products sometimes change on a monthly basis (Mitchell 1980). This appears to be related to competition and works as a safety net in case of lack of demand for the main product. It was found that design is necessary at all levels of manufacturing within small enterprises, although as the enterprise develops, the need for design input might be reduced and process become more important. The sources of design also vary. They can be straightforward copies of existing products, adaptations to suit existing technology or new creations. Again, these vary from country to country, depending on the level of industrialisation and isolation of the market. For example in more industrialised NICs like Brazil, there is considerable information transmitted by the media and availability of products in the market, which can be a source of ideas to the microentrepreneur. In other countries microentrepreneurs can be much more isolated.

One aspect became clear from the literature. Human factors in design are very rarely consciously addressed. Aspects related to the human interface with the product are, in general, treated as a consequence of the function of the technology, so that when the technical problem has been solved, it is assumed that human-product factors will have been resolved. These factors are not considered as a technical problem which has to be dealt as an integral part of the design being generated. This practice can bring problems such as the rejection of the product for simple reasons, like difficulties of operation due to small size of components, difficulty of access for maintenance, and confusing operating instructions such as positioning of control knobs.

One point worth mentioning is related to the cost of development. In general the innovating entrepreneurs do not treat the costs of development as a separate item and the client understands that this is part of the product he is buying, even if the product is designed from scratch. This appears to be related to the fear that if the entrepreneur charges for the development of the idea the client will not accept this. Because the entrepreneur is generally short of money, a compromise is made and the development time is included in the overall price.

In relation to the method used to design a product, it is clear that drawing skills are little used. Three dimensional means of representation are much more widely used, involving a trial-and-error procedure, where a prototype is constructed and modifications are conducted on the product while testing it. Occasionally time scales are used. Some times the product is sold to the clients and, after using it for a period of time, they will come back with suggestions which will then be incorporated by the manufacturer in a latter version of the product. Thus, the development process occurs as part of a close relationship, between client and entrepreneur who in a certain sense share the costs. Such behaviour is linked to the need for the entrepreneur to obtain the quickest possible return on investment in raw materials. For small production units, cash is crucial because it will finance the next job and might mean food for the present week. For the client, it will mean a much cheaper product than the mass produced alternative — and in the case of capital goods this means substantial gains.

Important information about design capacity and marketing in microenterprises emerges from the case study of Clafer Manufacturing (cf. 3.5.). The first aspect is the obvious creative ability of the owner to generate concepts which are acceptable by users, although she had no training in design or crafts. She is aware of the importance of the quality of the product because she knows that the customer cares about that, and that this is an important competitive advantage in a market which is characterised by the poor quality of goods. She is very intelligent and makes the best use of observation in order to find ideas for her product, undertakes informal market research which is limited by the shortages of resources of her firm. She does not limit herself to observing one type of product, but looks at other products which are linked, even if peripherally, to her business, to extract ideas, as she knows that those products by larger competitors, are selling well. Thus she will minimise risk in product development by going directly to the most potentially marketable product.

She then manages to amalgamate all the information collected and attempts to generate concepts which are evaluated and discarded after analysis. In this process she involves consumers, family and workers who have the necessary experience in production and who can pinpoint ways of cutting costs in manufacture. She constructs models and prototypes to determine possible mistakes before producing in quantity and thus reduces risks and unnecessary costs. It is also interesting to note that this creative activity occurs in her personal leisure time, and is not an activity integrated with the business. This appears to be a pattern in design activity in microenterprise and is related to lack of time, and to the perception that the 'creative' side of a manufacturing business is almost a luxury which has to be addressed when spare time is available. The case study also illustrates the change from design-intensive to process-intensive as the products become more standardised. In this case, in-house mechanical engineering skills and tool making abilities made a difference in speeding up production to fulfil existing demand.

Entrepreneurs are only partially aware of market needs but their exploration of market potential is limited by their isolation and lack of funds. However they constantly scan the market for opportunities to sell. Competition is rife and there might be stagnation in some product categories. So very small firms depend on small, localised markets, such as neighbourhoods or isolated rural areas. This allows a close relationship with the user in the design process but limits the potential for expanding the market because these users, in many instances, are as poor as the entrepreneurs themselves. If there is to be market expansion, wider information on user requirements in other markets will be necessary and external help might be required.

One major point related to design at this level is the diffusion of the technology or products created. The role of the entrepreneur is of crucial importance and must be recognised by support institutions. When diffusing design ideas generated in formal R&D establishments or from development agencies, the entrepreneur is the key element in carrying the idea forward. It is relatively easy to generate concepts in the laboratory of a research institution but quite another matter to 'deliver the goods'. Thus direct co-operation with business is necessary in all stages of product development. The important thing is to develop the technology in collaboration with businesses which have an interest in making a profit with that technology. However, as Harper (1983:11-2) puts it, there are difficulties in this relationship in appropriate technology projects

> [...] The entrepreneur, who dares to admit that his intention is first to make a profit and only incidentally to use or to sell a socially appropriate piece of equipment, is all too often mistrusted, rather then regarded as the unsung hero of development. In this, as in so many cases, he or she employs people, saves imports or generates exports, uses local materials and otherwise epitomizes successful development. [...] Simple agricultural tools have been widely manufactured and sold in the Philippines and elsewhere, because their designers worked with local entrepreneurs from the outset, and devolved responsibility for the later stages of development and manufacture to these enterprises as soon as possible.

Thus more research is needed to understand what goes on at micro-level if design in microenterprises is to develop. The role of training will be particularly important if this capacity is to develop, but alternative schemes to the existing training programmes will have to be considered. Emphasis should be given to training and education for self-employment (King 1990:105). Special attention should also be paid to the role of women entrepreneurs as they play a significant part in the informal sector in LIEs.

# Chapter IV

# Methodology Employed to Collect the Evidence for the Case Studies in Northeast Brazil

## 4.1 Introduction

This chapter presents the reasons for the choice of location of the field study, gives a brief introduction to the process of industrialisation of the North-eastern region of Brazil and explain the research strategy used to collect the empirical evidence.

## 4.2 Reasons for Choosing Northeast Brazil, Paraíba State, and the City of Campina Grande as the Location to Conduct the Field Study.

The North-eastern region of Brazil (Figure 15.) encompasses nine states and has a population of over 42 million people. It occupies an immense area of land which is larger than Portugal, Spain and Italy put together (Mitchell 1981:1-9) In this region live some of the poorest people in the Western world with a per capita income which is half the national average and, in relation to other regions of the country, income distribution in the NE is the worst. The wealthiest 5 per cent get 42 per cent of the total income while the poorest 40 per cent get only 8 per cent (Branford 1993: 3) Today 17 of the 32 million indigents, or 55% of the destitute in Brazil, live in the Northeast of the country. In States like Paraíba, Ceará, Piauí, Alagoas and Bahia over 32% of their population live in extreme poverty (Arraes 1994:3).

**Regions of Brazil**

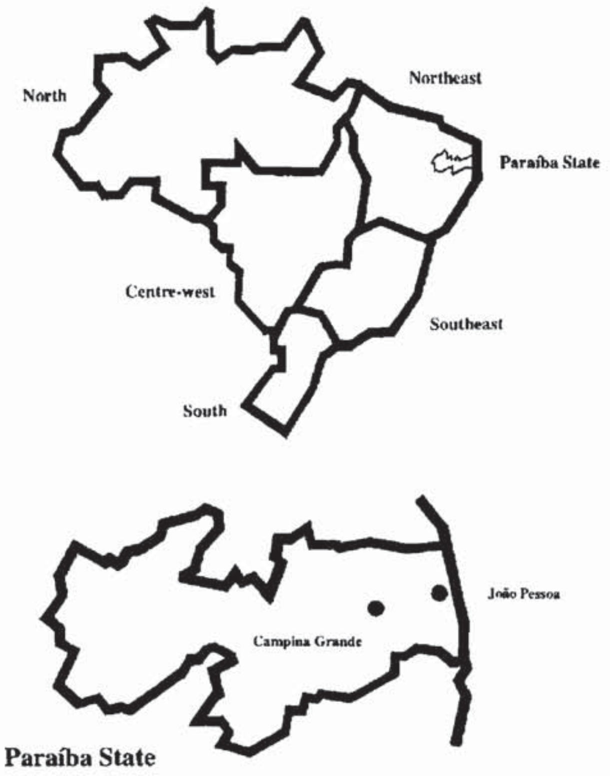


Figure 15. The North-eastern region of Brazil encompasses nine states and has a population of over 42 million people.

There are a number of causes of such poverty: the region's tendency to periodic drought; the economic importance of sugar and pastoralism, and the relationship of such activities with large areas of land and the inefficient use of land; the 'low proportion of the economically active population'; the lack of investment in education and health and Federal government policies which give priorities to the South-eastern region at the expense of the NE (Dickenson 1978: 189).

Although there is very fertile land in the North-east, such as the coastal *zona da mata* (forest zone) a densely populated area used mainly for sugar cane production, and the fertile *agreste* sub-region, 53 per cent of the NE is situated in the *semi-árido* (semi arid) area. The *semi-árido* is an area inhabited by 13 million people, 36,20 per cent of the Northeast population. Paraíba state, where the surveys were conducted, has 77 per cent of its territory in this area. The population of the semi-arído is mostly rural and works mainly in agriculture and cattle breeding. The area is frequently hit by drought and has a high level of migration, with thousands of peasants frequently migrating to other regions of the country. Both drought and the land structure, which is highly concentrated, are responsible for the migratory flux. Small producers represent 91% of rural production units (UFPB 1994).

## 4.3. Industrialisation of the Northeast

Extraction of dyewood and sugar production was the main activity developed by the Portuguese during colonial domination. The NE was the first region of Brazil to be economically exploited. Sugar was produced in the *zona da mata* and was mainly an export product. In the interior, extensive pastoralism predominated, mainly for the production of leather and meat. Cotton became important in the interior from the eighteenth century. Although in the 19th century the NE was in an advantageous position in terms of industry compared to other regions, this importance decreased in relation to the Southeast due to the gold boom in the 18th century and coffee production at a later date. (Dickenson 1978: 186)

Another distinctive characteristic of the region's industry is the great dependence on consumer industries which rely mainly on the processing of local vegetable natural resources. Diversification came at a later stage and varied through the region. Growth in dynamic industries benefited mainly three states, Pernambuco, Bahia and Ceará. In 1970 such states were responsible for 87 per cent of employment in the region, in engineering, electrical and vehicles industries. Manufacturing is mainly concentrated in the capital of the states, Recife, Salvador and Fortaleza (Dickenson 1978: 187).

In other areas of the region, industry is mainly small scale and concentrates on the supply of food, clothes and shelter. In the interior there is little industry, industrial activity being mainly related to the processing of local materials to fulfil local demand. This is done mainly by craftsman and artisans. There are two kinds of small artisanal industries. One fulfils local subsistence demands by producing crude sugar, dried meat etc., and the other makes craft based products based on local materials, tradition and skills, including, natural fiber products, embroidery and metal work (Dickenson 1978: 188).

It was during the government of President Juscelino Kubistschek (1956-1960) that the development of Brazilian industry really took off. Industrial production grew 80 per cent during this period. Important infrastructure projects, the interiorization of the country's capital and the establishment of basic industries, such as the automobile industry, modernised the country (Editora Abril 1992: 94). However, this development was highly concentrated. It was general believed by the Kubistschek Government, that it was possible to develop the country from a 'dynamic centre', in this case the state of São Paulo in the Southeast region. The development of this centre would subsequently influence and develop other regions of the country. Such a vision led to massive public investment and the development of both national and foreign industries. This policy resulted in the Southeast having a considerable economic development to the detriment of the other regions and led to an unbalanced concentration of wealth. Between the different regions of the country there occurred a process similar to the international division of labour, where industrial economies export expensive manufactured goods and the less developed nations produce cash crops and raw materials which are sold at lower prices. As Brum (1991:111) points out, the Southeast region, particularly São Paulo state was becoming highly industrialised and the rest of the country was becoming a producer of primary goods. As in the international division of labour, internal exchanges also maintained differences in prices. Industry in the second half of the 1950s for the first time took over from agriculture as the most important wealth producer in the country. The industrialisation process intensified the concentration in the Southeast and a redefinition of regional work and production emerged. Such injustice generated protests and by the end of the 1950s a number of regional agencies, among them the Superintendência do Desenvolvimento do Nordeste (SUDENE), were created (Brum 1991:112,113).

The creation of SUDENE in 1958 marked an important step in the Northeast's industrialisation. The aim of this regional development agency was to industrialise the region. In its First Plan (1961-3) it intended to establish a steelworks, a synthetic rubber factory using alcohol extracted from sugar cane, upgrade the textile industries and upgrade artisanal industries (Dickenson 1978: 190). Although there was a radical change and diversification in the industrial infrastructure, relatively few jobs were created. Development was concentrated in some parts of the region and most of the resources went to Pernambuco, Bahia and Ceará. These states had not only half of the Northeast workforce but attracted the most dynamic industries.

In this study I decided to focus the investigation on the North-eastern region of Brazil because it was the poorest region in the country, and possessed a similar level of industrialisation to other countries in Latin America and other LIEs in the world. I also have been living in the region since 1982.

Within the NE Brazil the study focused on Campina Grande. Campina Grande is situated 130 km from João Pessoa, the capital of the state. It is the second most important city of Paraíba and has a population of 340,000. It is 130 years old and is strategically located at the confluence of three important North-eastern states — Pernambuco, Ceará and Rio Grande do Norte. The municipality of Campina Grande exerts great influence over 57 neighbouring municipalities.

Economic activity in the city is concentrated in the services sector. Campina Grande has also a relatively large industrial infrastructure, totalling 939 industrial units (FIEP 1992). Among the most important industries are leather processing, shoe manufacturing, ready-made articles, mining and metal manufacturing (Lima 1991). In recent years, due to the support of the Technology Park of Paraíba (Parque Tecnológico da Paraíba), a small number of technology based industries has emerged, operating in areas such as fine chemistry, biotechnology and computer software.

Campina Grande is well known, at regional and national level, for the innovative behaviour of its population, particularly in metal manufacturing. The origin of this behaviour is attributed by some to economic difficulties which occurred in the 1920s. At that time, the main employers in the municipality were cotton processing industries which relied on foreign equipment. Lack of spare parts for imported machinery forced these industries to lay-off thousands of workers who, in their struggle for survival, were forced to improvise alternative machines to be able to remove the seeds from the cotton. At a later date, German expatriates fleeing the Second World War arrived in the city, set up the first foundry and trained the first mechanics (Bittencourt 1990:16-8). The city has always been linked with commercial activity as it supplied food and goods to the interior of a number of states in the North east. Since the end of the 18th century Campina Grande has been an important entrepôt between the smaller towns in the interior and the coast line.

Campina Grande's growth is also associated with the cotton industry, which in the 1950s rivalled Liverpool as one of the principal exchange markets for cotton. The growth in commercial activity was also due to the fact that trucks which transported cotton from the interior of the state to Campina Grande, and which previously returned empty to their places of origin, were now being filled with goods to be sold in these locations. This commercial activity led to the creation of the first Goods Stock Exchange (Bolsa de Mercadorias) of the Northeast and Northern regions of Brazil. Due to the number of trucks and the demand for technicians to repair and maintain them, auto mechanics concentrated in the city. From this demand in specialised knowledge emerged the first Polytechnic School. Today there are two main universities in the city, the Universidade Federal da Paraíba and the Universidade Estadual da Paraíba (Cardoso 1992:37-40).

During the 1960s and 1970s, with investment from the Federal Government, there was a boom in the city's industrial structure, particularly in metal manufacturing industries. But subsequently these industries gradually began to close down and the result was economic hardship and high unemployment which affected mainly the low income population. These economic difficulties and the fact that Campina Grande is situated in the NE region make it difficult for the poorest families to have access to goods available in other regions of the country. As in other urban areas, this situation has created an informal economy in which small entrepreneurs and craftsman manufacture the products that the majority of the population, which is poor, need to fulfil basic needs. Without these products the poor population would have no other alternatives as the prices of most mass produced goods are out of their reach.

## 4.4. Methodology Employed to Collect the Evidence

The research strategy was divided into three main stages and used mixed research methods. The first stage was an exploratory survey aimed at identifying the products accessible to the low income population in this particular context, their characteristics, who produces them and which industrial sector is most important in their manufacture. The second stage consisted of a survey of light engineering, small metal manufacturing firms. A number of case studies were selected from this survey. The aim of this stage was to produce an overview of the metal manufacturing sector and to identify if design capability existed at microenterprise level. If it existed, how did this capability manifest itself? Who designed these products and what design process was used? The third stage was subdivided into two: a) a case study with a particular group of users aimed at identifying reactions to the introduction of new or improved products specifically designed for the low income population; b) direct involvement with the low income community to explore their response to the introduction of design concepts and to verify to what extent participatory work in design was feasible.

### 4.4.1. Stage 1: Exploratory Survey of Products Available to the Low Income Population

Due to the lack of information available on product design for the low income population in the North-east, it was considered necessary to conduct an exploratory survey aimed at identifying the main existing products consumed by the low income population, which are available in the local market, and to analyse their characteristics. Due to constraints of time and resources the characteristics had to be observed directly, and information was collected on: type of product; level of technology employed in production; and material used in manufacture. I decided to use ethnographic non-participant observation survey methods which would allow me, within the restricted time available, to identify those aspects I considered relevant to my study. Non-participant observation techniques appeared to be appropriate in this case because as Kabecha (1994) points out

> Observation is a primary tool of scientific inquiry, used whenever a phenomenon can be observed directly by the researcher. It may serve a variety of research purposes. It may be used to gain exploratory insights that will later be tested by other techniques; to gather supplementary data that may qualify or help to interpret findings already obtained by other techniques; or as the primary method of data collection in studies designed to provide accurate descriptions of situations or to test causal hypothesis.
>
> Observational methods are however not effective in gathering information about a person's perceptions, motivations or future plans; and certainly they provide no information about past behaviour. Further, entry of an observer may introduce another variable into the situation that may change the behaviour being observed.

This exploratory survey would be conducted in the main market of Campina Grande, the *Feira Central* (Central Free Market). The *Feira Central* is located in the city centre and is spread around the Central Market which was constructed in 1925. It is one of the biggest open markets in the North-eastern region, being rivalled only by the *Feira de Caruaru* (Caruaru Free Market) located at the city of Caruaru, Pernambuco State, two hours by bus from Campina Grande. The *Feira Central* is composed of a mixture of stalls and shops selling a plethora of different goods. The market operates three days a week, Saturday being the busiest day. People come from a number of smaller cities to shop and to sell their produces, which can be agricultural products or consumer goods.

A direct observational survey started in August 1991 with a number of visits to the Central Free Market. These visits gave me a general impression of the situation and provided me with some basic information which proved crucial to the planning of the subsequent stages in the research strategy. Notes and sketches were used to record existing products and contacts were made with people involved in commercial activity in the market. This preliminary process was followed by a number of other visits conducted in 1993, when photographs and video tape were also used to record information. I also made contact with one of the shopkeepers in the Free Market who was very helpful in providing me with general information about the context, showing me products sold in the shop and, more importantly, giving me some other contacts with manufacturers of products sold in the market. These subsequent contacts also provided me with information about the constraints and difficulties encountered by small entrepreneurs.

As part of my plan for the first stage of the research I included informal methods such as speaking to people who were selling in the stalls. Informal methods were used due to constraints related to time and finance and because I considered them the main tool in obtaining information in such context. As Nichols points out,

> Informal methods are often chosen when time and money are short. They give a rapid 'feel' for a problem. But they are also essential in exploring community attitudes and priorities and when dealing with sensitive topics in depth. They can give a rich understanding of community life, and help to set up a dialogue between planners and the community (Nichols 1991:16).

It is important to use a combination of methods in a research project because this allows information collected in a variety of ways to be cross-checked later. (Ibid. p.18)

The main objective at this stage was to observe the existing products; and to undertake a superficial analysis of them in terms of the quality and material employed; and then to categorise them. I also decided to shop for some products because buying goods was a useful introductory technique, which allowed me to start a conversation with the seller and gather information. Another informal method was to walk around the Feira and go into some workshops at random and, after gaining the trust of the entrepreneur, observe how they worked, what techniques they used, their working environment etc. I also decided to use simple language to communicate with the subject and, whenever possible, not to introduce my self as a researcher from the university, since the local population in the city had a rather negative attitude to academia.

### 4.4.2. Stage 2: Survey of Metal Manufacturing Firms and Selected Case Studies

### 4.4.3. Survey of Metal Manufacturing Firms

To obtain an overview of the metal manufacturing sector, the best alternative was to use the case study method as this allows the researcher a deep investigation of a specific problem within a relatively short time frame. This method is particularly suitable for my research because it permits the investigator to focus on a particular instance or circumstance, 'or to attempt to identify, the various interactive processes at work' (Bell 1992:6). As Bell points, out,

> [...] These processes may remain hidden in a large scale survey but may be crucial to the success or failure of systems or organisations. (Bell 1992:6)

Although there are criticisms of the method, mainly in relation to its generalisability, Bassey, using an example related to education, argues that

> [...] an important criterion for judging the merit of a case study is the extent to which the details are sufficient and appropriate for a teacher working in a similar situation to relate his decision making to that described in the case study. The relatability of a case study, is more important than its generalisability (Bassey 1981:85).

A preliminary survey was to be conducted in order to obtain the necessary information which would allow me to establish patterns and allow comparisons between the existing firms. The methodology used in the survey would be based on existing studies. For example, Jeffrey and Hunt had conducted a similar survey focusing in small manufacturing enterprises in the Scottish context (Jeffrey and Hunt 1985: 18-23).

Due to the relatively short time frame and limited resources, I decided to identify a particular industrial sector which was important in the region's economy and which possessed certain characteristics such as; it used different technologies; it adapted and developed technologies; it had the potential for growth; it was linked commercially to other industrial sectors e.g. through the acquisition of raw materials or the supply of goods to other industrial sectors. It appeared that metal manufacture encompasses most of these basic characteristics and that research in such a sector could provide information on which recommendations could be made for improving existing practice, and which would be relevant for other industrial sectors.

One of the factors which influences the process of industrial development and which has been neglected in the development literature, is the role of light engineering in developing countries (Smillie 1991:165). The importance of firms operating in the light engineering sector cannot be underestimated. In metal manufacturing, light engineering firms provide, the necessary infrastructure for the repair and maintenance of machinery and equipment produced by the capital goods sector. They are also responsible for producing a considerable number of consumer goods used by the low income population, as most of the firms operating in this sector are small enterprises. Metalworking activities involve the manufacturing of capital and consumer goods and the knowledge of a number of skills which can be used in other industrial sectors of the economy (Kabecha 1994).

In the urban areas of LIEs metal manufacturing units are spread throughout cities, but they also operate in clusters, in industrial districts. The infrastructure of these districts varies according to the location, but, in general, they receive very little support from government or private agencies. Although there are firms working in the formal sector, the majority operate in the informal sector.

The metal manufacturing firms are mainly composed of tinsmiths, blacksmiths and metal fabricators. These firms are extremely important in the informal sector. A study carried out in 1989, for the United States Agency for International Development (US-AID), revealed that ...'in terms of product value, the aggregate output of the informal metal work enterprises probably leads all other producing informal subsectors except tailoring' (Smillie 1991:170).

### 4.4.4. Reasons for Studying the Metal Manufacturing Sector in Campina Grande, Paraíba State

The decision to study the metal manufacturing sector in the state of Paraíba in Northeast Brazil was taken based on the reasons described above and due to the number of such enterprises operating in the state. According to the Paraíba State Industries Federation (Federação de Indústrias do Estado da Paraíba) there were 205 industries involved in metal manufacturing in the industry in 1992 (FIEP 1992:291). The plan was to survey 30 small firms in Campina Grande varying in size, from 1 to 40 employees, (the sample represented over 10 per cent of the total metal manufacturing sector).

These firms would be contacted by mail to explore the possibility of conducting the interviews. A list of topics for a semi-structured interview was prepared. Semi-structured interviews were chosen because they allow a certain level of control over the topic and direction of the interview, without ruling out a possible contribution from the respondent. It was also decided that the interviews should be tape recorded as this would allow more freedom during the interview and it created a more relaxed atmosphere. Tape recording also allows a greater level of detail to be registered. However tape recording requires additional work in the transcription of tapes and captures unimportant information. There are also other negative points such as inhibition of the subject, problems of confidentiality and so on. The interviewees were entrepreneurs and persons involved with product design.

I anticipated no reply to any of the letters sent, because many of the entrepreneurs are semi-illiterate, it is relatively expensive to send an overseas letter and they might have difficulties in understanding the objective of the research. As a contingency measure I decided that once I arrived in Brazil I would contact the entrepreneurs in person or by phone. I also decided to contact additional enterprises because, since the addresses were taken from the 1992 Industrial Register, some enterprises might have gone out of business or changed site. The topics discussed in the interview were concerned mainly with the existing infrastructure and the design capability of the firms (See Appendice I for questions).

### 4.4.5. Issues Related to Firms Operating in the Metal Manufacturing Sector

The aim of this section was to produce a clear idea of how firms were organised, from a management and production perspective, and to understand how they operated within this competitive environment. This included a number of issues.

### 4.4.6. Size of the Firm's Workforce

This was an attempt to understand the composition of the sector in relation to the size of the firm's workforce and whether the size of the firm had any connection with it's innovative capability. It was expected that larger firms with more resources and better access to information would be more innovative and also employ professional designers. Information related to the competition and communication between entrepreneurs and the market was also sought.

### 4.4.7. Products Manufactured by Each Production Unit

This sought to identify what kind of products were being produced and in what quantity? To what extent the firms were creating or copying the products they were manufacturing? Did the size of the firm meant that they manufactured more original products or copied them? Were they producing only one type or different types of products?

### 4.4.8. Type of Working Practice

This was to identify what type of working practices are common in the sector. Did they work to order or run a production line and stock products? Why was this practice the most common practice in the firms? Was the size of the firm related to the working practice?

### 4.4.9. Type of Production Equipment Used by Firms

This was an attempt to identify the level of technology used in the sector. It was assumed that this level of technology might be a limitation in terms of the innovative capability, because the type of production equipment can have direct implications for the design of products and limit them in terms of form or in other aspects of design.

### 4.4.10. Support Available and Used by the Firm,

This was an attempt to identify to what extent the firms in the sector were using existing support mechanisms for innovation and, if not, why not.

### 4.4.11. Relationship Between Firms and Academic Institutions and Enterprise Support Bodies

This aimed to identify whether any relationship existed between academic institutions, the two existing universities, particularly the Centre for Science and Technology of the Federal University of Paraíba, and the metal manufacturing sector. There are also a number of research institutions which could be involved with the enterprises.

### 4.4.12 Firms' Design Capacity

The second set of questions was aimed at obtaining evidence related to the existence or non-existence of innovative behaviour within this specific industrial sector.

### 4.4.13. Evidence of Innovative Behaviour

This sought to find evidence of innovative behaviour. If so, what category of innovative behaviour? Was it related to product or process design? In the case of product design was it related to production equipment or to consumer goods, or both? It was also of fundamental importance to identify how the entrepreneurs perceive the activity of design, because the terminology used is confusing. For example, in Brazil 'Desenhista Industrial' has been used for many years to mean a mechanical draughtsman, and it is only in the past thirty years that 'Desenhista Industrial' has been associated with the activity of industrial design, as in England. Even so, in Brazil, the term encompasses all the activities related to three-dimensional design without the differentiation used in the UK.

### 4.4.14. The Process of Design

Another important aspect taken into consideration when designing the interview was to establish how, if there was design activity, the design process was conducted and who was involved in it. It was assumed that the design was copied or produced mainly by the entrepreneurs themselves without any outside intervention. If so, did the entrepreneurs use structured methods when designing or were their methods informal?

### 4.4.15. Training and Previous Experience in Relation to Innovative Behaviour

This was an attempt to verify the level of training and education of entrepreneurs in the sector and if this had any influence on their innovative capability. It was assumed that the level of education and training would influence their potential design capability.

## 4.5. Stage 3: Case Study of the Introduction of a Product in this Particular Context; a) Washing Machine b) Presentation and Workshop at Neighbourhood Association.

### 4.5.1. Washing Machine

### 4.5.2. Introduction

The objective of this case study was to collect information about low income users' behaviour, their perceptions and characteristics; to identify potential constraints related to the introduction of new or improved products aimed at the low income population; to establish the connection between such products and small and microenterprises operating in the light engineering sector. The information produced would be used in the design of a training programme aimed at enhancing or creating design capability in microenterprises. A secondary objective was to produce information which could be used in the production of a handbook on the construction of a product which could simultaneously benefit the low income population and the small manufacturers

An ethnographic method of field study was planned to investigate this particular group. In the field work, after being accepted and having a partial integration with the group, I planned to use participant observation and Participatory Technology Development (PTD) techniques. PTD has mainly been used in agricultural programmes where the fundamental notion was that:

> [...] any innovation from the outside should build on existing indigenous knowledge wherever possible. Generally solutions are looked for and possible, that are "not far away" from what people know (van deer Bliek 1993:35)

Some of the concepts used in PTD could be applied specifically to industrial design, by involving the target group in the process of determining the final configuration of the design (user involvement). My assumption was that involving the user in this experimental process, would help to develop the target group's design awareness and lead to a group approach to the generation of other ideas which could improve their daily life.

Using such methods would allow me to share daily experiences with the subjects under study and to understand their behaviour as a group. In a first trip to Brazil, I would spend 250 hours with the group in the preliminary part of the field work, accompanied by a research assistant. After I left Brazil my research helper would spent around 300 hours going to the wash house, a minimum of 5 hours per week until September 1995.

### 4.5.3. The Context

As a source of income, poor women who have no other skills, are compelled to sell their labour performing different domestic tasks, including, cooking, child care and cleaning. One of the tasks which requires little training or skill is washing clothes. Previous contacts with the washer women, showed that for these workers this occupation is their only means of survival. Some of them have been washing for over thirty years, and their working day normally exceeds 8 hours. Besides the washing, they also have to iron and transport the wash load, normally weighting 12 to 13 kg, to their clients' houses. Talking informally to some of the washer women, I discovered that they survived on very low wages (approximately US$200 monthly family income), with very poor conditions of service: there was no official working register, little medical assistance and few of the women have any prospect of a pension. These 'lavadeiras' (laundresses), work in 10 municipal wash houses spread throughout Campina Grande. This is an occupation which relies, mainly, on their physical capability and as they grow older and are not able to work, there will be little alternatives for survival. Their work is done by hand in the most precarious way on the banks of streams and rivers or dams, using simple equipment such as washing basins and concrete tanks with ridged surfaces. The clients' wash load is very heavy and besides this load, they have their own family washing to do, with generally a large number of people in the family. In Brazil, as in many other countries this kind of work is only done by women and is added to a series of daily household tasks. This happens in both urban and rural areas. Electric machines are available but too expensive for these women since the 'National Minimum Wage' is on average US$100.00 a month. The cost of the simplest machine available in the market is around US$200.00. Credit is seldom available because they have no collateral to offer and no registered employment.

### 4.5.4. Collection of Evidence for Stage 2

The case study was divided into two parts;

- **Software**: The relationship between the women and the product; between the women and the external agencies, i.e. the authorities responsible for the washing places; and between the women themselves.
- **Hardware:** The construction of prototypes, and technical tests.

### 4.5.5. Stages in the Plan:

### 4.5.6. Introductory Stage

I had previously maintained contact with the Secretary of Work and Social Welfare (Secretaria de Trabalho e Bem Estar Social - SETRABES), the institution responsible for the wash houses, before coming to the UK, as part of the design work conducted with an earlier version of the washing machine. As people in the managerial position at municipal institutions change when political power changes, it was considered necessary to renew contacts with SETRABES. I had to clarify my objectives and gain the confidence of the authorities responsible for the control and management of the wash houses. This had to be done at a higher level through direct contact with the Municipal Secretary and hers assistants and, after their approval, with the civil servant responsible for the specific wash house where the case study would be conducted — there are different civil servants responsible for different wash houses.

After this contact was established and agreement reached with SETRABES, the plan was to set up a date with the civil servant and to go to the wash house and have an informal meeting with the women to explain my intentions. This informal meeting's objective was to gain a preliminary understanding of the context where the case study was going to be conducted, to meet the subjects of the research, acquaint my self and my research assistant with the women and to set up a new date for an official meeting with the group of women who work in the wash house. From this preliminary meeting I expected to collect information which I could use in the preparation of the subsequent meeting.

It was my intention in the 'official' meeting to introduce my self and the research assistant and to explain the objectives and the philosophy behind the research programme to the group, thus establishing initial links with the subjects. Having some knowledge about the characteristic of their profession, particularly about the disrespect society has for these workers (they are one of the worst paid workers in the city and are not recognised as skilled labourers), I tailored a presentation aimed at valuing their professional activity. The design of the presentation took into the consideration the informality of the environment and the educational level of the participants (assuming that they were mostly illiterate, semi-illiterate, or that the literate ones had not had the opportunity to attend school at higher levels). I also took into consideration the fact that meetings are normally set up after working hours and thus, preferably, should not last too long.

Based on such criteria, a set of slides related to the history of the washerwomen's work in different countries and the different types of equipment used by them in the past and present, was prepared. A small number of slides showing some picturesque aspects of the work in the past were selected, with the intention of 'breaking the ice' and creating an informal atmosphere between us. I also selected a number of slides showing some simple devices used in the past by UK washer women. My intention was to spark a discussion on whether some of these solutions could be adapted to their reality (for example the hook used to wring large sheets in the 17th century). In 1991 I had a meeting at Rosa Mística (Mystic Rose) wash house, one of the ten wash houses in the city, with a number of women and asked a group about suggestions for improving washing conditions. There was no reply and I decided to describe the 'hook' method. Immediately one of the women said that she had seen this process being used in Maranhão state (another North-eastern state) by people dying hammocks. So I asked her why they were not using this method in this wash house? She said that she could not remember why not. I suggested that they could do something like that in this wash house and received a positive response. The woman who had seen the technique in Maranhão said she had a piece of construction steel at home, which was perfect for the hook, and another women said that her husband, a construction worker, could fit it to the wall. In two days this technique was being used in the wash house. These devices were also presented on a cardboard panel which contained some prints of the slides and some other photographs related to washing.

The second part of the presentation was aimed at introducing the prototype of the washing machine to be tested. Technical aspects would only be mentioned superficially to reduce the risk of confusion because of the amount of information already being introduced. After the presentation, a discussion with the group was planned to stimulate their involvement and to verify to what extent the proposal was understood and if there were any points they wanted to raise.
As part of the plan, a female research assistant, was selected from the Industrial Design Course at Federal University of Paraíba. It was considered crucial to have a female assistant since she would be able to integrate in a positive way with the group. The fact that I was a man could create problems especially to do with privacy of the washer women and, if that occurred, the fact that my assistant was a female would be useful as a communication channel between my self and the women.

Good communication with the group was considered fundamental to the study, and I aimed at demystifying the image of the 'professor' (lecturer) from the university which is impregnated in the minds of the local population, due to the importance of the Federal University of Paraíba in the city. To do this my intention was to present the technology in the simplest possible way by using popular terms in examples related to technology, and even dress my self in such a way as to dispel the, negative image of the 'professor'.

### 4.5.7. Installation of the Prototype in the Wash House

My plan was to construct a prototype in the UK and start conducting a number of laboratory tests at Aston University's Mechanical and Electrical Engineering Department. The results which emerged would be used in the modifications of the prototype in the field. In Brazil, after the modifications were conducted, a date would be set and the prototype installed at the wash place.

Careful thought was given to this process. I planned to be present when the prototype arrived at the wash house because I wanted to register the first reaction of the subjects when they saw it. My intentions were to capture their first comments and the experience of the initial physical contact with the equipment and to establish a link with the leaders of the wash house. I assumed that such experience could have some influence and facilitate the tests at a later date. From this preliminary contact a series of tests would be programmed, initially involving the leadership and gradually involving other members of the group.

### 4.5.8. The Tests

I planned to arrive daily very early — 5.30 a.m. — to be able to measure the wash load of each participant. This meant separating the dry load of each participant in categories of clothes, and counting them before they started washing. It was also planned to measure the amount of soap, quantity and temperature of the water and the amount of clothes and time taken to wash each load. In the early days of the tests these records would be registered by me and the research assistant, but gradually it was planned that the women would take over these tasks. The research assistant, once I had returned to the UK, would monitor some tests and gradually leave the wash place to return once a week to collect the sheets with the data. This data would then be organised and sent to me in the UK.

Arriving early at the wash house had also other objectives. I wanted to gain the subjects' confidence by showing that I was really interested in them in a general way and not only in the tests, and to be able to have informal conversations with individual women and the group before the working day started. This conversation would be about personal issues and, occasionally, working issues. I assumed that using such an informal approach would allow me to identify problems within the wash house and information which might be useful in eliminating future problems when the tests occurred. Early arrival would also allow me to observe all the nuances in the washing process, including whether there were any technical innovations related to the process of washing designed by the women themselves, and to observe possible problems related to the physical environment and working relationship within the wash place.

As the tests proceeded, the plan was to provoke the subjects into being more active in relation to the design of the machine, particularly to the aspects related to human factors through the product/user interface. It was assumed, based on the observation of the products sold in the local market, that one of the most important factors related to design was the lack of human interaction with the product, i.e. ergonomics, which is one of the concerns of the industrial designer. These aspects might have been an important factor in the rejection of a product, particularly in this context. Together with form they are the most evident factors to the consumers, who perceive the product first by its external shape and then by manipulating it. Rarely will the consumer, for example, look into the composition of materials and into the details of the mechanical or electrical system. Based on these assumptions I decided to introduce the 'rough' prototype, test the mechanical pedal propulsion and continue the tests of a hybrid system in the UK. I assumed that the women themselves were capable of providing innovative solutions to the mechanical system but, because of time constraints, an attempt to intervene in the design of the mechanical system would be counter productive.

The tactic to be used consisted of occasionally asking the women if they were satisfied with the machine and if they had suggestions on what could be improved. Once they suggested something I would provoke them to propose a possible solution. Changes were also considered in the organisation of the wash place as it was assumed that the introduction of a new technology could lead to the re-evaluation of operational procedures in the wash house. For example, if the machine worked properly and there was an increase in demand for its use, what kind of arrangements would have to be made to allow most of the women to use the machine? Who should have the priority? Would the women have to radically change their ways of washing?

### 4.5.9. The Hardware

The product was aimed at minimising occupational health related diseases, relieving workers from heavy and time-consuming tasks and increasing the income of professional washerwomen. The product was designed taking into consideration the technological level and physical infrastructure of local small and microenterprises. The equipment could benefit women in the following groups:

- Families: the machine could be used collectively
- Paid washerwomen: group or individual washerwomen who are taking their clients wash load home to wash.
- Institutions; Nurseries, health centres, small firms, orphanages etc.

### 4.5.10. The Plan

Both prototypes would be designed and constructed based on the existing infrastructure of small workshops. Production equipment, would be manufactured from scrap materials and use the technology of the small enterprises, whose technical knowledge had been recorded in the informal visits to the workshops (e.g. alternative ways of producing housings, alternative use of plastics etc.). This was a deliberate attempt to prove to small manufacturers that the product was feasible and could be made using existing technology such as bicycle parts, PVC plastic tube for water proof parts etc.

I assumed that the existing mechanical system used in the machine, which was adapted from a mass produced system, would wash satisfactorily as it was a well proved system. I had decided to use pedal power as propulsion for the machine because there are many parts of the NE without electric supply and also because pedalling could bring health benefits to the women. I also considered designing a hybrid system which allowed the introduction of a motor at a later date.

The main adaptation would be concerned with the propulsion system and some parts of the mechanical system. The dimensions of the tub and of the agitation of the prototype constructed in the UK were taken from an existing washing machine.
The design of the machine also considered production process of the small firms producing goods for the building industry and construction accessories manufacturers. This information would be used in support programmes providing training to small and microentrepreneurs.

## 4.6. Design and the Community

### 4.61. Presentation and Workshop at a Neighbourhood Association

This stage was divided into two. The objective was to introduce the activity of industrial design to the community, to obtain feedback from the participants and, at a later date, to conduct a workshop where one of the products presented would be constructed by the community. This was based on the assumption that the community can make a number of products which will benefit the group without relying exclusively on manufacturing firms. It was an attempt to demystify design activity, to show that a number of products are not available but can be created and manufactured by the community. In a sense my proposal was an extension of what is already being done in architecture, not only in Brazil but in a number of other countries, where the communities have decided to design and construct their own houses independently of architects.

For example in some cities of Latin America many basic services are provided by the community. As de Soto (1989b:18) points out.

> [...] of all the housing in Lima in 1982, 42.6 per cent were informal settlements ...for every ten formal dwellings in the capital city, there are nine informal ones

However, little similar experience exists in relation to product design. A contact with one of the Neighbourhood Associations (Associações de Moradores) would be established and a meeting would be agreed for a slide presentation. Real products would also be presented at the meeting to illustrate what design was about and what kind of benefit it could bring to the community. My idea was to present some simple alternatives to people which would perhaps stimulate them to design for themselves. Future workshops on design and the construction of products by the community would be considered to ascertain what the reaction of the community would be to the introduction of such a new activity as design; what types of product would be chosen, and what criteria would be used by the community in choosing them.

The products selected for the presentation took into consideration simplicity of construction and of function. They were products used as teaching aids in literacy classes, toys and equipment for disabled children. They had been designed by my students as academic tasks and by myself as extension work. The idea was to discuss the product with the community and to select one of them to be manufactured in a future workshop.

### 4.6.2. Workshop at the Neighbourhood Association

The workshop would be open to anyone in the community, particularly women and children. The main points I wanted to investigate were: what problems, particularly personal problems would emerge when a team worked together to produce a product?; what would happen when the group was stimulated to participate in the definition of the production stages of the product?; Would the groups be able to work together and to produce the product?

The workshop would take around three hours, be conducted at a neighbourhood association and it was planned to stimulate work in teams and by enhancing community ties. Due to my time constraints and because people were not able to attend during the day, the idea was to conduct the workshop during the evening, on a working day. The plan was that, once the product was chosen, to introduce the basic manufacturing techniques for its construction and let the participants conduct the process with my occasional intervention. it was expected that the results of this workshop would produce information which could be used in future projects involving the low income user and in the training of small entrepreneurs.

I intended to invite one of my design students responsible for the design of the product selected by the community to come to the association and to participate in the workshop. Initially, we, myself the student and my research assistant, would introduce ourselves and then show step by step the design and production of the product. The student would bring his detailed project report, to show how a design project was conducted and thus stimulate the participants.

In a second stage, after the participants had made their comments and suggestions, waste material would be distributed to people and construction of the product would begin. My intentions were to let the work proceed and intervene when necessary to stimulate more participation or to provoke shifts in the speed and direction of the workshop if necessary. My previous experience suggested that lack of experience in manufacturing products could delay the work during the workshop.

# CHAPTER V

# Empirical Evidence I

## 5.1. Introduction

This chapter presents the empirical evidence collected in two surveys. Evidence is presented from the first survey conducted in the Central Market of Campina Grande. Subsequently, data from 28 semi-structured interviews conducted in firms operating in the metal manufacturing sector and seven case studies extracted from them is presented.

The majority of the population in Brazil live in poor conditions, deprived of the basic facilities which are taken for granted in industrialised countries or for the wealthier in developing countries. These people are compelled by circumstances to design, adapt and construct products which are otherwise inaccessible to them, due to, lack of money or because such products are not available in the market. These products encompass a wide variety of goods ranging from simple kerosene lamps to houses. They can be manufactured as a one-off in the case of a house or produced in small batches by micro-production units. This is the common practice in the North-eastern region of Brazil. The region is well known for the creativity of its population, especially through examples of products made from reused materials (Figure 16,17).

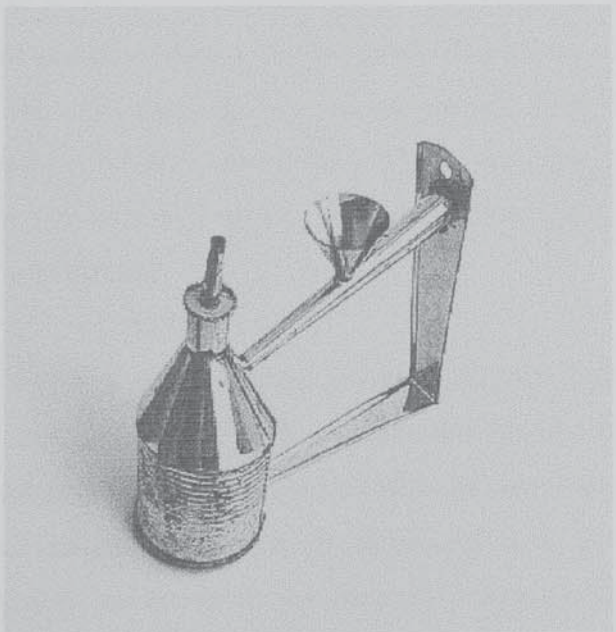

Figure 16. Kerosene lamps made from recycled cans.

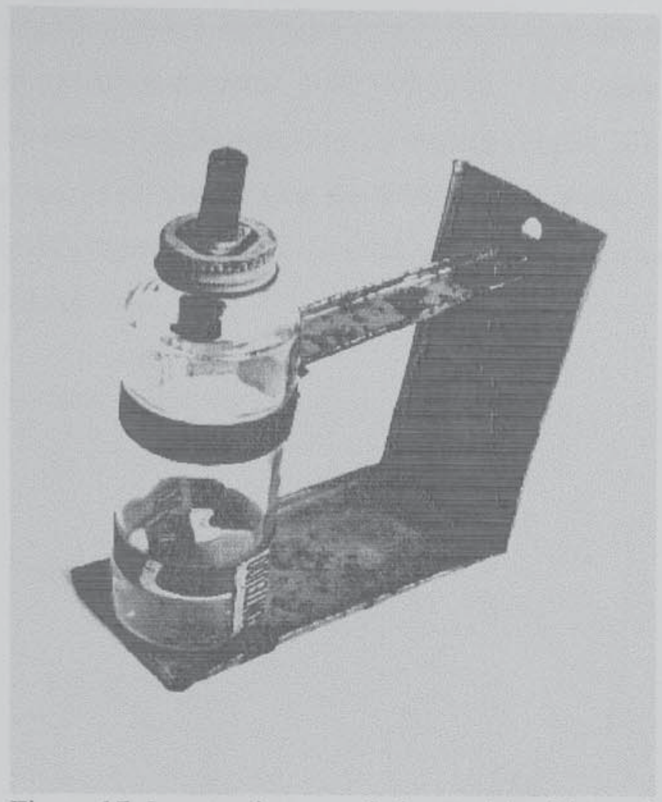

Figure 17. Lamp using recycled materials. The region is well known for the creativity of its population.

These are far more than decorative craft objects and provide a considerable part of the population, both in urban and rural areas, with every day products to fulfil their basic needs. They are designed and produced in artisan workshops and in small enterprises and are aimed particularly, but not exclusively, at the poorer consumer. The level of technology, management and the quality of products in these firms varies considerably. The example of kerosene lamps demonstrates a series of attempts to manufacture a product using simple technology, utilising whatever material is available. In this case, the products are made directly from discarded cans or using pieces cut from bigger cans used to pack butter, fat or paint, because, many producers cannot afford the price of raw materials. Thus in this region, as in many other parts of the world, improvisation and recycling are commonplace.

Because of the inability of the formal sector to generate employment for the majority of the population, and sometimes due to the low wages paid by the formal sector, a considerable number of people are setting up their own businesses in the informal sector. As pointed out in Chapter III, these businesses operate with many disadvantages such as unreliable production methods, problems with supply and access to raw materials and government policies which rarely benefit them. As in many other regions of the LIEs this can be extremely hard on small scale businesses, since entrepreneurs themselves play a significant part in the design and construction of their own factory equipment and machines (Gamser 1989:189-201). The needs of the community are diverse, varying from household appliances to transportation (Figure 18). This picture was taken in the state of Paraíba and shows that, despite the availability of motor cars and trucks, the poor population have to rely on primitive methods in order to fulfil their transport needs. These needs exist both in urban and rural areas.

Figure 18. Improvised method of transport in Paraíba State.

Figures 19 and 20 illustrate the difficulties encountered by the poor in rural areas. In the case of post harvest operations, in general, small rice producers cannot afford to buy complex machinery to de-husk rice, having to pay wealthy farmers to de-husk and polish it for them, so it can be sold commercially. If they have no financial resources, the only alternative is to use a mortar and pestle, a back-breaking device, heavy and slow to operate and producing a low quality output, as pounding breaks the rice grains and devalues the product. In some parts of the North-eastern region, if the machines owned by wealthy farmers are not available for some reason, e.g. maintenance, repairs, etc., small producers may have to stock the rice inside their houses and depending on the time this will take, they might loose all their produce due to insects. There are important non-technical factors that have to be taken into consideration when intervening at this level. Despite widespread poverty, producers informed me that the brown rice grains which are broken by pounding of the mortar and pestle are used to feed pigs because: 'people eat white rice'[1]. Another cultural aspect is the fact that, if there is a need to use the mortar and pestle, men will refuse to do it. Conventionally this operation is carried out by women, adding to the numerous daily tasks they have to perform. Thus, lack of financial resources or lack equipment or machinery appropriate to the size of small production means that primitive technology, which produces little output and is physically demanding, is still used in many rural and urban locations

Figure 19. Difficulties encountered by the poor in rural areas.
De-rusking rice using a pestle and mortar.

---

1 The rice has a brown colour because they have not passed through polishing, one of the post harvest operations. The main operations are, threshing, de-husking and polishing.

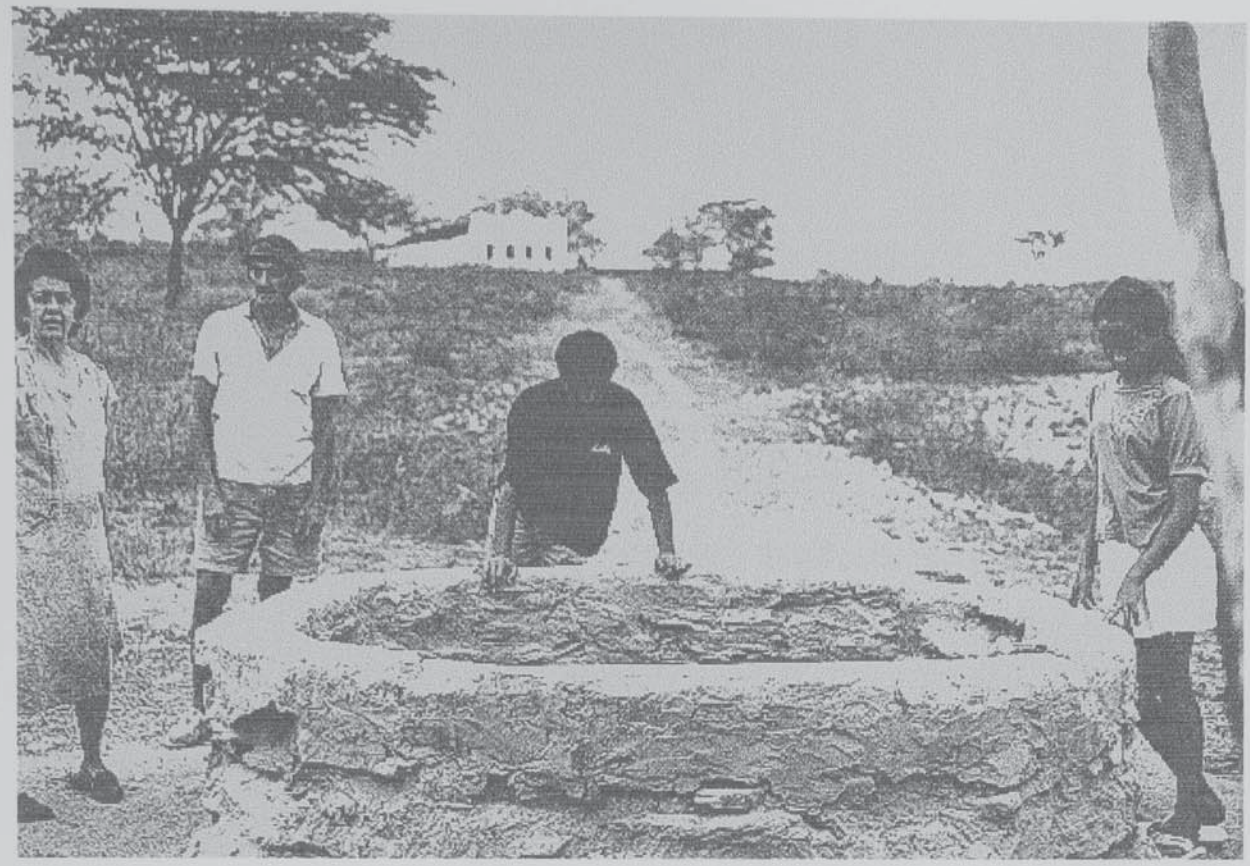

Figure 20. Transporting water is a constant problem.

In urban areas despite some advantages, e.g. better infrastructure and wider availability of mass produced goods, for the poor the situation is critical. People have to struggle for survival and are compelled to come up with ingenious solutions to generate employment. This can be illustrated by the existence of a number of alternative means of transportation which are designed by the population. Figures 21-23 show different solutions for the same needs. These vehicles, conceived by unknown designers, are widely used, not only in Campina Grande, but in many other cities of the NE. They are an enlarged version of children's toys, are made mainly of wood and are controlled by steering wheels taken from a motor car. The trolleys carry loads up to two hundred kilograms and are pushed through the streets. They are a mean of generating income and employment as they can be hired, providing a cheap alternative to motorised pick-ups.

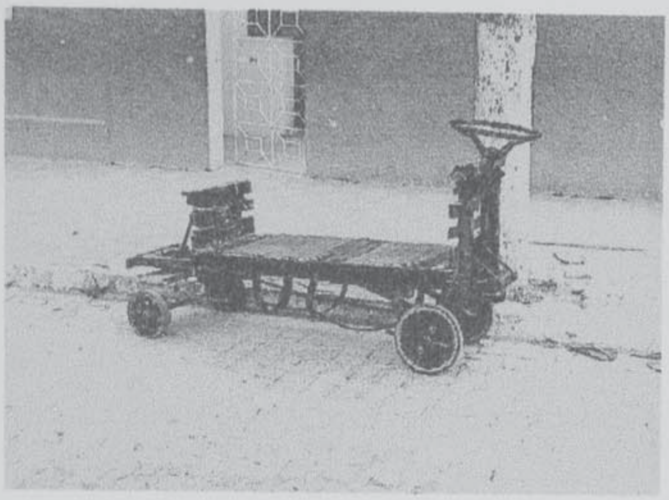

Figure 21. Alternative found in the interior of the State.

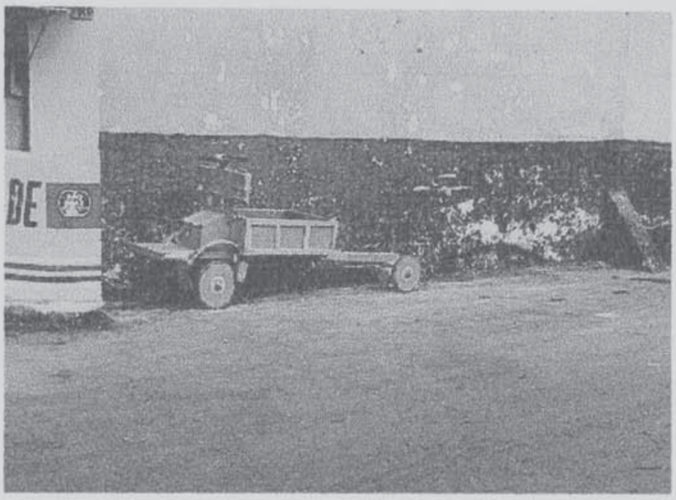


Figure 22. Transport trolley found in the Campina Grande Central Market.

Figure 23. These vehicles, conceived by unknown designers, are widely used in the NE.

Other examples of alternative products, competing with large firms mass produced goods, can be found in this market. Figure 24 and presents a hammer made from a steel screw (head) and a handle made from ordinary steel. This is a cheap alternative to the industrialised tool, which is much more expensive. This example was purchased in the Central Market for fifty pence while the industrialised one costs approximately five pounds. Evidently, the quality of this product can be improved at the design stage. Its manufacturing involves blacksmith's technology, lathe machining and electric arc welding. In spite of being relatively cheap, it's design makes it uncomfortable to use. The tool is badly dimensioned. The handle, which is made from a square profile rod, has the wrong proportion in relation to the head.

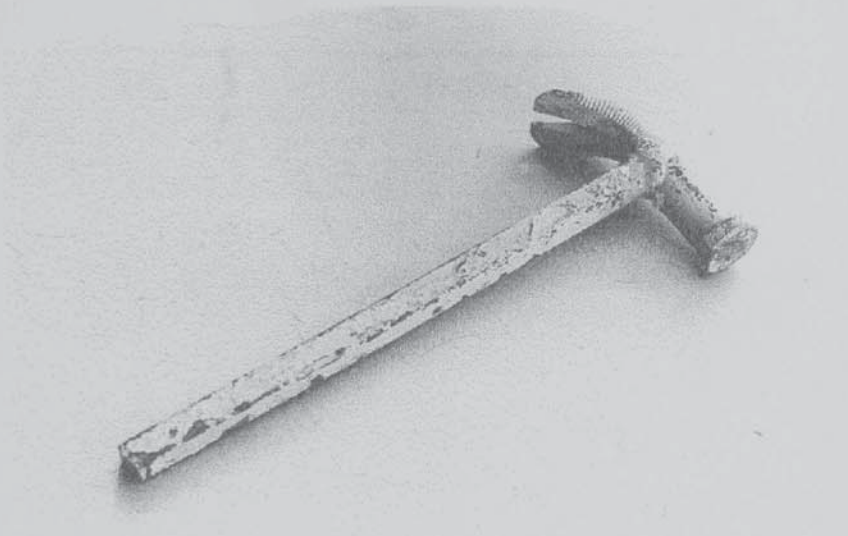

Figure 24. Cheap alternative to the mass produced tool.

From these preliminary observations of the local context it was considered that a wider survey of the products consumed by the poor population would be necessary .

## 5.2. Exploratory Survey of Products Available to the Low Income Population in Campina Grande Central Market

A survey of one hundred products sold at the central market of Campina Grande was conducted (cf. Chapter IV for details). It emerged from it that the majority of manufactured products sold in this outlet are household items (see Table 4.1.). These products are made either by industries operating with sophisticated technology in the formal industrial sector, by small legalised firms or by microenterprises operating informally. They compete in the same market and, sometimes the products of the later prove much more appropriate. This is the case of a dustbin made from reused automobile tyres which is a product used, both by low and high income groups (Figure 25)[2]. The technology is very simple. The interior steel ring of the tyre is cut out using a knife to cut it (Figure 26). Subsequently, the canvas is separated from the rubber also using the knife and then a hook, where the rubber/canvas is fixed to and 'exfoliated' resulting into two sub-products (Figure 27). The body is then assembled using cramps and nails (Figure 28). A number of other products such as water containers and animal feeding bowls are also produced using this technology (Figure 29).

Figure 25. Dustbin made from reused automobile tyres which is a product used, both by low and high income groups.

Figure 26. The interior steel ring of the tyre is cut out using a knife to cut it.

---

2 Figures 18-22 were taken from Bonsiepe, G. *A Tecnologia da Tecnologia*. Edgar Blücher. São Paulo. 1983. There are also number of other 'vernacular' products.

Figure 27. The canvas is separated from the rubber also using the knife and then a hook, where the rubber/canvas is fixed to and 'exfoliated' resulting into two sub-products.

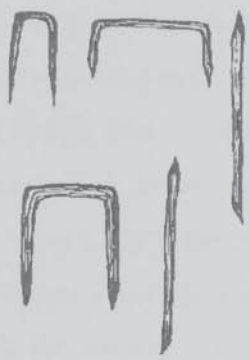

Figure 28. The body is then assembled using cramps and nails.

Figure 29. A number of other products such as water containers and animal feeding bowls are also produced using this technology.

The dustbin is extremely cheap and robust, out-performing existing products which are made from sheet steel or plastic using more sophisticated technology. The steel product has the disadvantage of rusting and the plastic alternative, due to long periods of exposure to the sun, and to the quality of the material employed in its manufacture, after a period of time dries and becomes brittle. Both are much more expensive than the rubber version. The rubber product also has the advantage of being flexible and washable. Being flexible is particularly important because the dustman usually, after unloading its content, throws it violently onto the side walk. Another aspect is related to the fact that the mass produced dustbin is visually more appealing and this attracts the attention of thieves who steal them.

As in other LIEs, the re-utilisation of materials is widespread in NE Brazil. A good illustration of such practice is the catapult (Figure 30). This is a seasonal product used both for hunting birds, and as a children's toy. The product is seasonal because the bird to be hunted only appears at a certain time of the year, when a fruit from a local tree ripens. The worker, a nephew of the owner, is preparing a batch production to be sold locally and in other smaller cities in the interior. He buys used rubber inner tubes from truck tyres, which are then cut into strips using a knife as a tool. The process of preparing the raw material is particularly ingenious. He opens the inner tube and fixes it to the bench with nails. He then, without any measuring or marking, cuts the rubber using the arc of circumference as a guide, thus not wasting any material (Figure 31). The second operation is covering the wooden fork with the rubber, at the same time fixing the elastic, which is made from hospital drip hoses. The covering of the fork has a triple function: to strengthen the fork; give a better grip; and eliminate the use of glue or any other fixing element when assembling the elastic. The part that holds the projectile is also made from reused material (Figure 32). Leather, which is waste material used to make gloves at a safety equipment factory, is cut into a rectangular shape and attached to the elastic. The reusing of materials continues since the left-over scraps of leather are then sold on to small broom manufacturers who cut them, bend them, punch a hole through the leather, and then fix them to the handle of a broom to form a strap to hang the broom on a nail on the wall or behind a door. This product is a good example of providing a solution to raw materials constraints and to the creativity and simplicity of design.

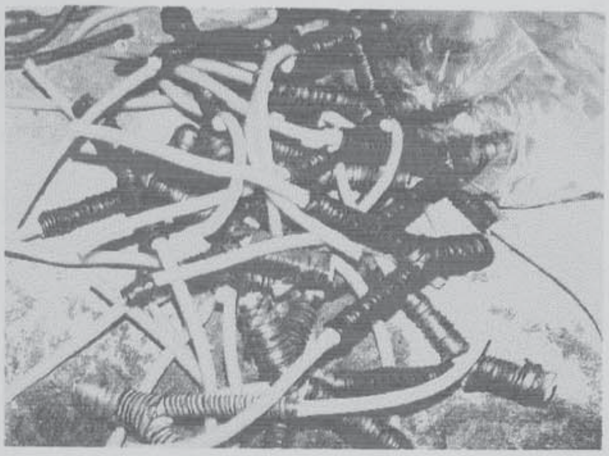

Figure 30. Seasonal product used as a hunting tool.

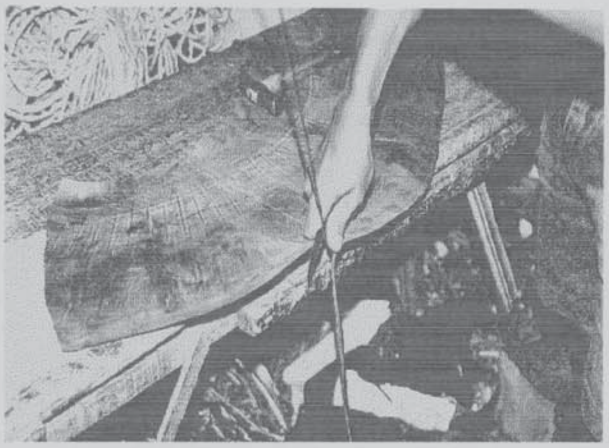

Figure 31. Worker cuts the rubber using the arc of circumference as a guide thus not wasting any material.

Figure 32. Leather from waste safety equipment is used in the assembly of the product.

It is worth noticing that this workshop, besides manufacturing catapults, operates as a small wholesale shop selling items such as one burner cookers (Figure 33) and other products made by other small producing units. This cooker is a good example of how small manufacturers solve problems related to the constraints of raw materials. The cooker producer, who keeps a constant 'eye' on local scrapyards, spotted in one of them a number of schools chairs being scraped. He bought the lot and used it to make the legs of the cooker.

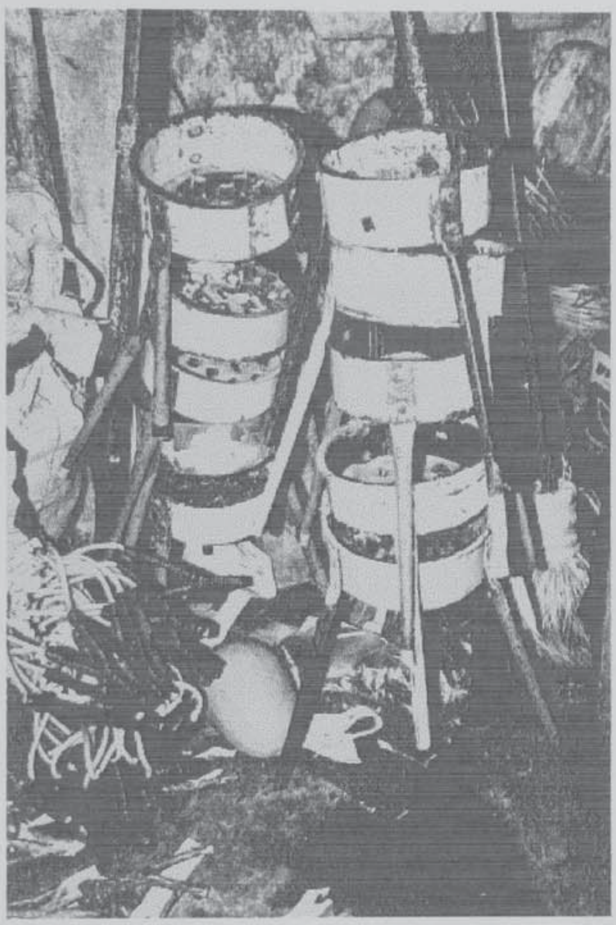

Figure 33. The workshop operates as a small wholesale.

Other examples of more elaborate products were also found. I had access to two cooker manufacturers, using different raw materials and technology to make their products. Their reasons for producing the goods were different. Manufacturer 'A''s business was directly linked to his personal and family survival. He lived with his family and operated the business in the back of a metal workshop belonging to another person. Manufacturer 'B''s activity was conducted as a secondary occupation. His main income derived from a small grocer shop. He explained that making cookers was more of a 'hobby' because, due to a health problem, his doctor recommended some physical work.

Both of them used scrap metal as the main source of raw materials. Producer 'A' used large cans, waste cans used to pack butter and other food products. Producer 'B' used scrap metal from old mass produced cookers which were brought by the buyers themselves. The products made were charcoal cookers (Figures 34, 35) but, producer 'A' also made a dust collecting shovel (Figure 36). The cookers were mainly composed of two or four burners, and an ash collecting drawer. Although ingeniously assembled, they had some problems related to safety, e.g. parts of the metal were not finished properly and had sharp edges, the structures were not very stable, and the quality of the burner's construction made it difficult to remove them.

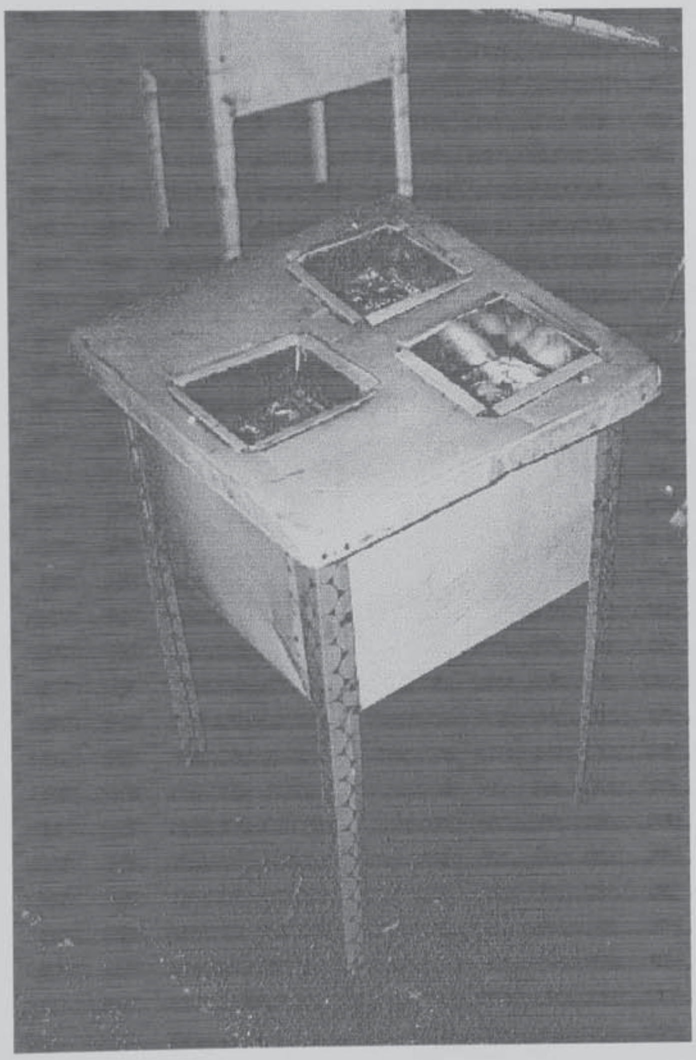

Figure 34. Cooker made from recycled butter cans.

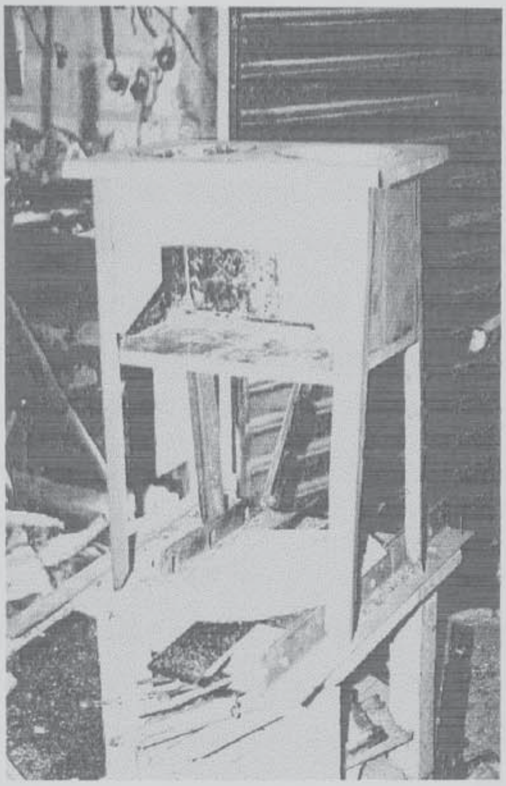

Figure 35. Alternative made from recycled sheets extracted from mass produced cookers.

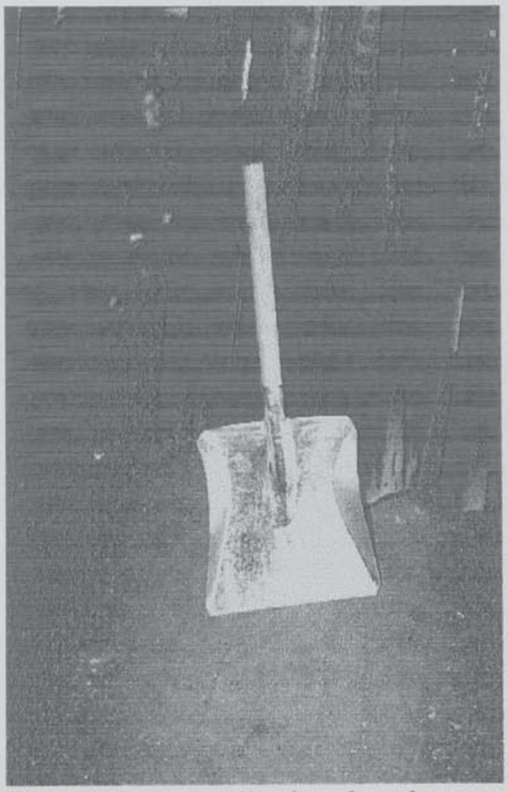

Figure 36. Dust collecting shovel stamped out using a hand press.

These entrepreneurs produce around 40 cookers per month each. Both sell their products in the open market in Campina Grande and to other cities of the state. The products cost between £3.00 and £5.00 (1994 prices). Producer 'A' sells a dozen shovels for approximately £5.00. According to producers, cookers sell best during June because of the 'São João' (St. John's party). This party is celebrated with particular enthusiasm in NE Brazil and is related to the period of harvest. Thus, roasted and boiled corn is sold all over the city. The main consumers are poor people who buy cookers to sell food in an attempt to supplement their incomes, because locals spend more on leisure at the time and there is a good influx of tourists visiting the city. Both entrepreneurs said that the cookers were their own design and that design was a straightforward process where an initial model was made and gradually improved while being produced.

Production technology varied. Producer 'A' invested in a spot welding machine — something quite rare in metal manufacturing firms operating locally — and used other simple metal producing equipment. He also made a hand press (Figure 37) to which a tool, made by a local toolmaker was fixed, to manufacture the shovels. Manufacturer 'B''s cooker design was slightly different, having round burners, and the whole cooker was made using hand tools (Figure 38) and assembled using rivets. Both units were involved in the construction of capital goods for self-use due to the high costs of existing mass produced equipment. The manufacturers informed me that their main production procedure was to make a small batch of cookers, and then to stop manufacture until they sold this stock. They also took orders from clients who occasionally bought the whole batch for retailing.

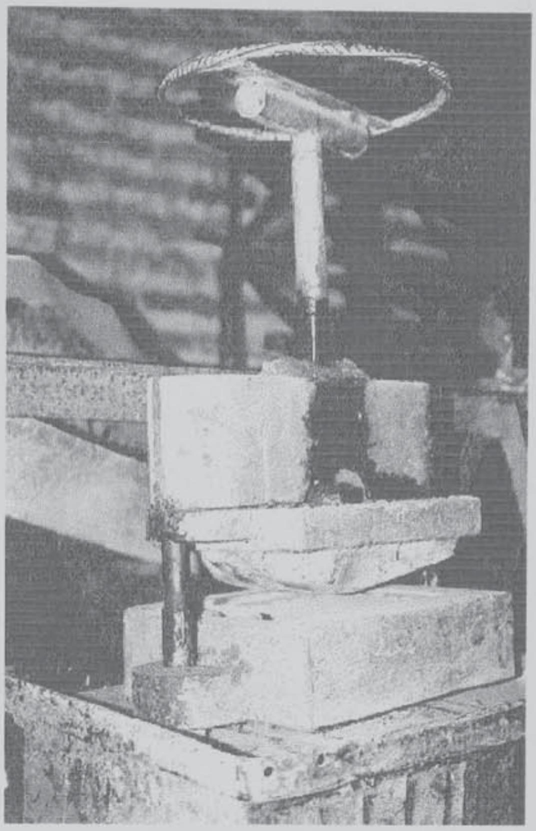

Figure 37. Hand press made in house.

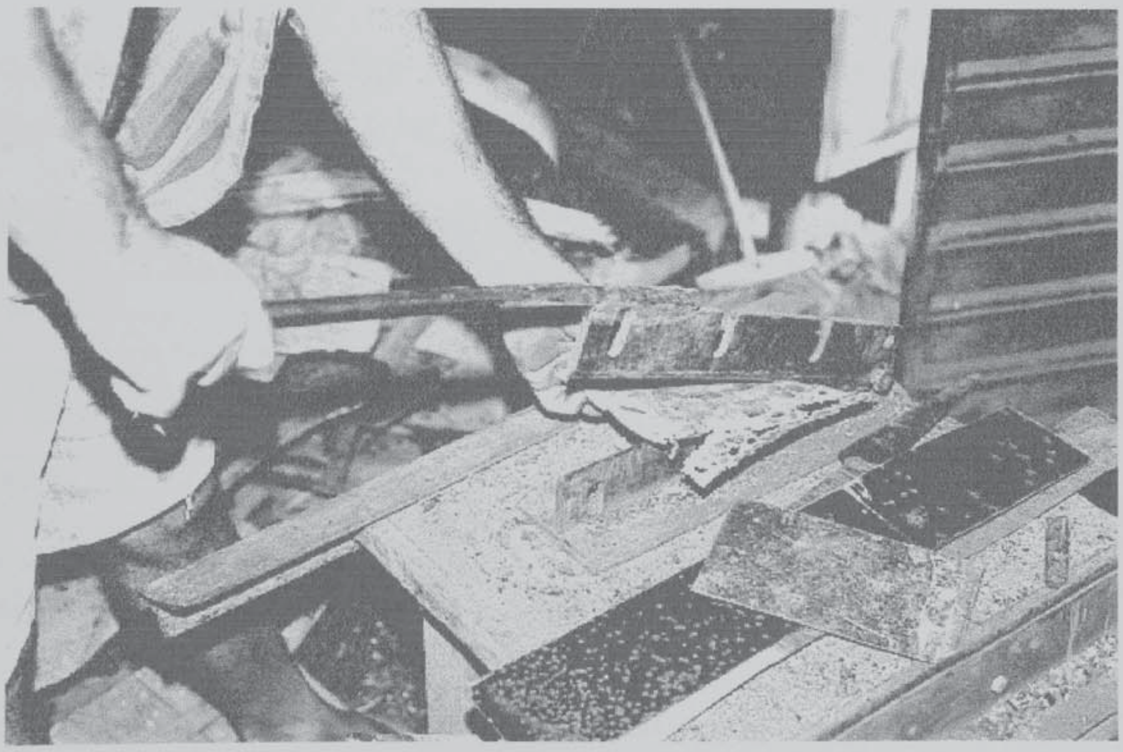

Figure 38. Cutting tool made from blade from a forage machine.

I was also able obtain insight into the operation of one of the distributors in the central market. These contacts proved to be very useful in gathering information and obtaining names of firms which were potential interviewees. I was actually introduced to one of the cooker manufacturers by a distributor who wholesales and retails many different products made by small firms and artisans. His shop is like a microcosm of the open market, selling most products which are available in the stalls with the exception of food. Among the many products he sold were: hammocks, suitcases and tools for brick work. In another shop, owned by the shop keeper's sister, I learned that many products sold by her were seasonal. The shop owner was very aware of the constraints and mechanisms of the market she operated and gave me some interesting examples of the seasonal products. For example, she confirmed that the catapult sells well during the summer time due to the fact that the 'mameleiro' tree dries and 'rolinhas' (the name of a species of bird) come to eat its fruits. The 'ralador' (grater) sells more during harvest time because a number of staple foods use grated corn in their recipes. Safety gloves sold well in the summer because it is at that time that building and refurbishing of houses occur. Other products sold better in the winter time which is also the rainy season. For example mouse traps sell well then because the sewers overflow and the rats come out, infesting the houses. The winter rain is also responsible for the increase in sales of oil lamps because of power shortages due to cable ruptures.

The survey conducted in the central market of Campina Grande, revealed that most of the goods are manufactured by the light engineering sector. (Table 5.)

**Table 5. Material used in each product category (100 products)**

| Category/Material | Metal | Plastic | Wood | Fibre | Clay | Rubber | Metal/wood | Others | Total |
|---|---|---|---|---|---|---|---|---|---|
| **Cleaning utensils** | | 5 | | 3 | | 1 | 1 | | **10** |
| **Decoration** | 1 | | | 1 | 1 | | | | **3** |
| **General use utensils** | 7 | 3 | 2 | 1 | | | | | **13** |
| **Kitchen utensils** | 31 | 9 | 3 | 1 | 6 | | 2 | | **52** |
| **Lighting** | 3 | | 1 | 1 | | | | 2 | **7** |
| **Personal hygiene** | | 3 | | 1 | | | | | **4** |
| **Stock products** | | | 1 | 1 | | | | | **2** |
| **Tools** | 9 | | | | | | | | **9** |
| **Total** | **51** | **20** | **7** | **9** | **7** | **1** | **3** | **2** | **100** |

This product survey attempted to give an overview of the kind of products sold in the Campina Grande Central Market, and thus concentrated only on the category and material used in the construction of such products. This material was collected using direct observation and by photographing and videoing some products. As can be seen in Table 5. over 50% percent of the products are made using metal as the main construction material or by mixing metal with other materials. It also emerged from the survey that most of the products were household items. From the result of the overview it was clear that metal manufacturing is still an important source of supply of products used by the low income population.

## 5.3. Survey of Metal Manufacturing Firms

Initially thirty firms operating in the metal manufacturing sector were selected at random, using as a reference the Industrial Register of the State of Paraíba for 1992 (Cadastro Industrial do Estado da Paraíba 1992). These firms were contacted by mail to explore the possibility of conducting interviews, and a list of topics for a semi-structured interview was prepared. The interviewees were entrepreneurs and persons involved with product design. In the end twenty eight interviews were used, twenty seven in the urban area and one in the rural area. With one exception, all the entrepreneurs were receptive and allowed tape recording of the interviews.

## 5.4. Issues Related to Firm's Operation

### 5.4.1. Size of Firm's Workforce

It emerged from the survey that the metal working industry is composed mostly of small firms. Twenty three firms in the sample had a work force of 1-11 people. A number of firms had a workforce of less than four people (Table 5.1.). These very small enterprises are the most vulnerable, with a number of firms operating informally, working mainly in metal fabrication such as gates and window frames.

**Table 5.1. Size of workforce.**

| Work force | No. of firms |
|---|---|
| 1 - 3 | 10 |
| 4 - 7 | 9 |
| 8 - 11 | 4 |
| 12 - 15 | 1 |
| 16 - 20 | 1 |
| 21 - 30 | 1 |
| 31 - 40 | 1 |
| 41 - 50 | 1 |
| **Total** | **28** |

NB: Total number of people working in the unit.

## 5.4.2. Products Manufactured by Production Units

With few exceptions, most firms were involved in the production of more than one type of product (Table 5.2.). These were classified into five main groups; machinery made to order; metal fabrication (e.g. windows and door frames); metal furniture; public cleansing equipment; and repair and maintenance services.

**Table 5.2. Products manufactured by units**

| Products | No. of firms |
|---|---|
| Moulds/Tools | 5 |
| Machine parts | 3 |
| Machinery specials | 9 |
| Machinery/production | 3 |
| Metal fabrications (e.g. windows, doors, etc.) | 9 |
| Metal furniture | 8 |
| Public cleansing equipment | 10 |
| Automobile specials | 1 |
| Consumer goods (e.g. household appliances) | 2 |
| Components/accessories/fixtures | 2 |
| Miscellaneous | 4 |
| Metal castings | 2 |
| Services (e.g. machining, repairs) | 11 |

NB: Most firms manufacture a range of products

It is worth noting that in some companies the alternative products bear no direct relation to the prime products manufactured by the firm. Figure 39 shows a barbecue grill which, although copied from a company in the South of Brazil, is being manufactured in Campina Grande by a concrete casting mould manufacturer.

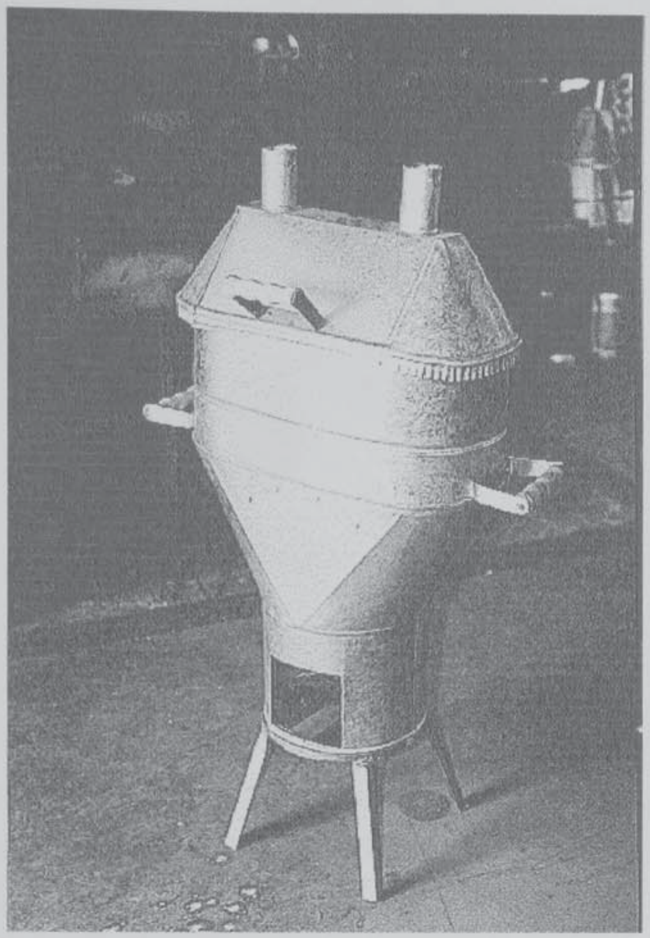

Figure 39. An alternative product made by a concrete mould manufacturer.

Nine firms were involved in the production of machinery made to order. These were machines for the building industry, agriculture and production but some entrepreneurs would accept proposals to manufacture any sort of machine. They varied from simple tube bending equipment, to more sophisticated mining machinery. In general their clients were other small entrepreneurs who had little financial resources to buy standard equipment. Some firms manufacturing windows and door frames also produced metal furniture made from tubes. Most were copied directly from interior decoration magazines and had undergone some minor modifications. Because of the relatively small investment in equipment, many people set up metal working firms, increasing the competition in this market. Thus, producing metal furniture is an alternative to the already saturated market, for windows and door frames. Making equipment for the public sector is also an attractive option. These products are public cleansing equipment, school desks and lighting equipment, mainly used by prefectures in the interior of the state (Figure 40). Eleven firms admitted that repair and maintenance of equipment was the quickest way of obtaining cash and also a form of making use of inactive equipment.

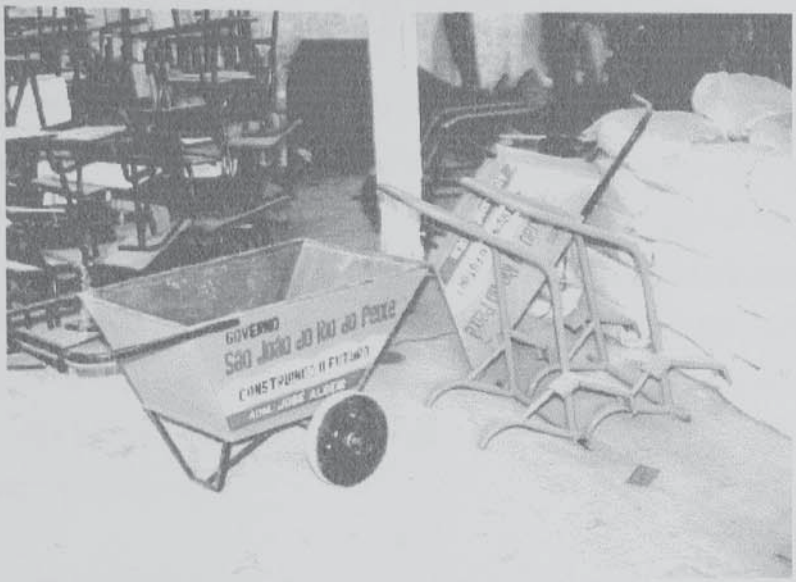


Figure 40. Public cleansing equipment used by Prefectures.

The only entrepreneur involved with transportation manufactured automobile bodies (Figure 41). These were one-off versions with bodies made from second hand tubes and fixed to a standard chassis. This was a rustic but cheap alternative to the mass produced automobile. He estimated that he had made over fifty bodies by the date of the interview.

Figure 41. A cheap alternative to a mass produced automobile.

### 5.4.3. Type of Working Practice

Most firms in the sample work by contract (Table 5.3.). Different reasons were presented for this. Some lacked capital to buy raw materials, some were cautious about the economic recession at the time and were not willing to make any move, such as investing in capital equipment, that could put their existence in the market at risk. Only four firms in the sample had a regular stock. These were larger or better equipped firms which had a production line. One entrepreneur, to avoid paying tax on manufactured products, asked clients to bring their own raw material which he then processed in his wire netting machine. Because this form of operation was classified as a service provision it would pay lower taxes.

**Table 5.3. Working practice.**

| Working practice | No. of firms |
|---|---|
| Contract | 19 |
| Stock products | 4 |
| Contract/stock | 5 |
| **Total** | **28** |

Most firms operate in a local market, mainly in the north-eastern region, and fifteen companies were selling in Paraíba state only. However, one firm was exporting overseas. This was owned by an entrepreneur of European origin who manufactured ammunition reloading machines, supplying the internal market but also exporting to Germany, France and to some countries in Latin America (Figure 42).

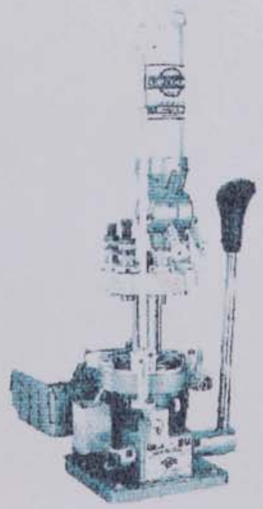

Figure 42. Ammunition reloading machine for local and export market.

In general, firms in the sample did not keep a record of how many products they manufactured. Eighteen respondents were not able to state their monthly production figures (or were not interested in doing so). Some respondents kept a record of production but were not keen to speak about it. Although they mentioned quantities superficially one has to be cautious about this sort of information as intentional distortions may occur. It emerged from the survey that the two main forms of identifying market demands and opportunities were an informal communication network and the direct observation of the market, such as talking to people in commercial, services and industrial firms. Sales in twenty two of the companies were made directly to the client and few companies had sales representatives or salesmen.

### 5.4.4. Type of Production Equipment Used by the Firm

The firms surveyed utilised a variety of production equipment, ranging from simple hand tools (Figure 43) to sophisticated computerised numerically controlled machinery. Interviewees were asked what kind of equipment they had in-house. It was understood that they mentioned those items considered to be more important for their unit.


Figure 43. A Tinsmith building an ice cream trolley.

A pattern of production equipment emerged (Table 4.5.). In the majority of firms the most common equipment found was: arc welding sets, cut-off machines, drill presses, manual shears and sheet folding machines. This suggests that the general level of technology available in most firms is very basic, especially in the smallest units.

**Table 5.4. Type of production equipment used by firms**

| Machine/equipment | No. of firms owning equipment |
|---|---|
| Manual shears | 7 |
| Power shears | 7 |
| Cut-off machine | 10 |
| Power hacksaw | 7 |
| Band saw | 1 |
| Circular saw | 1 |
| Vibrating scissors | 1 |
| Forge bellows | 2 |
| Hydraulic press | 3 |
| Power sheet rolling machine | 4 |
| Manual sheet folding machine | 9 |
| Stamping press | 6 |
| Tube bending machine | 8 |
| Manual stamping press | 2 |
| Wire straightening machine | 1 |
| Power drill press | 17 |
| Arc welding set | 20 |
| MIG welding set | 2 |
| Oxyacetylene welding set | 4 |
| Spot welding set | 2 |
| Milling machine | 4 |
| Planing machine | 5 |
| Thread rolling machine | 2 |
| CNC lathe | 1 |
| Lathe | 9 |
| Manual sander | 5 |
| Sand blasting machine | 2 |
| Electrostatic painting chamber | 1 |
| Flexible power grinding wheel | 1 |
| Multipurpose drill/sanding/saw machine | 1 |
| Wire netting machine | 2 |
| Compressor | 6 |

### 5.4.5. Relationship Between Firms and Academic Institutions and Enterprise Support Bodies.

Most companies had little institutional support (Table 5.5.). More than 80% of the sample did not receive any kind of support and few had financial support.

**Table 5.5. Level of support used by the firm**

| Type of support | No. of firms |
|---|---|
| Technical support/public sources | - |
| Technical support/private sources | - |
| Financial support/public sources | 4 |
| Financial support/private sources | - |
| No support | 23 |
| Not known | 1 |
| **Total** | **28** |

In general the respondents were cautious about seeking support because of previous negative personal experiences or knowledge of situations experienced by others. Regarding credit support, they were reluctant to apply for grants, private or governmental, because these institutions require warrants and because of the high inflation and high interest rates in the market. Their main concern was the possibility of not being able to repay a loan and so have their machinery and other assets taken by creditors. Thus, the alternative is self finance, resources from relatives and friends or the informal lending network. This was the case in both formal and informal enterprises. Recently some special programmes, private and governmental, have been set up and are providing credit to small entrepreneurs to buy production equipment without asking for any sort of warrant.

The survey identified the fact that no technical support, either private or governmental, is being used by the majority of entrepreneurs in the sample. Again, despite the existence of support programmes, the fear of not being able to repay loans appears to be the main reason inhibiting the use of existing support programmes.

The relationship with academic institutions was almost nil. There are two universities located in the city, but little use was being made of their potential support for innovation. Most entrepreneurs, when referring to 'the university' meant the Centre for Science and Technology at the Federal University of Paraíba - UFPB (Universidade Federal da Paraíba), which has its Campus II located in Campina Grande. This campus houses both Mechanical Engineering and Industrial Design Departments. Some entrepreneurs maintained an informal relationship with the university, mainly through the use of some workshops and the facilities of UFPB, others did occasional work for the university. They also commented on the lack of co-operation between the university and local industry. Only a small fraction of the sample admitted using students from the university, and these were the larger and more technologically advanced firms.

Another important problem identified by the survey was the lack of communication between entrepreneurs. They operate in isolation and the majority do not belong to any professional body or organisation. Firms with less resources are even more isolated. It appears that they do not see any advantage in organising themselves. Some entrepreneurs even suggested that organisations such as this will only benefit the people that are in charge, never the majority.

### 5.4.6. Firms' Innovative Capacity

Innovative behaviour in this chapter is understood as an attempt to conceive a new product or adapt an existing one with the intention of manufacturing it to sell or to use in-house. These can be both consumer and capital goods. The firms were classified in three groups (Table 5.6., 5,7.).

1. Innovative firms: these create consumer goods, and machinery for their own use or for sales. The entrepreneur is constantly attempting to create or differentiate products from existing ones. He understands the need to innovate as an important factor for the survival of the firm and uses some systematic method to design products.
2. Sporadically innovative firms. Here innovative behaviour is mainly concentrated on the design of new production machinery or modifications of existing machinery, for internal use and occasionally for sale.
3. Non-innovative firms. They produce standard products and have not attempted to create new products or machines for self use or for sale.

**Table 5.6. Innovation categories**

| **Category** | **No. of firms** |
|---|---|
| Innovative | 6 |
| Sporadically innovative | 12 |
| Non-innovative | 10 |
| **Total** | **28** |

The majority of firms were involved in the adaptation and construction of machines for their own use. The main reason for this behaviour appears to be the high cost of existing equipment.

**Table 5.7. Type of innovative behaviour.**

| Type of innovation | No. of firms |
|---|---|
| Introduced a new product to market | 6 |
| Machines for own use | 16 |
| Tools and accessories for own use | 5 |
| Production and sales of self constructed machines/equipment | 4 |
| Copies of machines (e.g. tube bending machine) | 6 |
| Copy consumer goods (e.g. household appliance) | 9 |

NB: Most firms use several types of innovation

Campina Grande is a relatively well supplied market for machinery and equipment because of the number of existing industries, but most of the machinery is acquired from the South and South-eastern regions. According to some respondents, by the time products have arrived at the local market their prices have trebl. This is due to the costs of transportation and the profit margins of intermediaries. Recife, another large city in the North-eastern region, sells machines at better prices, but the best option, according to the same respondents, is, to purchase them directly from the southern states if you have the resources.

Another factor which stimulated innovative behaviour and was mentioned by some entrepreneurs, was the lack of machinery/equipment designed specifically with small scale operations in mind. Some machines are too large and sophisticated to meet the needs of small firms. Examples from the sample suggest that entrepreneurs do not make a straightforward copy of the machine they need. They modify, create different alternatives and occasionally re-design them completely to suit available raw materials and their production facilities. The difficulty of obtaining raw materials was pointed out as one of their main concerns. This was due to the difficulties in obtaining credit from traders to buy the minimum quantity sold in the market, as local shops do not sell small quantities of material. Raw materials had to be paid for in cash, especially by the smaller entrepreneurs who do not have a bank account. There were also complaints about the quality of the raw materials. For example, one of the respondents mentioned that the quality of steel sent to the North-eastern region was inferior to that used in the South and South-east. This fact, added to the lack of financial resources, compels them to reuse waste materials. For some firms, the scrap yard was the only way to obtain raw materials.

The most common self-constructed machines were drill presses, manual shears, and hydraulic presses (Figure 44). Nevertheless, there was evidence of more specific, specially designed production machinery. Examples of wire net manufacturing machines using recycled automobile parts were found.

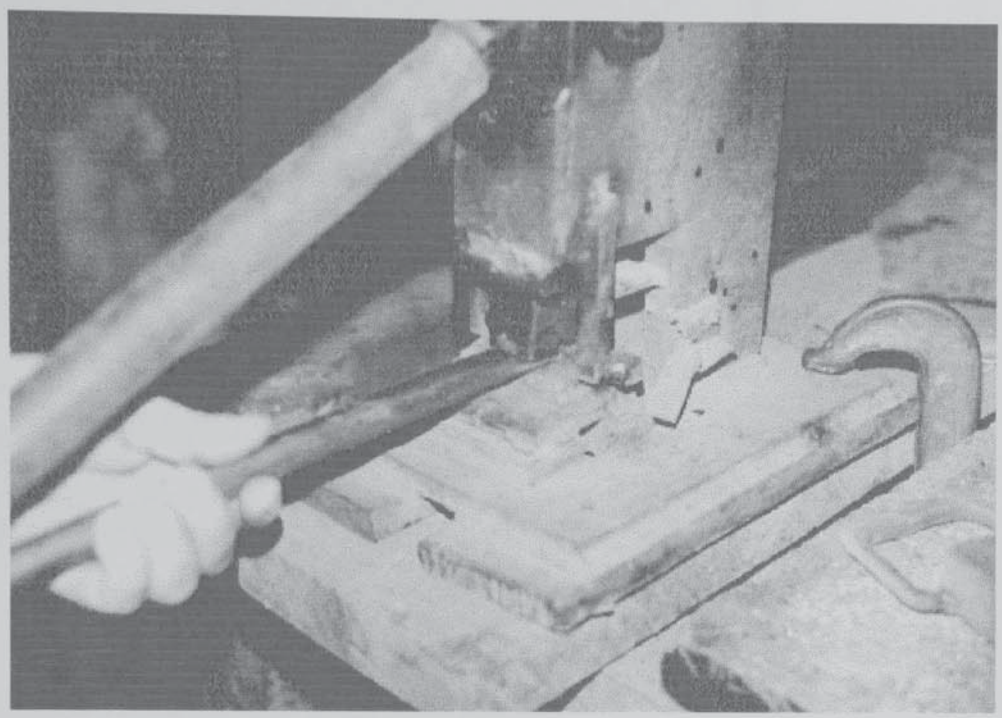

Figure 44. Most firms were involved in the adaptation and construction of machines for self use.

In one of the two firms producing wire net, the high cost of existing equipment was the main thrust for innovation. The entrepreneur lacked financial resources to buy imported equipment from Germany and decided to design and construct it himself. There were also some firms involved in manufacturing production machines to sell. In general, they were copies of production machines which had undergone minor incremental modifications and improvements. This activity seems to be peripheral to the central activity of the firm. This is the case of a firm whose main operation was repairing refrigerators but also manufactured furniture using steel tubes and occasionally machines for production (cf. 5.5.3)

Evidence of innovative behaviour in relation to consumer goods was also found. There were some entrepreneurs constantly attempting to create new products. Generally these attempts rely upon superficial market research and occasionally resulted in failure when the product was introduced into the market. The consumer goods were mainly household items and furniture which sold locally (Figure 45).

Figure 45. The presentation of products.

Two other indicators of innovative behaviour used were the ability of the entrepreneur to maintain, repair, and construct his own machinery and tools (Table 5.8., 5.9.).

**Table 5.8. Maintenance and repair of machinery.**

| Type of operation | No. of firms |
|---|---|
| Maintains and repairs in-house | 25 |
| Maintains and repairs externally | - |
| Other | 3 |
| **Total** | **28** |

They were used as indicators because it was assumed that entrepreneurs who understand the basic design principles of the equipment could use this knowledge to create new products.

**Table 5.9. Design and construction of tools * for use in-house.**

| Type of operation | No. of firms |
|---|---|
| Makes owns tools | 10 |
| Sends externally ** | 5 |
| Has no need for tools | 10 |
| Other | 3 |
| **Total** | **28** |

* The word *tool*, in this case, refers to both simple production devices and more sophisticated tool making for hydraulic and stamping presses.
** *Sends externally* does not necessarily mean the job is sent to a professional tool maker, tools are also made by some machine operators.

### 5.4.7. The Process of Design

The survey revealed that the process of designing both consumer products and production machinery occurs in an unstructured way with them formal methods of control such as tabling or charts being used (Table 5.10).

**Table 5.10. Process of Design**

| Design methods | No. of firms |
|---|---|
| 'Blends' existing designs to make his own | 2 |
| Straightforward copy of existing designs/makes minor modifications | 3 |
| Makes a sketch and constructs the prototype | 5 |
| Mixed methods (sometimes uses models/sketches etc.) | 7 |
| Design emerges as the prototype is being constructed | 8 |
| Uses formal design methods | 1 |
| Does not design any product | 2 |
| **Total** | **28** |

Communication with the client is a straight-forward, informal matter, and in general part of the project is already being developed when defining the brief (Figure 46).

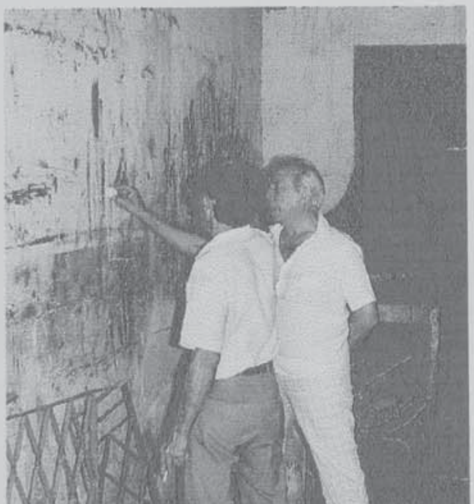

Figure 46. Products are designed in close contact with customers.

It became evident that drawing is not common practice in most enterprises. Even where they existed, technical drawings were produced in the most rudimentary way (Figure 47).

No computers with CAD/CAM facilities were found in any of the firms and the only firm which had a computer was using it for administrative tasks. In some instances entrepreneurs relied upon their ability to visualise objects in three dimensions and constructed the prototype directly from the raw material without using any drawing. From this first attempt, they improved the design and made templates to be used in production. With few exceptions, most of the products are copies of existing designs, and some entrepreneurs openly admitted this practice.

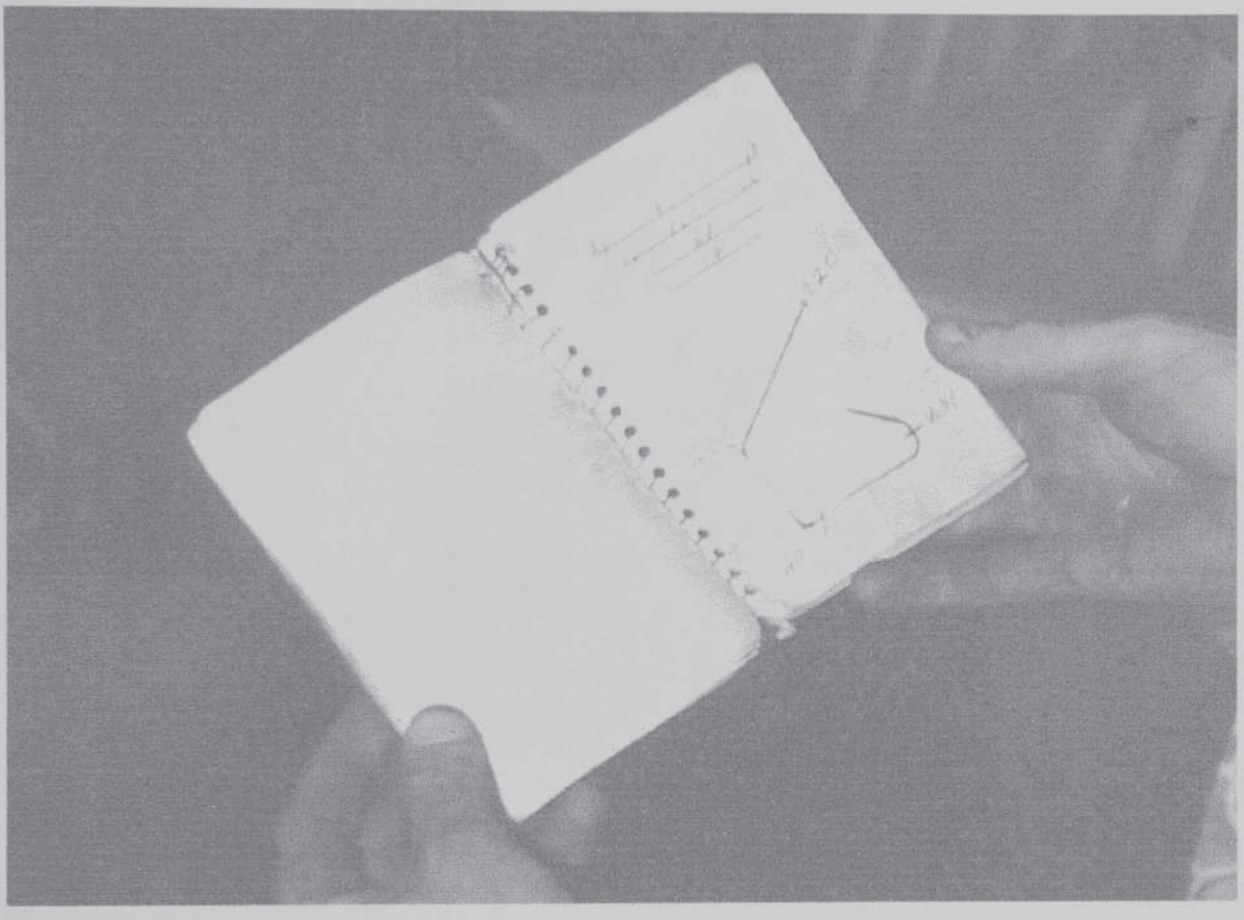

Figure 47. Example of a firm's database.

Others were more cautious and explained that they designed their products based upon existing ideas which would then undergo incremental modifications. Nevertheless, some attempts to create new products were identified. The reason for designing new or improved products was to increase the chances of survival of the firm and in some cases personal survival, as the firm was interlinked with the subsistence of the family. This can be illustrated by the example of one of the firms in the sample - a small family unit operating illegally - where in the back of the house there was both a metal manufacturing workshop, generating the main income of the family, and a secondary business manufacturing fireworks (Figure 48).


Figure 48. A secondary business manufacturing fireworks.

Most entrepreneurs appear to design their products during their leisure time at home. They mentioned that, during working hours, they are always too busy involved with problems related to production. According to most entrepreneurs, designing was done at home, after meals or during the night time, while 'sleeping' or at the weekend when they had some time to spare. Evidence of the use of more structured methods in the design of products, the use of anthropometric data and ergonomics, (all based on common sense), was found. Respondent No.7 described his method for dimensioning schools chairs based on the direct observation of the equipment in use by a 'sample of the population' — five of his close relatives. Respondent No. 25 also based the dimensions on some of his products the anthropometric measures of his close relatives, taken from direct observation of the product during use (cf. 5.5.2, 5.5.6). Customer feedback appeared to be an important source of information concerning the design of products. Most entrepreneurs admitted that the customer was responsible for modifications both during the design process and after it.

### 5.4.8. The Entrepreneur's Perception of Design Activity

Respondents had a confused perception about the activity of design particularly about the terminology used to define the activity of industrial design. 'Desenho Industrial', the equivalent of industrial design in the UK, was understood in a mixed way. It was mainly associated with the activity of a draughtsman but also with project activity, both machinery and consumer goods. Factors such as aesthetic treatment were considered important in enhancing the possibility of product acceptance in a competitive environment. The word used by most interviewees to describe the process of design was *invention.* In general the interviewees considered the quality and the 'boniteza' (beauty) of their products as an important factor in selling them. They alluded to 'models', referring to the external part of the product and also to the finishing, or to the colours of the product. However, the visual model and 'boniteza' appeared to be secondary in the process of 'invention'. In general aesthetics was perceived as something separated from the main function of the product, something to be added, after the product was finished

Respondents were not unanimous in their perceptions of the benefits or advantages of using design as an activity which determines the 'beauty' of the product. Shape, colour and finishing (quality of the sanding and painting) were considered as important elements in a product but the majority of entrepreneurs associated 'boniteza' with the *quality* of the product. Quality in its turn, was understood by most entrepreneurs to be related to the sound robustness of the product. Nevertheless, some entrepreneurs stressed the importance of generating different models or visual alternatives as an attempt to attract more clients. One entrepreneur mentioned the importance of new designs in enhancing the *'modern'* image of a product. This was the case of a hospital equipment manufacturer, although his remarks were related mainly to product differentiation by changing the external form of the product. He believed that creating new, *'modern'* designs would 'heat' the market for his products and in the case of bidding it would provide him with a competitive edge. This was a better informed entrepreneur in a company with greater financial resources. He also pointed out that the designer should be a link between the different sectors of the enterprise. Another entrepreneur, producing a technologically more advanced product, perceived design to be a fundamental activity defining the geometry, the 'lines' of machines and said that it was very important in terms of marketing his products. Nevertheless, he did not employ industrial designers. All project work was carried out by himself, as he had been trained as a mechanical engineer. In general there was little differentiation between the role of the industrial designer and the design engineer but, most firms in the sample were not using the skills of either, and designed or adapted the products themselves. In general respondents were very proud of what they were manufacturing and praised the quality of their products. Some were keen to explain that they used strong materials, criticising others who, for the sake of increasing their profits, compromised on the quality of materials used. It is interesting to illustrate this point with two contrasting examples of entrepreneurs manufacturing similar products (cf. 5.5.1, 5.5.2). Both firms manufacture, among other products, school desks. One of the entrepreneurs explained how he managed to almost double his production of the seat and back rest of the school desk, by using the same amount of plywood. His formula was simple; reduce the size of the parts without having any consideration for user characteristics. In addition, the back rest was a flat piece of wood that was particularly uncomfortable for the user (Figure 49 ).

Figure 49. The back rest was a flat piece of wood uncomfortable to the user.

There were also problems with the way he fixed the writing surface to the structure. This was riveted with an aluminium rivet which protruded above the writing surface and the surface of the wood was rough, with minimum sanding and no varnish. By contrast, the other manufacturer of desks was very conscious of the end user and emphasised the fact that he made the desks as if he was personally going to use them. The seat and back rest were larger, had two layers of sealant and one layer of varnish to protect the children against splinters, and the back rest was bent to accommodate the back of the user comfortably. It is interesting to note that the companies are similar in size and that both sell to the same sort of clients. These examples illustrate the diversity of working practices and philosophy and show that size of firm and availability or lack of resources is not necessarily related to good design practice.

### 5.4.9. Training and Previous Experience in Relation to Innovative Behaviour

Most entrepreneurs learned their skills through informal training (Table 5.11.). Some came to Campina Grande from rural areas where vocational training was not available and started working as apprentices in larger enterprises. This kind of training was thought by some to be useful in learning about more sophisticated production processes, tooling and about the operation of a larger organisation. One respondent admitted that before setting up his own business he had worked for some years in more than ninety enterprises which had served as his learning process. (cf. 5.5.4)

**Table 5.11. Training background**

| Type of training | No. of firms |
|---|---|
| Learned by doing/apprenticeship | 6 |
| Industrial training course | 8 |
| University Eng./Design graduate | 2 |
| University - Business Graduate | 1 |
| Family skills * | 5 |
| Self taught | 5 |
| Other | 1 |
| **Total** | **28** |

* Family skills here means that the skills were passed down through the family, and from a very young age the respondents had been in contact with the family workshop.

Existing skills within the family were also an important form of training. This learning process had begun at an early age, through informal contact with relatives' workshops until as an adolescent, the individual would start 'real work'. It is interesting to note that in metal manufacturing it appears to be a tendency of enterprises to be owned and managed by males. When asked if they knew about females working in metal manufacturing workshops, only a small number of said they had ever seen women involved in the production of metal products. Those respondents who had had contact with females in metal manufacturing said that this was in larger cities such as São Paulo and Recife. During my visits to firms, I had contact with only one firm which employed a female, as a lathe operator.

Some of the respondents learned their skills by themselves, they had been involved in a completely different occupation, such as truck driving, and saw an opportunity to improve their living conditions by working in metal manufacturing. This process was achieved by acquiring a machine or equipment, experimenting with available materials and setting up a business.
The next section presents seven case studies in order to provide more detailed, additional information about design at this level.

## 5.5. The Case Studies

### 5.5.1. Interview Number 3

Contact was made by telephone and a date was agreed to meet the owner. I was received by the entrepreneur's son who informed me that his father was not in. He asked me to wait and after five minutes a man approached me and started a conversation without identifying himself. I asked a couple of questions about the kind of products made by the firm, to which he gave some superficial explanations. Ten minutes later, when he was more certain of my intentions, he identified himself as the owner. This behaviour probably reflected concern over some illegal aspects of the business such as non-conformity with health and safety regulations or evasion of taxes.

The firm had 9 employees and manufactured three main categories of products: public cleansing materials; public use materials and school equipment. The first encompasses dust collecting trolleys and stationary dust collectors, the second bus stop shelters, posts and street lamps and the third school desks. He also manufactured another product as a complement to his normal production to earn more cash: wire net. Because of high costs of equipment he designed and built a machine to make this product (Figure 50).

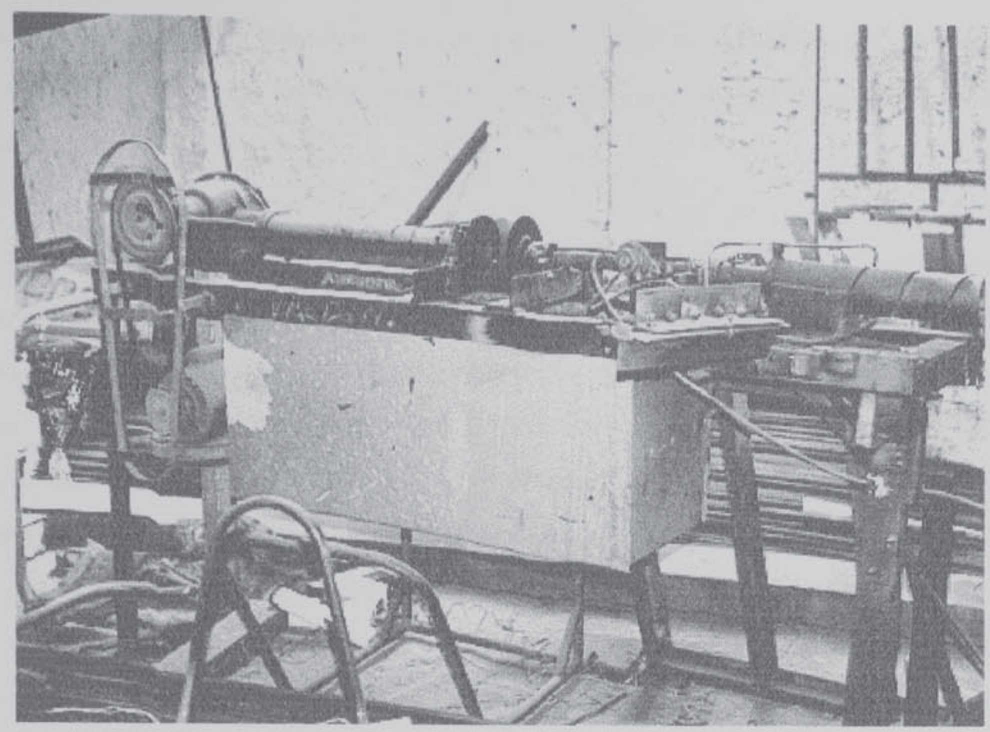

Figure 50. Alternative wire net manufacturing machine constructed from automobile parts.

He estimated that the firm produced around 30 or 40 different products, and it also takes special orders if they interest him. There were a number of family members working in the firm. The respondent pointed out that the initial suggestion to set-up the business came from friends who thought he could do well if he worked in metal manufacturing. The firm has been in operation for approximately four years. The interviewee used to be a truck driver and had no formal training in metal manufacturing, and attended school until the first grade of secondary level. All his present skills were learned-by-doing.

Most work is done to order. He sells to twenty independent salesman who buy the products, add their profits, and resell them to the municipal prefectures in the interior of the state. However he is not satisfied with this system which, according to him, reduces profit margins. The salesman reap the benefits without having to pay employee's wages or meet the rising costs of raw materials. According to him competition is fierce, with more than 30 competitors manufacturing similar products.

The sales of most of his products are seasonal. School equipment is sold at the beginning of the year and in the middle of the year, following the school calendar. He estimated that he sold approximately 1000 school desks per year. Sales are considerably increased when new mayors take office. According to him, this is due to the fact that politicians like to 'pretend' they are doing a lot at the beginning of their mandate. His best selling products are dust collecting trolleys and stationary dust collectors. His market is mainly the North-eastern region and part of one of the South-eastern states.

The most important machines used in his production are welding machines, guillotines, folding machines, sanders and specific machines including the wire net manufacturing machine manufactured by him using waste automobile parts. Although resembling a Heath Robinson contraption, the wire net manufacturing machine is being used quite profitably in production, according to him. It is important to note that this is not his main line of production and that he only occasionally has clients asking for such products. It is one more alternative for survival. From the engineering design point of view the machine is very simple, with a device to straighten the wire before it is fed into the tool and a system to move it forward into the tool, which will bend it to create the mesh. The respondent designed and constructed it based on direct observation of an existing machine. This was an attempt to cut costs in capital investment which are very expensive. A similar process occurred with a band saw which was manufactured from raw materials found in the scrap yard. This included alternative forms of making the pulleys, housings, and part of the wood used in the construction of the body of the machine came from used rail lines. This machine is at present used to cut the plywood for the school desks. All the workforce was trained in house and learned-by-doing. Quality control is undertaken by each worker and he has no specific person to check the job after it is finished. Access to raw materials is a considerable problem: prices are high, access to some materials is difficult and the quality of materials varies considerably. Some of the small equipment and jigs, used to accelerate production, have been constructed in-house and both maintenance and repairs are done in-house.

During the interview he expressed pride in the fact that he has managed to increase production of certain parts of the school desks considerably, for example, output of the writing surface, has increased from 24 parts to 40 parts, using the same amount of material (plywood), the back support from 30 to 50 parts and the seat from 24 to 30 parts. The main reason for this was: 'reducing material waste'. He regarded this as making progress because by doing so he managed to reduce production costs to a minimum.

As described in section 5.4.8. he is able to do this because his products are built without any consideration for the user. In the case of the writing surface he did not measure the size of a standard notebook or sheet of paper and there was no consideration for anthropometric measures.

The increased production and cost savings therefore, occur at the expense of the student's comfort and can cause back problems.

He described his process of designing as 'mainly mental', meaning by this that he modifies something which already exists in the market, in his head, rarely sketching out his idea but directly constructing a prototype. He explained that sometimes the client comes with a rough idea for a product, which he then develops further. He illustrated this practice with an example of a client who asked him to make a lamp to be fixed to a post. These are expensive products which are imported from the South of the country. From the client's description he was able to make an exact replica of the mass produced lamp and substituted it by his own version.

The interviewee explained that his products have a number of competitors and that with some competitors he has a good relationship. He then suggested that I should visit a competitor of his, whose work he respects, pointing out that this man's products are of better quality because the school chair he manufacturers has an 'oval' back, i.e. the desk was designed with some consideration for the user. According to him this is a better product, but more expensive.

The firm had no support from government or from private institutions. The entrepreneur explained that his contact with the university was in providing certain services to the institution's crèche and sporadically providing school desks.

### 5.5.2. Interview Number 7

This respondent's firm operates in the Mechanical District of Campina Grande (Distrito dos Mecânicos de Campina Grande). The district was created in 1983 and today has more than 200 workshops mainly involved with automobile motor and body repairs. There are two partners in the business, the respondent, who is in charge of the manufacturing and his partner who provides capital. The firm produces public cleansing equipment, street furniture and school equipment e.g. school chairs and tables. It also produces a range of trolleys such as funeral trolleys, meat transporting trolleys and hospital equipment. He has 3 workers involved in production and when necessary he subcontracts firms which bring in their own workers. He explained he did that to avoid having problems with employees and with the unions which, he stated exist only to 'complicate' business. He was originally a manufacturer of commemorative plates but, as competition increased, had to diversify and decided to go into metal manufacturing. The interviewee never attended a school and all his knowledge was learned-by-doing. However, he felt that there are advantages in working in larger companies in terms of having contact with advanced technology etc. In his words 'if a person is curious and intelligent he can learn many things'.

The firm sells directly to clients through a network of contacts. Having no salesman reduces costs and allows him to translate this reduction into cheaper products, benefiting the clients. He pointed out that his competitors normally use their clients' capital, asking 50 per cent of the total amount when the job is agreed and the other 50 per cent when the job is completed. The interviewee does not use this practice and explained that not doing so has been an advantage in attracting more clients. The firm only stocks school chairs, a seasonal product. His market is outside Campina Grande, mainly in the cities in the interior of the state, because, as he explained, in Campina Grande there is unfair competition from a factory which belongs to the state governor's nephew and which therefore gets all the contracts from the municipality.

Every one working with him also learned-by-doing. The existing equipment consists of: welding machine, grinding wheel, hand drill, industrial drilling machine, spot welding machine, tube bending machine, wire straightening, cut-off machine, manual shear and sheet folding machine. The cut-off machine was constructed in-house.

The client provides him with constant feed-back on the products he manufactures but this feedback is mainly related to maintenance problems. For example there is a frequent need to repair school desks because of the poor quality of welding in his competitors' products. The State Education Department, responsible for choosing equipment for schools, considers his products the best quality equipment made in Campina Grande, because his products are 'anatomic' and have good finish.

The respondent provided an interesting insight into the process of designing his products when he described how he defined the dimension of the school desk. The dimensions of the writing surface are based on a 12-14 year old child, and all his production templates are based on these ages. He arrived at the dimensions by using people close to him as models. According to the interviewee, users expressed discomfort about existing chairs at some schools, complaining they had to 'bend' themselves to reach the paper, so he decided to solve such problem by using six children to determine the correct position of the writing surface. The method he used was to ask six relatives of various heights to participate in the 'research'. He loosened one of the writing surfaces, thus allowing the user to reach the best writing position by 'snuggling' (adjusting) the surface until he found the one most comfortable. This done, the manufacturer fixed the surface and made the template. One person found it uncomfortable and the other five felt the position of the surface fitted them right. It was his own idea to conduct these tests because of his 'conviction'. He said:

> I had bought products which did not please me, so I thought that, if I was to sell my product I had to do something which was pleasant. Is it not so?.

He emphasised the fact that he uses similar procedures when dimensioning other products. The same respondent also uses scale models when designing furniture (Figure 51) to minimise the possibility of error, reducing development time and resources when investing in the construction of a prototype.

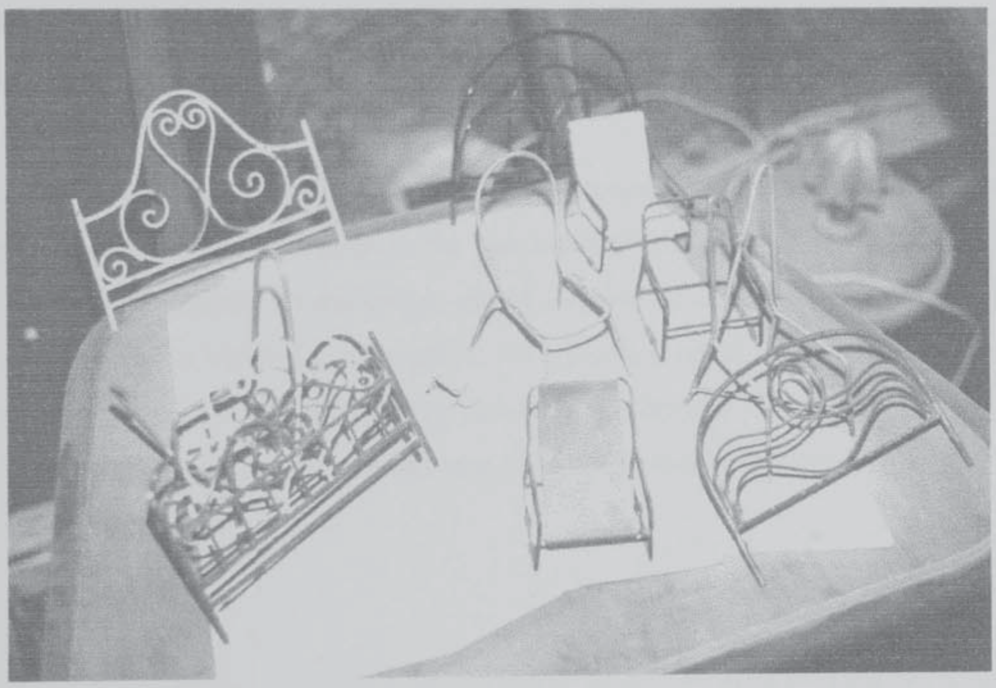

Figure 51. Scale models are used to minimise the possibility of error.

This particular entrepreneur was very conscious of the importance of product quality and customer satisfaction. In his opinion the client is the 'masterspring' of everything, the 'soul of the business', he is the primary consideration. So, when a potential buyer comes to him, the respondent suggests that the buyer should shop around, to decide himself which is the best product. He illustrated this by giving an example of a school desk which uses a thin aluminium rivet to fix the writing surface, as opposed to the much stronger rivet used in his products. The respondent admitted that his products were based on those already existing in the market, but that he improved on them.

The interviewee also expressed concern with the user's safety, giving as an example, a dust collecting trolley. There is one component in the trolley which is potentially hazardous and which has caused a number of accidents among dustmen. He tried to 'innovate', and redesigned this part making the product safer to use. Asked about the height of the dustman he explained that the stature of the Brazilian people is 'medium' and thus he based the product on a height of 1.65 cm. Based on this standard, he would then make the trolley to accommodate different sizes of the user population. According to him, the average emerges from a 'relativity' within that height. The respondent used similar methods to design other products.

Maintenance was also an important consideration in the design process. He exemplified this by referring to his competitors' products, where, according to him, a part which normally deteriorates faster (i.e. rusts) and has to be cleaned often, is not removable. Thus, from time to time the client is compelled to buy a new product. In his view, this is wrong. He emphasised the responsibility of the manufacturer: '...what he does not like done to him he should not do to others'.

The interviewee explained that his 'invention' process occurs mainly during leisure time at home, normally after meals when he is relaxed: he considered this a leisure activity, like playing sports. There were different reasons for designing: direct observation of the market was one of them, for example, a street lamp which he redesigned. He has also re-designed a lamp to substitute for a cast aluminium product imported from the South of the country. This redesign was undertaken bearing in mind his production machinery, raw materials available in the region, and a reduction in the final price (Figure 52).

Figure 52. Redesign to fulfil the requirements of small prefectures and the firm's production infrastructure.

He decided to redesign this product because the existing product is made of cast aluminium and comes from São Paulo (the most industrialised state, located in the Southern region of Brazil). The product, in his opinion, was 'beautiful' and made of good material but very expensive due to the quality of the materials used in its construction and the transportation costs. With his knowledge of the market, it was evident that local clients, such as the small prefectures in the interior of the state, normally trying to make ends meet with their meagre budgets, would not be able to afford such expensive products for long. Therefore, he invested time in redesigning the product, adding a number of incremental improvements and providing the same after-sales guarantee, and eventually captured the local market.

Asked if it was important for a product to be visually pleasing, he replied that it was crucial and gave as an example a badly constructed road with lamps which are very beautiful, sometimes costing the same price as an 'ugly' one. 'Beauty', he maintained, greatly 'improves' things. Again he used the example of an avenue which although not visually pleasing could, with a 'beautiful installation in the middle, be changed from ugly to be beautiful'. The respondent associated 'beauty' with quality. In the case of school desks the beauty consisted of a high quality finish given by the number of layers of varnish on the sanded surface. Once more he pointed out to the poor quality of his competitor's products, which are roughly finished and full of splinters, which could potentially hurt a child. He condemned this and said that his maxim was: 'beauty, quality and safety'. Safety in his opinion is paramount: although he agreed that beauty helps to sell a product he, as a manufacturer, did not want to be responsible for hurting people by making badly designed products and felt that it was preferable to sacrifice his profits by selling less products.

The respondent was also designing production machinery for his own use; that is a tube bending machine which would perform a number of operations not normally done by any existing product. This equipment was unique but he had not thought of patenting it, and he actually had no knowledge of how to process a patent application. The interviewee was keen to explain that he had also been involved in designing a process for emulsioning metal plates. It was sheer pressure for survival that made him undertake this because he was denied access to information by people from the Federal University of Paraíba. His aim was to substitute the KODAK KPR, an expensive product used for photosensitising metal plates. It requires a relatively sophisticated infrastructure to use it e.g. photographic darkroom with a certain level of cleanliness. By a trial and error process, he came out with a product which substituted KODAK's KPR, and had a number of advantages such as; no need for a dark room or film, the user is able to make the product himself, it can be used in relatively 'dirty' environments, and is made with easily found local materials. It also eliminated the need for an air compressor to fix the film with the image to be transferred and a strong special lamp, as his product works in day light. The product is made basically from bitumen and flour and, he said most people involved with commemorative plates today in the city use his process.

Of all the entrepreneurs interviewed, he was the only one who used methods similar to those used by professional designers, but all based on common sense. Not only did he study tubular furniture by using small scale metal models, but he also used scale models to simulate interiors where his products would be used. These were constructed and assembled inside a shoe box and then photographed to be shown to clients, giving an approximate idea of the possible disposition of the furniture in the room.

The respondent considered the recession in the country as his main difficulty emphasising the fact that he does not borrow money and accusing the lending business of being a farce to 'make us slaves of the government'. In his opinion there are 'tricks inside their maths' which are aimed at taking what belongs to him. He complained mainly about the level of interest rates and explained that when a person borrowed a certain amount of money there were a number of 'surprises' embedded in the loan which could raise the interest rates up to 80 per cent on top of the agreed rate. He did not belong to any professional association and complained that it was impossible to get support with such high interest rates. He has no support from the university but some people who work at the university through foreign aid programmes have been helping him to improve his welding skills. His firm occasionally provided products for the university.

### 5.5.3. Interview Number 9

This respondent has been working in this field for over 12 years. He works in a small, rented workshop which allows only limited production (Figure 53). One of his main problems is this small physical infrastructure but he has made no attempt to move because of the good local clientele. The workforce is composed of 2 boys, one being a cousin, and the owner, and all his income is generated by the business. The firm manufactures tubular furniture and general metal working (gates, windows etc.), repairs refrigerators and occasionally he designed and manufactured production machinery made to order. He was trained informally, working as an apprentice in a relative's refrigeration workshop.


Figure 53. Entrepreneurs' main activity is to repair refrigerators, but he also makes furniture using tubes and occasionally capital equipment to sell.

All work is made to order, products being manufactured for people of different classes. There are relatively sophisticated products for more wealthy people and very cheap products, mainly bought by people in the neighbourhood. Competition is fierce in the market. The firm has no salesman and clients go directly to buy in his workshop, the main advantage of such practice being the lower price of the product which is in tune with the market and can compete with larger manufacturers. He estimated that he sells approximately 12 beds and 4 shelves a month with the other products varying considerably.

The quality of his product is similar to the mass-produced ones but some of the finishing is poor, for example he uses sprayed enamel painting instead of the epoxy electrostatic paint finishing of the large manufacturers. Machine sales are rarer because manufacturers are not so keen to invest in production equipment. Sales of machines are better in João Pessoa, the capital of the state. He has made a machine to mill glass and has sold 8 machines in 6 months. He makes machinery to sell but also makes his own production equipment, only relying on outside help when he needs machining, such as lathe or milling operations (Figures 54, 55).

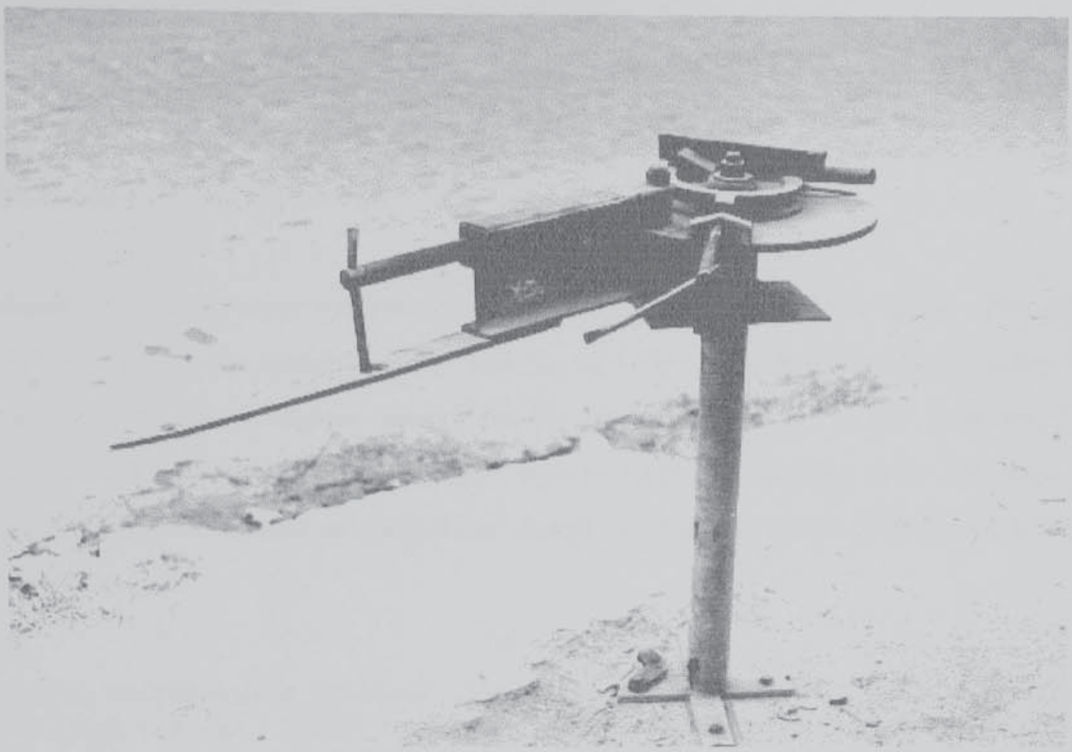

Figure 54. A tube bending machine for self-use and for sale.


Figure 55. Sheet folding machine built for self-use.

He constructed his spot welding unit and sheet folding machinery himself because the mass-produced equipment is expensive and of poor quality. For example, part of the mass-produced tube bending machine available is made from cast iron which is relatively weak so he uses forged steel in his alternative equipment instead.

The respondent's creative process starts with a conversation (the brief) with the client. This done, he works at home and 'loses a night's sleep' and the next day, he claimed will have sorted the problem out. His process is mainly mental but he admits doing some rough sketches. He imagines the working principles and what may happen when the machine is in operation by mentally isolating individual parts and generating alternative movements to specific functions. The process is as follows

> [...] each idea, each thought in my mind, I am not going to make it, no? I will imagine how it works, and then I choose. ...When I see a very interesting idea I stick with that, is it not so? Then I pick up my pencil, and I will make a little cardboard model ....I do it brutally, I create it in my mind and do it.

The use of simple cardboard models enable him to visualise the product in three dimensions and to show the client the functional principles of the product. This done, and with the agreement of the client, he estimated the cost and timetable. He pointed out that drawing (technical drawing) is a good help but that the model works better to get the message through the client. The respondent used the example of a windmill he designed by using a scale model which allowed a 'deep' understanding of the product by the client. He does not know how to do technical drawing and relies on his brother when needs so. His personal drawing abilities are poor and only used when generating alternatives, the quality of the drawing is very bad and can only be understood by himself. Dimensions and location of certain components were defined by using the height of the prototype's operator as a standard. No other anthropometric data were used. The development of the machine took place through incremental improvements based on direct observation of the prototype in operation. For example, in a glass milling machine it was noticed that when feeding the machine, the operator was hit by glass powder which could be hazardous for his eyes and lungs. Direct measures were taken from the operator and modifications made to redirect the flux to a lower level. A later and more expensive version of the machine was improved by designing a conveyor belt to feed the machine to a hopper. It is worth mentioning that cost of development was not even considered in the cost of the equipment. The agreement with the client was to produce an operating machine independently of the amount of time involved in the study.

In relation to furniture, he claims to have used 'standard' measures based on direct observation of other people, and his own size. The ideas for the furniture came from examples he saw in the market place. However, improvements were made and he tried to conceive his own designs, attempting to produce a product which was more 'beautiful'. This specific product was constructed full size and developed over the prototype by adding embellishments such as brass parts. Clients also brought photographs from interior decoration magazines and asked him to copy that model. According to the respondent, this was done because small metal furniture makers copy products from one another saturating the market with the same models.

The firm never had any support from the university nor any apprentice from the University. Contact with the university consisted mainly of manufacturing products for the university crèche. The respondent obtains support neither from the private sector nor from government and relies on his personal funds generated by work with the clients. The main reason for not borrowing money was the fear of high interest rates and the lack of ability to repay loans.

### 5.5.4 Interview Number 14

This firm has been in operation in the local market for over 30 years. It has a workforce of 25 employees engaged in production and 4 members of the family in management. The main product manufactured is a windmill to pump water from wells. The owner of the firm has recently invested in research and development aimed at producing a new windmill to generate electricity but R&D is a slow and costly process especially for a company of his size and he relies on his own financial resources. Thus, there are constant delays and drawbacks.

This entrepreneur started to work when he was 8 years old in his father's car repair workshop, but, as he pointed out, his vocation was to create products and he decided to work in industry. He worked in 96 different firms between the ages of 8 to 19, learning how industry functioned. His own company started with the production of hooks for hanging up hammocks and gradually progressed onto the manufacturing of windmills. His training was informal, learning-by-doing, as he was not able to go to school, a fact he regrets because today he feels the lack of theory as an obstacle in the creation of his designs. The firm has employed a number of apprentices from the university and in the workforce there are people who have participated in industrial training schemes.

The firm stocks a small number of windmills because sales varied monthly according to the amount of rain. They sold all over Brazil and some were exported to Germany. Salesman are not employed, so clients come directly to him, recommended by others. Selling directly is cheaper for him and for the clients, who are generally small farmers. The windmills cost approximately US$1000. Although he has managed to maintain sales, he admits that there is a need to have someone in the firm responsible exclusively for marketing, which will pay for itself through increased sales.

Existing production equipment includes lathes, milling machines, planes, presses, drilling machines, thread rolling machines, grinding machine, and tube bending machine. Although he said that there was a degree of quality control, there were problems because of the poor quality of some raw materials. For example, he said that the steel which comes to the NE is that left over from steel plants in the South, and some standard materials are not even sent to the NE.

He described a number of projects which have not been developed because of lack of support. A moto-cultivator and a hobby tool support accessory, are two examples of his designs which had to scrapped, because there was no support to develop and to produce them from whatever source. One of the problems he complained about was the prejudice of the local population against products made locally and in the North-eastern region. He said that people valued all that came from the Southern regions and from abroad as they associate them with better quality products. Sometimes this is true but it is not always the case: there are a number of products which could be supplied locally and would fulfil local needs without using sophisticated technology and which would be more suitable to local tastes and incomes.

He admitted that he did not invent the windmill produced by his firm, but that he improved it through a process of incremental changes to the mechanical system. His product was a substitute for an existing American one. His process of design included constant feedback from clients and he considered this an important aspect of improving products.

Design was something he learned by himself, and he used both rough sketches and scale models when generating concepts. He constructed card board models in order to study the working principles of machinery. He has designed a number of machines to process semi-precious stones but said that these machines 'have no design, they are just for working' (Figure 56).

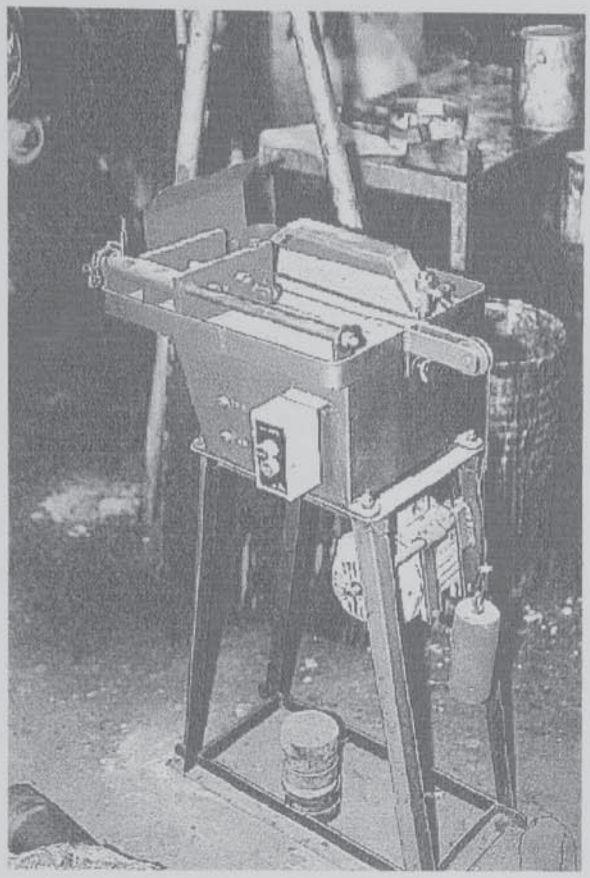

Figure 56. A precious stone cutting machine. The entrepreneur stated that: 'they have no design, they are just for working.'

As mentioned before, one of the difficulties he complained about in the innovation process of his firm was the lack of a theoretical base, which was an obstacle in some projects. The respondent was aware of the importance of interdisciplinarity and team work in a firm and criticised the vanity of some people who were not modest enough to ask questions about the work, and refused to consult other people. According to the entrepreneur such behaviour would stop the flow of information and prevent the attainment of a common objective. Without a team, ones' work does not go too far he said and he expressed regret that he was unable to be linked to such a team, and had to merely work on his own to survive.

He had asked for financial support in the past but because he had considerable problems in repaying the money he borrowed, and had had to sell property, he decided not to borrow any more. Today he relies solely on his own funds. The interviewee criticised the Federal University which he said received a lot of money but did not deliver the goods, but he explained that he has a good relationship with some people from the university and uses its specialised knowledge when necessary. He has also manufactured some of equipment and machines for use in the university.

However he was more sceptical about the role of the local Science Park. He also criticised the lack of co-operation between entrepreneurs, a factor that has delayed improvements in local industry. His firm casts metals, and he had tried to work together with the other four foundries to improve the quality of their casting, and thus improve their products and sell to a wider market. He was not successful and said that this attempt had failed because of the greed of the other entrepreneurs.

The respondent was not happy with the state government for its lack of support for enterprises with good potential for exporting products, blaming excessive bureaucracy as an inhibiting factor. He cited as an example a multi-cultivator he had designed which had an export potential of 2000 units per month. There was no stimulation from local government and the bureaucracy made him give up the project.

### 5.5.5. Interview Number 23

The respondent was the President of the North Eastern Inventors Foundation (Fundação Nordestina de Invenções). This Foundation, which was one and a half years old at the time of the interview, was set up because of the lack of technical and financial support for individual inventors. Some inventors from Campina Grande united and formed the Foundation. The Foundation, which at the time of the interview had 38 associates, helps members with ideas, suggestions, specialised labour and any other services. The Foundation has also made contact with other states. There were people in Recife trying to establish a local association based on the Campina Grande model, which was the first association in the NE, perhaps in Brazil, since, according to the interviewee, the association in São Paulo is only a government agency to support inventors. Since the Foundation had no support from municipal or state powers, they decided to do things privately using their own resources. When asked if he had sought institutional support he mentioned the Science Park of Paraíba. In his view, although the aim of the Park was to help the inventors to make contact with industry, in reality, it was just 'political marketing'. There was no real support from the Park available to the local inventor, because although the Park was capable of helping him, the government did not give enough support. There were no facilities such as a room, and, when asked, the Park did not give information about obtaining resources from the government. He felt that the Park had usually only benefited often firms which already had capital and that the individual inventor continued to be marginalised. He even accused the municipal powers of stealing one of the member's inventions.

Due to the situation described above, the Association decided to go directly to some industries which had the financial resources and try to get support from them. He pointed to other positive aspects of the Association, for example it was acting as an intermediary in negotiations over a couple of patents to be produced by Brazilian companies. At the time of the interview there was no financial support available to members.

The Association also participated in exhibitions such as the Technology Fair in Campina Grande Grande's (Feira de Tecnologia de Campina Grande - FETEC) and Campina Grande's Business Exhibition (Campina Grande Mostra Negócio) The Association's stand was donated by the Bank of the NE. The President of the Association thought that the exhibition maintained a positive balance between contacts with people from outside the state and the exchange of information within the locality on a number of matters such as raw materials.

The respondent pointed out that there were some advantages for inventors living in Campina Grande. The costs of developing an invention were low due to the fact that Campina Grande was a relatively small city, and it was therefore easier to obtain specific information from acquaintances. He also suggested that the existing labour force which was unemployed is a source of creative potential and was effectively already inventing things. Talking to such people could be an important source of ideas and technical information.

The entrepreneur claimed to have 12 patents registered in his name and he defined an invention as a product deriving from an identified need. According to him, inventions aim to solve problems in the most practical way and inventors thrive upon challenges. Inventors try to overcome challenges whereas non-inventors tend to seek for help once an obstacle appears. The interviewee's R&D was slow due to lack of financial resources and the creative design process normally took place at night because during the day he was too busy with management problems in his firm.

The respondent stated that members of the Association cited lack of financial resources as their main problem. Secondly, there were difficulties with developing the invention such as applying for a patent which, at the time, cost approximately US$300. There is a patent agent at the University, the Centre of Technological Innovation (Núcleo de Inovação Tecnológica - NIT), which can advise people on how to structure the patent application and submit it to the Patent Office in the South of the country. This was seen as a positive move because before this branch was opened, people had to go to Rio de Janeiro, a trip that took two and a half hours by jet plane or 48 hours by road.

The respondent stated that he has 3 products: electronic tap, electronic shower and electronic flush being industrially produced by a firm in another state of the NE and one other, a burglar alarm, being manufactured by himself. He pointed out that one of the difficulties of manufacturing his products through a larger company was the lack of information on how to make a contract, and a joint venture.

He mentioned a number of good products invented by locals, such as an electronic taximeter, a PVC water pump and a process for making powdered potato, which were copied and patented in the South, and were now being produced by a big company there. His own company produces a number of burglar alarms. He estimated that if support was available he could produce 50.000 units a month, whereas today his production is 1000 per month. He felt that the government should set up institutions to give all the necessary support to entrepreneurs to put their inventions into production. Seeking for such support, the respondent had tried to arrange an interview with the Governor of the State but, this was not granted. He implied that this behaviour from the state authorities was a deliberate attempt to allow the commercially potential inventions to become public domain so that they could be copied by richer firms after two years. He is currently lobbying MPs to get the law changed.

Five members of the Association are industrial designers. The interviewee felt that the design of his products was 'very bad', but emphasised that the technology he used was 'state of the art'. He showed photographs of models of his inventions shot to be used in a market research exercise and suggested that if his products incorporated design, a 'better make up', his market research would have been more successful. During the market research, when explaining the technology, people were impressed and very interested but when he showed them the photo of the prototype every one lost interest. Potential buyers commented that, aesthetically the products did not fit in with the environment, meaning they did not match the colours of the bathrooms where they were to be fitted and that the form was badly designed.

According to the respondent, 62% of the equipment manufactured in Brazil did not work properly. In the case of showers, they 'leak' electric current due to inappropriate insulation, causing the bather to receive an electric shock. So he designed an alternative which eliminated this problem; the shower is activated by photoelectric cells when the person stands underneath it.

He said that he had no contact with the industrial design course at the Federal University of Paraíba. Making contacts is a problem as most members of the Association have their own business and little time to invest, and they lack specific personnel to do this. He did once contacted an industrial designer to help develop his invention but the prices for the consultancy were too high for his budget. He felt that such a professional would have to work in close co-operation with him, and have a deep understanding of the equipment's functioning, in order for the collaboration to work.

One of the problems pointed out by the respondent was that North-eastern entrepreneurs are afraid of investing in new technology. He blamed the high costs of the innovation process, such as market research and also the uncertainty involved in the innovation. He knew a number of people who had invented advanced products but had no prospect of developing their products because bigger entrepreneurs were not interested.

According to the interviewee, SEBRAE and the Science Park were able to offer financial help to inventors, and would give them two years to pay back the loan but the problem was that the borrower had to pay monthly interest rates on the amount borrowed. For the inventor this was too high a risk because it was not certain that his idea would be successful or that he would be able to recover the investment made. There was also a need for collateral, which not every one possessed. For those able to give collateral, failure meant losing their assets. So it was very difficult for the small inventor to succeed, even if he managed to be granted a patent, because if he did not put the patent into production within two years then he would lose the right to do so, and lose all the investment too. Another problem for the inventor was that the potential manufacturer generally required the whole package to be ready: that is, material requirements, quantity of production, market research etc. all to be already fixed by the inventor.

### 5.5.6. Interview Number 25

This contact was given by another entrepreneur who worked illegally in the same neighbourhood. This unit also operated informally in the back yard of the entrepreneur's house. He has a workshop of 60 m2 and only two people work on the premises, the owner and a next door neighbour, however, the owner's wife sometimes gets involved in the workshop. The products manufactured are pan holders and a shoe holder (Figures 57, 58).

Figure 57. Example of the firms' main product: saucepan designed by the entrepreneur.

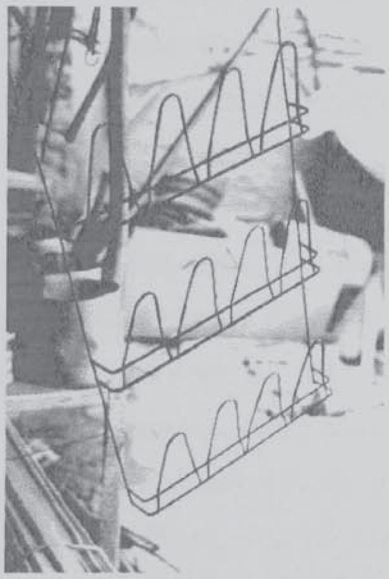

Figure 58. Example of a shoe-rack made from recycled wire.

When asked about the origin of the business, he explained that the need to leave school when he was a child, because of money difficulties, was important because he had to acquire technical skills. He had no formal training and only attended school up to the age of ten. This compelled him to travel to a number of states in the NE and to the North region working for different companies. This experience made him realise that he could set up his own business. The firm had been in operation for the past three years (date of interview 1993). The fact that he had worked in a factory manufacturing metal products gave him the self confidence to start his own firm. His previous employer was supportive when the respondent was his employee and taught him a number of skills. His employer had a peculiar way of operating: although its base was in the capital of Paraíba state, if they received a big order, the owner would move his equipment to the place where the order was to be delivered, and manufacture the goods *in loco*, according to him, a cheaper alternative to shipping it to the buyer.

The respondent's income derived exclusively from the business. Working without a permit is his alternative to paying taxes: he said that if he registered the unit and paid all the necessary taxes there would be no money left to eat. At the time he earned little more that the national minimal wage (less than US$100 per month). He mentioned that if he was caught by the government authorities then he would have to bribe them. Working in such a situation can be a tense experience: while the interview was being conducted, the interviewee's mother arrived and thought that my colleague and I were policeman, who had come to arrest her son. She misinterpreted our aims because she saw my camera and thought that I was recording the evidence against her son; she was very distressed and it took a lot of explanation to calm her down. In the end she explained she had reacted in this way because her next door neighbour had threatened to denounce her son after an argument.

One of the major difficulties this entrepreneur experienced was the price of raw materials: because his capital is linked to the family budget he explained that stocking raw materials would mean taking the 'bread' from his table. The entrepreneur stated that competition was not so fierce for the kind of product he makes, but he complained that the policy of the local authorities of stimulating tourism in the city was not beneficial to manufacturers like him but to the service and commercial sectors. The respondent explained that during a period of approximately 6 months there was one commemoration after the other and that people spent their money mainly on leisure activities and more superfluous products i.e. shirts printed with the logo of Campina Grande's carnival. Thus, products for the household would not be considered so important during this festivity season.

His market outlet is the Central market of Campina Grande, where there are shops which sell a variety of products: he leaves the product there and if the shops sell it, he will be paid. He also has clients in different neighbourhoods, supplied by 'prestamistas' — people who carry the goods and sell them on a house to house basis[3]. According to him this form of selling is not working too well because people are only buying very basic things like food, and he has had to stop production a number of times because of lack of demand.

There are two competitors for his products: one operates in the same market, and the other works in the interior of the state in smaller tows. The later owns an automobile, a competitive advantage which allows him wider mobility and thus an increase in sales. However, it is possible to operate in the same localised market. His pan holder was sold to retailers at 50.000 cruzeiros (34.000 cruzeiros to a dollar) the shoe holder costs 100.000 cruzeiros. The respondent thinks that the pan holder is the weakest product, he has had to compromise over the quality of the product by using a material which is cheaper and easier to work with. He makes 75 pan holders and 50 shoe holders per week and has also occasionally been involved in tubular steel furniture manufacture.

His production facilities, from tools to safety equipment, are mostly improvised (Figure 59) due to lack of money, but sometimes because the appropriate equipment is unobtainable.

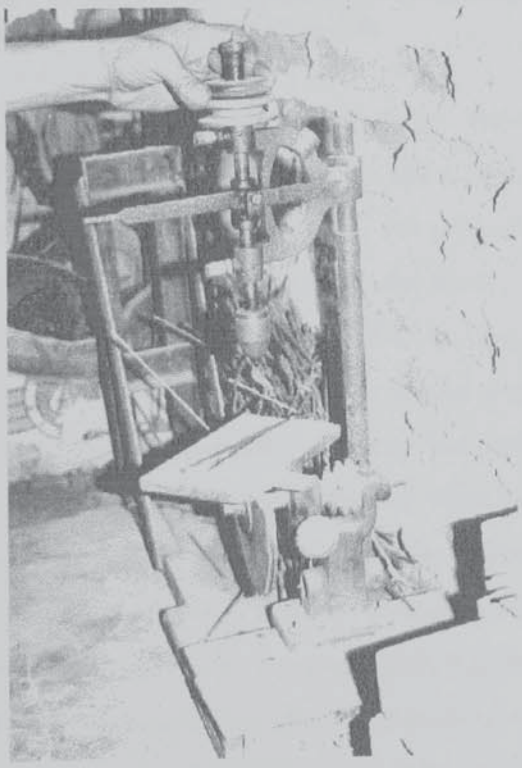

Figure 59. An example of improvisation in production equipment: machine tools.

3 The term 'prestamista' is used here in a different sense. The term is in general used to describe moneylenders and also a person who buys goods in instalments.

He gave the example of a 'safety glove' which he improvised because existing ones designed for use in factories did not allow the movements needed for certain operations in the construction of the pan holder (Figure 60). The interviewee explained that the tool was based on a hammock hook and described the process of improving and speeding up production.

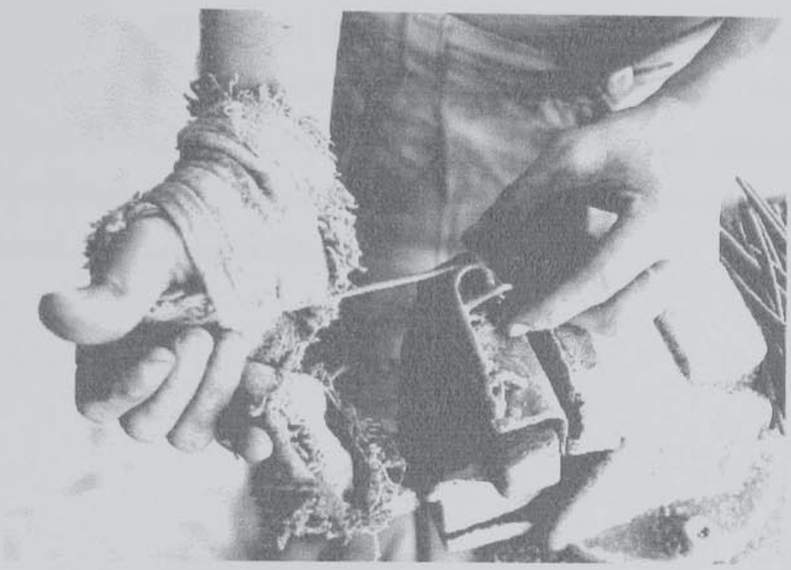

Figure 60. 'Safety glove'. Existing mass produced safety gloves do not allow such delicate movements.

The respondent described himself as having been a creative person since he was a child. Due to financial difficulties he had to work selling food on the streets, from the age of 5, in order to survive, and had to make his own toys from tin cans. He gradually started making toys to sell and then went on to other products such as corn graters and kites. He said that design activity was necessary in his enterprise because new products had to be launched onto the market. The shoe holder was designed because 'everyone needs one', but he also 'invented' the product because sales of the pan holder had fallen dramatically. He also designed other alternative products, such as a support for a clay water filter, which was 'different' from existing products and more robust. But soon he had to stop making this product because the raw material manufacturer had closed down. The price of the steel was also very expensive, making it difficult to buy this raw material. Gradually sales of the pan holder started to increase again, but because the sales of the pan holder fluctuated, he designed the shoe holder but did not launch it into the market for fear of losing money: the shops would not pay the amount he was asking for. The creation of his products was closely linked with his personal life. He explained that once you need something like a kitchen cupboard, you can make it yourself just like you can make a wall of bricks and even your own bricks. Based on this philosophy and his personal habits, such as leaving shoes around the house, he decided to design the shoe holder. He thought that if he needed a shoe-holder why won't others?

The respondent worked directly on the material, by trial and error. Although he knew how to draw he did not like designing using drawing skills. He proceeded directly to construct a working model and if this prototype did not work then he would give up. He contradicted himself later and admitted that sometimes he used drawings when he did not want to 'heat his head'. The interviewee had also re-designed two coconut scrapers to compete with existing products (Figures 61, 62), and these designs again originated from his personal domestic problems: the need to alleviate his personal drudgery in the kitchen.

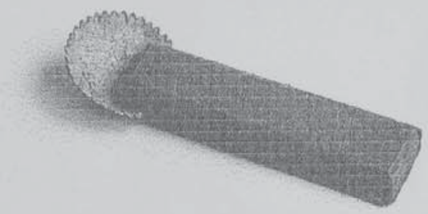

Figure 61. Existing hand operated coconut scraper.

Figure 62. Existing cast aluminium 'fixed' coconut scraper.

He designed two different models. One of them he wanted to make more 'modern', practical, easier to operate and which could be used in a number of places. The other was to be fixed on a table (Figure 63). However he admitted the products were a market failure. According to him, designing production machinery was the same as designing consumer goods. The best time to create was under pressure. Designing is a process which he frequently does when sleeping and when he wakes up he sketches the ideas.

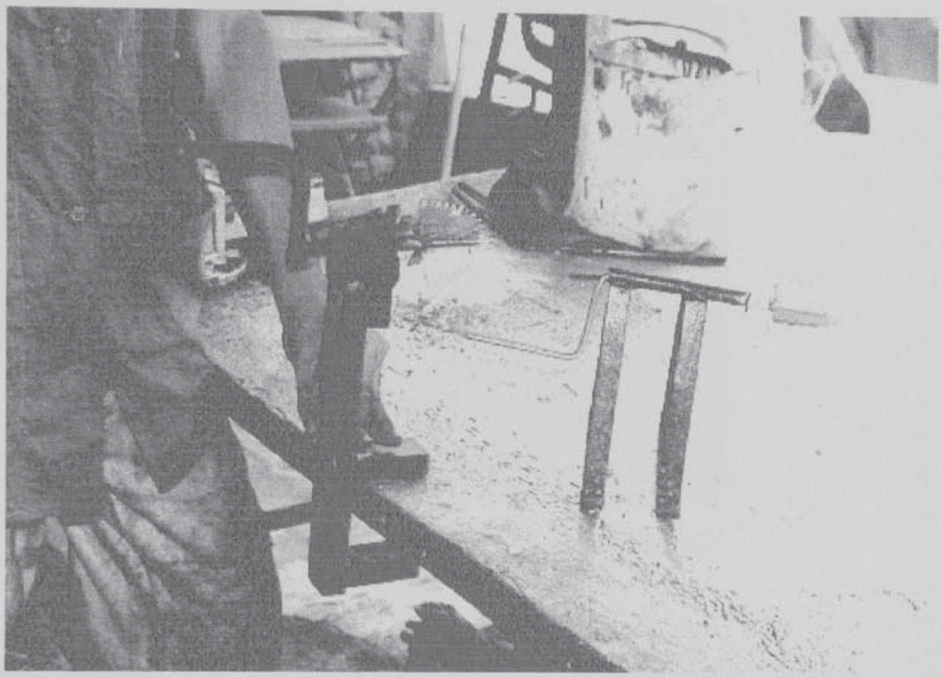

Figure 63. Redesign of coconut scrapers.

Asked about the beauty of his products, the respondent said that the filter support he manufactured was of good quality and robust construction because he used good materials, but the buyers (retailers) thought it was 'ugly'. He argued with them explaining that artistic aspects are not so important, that the product had to be robust, and he criticised the salesman for promoting a dangerous product which 'wobbles'. If an accident happened then the manufacturer was to blame. However, he did recognise the importance of certain details in the product in attracting the attention of the customer. He did not describe any 'beautiful' aspects of the coconut scraper, but emphasised the high quality of the construction and assembly of the pan-holder and referred to the embellishment he called the 'S', a decorative element that he identified as his 'touch' and which clients appreciated. (Figure 64).

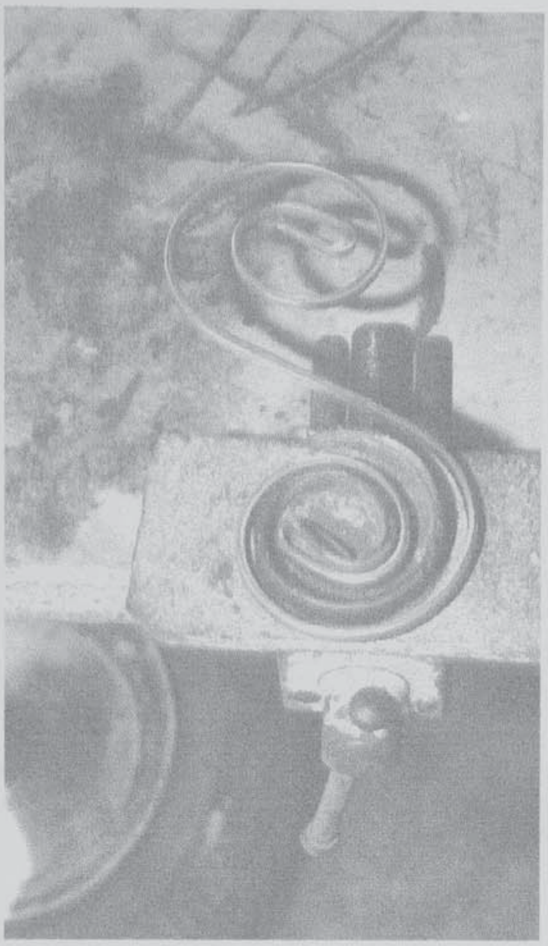

Figure 64. Decorative 'S' identified as this entrepreneur's personal touch.

The entrepreneur was aware of problems concerning the design of new products, he feared being copied by others and explained that it was small businessmen who always suffered. He also suggested that entrepreneurs should make more use of materials which are wasted by industry to make new products.

The interviewee provided an interesting insight into his design process when describing the process of designing a tool to be used in a domestic context. This is a tool designed to remove a kitchen gas tank valve. He identified the need for this product from direct observation of the difficulties women had in removing the gas valve from an empty kitchen gas container, when replacing it with a full one. On some occasions the valve was tight and difficult to remove and the use of a tool was necessary. The problem was that the valve's thread became stiff after a period of time and this made it difficult to remove the whole valve. People often used a hammer or another improvised tool to remove the valve and some times broke part of the valve. The entrepreneur investigated the market and found two different tools for removing the valve (Figure 65, 66)[4]. He purchased them, and conducted some tests. The first product was dangerous because, when force was applied to twist the valve, the tool could slip, hurting the user. The equipment could also be damaged if the valve broke because the part which fitted the body was manufactured using a round grinding wheel which did not fit the valve's square profile properly. The second product was a pressed and chrome plated tool imported from another region that, according to him, performed its function properly but was more sophisticated and too expensive.

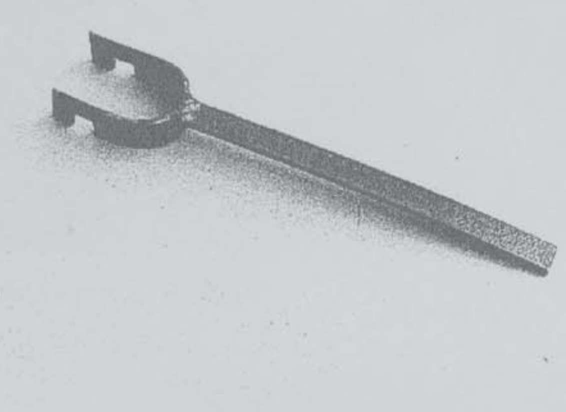

Figure 65. A product made by another small firm

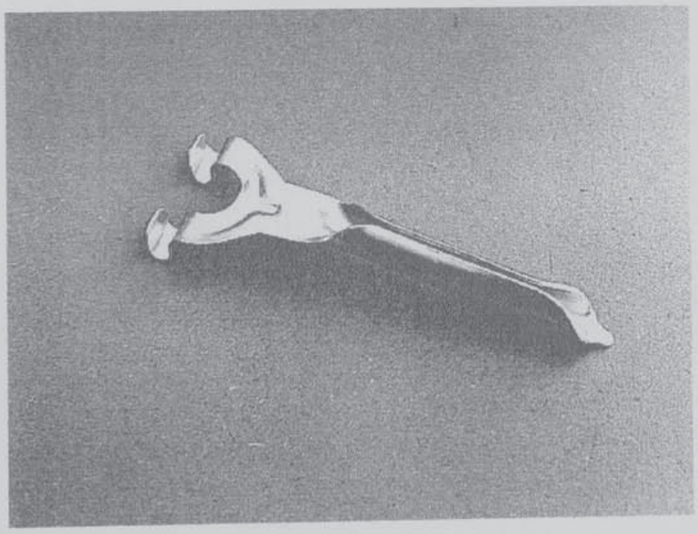

Figure 66. The expensive mass produced version.

4 Due to the lack of an actual example, Figure 58 presents a product which is very similar to the one he identifies as badly designed. The only difference is the slot which fit onto the valve's neck, in this illustration it is square shaped rather than round.

Based on this information, he decided to design a new product to compete with the existing ones in quality and price (Figure 67).

Figure 67. The improved redesign.

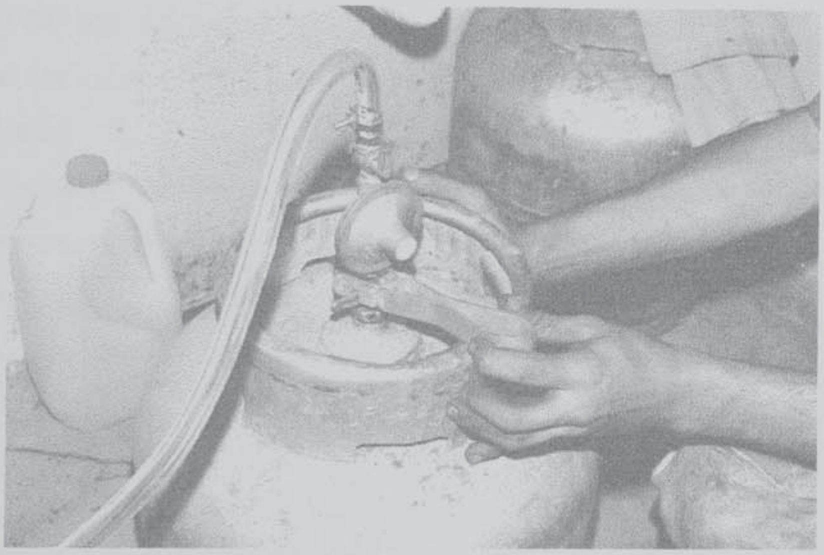

Figure 68. Alternative product in use.

The product was therefore designed with the female user in mind. Initially he measured his own hand and concluded that the size of the tool was suitable for a male, but after his wife tested it, he saw it that was too big for a woman and decided to reduce the diameter of the handle. He then measured his wife's and his mother's hands to be sure it could be used by 'all' women. He said he often did a number of simple tests like this with people close to him in order to get the product right. He designed it to be manufactured using his present production facilities and equipment, mainly an electric welding set and some hand tools.

His redesigned product had a square profile which provided a good grip on the valve's neck, and also eliminated unnecessary effort as he extended the handle of the tool to increase leverage. However he failed to take into consideration that there were valves from different manufacturers with different dimensions not covered by his tool. The respondent admitted that his product did not sell well. The shops were reluctant to take the risk of stocking his product because people preferred to buy factory-made, chrome plated, more expensive tools, which were visually more appealing, and he was unable to convince the shop owners. The respondent has never sought any financial support and has had no contact with the university and no support from any other institution.

### 5.5.7. Interview Number 28

This interview was the only one conducted in a rural area, and it was included because this entrepreneur had won an important national prize, the Talento Brasileiro 1987 (Brazilian Talent) for innovation and also works in metal manufacturing. The firm operates in a workshop approximately 700 m2 with a workforce composed of two people and the owner. The interviewee works to order, the client giving him 50 per cent when ordering and 50 per cent after the work or service is delivered. His clients find out about his firm from people who know his previous work. Besides the workshop, the entrepreneur also runs a small car repair business. He manufactures agricultural processing machinery and also repair machinery and equipment. He has always worked alone and has never been employed by other firms. He considered raw material costs and lack of working capital as his biggest difficulty and was afraid of borrowing money to stock raw materials because he knew a number of people who had lost their business when interest rates soared.

This entrepreneur started working with his father who had a workshop, never had any formal technical training and only attended primary school and two years of secondary school. He complained about the lack of theory in his work and felt that schooling would have helped him today. He thought that his ability to work with mechanics was hereditary and he had always been interested in making modifications to cars, adapting the structure etc. However, he believed that children could be stimulated to create things, and be trained to improve their creative potential. From this practice could emerge people able to create useful things for every one. School should be the first step in this process and teachers should be able to spot the creative potential of some children and help them to develop their vocation. According to the respondent, enterprises could co-operate with schools and create opportunities for people to develop their vocation.

This firm manufacturers a sisal processing machine (Figure 69), and the idea for this product emerged from observation of the difficulties concerning sisal processing. It took him 10 years to develop the machine from the inception of the idea but now, as sisal is becoming uneconomical and people are investing in other crops, he is afraid of losing an already reduced market. There is a demand for the machine in other states of the NE but, because the machine needs further development, and he has no financial resources available to do this, he cannot sell it.

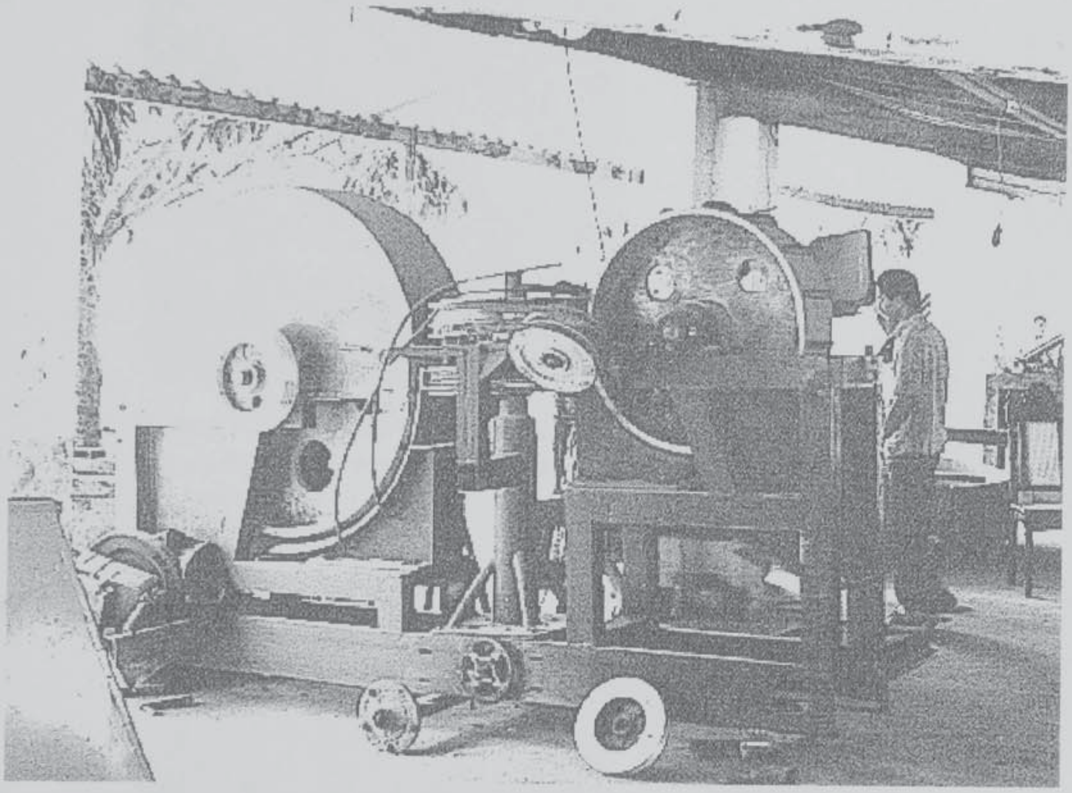

Figure 69. Double rotor, sisal processing machine. It took the entrepreneur ten years to develop the machine.

He has no promotional material, but says that there is no point in producing promotional material if the machine still presents a series of technical and operational problems. When there is a potential client, he takes him to the field and shows the equipment in operation. The main advantage of his machine is the fact that it can be moved around the fields to process the sisal *in loco* and also that it is much safer than the existing machines made by competitors. The machine differs in a number of aspects from existing ones: it allows increased production without the risk of the operator who feeds the machine getting his hand caught between the rotors; the leaves are fed onto a sort of conveyor belt (Figure 70) which carries them to the rotors which expose the fibres and then continue to move to be picked up by another operator, this operator can be a child as young as 8 years old (Figures 71-73).

Figure 70. Leaves are fed onto a sort of conveyor belt which carries them to the rotors.

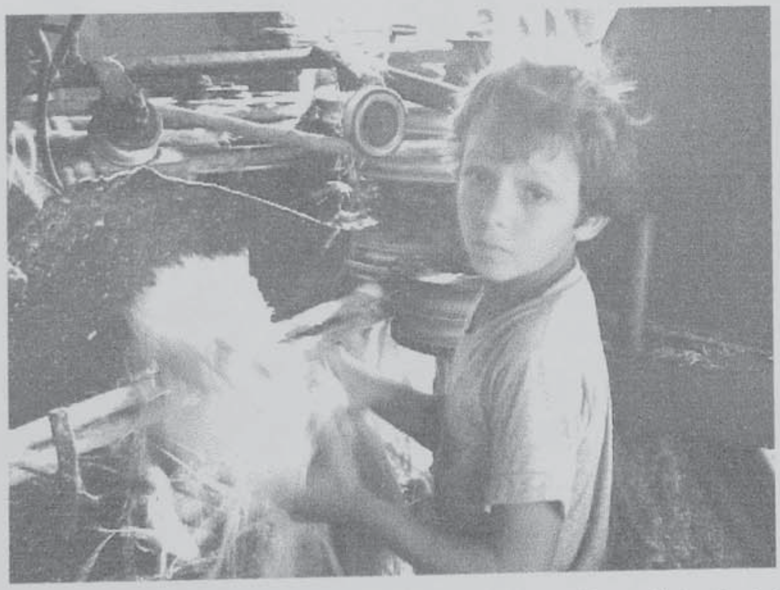

Figure 71. Children as young as eight years old work in the high speed conveyor belt.

Figure 72. Processed sisal is picked from conveyor belt and then separated to be weighted.

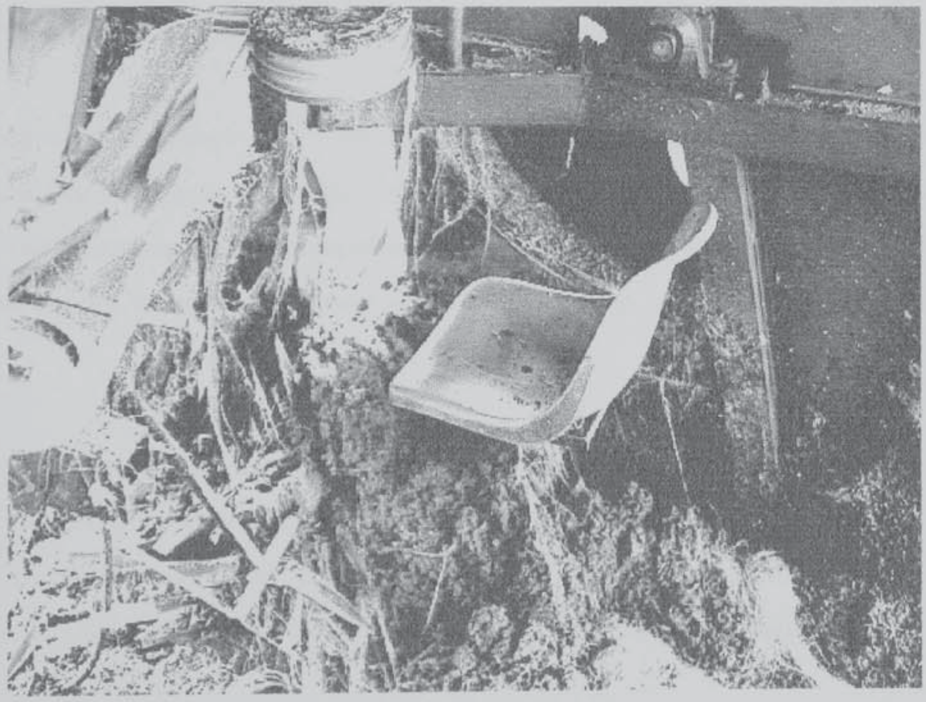

Figure 73. Operators work in unhealthy conditions.

Nevertheless, observation of his machine in operation, shows that it offers considerable danger for operators. He stated that one of the most difficult problems to solve in the machine was the joining of the ropes to carry the sisal leaves to the rotor.

The interviewee's main objective today is to see this machine completed. He said that his main reason for doing so is to obtain recognition for his work as an inventor. This is very important to him because when he started the project no one believed he would be able to do it, and even suggested he was mad, but he persevered and managed to develop the invention to its current stage.

The reason for lack of demand for his machine is that sisal is becoming an un-economical crop. According to the respondent, of the 12 machines produced only one is working satisfactorily. The main problem with the machine is the fact that it has to be moved around so it can only have one motor instead of two, although two motors would make the machine work more satisfactorily, and in the version with one motor, components break easily. According to the respondent, the main problem with the machine is the power source: he needs to install two motors, but doing so would bring a number of subsequent problems such as increased weight etc.

The 12 machines were produced until 1992 and are scattered around 3 states of the NE. It is interesting to note that the machine is sold to the client without being totally tested, but the client will contact the manufacturer when the machine poses a problem. However, the major problem for the manufacturer is that when he receives this feedback, he has no capital to do the necessary modifications.

According to the respondent, representation techniques are important. If a person knew how to draw, he could present a better image of the equipment because drawing makes things easier to understand. The entrepreneur does himself draw rough sketches as an auxiliary tool in his thinking process, but he admitted that they were so bad that only he could understand them.

When he wanted to dimension something he assembled the equipment, went out to the fields and ran the machine for a number of days to see how it behaved and after these tests were conducted, modified it or not. He complained that this was where the university failed him (he asked for help with his products as a first testing step but did not obtain it). Time taken up with research and development for his machine was becoming more critical now that sisal was no longer an attractive crop in Paraíba. In relation to the prize *Talento Brasileiro* he complained about the razzmatazz made about the benefits of winning such a prize, and the many medals and trophies he got. Although he did receive an amount of money which was invested in further development of the machine much needed support in the subsequent stages of the design process was not available.

In his opinion, it is very difficult for an inventor to be organised. Every inventor is disorderly. The respondent provided an interesting description of the creative process

> [...] creation, that is the ideas which appear to the inventor, are like lighting a match. If you take the opportunity and light something else that's all very well, [...] but if the match goes off, that is it!

Normally he uses no models when generating alternatives. This machine was an exception and the reason for producing the model, was the lack of capital to construct a full scale prototype. So he used a scale working model to prove to potential clients and others that his principle worked. Even so people were sceptical. So he decided to find the money to make a full scale model to prove his point.

He acknowledges the importance of appearance in products. According to the respondent, in the majority of cases if the product is not beautiful people will not want it: the aesthetic factor is therefore important and creates an impression of quality. He gave as an example a machine with the mechanical system exposed, all 'ugly', the client might think this would not work. But once you cover it, paint it, and apply 'decoration', and a good finish, the client will be impressed even if the quality of the welding is not good. Appearance in his opinion helps to sell the product.

Asked how would he improve his machine, he replied that he would have to change its visual form and he compared the machine with a human being who has to change his /her visual appearance from time to time. He argued that if there were two machines with the same function and one was visually more appealing then it would outsell the other. So he thought that it is was important for the entrepreneur to think about this visual aspect. However in his case there was no need to worry about it because his machine had no competitors.

In relation to other factors in design, he mentioned that he was concerned with the operator's safety. Since the sisal processing produces a liquid, when the operator climbs onto the machine he/she could slip and hurt themselves. He based the height and dimensions of the seat on his own anthropometric measurements and tested the equipment himself, thus he claims to be aware of ergonomic problems. He was also concerned about noise reduction in the equipment and planned to move the motor away from the machine as a way of overcoming this problem, and allowing communication between operators. He felt that protection from the weather was the responsibility of the owner, who must provide shelter. When asked if other people he knew cared about such questions, he replied yes because this was something all inventors and entrepreneurs had to worry about. It was important, for example, to select quiet, rather than noisy equipment: this did, however depend on the buyer, whether he cared about his workers or not.

His creative process worked better during day time and he said that when he had a creative problem to solve he went out into the fields to think: he needed contact with nature to be successful. He said he had not spoken about the creative process with others since his contact with other inventors was nil. However, he did acknowledge the importance of having contact with other people and felt that other people could help him to arrive at a solution. The interviewee had had a brief contact with the inventor's Association in João Pessoa but, subsequently lost this contact. He saw the association as a positive thing which could benefit many inventors.

He did not feel that his inventions, had improved his quality of life. The difficulty for the inventor was that he took a long time to create and someone took over his invention and improved it so that the original creator did not get any benefit. He was concerned about being involved in the design of equipment when the product it was processing, sisal, would no longer be available in the state. He felt that if he had invested in another area he might have been better off. His machine had been modified four times. There was an alternative for him which was to adapt the machine to work with ramie, - another fibre- and some company had already contacted him about this possibility.

He has never had an apprentice from the university. He has contact with the university through individual members of staff, but their support took the form of bureaucratic information on how to patent inventions, rather than help in designing or testing the machine. He has no other kind of support for his business. He believed that the Federal University had not helped him because the Mechanical Engineering Department had developed its own model, and had decided to support that one, although he said it did not work properly, and there were a number of those machines in different parts of the state, which were not in use.

He tried to get support from a number of banks but, borrowing money was expensive because of high interest rates. He also has no link with any professional associations. He had been contacted by the Association of Inventors but found it difficult to maintain contact with them because of the distance he had to travel to attend meetings happening 200 km away.

## 5.6. Commentary

A number of points emerged from the evidence collected in Campina Grande. The most important is that there is design capacity in microenterprises operating in the metal manufacturing sector, although such capacity varies according to the firm. This capacity includes the copying, adaptation and creation of both capital and consumer goods. The second is that there are a number of obstacles which impede the development or creation of design capacity at microenterprises level, and that these are interrelated. Other actors have to be involved to remove them. The third point is that there is room for co-operation between professional design and existing non-professional design.

An interesting parallel can be made between retail outlets manufacturing production units in the sense that both are very flexible and adapt themselves to the demands of the market. That flexibility is an important aspect of the survival of the firm. Similarly, there are many products manufactured in some small units, and shops also sell a variety of products. This allow them to survive, and accounts for the diversity of products sold. Most products were household items. Direct observation of the small workshops and of the central market activities showed that there was widespread use of child labour.

Some entrepreneurs, in metal manufacturing firms, regarded the workshop as a school and themselves as masters who taught working skills to the children. It also emerged from informal contacts that, in general, the level of education and literacy is low. There was also evidence of health hazards such as dangerous equipment being used.

The data from the survey suggests that there is an informal innovation system which is composed of small firms and of individuals. Although many firms work in isolation, many form links in order to survive. Design in this context is an activity conducted by people who are rarely aware they are doing design. This activity is carried out in the majority of firms mainly by informally trained designers, the entrepreneurs themselves, or their employees and, formally educated industrial designers are rarely involved. Most respondents had no formal training in design and relied on their individual creativity to innovate. Non-professional design in local microenterprises is characterised by attempts to introduce new consumer goods in the market, production of capital goods for self use and the occasional design and manufacture of jigs and production machinery for sale to other production units. Many of the products are competing with, or are an alternative to, products produced by the formal industrial sector.

The production of consumer goods is more widespread than capital goods. This is because, among other things, they are easier to market. From the design and development point of view, they are also easier to copy and to adapt to existing production capability, and relatively easier to create from scratch. The creation of the products is based mainly on other products already sold in the local market, and by direct observation of products advertised in the national media. Another characteristic is the production of a variety of products which are not directly linked to the main activity of the enterprise. This appears to be directly related to the uncertainties of the economic system at the time. For example, manufacturing other products functioned as a safety net, in case the main product was not in demand, and also made use of idle equipment. Another reason is the competition within the sector. Many firms were involved in metal work, producing gates, windows etc. These types of product saturate the market. Thus making different products is an feasible alternative and has the potential to increase sales. Making different products also has the advantage of making use of existing production machinery and avoiding the need to invest in expensive new capital equipment.

Paradoxically, the constraints suffered by manufacturers appear to stimulate their innovative behaviour and self confidence in design. Innovative entrepreneurs perceived product design as a challenge to their creativity and were keen to describe how they've achieved ingenious solutions in their products. They enjoyed tackling design problems despite very little time available for design and development activity. This activity, is conducted using very few formal design methods and usually occurs during leisure time, as their time at work is dedicated to solving production and management related problems. These creative opportunities are seen almost as a luxury, a moment of leisure, although some entrepreneurs admitted creating under pressure. Two-dimensional means of representation were very seldom used, and innovators relied mainly on their ability to work in three dimensions. Only occasionally do they use scale models. In general the product emerged from incremental improvements in the prototype. This was because most did not known how to draw, had no industrial technical training and had learned their skills as apprentices working in workshops.

One point worth noting is that when designing a product, the cost of creation and development was not considered separately. The client and the designer perceived this cost to be included when the product was sold, even if the product was designed from scratch. Special orders, like production machinery, are in general designed in close contact with the client, who would start using the product and as problems emerge the designer is called in to sort them out. This occurs because there are no facilities to test and refine the product in-house and even if there were, the client might not be keen to pay for the development. Because both the entrepreneur and the client are in a hurry, the entrepreneur because he needs cash, and the client because he wants a cheaper deal than the expensive mass produced equipment, they want to get the product in operation as quickly as possible and are compelled to develop the machine together. However, consumer goods are designed more in isolation. Some entrepreneurs even use this isolation to produce bad quality products. For example respondent No. 3 stated that he never received a complaint from his clients but this would, in fact, be unlikely to happen as the users are located in isolated areas of the state and very seldom have the right to express themselves in such matters.

Design and production skills are based mainly upon previous working experience gained while working in larger organisations, and common sense. Work experience and training in larger, formal enterprises were considered an important aspect of the ability to innovate. Actually, as pointed out in interview No. 14, some entrepreneurs used such experience as a substitute for formal technical training. At present these small units have little access to technical information through formal channels and institutionalised support, leaving them to depend upon informal networks such as suppliers and other businessmen when needing specific technical information.

Another important aspect highlighted by the survey was the fact that even with products intended to appeal to the low income population, embellishments are valued by both the end user and the manufacturer. In Interview No 25 consumers made their decision to buy the mass produced gas valve remover based on a non-price factor, the form and the finish, despite the product being more expensive. It is worth noting that a considerable number of the firms were involved in manufacturing products such as gates and window frames or furniture, which allowed only minor aesthetic modifications. There was need for improvement in relation to safety aspects, both in consumer and capital goods. Many presented risk of serious injury or even fatal accidents, as in the case of welding machines which had no enclosures, broken electrical components and exposed wires. Consumer goods had problems related to bad finishing of parts, such as splinters and sharp metal edges. Other products, designed from scratch, like the sisal processing machine, which was praised by the designer as much safer than existing alternative, were actually highly dangerous. In this case parts moving at high speed were uncovered, chemicals derived from the sisal leaves were in contact with operators and parts of the machine, and added to that, children as young as 8 years old were operating the machines.

It emerged from the survey that the majority of firms are very small, with a workforce of less than eleven people. They are managed by one person, usually the owner, who is also involved in production and other functions within the firm, and operate in a localised and isolated market. They suffer from a series of constraints, the most pressing being lack of capital, limiting the firm's ability to operate in the market. Most of them work by contract, using technology which ranges from simple hand tools to sophisticated machinery. Despite the existence of enterprise support bodies, providing finance and technical assistance, little use is made of them and in general the entrepreneurs rely on self-finance and previous technical experience.

The data also suggests that, at least in metal manufacturing, design capability has not developed further for a number of reasons. The most evident are lack of time to concentrate on creative activity and the lack of resources to invest in the materialisation of the new ideas. There is also the lack of support by government and private institutions to develop the existing innovative potential.

Lack of use of design emerges for other reasons, the most obvious being the perception that some entrepreneurs and designers themselves have about design activity. Design is regarded as something related to the external aspects of a product and is perceived as an add-on, the designer being seen as a professional who is called in after the technical aspects of the product have been resolved. Entrepreneurs perceived the activity of 'desenhista industrial — the equivalent to industrial designer in the UK — in a confused way. Some associated the professional designer with a mechanical draftsmen, some had heard the term 'design' in the media and associated it with the visual aspect of the product alone. Others confused industrial design with mechanical engineering. However, for most of them design was an activity related to creativity. Because of difficulties facing small enterprises, especially financial constraints, it is doubtful that small entrepreneurs will often be able to hire the professional services of designers. Thus, entrepreneurs are compelled by circumstances to be involved in product design. The data collated highlights the distance between practitioners, specialised bodies and support institutions.

In spite of the little use of professional design in the sector there is room for intervention aimed at improving this existing capacity. Local research institutions, particularly the Federal University of Paraíba could provide support in terms of human resources and research and development facilities, which are not available to the small production units. Existing private sector organisations could also design specific programmes aimed at enhancing or creating local innovative capacity. This could bring direct benefits in terms of opening markets, improving product quality, and widening product availability.

# Chapter VI

# Empirical Evidence II: Introduction of Product in Context (Washing Machine)

## 6.1. Introduction

The objective of this case study was to develop and test, in a particular context, a product aimed at the low income population, which could be manufactured by small and microenterprises operating in the light engineering, metal manufacturing sector. These tests of the prototype were expected to provide crucial information related not only to technical matters, but, also to possible obstacles which could emerge when introducing and diffusing products aimed at the low income population. Information derived from the case study would be used in the design of support programmes providing training for microentrepreneurs.

## 6.2. Introduction of a Product Aimed at Low Income Users in a Specific Context

The equipment tested was a development of a study conducted as an academic research project (Guimarães 1988). The initial proposal (Figure 74, 75) used an impeller, also called a turbulator or pulsator. The impeller is a disc with four blades generally powered by a 1/8 HP motor at 1,425 RPM. This system has been used successfully since the 1950s. The present proposal was based on existing mechanical designs because it was thought there was no point in trying to develop a new system of washing with so many proven systems available in the market. The mechanical system was based on, and adapted from, a mass produced washing machine. Using existing systems which are well proved and tested allowed me to gain time in the introduction of the equipment in the field and to conduct tests related to the human interaction with the product. The main adaptation was related to the propulsion system, substituting pedals for the motor, and to some parts of the mechanical system. The dimensions of the tub and agitator were based on the same dimensions as the existing machines. In fact, the prototype constructed in the UK used a tub extracted from a twin tub washing machine (Figure 76.).

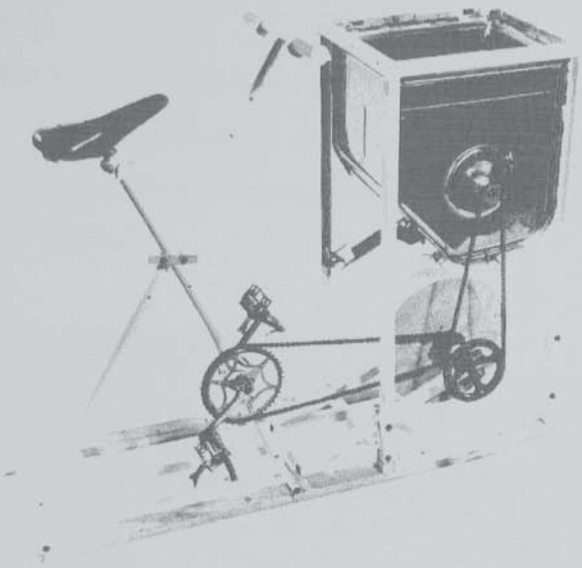

Figure 74. Prototype of the mechanical system using an impeller.

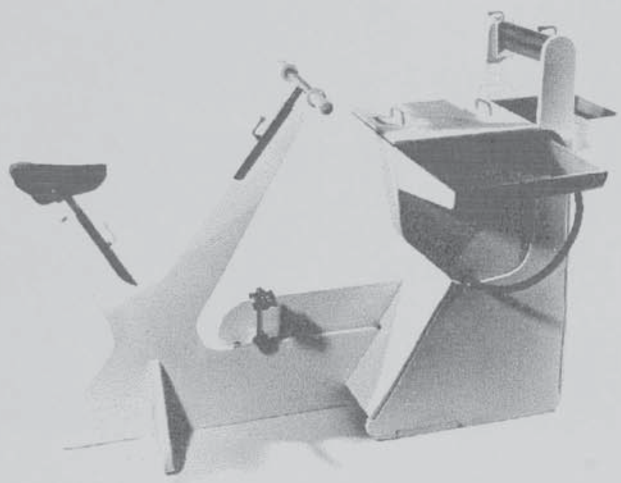

Figure 75. Final version constructed in reinforced concrete.

Thus, adaptations which took into the consideration the existing production and financial constraints of small manufacturers, were made. Special attention was paid to the use of inexpensive tooling, to using existing solutions designed by local innovators, and to the existing equipment/machinery used in metal manufacturing workshops. For example, Figures 77-82 were designed based on ideas collected in local workshops. They were attempts to circumvent constraints related to mass produced components, and included innovators' design alternatives, adapted for the use of scrap raw materials, and hybrid design solutions, adapting mass produced items to their production capabilities. This is the case in the use for the housing of a bronze bush (Figure 78), which was originally designed for an automobile motor. Other examples (Figures 80-82) of engineering components were found. Figure 80 is an alternative rubber roller made using steel and covered with tyre canvas. Adjustments for the

82) of engineering components were found. Figure 80 is an alternative rubber roller made using steel and covered with tyre canvas. Adjustments for the rollers were also improvised. Figure 81 is an attempt to substitute an expensive set of gears and Figure 82 is a cheaper way of substituting cast iron or cast aluminium pulleys.

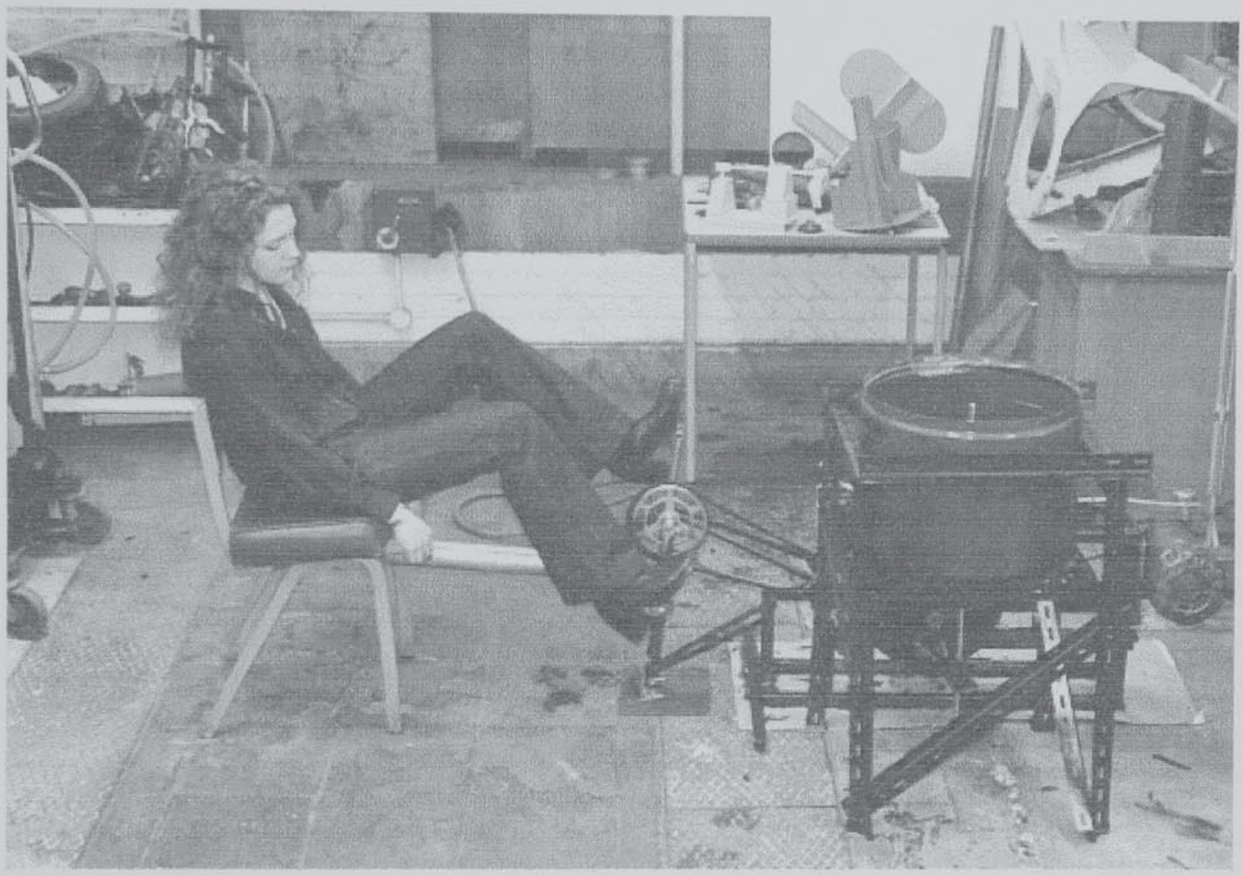

Figure 76. Prototype constructed at Aston University. Hybrid system using pedals and a motor

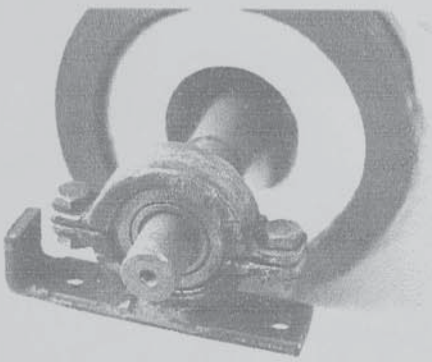

Figure 77. Housing made of steel, using an electric welder.

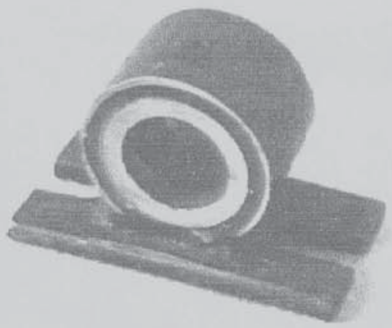

Figure 78. Housing made using a lathe, electric welding and a bronze bush inserted using a hand press.

Figure 79. Housing made from welded steel, machined in a lathe. Ball bearings are inserted using a hand press.

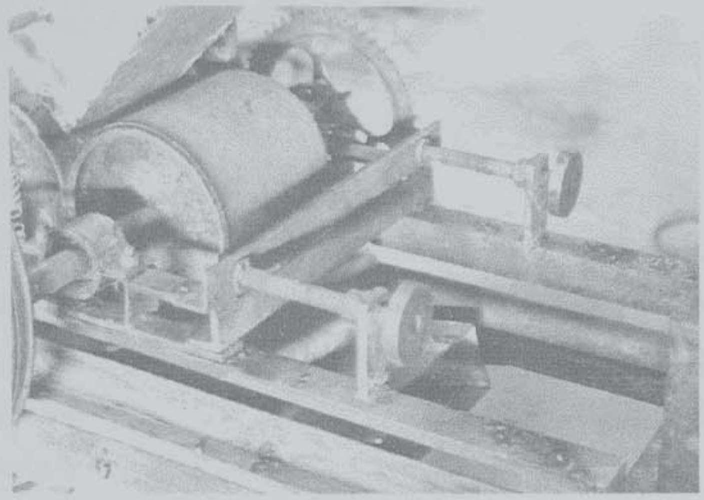

Figure 80. Rice de-husking rollers made from steel and dressed with canvas extracted from used tyres.

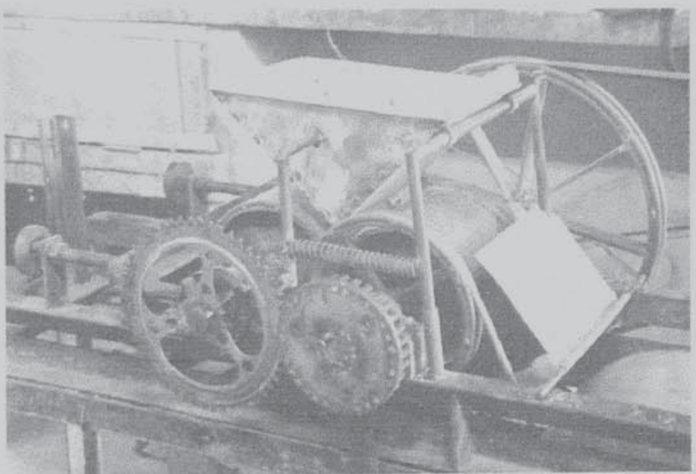

Figure 81. Alternative set of gears using bicycle parts.

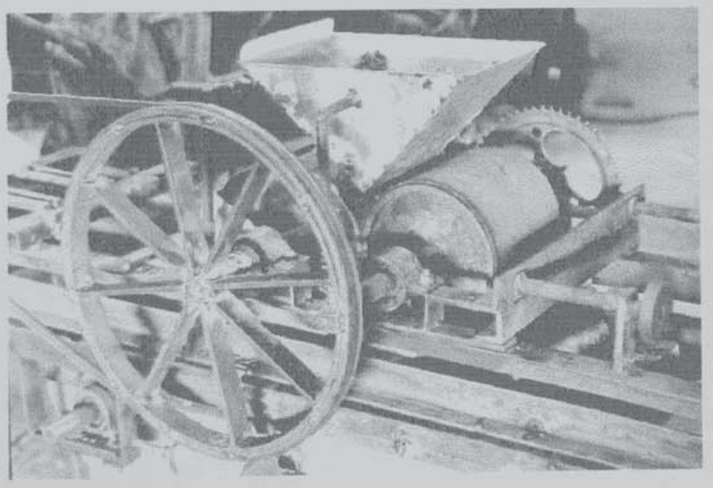

Figure 82. Simple alternative to cast steel and aluminium cast, mass produced pulleys.

Because of lack of electricity in many parts of the NE region, especially in the rural areas, and its relatively high cost in peri-urban areas, alternative forms of propulsion had to be considered. Of the 2.450.700 rural properties in the nine states of the North-eastern region only 79.629 had electricity in 1986 (Editora Abril 1986:721). In small properties without electrical power, farmers do not have access to sufficient finance to install electric generating systems such as windmills, or to buy stationary fuel powered motors, and thus rely on manual or animal labour to carry out daily tasks. In urban areas, in spite of the availability of electric power, the poor lack the resources to pay for it. It is common to see dangerous connections called 'gato'(cat) made to steal electricity from the grid.

## 6.3. Sources of energy

Due to the lack of access to electricity, the population has been using alternative sources of energy for a long time. In many areas of the North-eastern region, water pumping windmills and water wheels and animal drawn equipment are still to be found in daily use. Energy from the sun is abundant but used mainly for drying agricultural products. Sophisticated solar technology is still out of the reach of the majority. The problem with most forms of generating energy mentioned above, is that they all depend on weather conditions. There are relatively few rivers in the North-eastern region which could be used to move the paddles of a water wheel, wind is constant in some areas but not in others and sometimes the wind speed is a major obstacle, especially in the generation of electricity where higher speeds are required. The sun, despite being plentiful most of the time, is not always shining and needs relatively expensive technology to be transformed into electricity. Animal-powered equipment, in the present economic situation, is relatively expensive because of the price of animals. It is also a problem to use the animals in tasks other than agriculture or transport. Electricity generators using fuel, wood or other materials to power them are expensive and their technology relatively sophisticated, bringing problems of maintenance and repair. There is also the problem of storing energy which, in the case of wind generators, is done using automobile batteries, which very few can afford. The situation described above leaves little alternative for the poor population but, to depend on themselves as a source of energy.

### 6.3.1. Human Muscle Power

For centuries people had to rely on their own muscle power in order to survive. The major problem with this form of power is that, in the majority of situations, human muscle power does not reach its optimum capabilities. According to Wilson (1977:2), this is due mainly to:

a) wrong muscles of the body are used to exert the force.
b) the speed that the muscles are moved at is not optimum
c) the type of movement itself, even if carried out at the most suitable speed by the most strong muscles, may not be optimum for the desired objectives.

Pedalling is a good energy converter. Our leg muscles used correctly will give us maximum output with minimum strain. We can divide the application of leg muscles to treadles roughly into two categories (Wilson 1977:15)

a) where low power was required and hands were required to perform an accurate task. Treadles often produce energy in a reciprocating manner;
b) where a maximum power was desired principally in application to cycles. They are generally connected to cranks on the driving wheel.

Thus, a system which employed pedals such as a bicycle appeared to feasible. As Wilson points out

> The bicycle uses the most powerful muscles in the body - the thigh muscles in the right motion, a circular pedalling motion, at a right speed, 60-80 revolutions per minute, and then transmits the power efficiently by means of a sprocket and chain mechanisms and ball bearing' (Wilson 1977:37).

### 6.3.2. Stationary Pedal Power

In practice a wide range of machinery and equipment can be driven by pedal power using the mechanical transmission of a bicycle. The components of the system are cheap and available in the North-eastern region of Brazil and are easy to assemble, maintain and repair.

The efficiency of converting muscle power into rotary motion with a stationary bicycle pedalling system is higher than that obtained during transport. However, the absence of cooling wind can be a problem and can lead to overheating of the body, reducing the capability of the operator to pedal. The equipment should be placed in a ventilated area or have some type of cooling device (Gosh 1981:129-36). When using stationary pedal power we can have three approaches:

a) use equipment which is hand cranked; adapt it with pedals for direct pedalling;
b) use a basic stationary pedal power unit or 'Dynapod' (from the Greek word for power and foot) that can be attached to any device that needs to be driven;
c) design the equipment with the specific objective of using pedal power (Wilson 1977:38).

The power available in the bicycle system is approximately one-third and one-half of a horse power for a period of ten minutes. In order to get maximum output, the power of the rider must be available in the pedals. This makes it imperative to have the rider ergonomically seated, with the handle bars positioned so as to help locate she and control the torque reaction on her body as she pedals. Therefore, it is necessary to have a rigid strut between the driving

and the driven sprockets to take the pull of the chain, which can be approximately twice the rider's weight. An adjustment for the chain must be provided. (Wilson 1977:45).
Because of the need for inertia to carry the mechanical operation through high peak torque requirements, it is crucial to use a flywheel. The flywheel will be necessary to even out fluctuations in the cycle, equalise the energy exerted and the work done and thereby prevent excessive or sudden changes of speed. The idea is to get the wheel rolling and then get it to carry the operator through the peaks of effort.

## 6.4. Existing systems for washing clothes

Because of the characteristic of this project, it was considered important to conduct a literature survey aiming at finding historical examples with a potential to be adapted to the present North-eastern situation. I also conducted a survey of the most common existing types of washing systems available in the market. There are a number of systems for washing clothes and they can be classified into two main types;

- Machines with a tub (e.g., nozzle machines, machines using agitators and machines using a pulsator);
- Machines using a drum (front or top loading).

In the first case the load of clothes is moved inside the tub suspended in water. In some tub machines, mechanical agitation is produced by a *gyrator* or agitator. This device, which was developed in the 1920s, uses oscillatory angular motion to create a turbulence of water. There are variations in the geometry of the agitators, like the *spiralator*, with blades in form of a spiral, which increases turbulence in the water (Hot Point:1).

In the nozzle type, machine agitation is produced by jets of water coming from a spout located at the lower part of the tub. The other system uses an impeller, which is a paddled disc rotating at great speed These machines come with a draining system and are heated by electric elements. The second type is the drum washing machine. They can be loaded through the front or top. With a couple exceptions, their main characteristic is a drum with paddles which revolves and tumbles the clothes immersed in the cleansing solution (Figure 83).

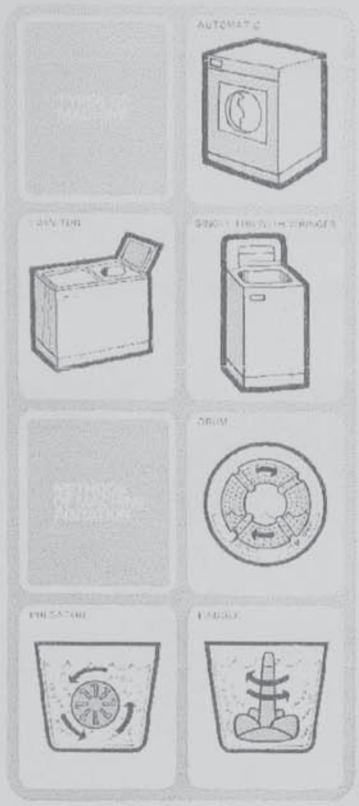

Figure 83. Existing types of washing systems.

Because of the requirements of this product, a bibliography search, aiming at finding alternative ways of washing clothes, was conducted and six main systems were found:

- Presawash (hand operated)
- John Noble Stores (hand operated)
- VITA Washing Machine Type One (hand operated)
- VITA Washing Machine Type Two ( hand operated)
- VITA Washing Machine Type Three (hand operated)
- The Nava Jeevan Washing Machine (hand operated)

### 6.4.1. Presawash

Equipment manufactured by 'The Original Pressure Washing Co. Ltd." in the UK.

**Software:** The following description is given by the manufacturers:

> When hot water is sealed in the air tight drum of your washer, heat expansion causes the air trapped inside to expand and compress. This pressure movement literally blows through the fibres of the fabric removing all the dirt. A pressure action which speeds up the washing time many times (Presawash).

The suggested wash temperature varies from 90o C maximum to 40o C minimum, depending on the kind of clothes to be washed. The maximum load is 2.5 kg of dry clothes.

The company also claims that this method of washing uses less soap and washes its full load in two minutes.

**Hardware:** The tub is manufactured in metal, pressed aluminium and the structure in round bent metal tube. The tub is turned using a hand crank made of metal (Figure 84).


Figure 84. The company also claims that this method of washing uses less soap and washes its full load in two minutes.

## 6.4.2. John Noble Stores

**Software:** The same system as the Presawash but with a wash load of two Kg (John Noble 1987:833).

**Hardware**: The tub is made of plastic material and the structure in metal. It also has a hand crank made of metal.

The Presawash costed approximately £55.00 in 1988 and the John Noble Machine £30.00. A study undertaken by the Consumer Association and published in *Which* magazine, maintains that this system does not work and that it has no advantage over hand washing (Consumers Association 1981). Even if the system worked — and this is doubtful —the manufacturing process used in the construction of the equipment would need expensive tooling and machinery and this is a constraint in the technological context of microenterprises.

### 6.4.3. VITA Washing Machine Type One

This equipment was developed by Dale Fritz for Volunteers in Technical Assistance (VITA:1). It uses an agitator similar to the *posser* used in the 19th century and a tub (Figure 85).

Figure 85. The posser was used in some UK households until the 1950s.

**Software:**

The agitator is lifted up and down with the action of a plunge churn, and pumps and sucks the water through the linen. This is done with a quick motion, stopping slightly between strokes. The movement that the agitator causes in the water will continue for a few seconds before more agitation is needed. When going upwards the agitator should be completely out of the water. It cannot hit the bottom of the tub because this would damage both, the tub and clothes (VITA:1)

**Hardware:** The lid and the tub are made of galvanised rolled sheet and the agitator of galvanised sheet with a wooden handle

A problem with the metal tub is the fast dissipation of heat which is a disadvantage when you have to use hot water for washing. It seems relatively cheap to manufacture but, still entails heavy work for the arms. There is a variation of this equipment using a still drum and a handle which is pivoted to a structure.

## 6.4.4. VITA Washing Machine Type Two

This machine was designed having in mind the use of materials available in most less industrialised economies and was to be constructed requiring semi-skilled carpenter or furniture-making skills (Figure 86.). A prototype was tested by the US Department of Agriculture Home Economics Laboratory and compared to standard electric commercial washers with good results.

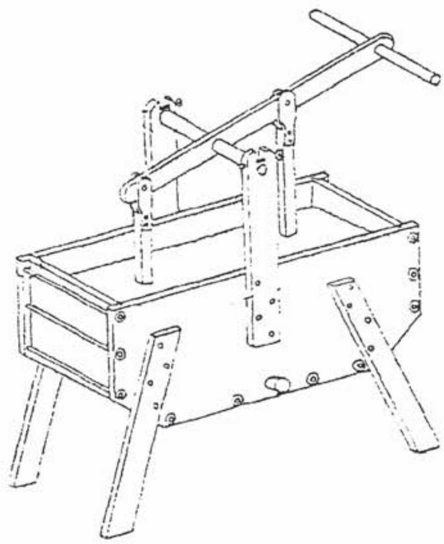

Figure 86. This machine uses an agitator similar to the *posser* used in the 19th century and a tub.

**Software:** For this operation it is better to use a rectangular tub. It takes a load of 3 kg of dry clothes and 67 litres of water. Normally, washing is done with 50 strokes a minute for ten minutes

**Hardware:**

Clothes stay more or less stationary while water was forced back and forth through the clothes by the piston action of the plungers. One plunger creates suction as it rises and other created pressure as it moves downward. The slopes at the end of the tub bottom help the churning action of the water caused by the plungers' (VITA:7).

### 6.4.5. VITA Washing Machine Type Three.

**Software:** Uses a tumbling action similar to electric washing machines. Uses hot water which has to be changed occasionally. Allows timing and control over the wash load (APTDA 1977:239).

**Hardware:** Uses an used oil drum with wooden strips attached to its inside. The drum is driven by a handle. The machine is fixed to a simple structure.

### 6.4.6. The Nava Jeevan Washing Machine

This machine was designed in India to be made using locally available materials and mass producing methods. It is cheap to produce and uses a minimum of tools in its manufacture (Wiedenhaupt 1965).

**Software:** It uses a vertical stroke action similar to the VITA Washing Machine Type One. Experience has shown that, because of the surging action needed for cleaning, washing has to be done only in round or spherical-shaped tubs. Its washing load is of 2 kg of dry clothes. To get clothes clean would take about 15 minutes at a speed of 100 strokes per minute using hot water.

**Hardware:** It uses wooden parts for the structure and plungers. Metal is also used in the moving parts and the tub is made of pots already available in the market place of this region of India. According to the author of the project the advantage of clay compared to metal is that the former holds heat in the wash water while the latter would accelerate its loss. This equipment seems to be very cheap to manufacture and has the advantage of using parts already manufactured by the population. This would help to increase income for the pot makers. One problem would be the fact that it is operated by hand.

## 6.5. The Present Proposal

The present proposal was defined after testing the prototype using the impeller system. This prototype washed 2.5 kg which was considered insufficient for the needs of the washerwomen. It was necessary to wash at least 3.5 kg of dry load. It was then decided to construct a prototype of a tub type washing machine, based on an existing system using an agitator. The geometry of the parts, tub and agitator was based on existing washing machines. The proposal is aimed at reducing the drudgery involved in the task of washing clothes by hand, and eliminating, through improvements in the design of the hardware, the main causes of occupational diseases. Preliminary contacts with washerwomen in Campina Grande had revealed that there was a high incidence of occupational health problems, such as: dermatitis, due to the use of soap and other cleansing agents such as caustic soda; back pain, due to leaning long periods over a low working surface (tanks and ironing boards); muscular and circulatory problems (e.g. varicose veins) and others (Figure 87).

Figure 87. There was incidence of occupational health problems, such as: dermatitis, back pain, muscular and circulatory problems (e.g. varicose veins) and others

The design of the equipment was based on the information which emerged from the literature search and from the tests of the first version of the washing machine.

### 6.5.1. Tests

The tests were divided into two parts:

a) Feasibility of using pedal and electrical motor power/propulsion in the agitation system.

b) Tests on user interface and production

## 6.5.2. Feasibility of Using Pedal and Electrical Motor Power/Propulsion in the Agitation System.

The tests were conducted aimed at producing reliable information about the mechanical system which changes rotary into oscillatory angular motion. The original design of the mechanical system was patented by Mr. James Condy, in 1917. According to the specification

> [...] a shaft adapted to be rotated by a handle is provided with a slotted crank, in the slot of which engages an arm projecting from a yoke pivoted to the shaft carrying the blades or beaters, so that on the rotation of the crank-shaft an oscillatory movement will be imparted to the yoke and thus to the blades or beaters.' (Patent Office 1917)

Modifications have been made, to substitute the handle by pedal power and use a different agitator (e.g. in the original patent a mechanical system was located in the top of the tub and used a metal agitator). In the present proposal the system was assembled underneath the tub because of the risk of damaging the clothes. One of the alternatives designed was a hybrid system, composed of bicycle parts and a motor (cf. Figure 76).

These tests were of particular importance when evaluating the performance of the flywheel when the machine was operating with a full load. The tests lessened the likelihood of immediate rejection of the equipment due to mechanical failure and helped to gain the trust from the users, allowing the equipment to be immediately introduced in the wash houses.

## 6.5.3 Components of the Machine

The machine was composed of the following parts:

- Mechanical components:
- Structure
- Bicycle propulsion system
- Reinforced concrete flywheel
- Mechanical system to transform rotary motion into oscillatory motion.
- Reinforced concrete tub
- Agitator's shaft

Special parts to be tested in the mechanical transmission system:

a)Agitator b) Agitator's fix to the shaft c) Agitator's shaft d) Rotary/Oscillatory Motion Transmission e) Flywheel

**Agitator**

The geometry of the agitator was based on an existing mass produced agitator. This product is mass produced by plastic injection process and presupposes demand for a considerable number of products to be economically feasible. One of the main costs involved in this manufacturing process is tooling, which can amount to several thousand pounds. An alternative had then to be found if the product was to be manufactured by small scale firms with very little financial and technical resources. A plastic agitator, using PVC sheets derived from a round tube, was constructed and assembled using PVC adhesive (Figure 88).

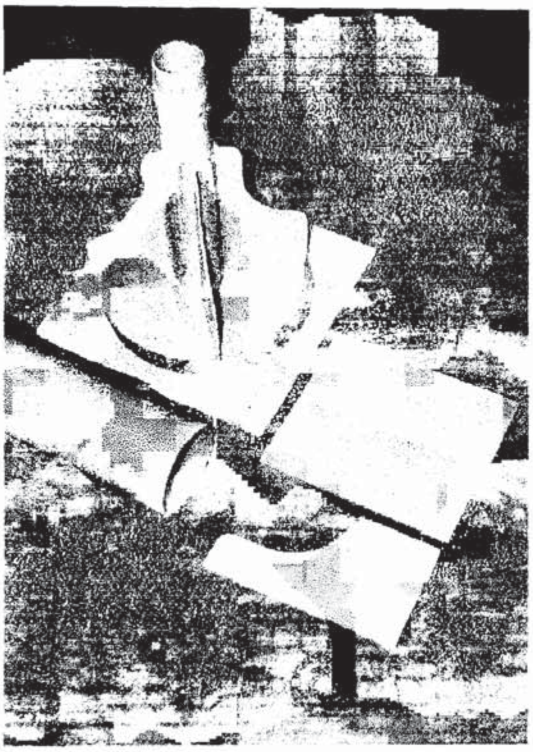

Figure 88. Construction of alternative agitator using sheets from flattened PVC.

The design of this manufacturing process for the agitator was based on the existing alternative use of PVC sheets, which are commonly employed by plumbers and other professionals in NE Brazil. Because PVC sheet is very expensive, these workers cut one side of a PVC tube longitudinally, heat it, flatten it, using a piece of wood, and then cool the plastic with cold water. This provides a reasonably sized sheet of material — approximately 300 mm width for a 100 mm diameter tube — which can be used for a number of purposes.

## 6.5.4. The Construction of the Alternative Agitator

The design and construction stages of this agitator took into consideration the existing production machinery and equipment of small and microenterprises. The measurements of the blades were taken from a second hand agitator and marked on a sheet made from flattened tube which was then cut in the band saw. These blades were then heated (Figure 89) and bent using a specially designed jig and glued around a smaller diameter PVC tube, which formed the body of the agitator. The jig to bend the blade was designed to allow precision for the job. (Figure 90). It had to be extremely simple to manufacture and the process of making it has to be easily understandable by small manufacturers. A prototype of the jig was built using wood and cardboard box and 15 blades were successfully bent (Figure 91). Two agitators were then assembled.

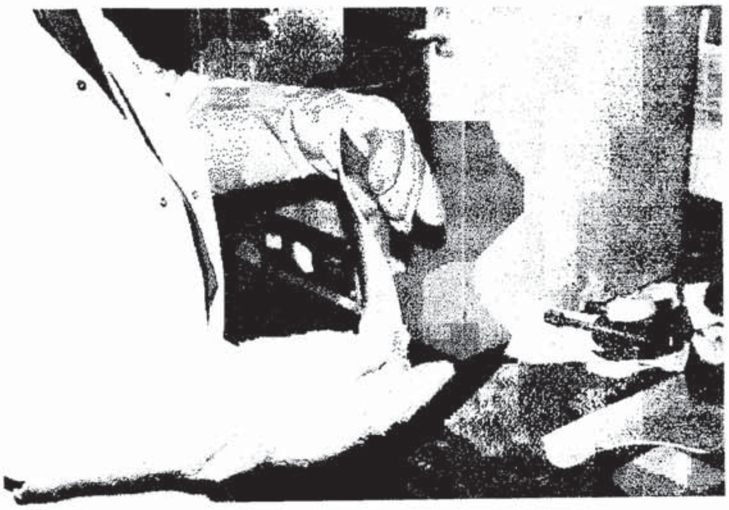

Figure 89. PVC Blade is heated in an oven and then bent and cooled with water.

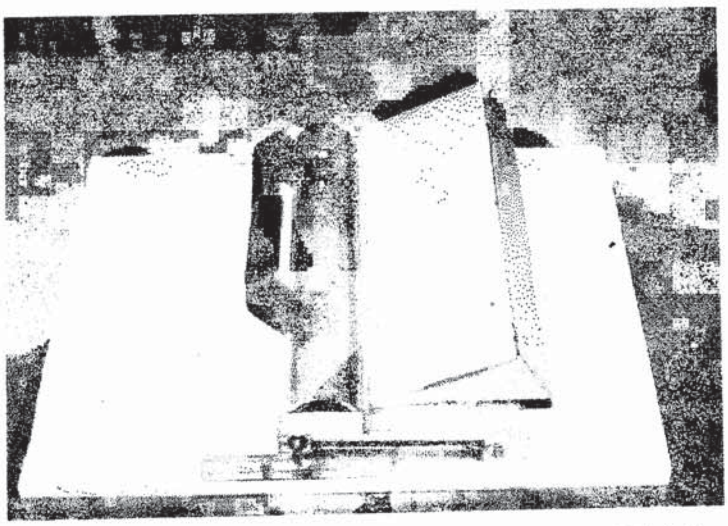

Figure 90. Prototype of a jig used to bend the PVC blades.

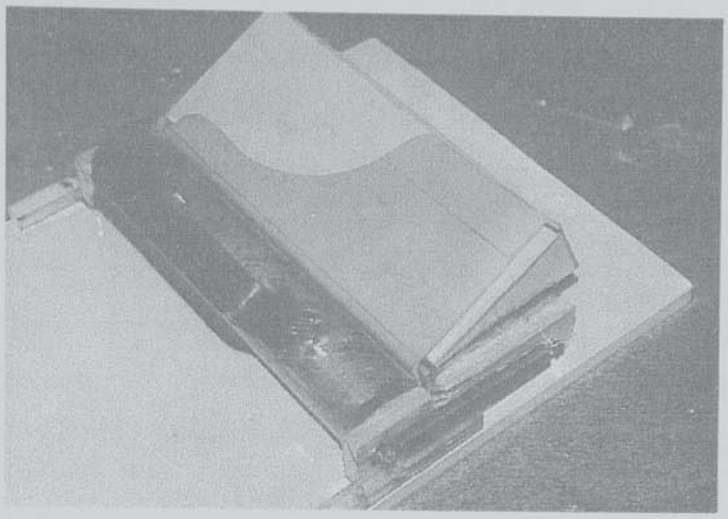

Figure 91. Bent PVC blade.

The test method in the washing tests conducted in the UK was the *Comparative Split Cloth Test,* which consists of staining a piece of white cloth with different substances such as tea, coffee, beetroot, spinach, sand, and permanent ink. These pieces of cloth are then cut in half and one of the parts is washed and dried, then compared visually with the unwashed part. A real wash load was also used in the tests. A number of tests were conducted from November 1992 until February 1993. Different temperatures and soaking times, using various soaking agents were tested.

### 6.5.5. Tests on User Requirements and Production

The second part of the tests were conducted in Campina Grande. The initial tests were conducted within a period of 90 days with a prototype which was placed in one of the washing places in the metropolitan area of the city. It was suggested to the Department of Mechanical and Electrical Engineering at Aston University that, only the prototype of the mechanical system, which already existed in Brazil, should be introduced, and that the tests and the development of the human-interface with the product should be conducted with the actual users.

The main considerations related to the product/user interface with the hardware were:

- Ergonomic factors regarding the seat height, adjustments, manipulation of adjustment knobs, the design of the seat (angles and shape), overheating of operator's body due to the fact it will be a stationary machine. Accessibility to the mechanical system for maintenance and substitution of parts. Protection of parts for safety and protection from the weather. Easy access to the tub for loading, unloading and cleaning purposes. Height of tank and support for complementary activities. Easy access for filling and draining the water. Instructions on how to use the equipment. Consideration of the fact that the majority of the users might be illiterate, semi-literate or elderly (size of symbols and type). Ease of operation. Safety. Aesthetics aspects.

The main considerations related to the existing production facilities were:
Technology available in the small production unit. Access to raw materials. Raw materials had to be cheap, strong, water-proof, easy to manipulate and to repair. Use of minimum machining (lathe, milling machine). Easy tooling and moulding. Easy to assemble.

## 6.6. Description of the Wash House

The Lavanderia Municipal do Santo Antonio (Santo Antonio Municipal Wash House) is located in one of the neighbourhoods of Campina Grande, close to the city centre. The information below was collected in informal conversations when conducting the tests and in the constant visits to the wash house by me and my research assistant.

The wash house is run as an association and has 45 women registered, the majority living in the neighbourhood or close by. The women pay a small fee to join the association. This number of women in the association varies during the year. The reasons for this, according to the President, can vary but it is common for women to leave the association because of internal fights. There are also women who only occasionally come to wash their family load. But most women wash clothes as an income generating activity: 'lava de ganho' (wash to gain). Thus, there are women who work every day, including Saturdays in the wash house.

Normal working hours can start as early as 5.30 a.m. This early start is mainly due to the amount of work, which includes transporting the load from the client's home and back again by foot or by bus, as well as washing and ironing. A normal wash load weights around 8 kg of dry load (we have registered dry loads of up to 15 kg, which is considered by the washerwomen a heavy load). The normal wage for a day's work can vary. Some women charge less than others, and some have special agreements with their clients. In general the wages were around £4.00 per day. The washerwomen do not take into consideration the amount of soap, the time taken to wash each item of clothing or any other information when they decide how much to charge their clients. The load is 'measured by eye' and labelled a 'normal' or a 'big' load.

The clients generally provide the powdered soap and for the more demanding, the softener. The women always complained that the quantity of soap provided was never sufficient to wash the amount of clothes. But, because they were afraid of upsetting their clients and loosing their job, they kept quiet about it and sometimes had to use small quantities of their own soap. The water and the electricity is provided by Secretary of Work and Social Welfare - SETRABES, which helps to reduce their costs. Availability of water is another reason for getting to the wash house as early as possible in the morning. Because of the occasional lack of water in the neighbourhood, officially there is a first come first served policy in the wash house. Daily contact showed that this was not always the case. Some women who wash on a daily basis appear to have their tanks reserved and, on a number of times, some women arrived at the wash house late to find their tanks filled with water waiting for them.

The physical infrastructure of the wash house consists of two large rooms, one used for ironing, with ironing boards made of concrete (Figure 92) and the other used for occasional meetings, and to dry clothes when it is raining. There are a total of thirty two concrete tanks, in four rows, two other small rooms and two toilets (Figure 93). There is also an open area used to dry clothes in the sun. The gate to the wash house is always locked because of vandals.

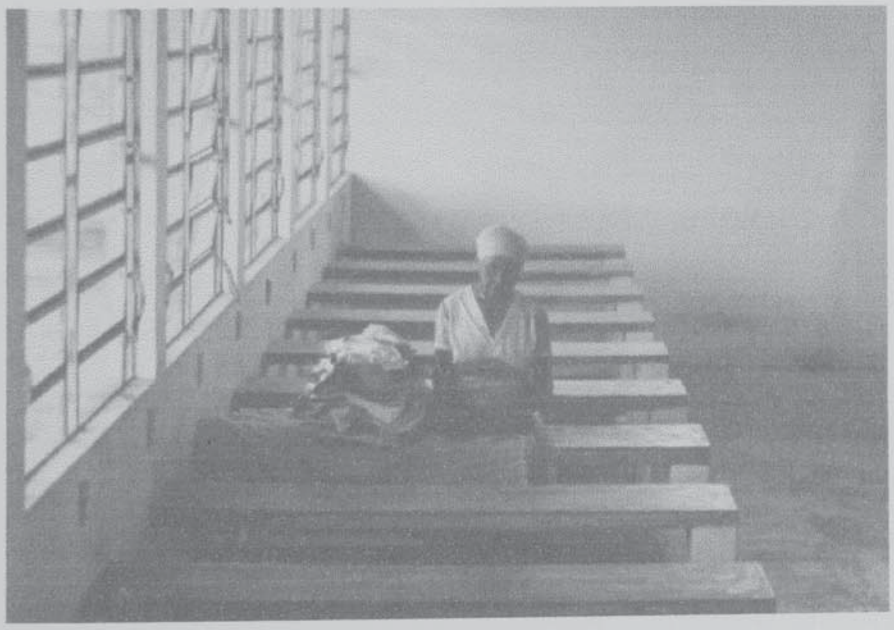

Figure 92. Ironing boards made of reinforced concrete.

Figure 93. All work is done by hand in rustic concrete tanks.

The Association is lead by an elected President whose function is to control the working shifts of people in charge of cleaning the bathrooms and other areas of the wash house. She is also responsible for reporting any complaints to the social worker in charge of the wash house. These complaints, and any other relevant subjects, are debated at a monthly meeting with the social worker and, depending on the gravity of the matter, with people of higher ranks in SETRABES. It is interesting to note that role of the social worker can be quite broadly based. In one of the meetings I attended, the subject of clothes 'disappearing', something which had occurred before, was raised again. As it appeared to be a subject which had been ignored by some women, the social worker suddenly started threatening them with the possibility of bringing the Police in to sort things out. This possibility seemed to terrify some of the women, and even the President was a bit shocked at such a proposal.

The age of the women varies. There were a couple of teenagers but the majority of women were over 40 years old and at least ten over sixty. Some women brought their daughters or other relatives to help in the washing or ironing or carrying the load to the clients house. Daily observation of the wash house showed that it is not an homogeneous environment. There appear to be groups of women who are very active and outspoken and other who are apathetic. However, it was clear that there was a leader ship, although not open and manifesting itself in peculiar ways. Some womens' opinions were highly regarded and respected by the whole group. Other women were outspoken, always joking and amusing the group, they had some influence mainly playing the role of cheering people up in their rough daily existence.

### 6.6.1. The Process of Washing

The process of washing is composed of a number of operations. Once arrived at the wash house, the women separate the clothes to check which are the dirtiest and let those soak for a while. They then start to water and soap individual items of clothing and scrub the dirtiest. After the roughest dirt is removed they will take the soaped pieces outside and let them rest in the sun for about an hour (Figure 94). This is followed by rinsing and again each individual piece is rinsed separately. The last operation is to remove the water by twisting the clothes. The clothes then are hanged on barbed wire to dry. Barbed wire is used as a mean to substitute the pegs. The clothes stick to the sharp part of the wire until it dries. The next step is ironing and packaging the clothes to take to the clients.

Figure 94. Soaped pieces are laid outside in the sun for about an hour to whiten the clothes.

It is worth noting that the women, due to financial constraints, are extremely creative and economical with the material they use. They have designed simple techniques which make their daily life easier, improve the quality of the wash and speed up their job. Some washerwomen adapt the original parallelepiped shaped soap, which is an awkward form to hold and scrub the clothes, by hitting it against the floor and transforming it into a spherical shape (Figure 95). They mix the larger piece of soap with small pieces of soap left over and add them to the sphere. This sphere is then inserted into old fruit packaging (Figure 96) and fastened and tightened at one corner. Six subsequent packages are wrapped around the first one. According to the women, this spherical shape has a more comfortable, 'ergonomically' designed grip. This 'tool' has a double function. The first function is to replace the rough plastic brush available in the market. This brush, which is suitable for washing jeans and other heavy clothes, damages more delicate clothes. The second function is to use the sphere of soap to the very end. The plastic mesh holds the soap inside until the smallest piece of soap is diluted. When the soap is finished, the mesh continues to be used as a soft 'brush' until it disintegrates.

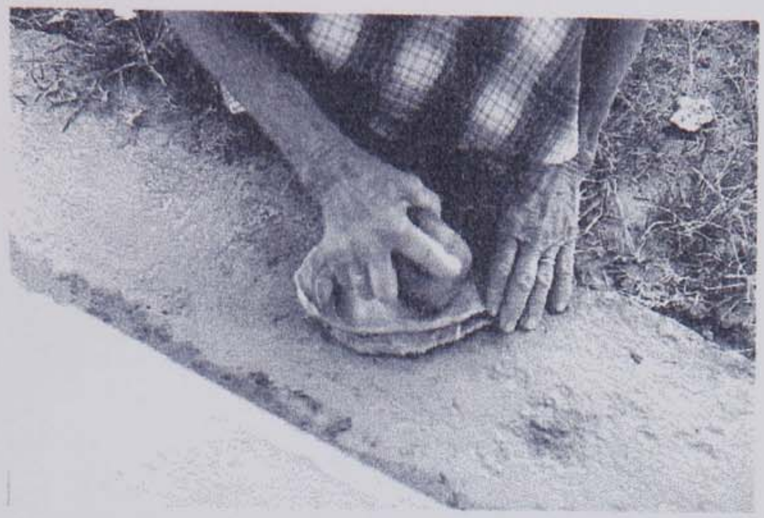

Figure 95. Women have designed simple techniques which make their daily life easier, improve the quality of the wash and speed up their job.

Figure 96. This 'tool' has a double function: to replace the rough plastic brush available in the market and to use the sphere of soap to the very end.

Another interesting example is the lids for the concrete tanks (Figure 97). Again, economic constraints forced the women to invent a simple and effective solution. One of the women has 'specialised' in preparing the lids. I asked her to make a lid for the machine and offered her a piece of pipe as a template. The woman delicately declined my offer, looked directly at the diameter of the flange in the tank and with a kitchen knife cut, without measuring, a perfect lid which fitted the flange exactly. With the modifications to the machine it became difficult to remove the lid after the washing and they came up with a very simple solution. They involved the lid with a small piece of cloth so it was easier to grip and pull (Figure 98). They were anxious to show this solution to my research assistant. To an external observer who does not know the context this might seem insignificant but for poor people, whose main preoccupation is the next meal, such improvements can make quite a difference in their daily struggle.

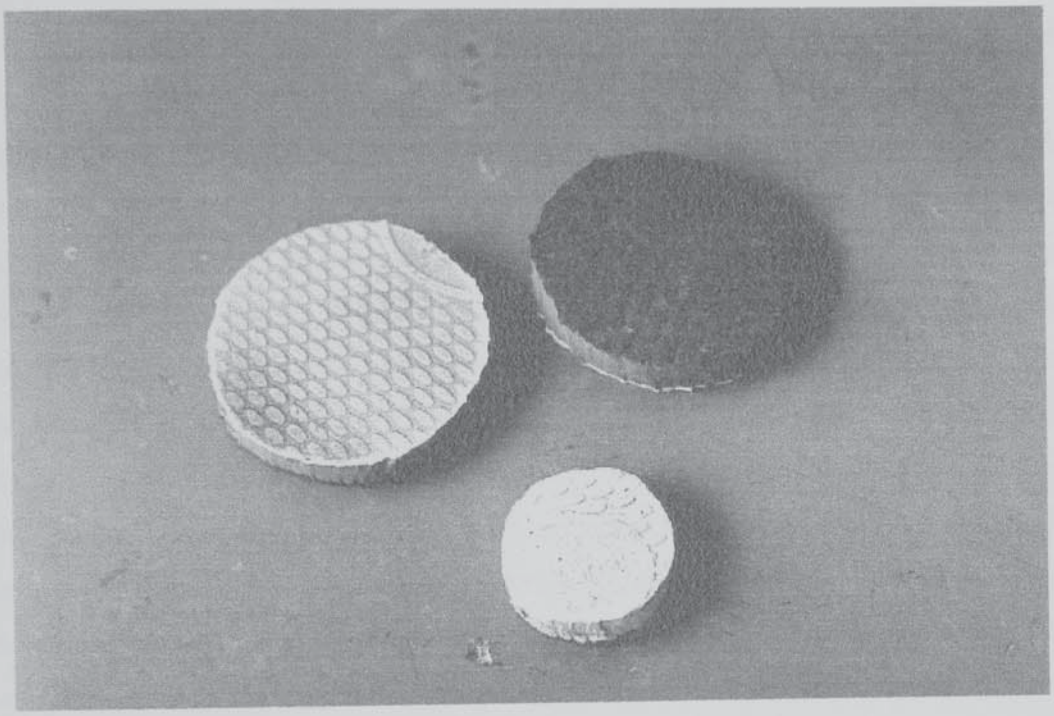

Figure 97. Alternative lids for the concrete tanks.

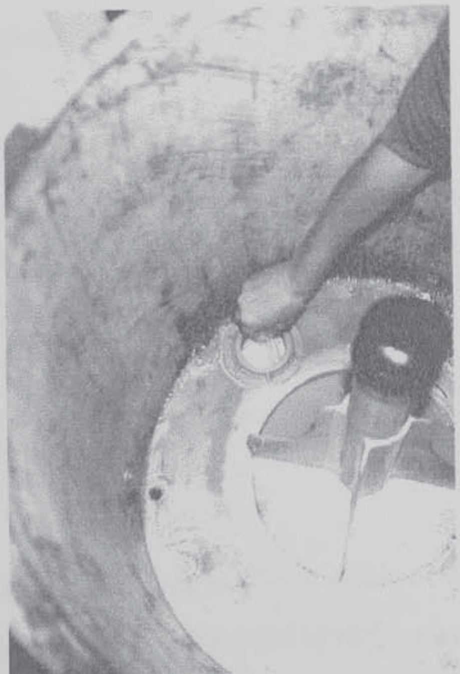

Figure 98. System to remove the lid after washing.

### 6.6.2. The Introduction of the Prototype into the Wash House

In April 1993 I went to Brazil to conduct the survey described in Chapter 5, and to conduct tests on the prototype of the washing machine in one of the wash houses in Campina Grande. Due to the relatively small time available, preliminary contacts by phone were made with the SETRABES, and subsequent personal contacts with people in charge of supervising the wash houses were arranged. These preliminary meetings with SETRABES' employees were very productive and it was agreed that one of the wash houses, the one which offered better security and had easy access, should be chosen to undertake the tests. It was agreed that the Santo Antonio Municipal Wash House was a suitable place because it was relatively new and safe against vandals. It had the advantage of being located close to the city centre, what made easier for me to monitor the tests. Although the meeting with SETRABES was productive in terms of receptiveness and acceptance of the institution regarding my proposals, this support was no more than moral. When asked for financial and material support, they explained that this Secretary was one of the poorest in the Municipality and had little resources available to be invested in such projects. It was also explained by the institution, that the physical infrastructure in most of the other wash places was in very bad conditions and thus, any of their meagre resources would have to be allocated to other priorities. In reality what this meant was that social welfare is not a priority of politicians and thus wash houses were at the bottom of the Municipality agenda. According to informal contacts with washer women, the wash houses are only visited by politicians at election time, when promises of improvements are made. After the election effervescence settles down, those promises fail to materialise. Nevertheless, it was necessary to have the approval of SETRABES in order to visit the wash houses.

The next step was to visit the wash house accompanied by one of the SETRABES' social workers, who is in charge of the Santo Antonio Municipal Wash House. The ten existing wash houses are under the responsibility of different people. The social worker met us at an agreed date and the first contact with the washer women was made. I explained to some of the few women present, that my intentions were to install the existing prototype of the washing machine and test it in co-operation with them. I also suggested that we set a later date to meet with more women.

One of the main problems in the introduction of the existing prototype of the washing machine in the field was the need to make some important modifications to it, particularly in relation to the agitation system. It was also necessary to replace the tub, which was made of a waste plastic container, with one made of concrete. Another prototype was constructed in England before going to Brazil. This prototype was based on the existing prototype in Brazil and some parts were modified, particularly the size of the tub and the type of agitator used. Parts of the mechanical system were also modified to allow it to be constructed by simple production technology (Figure 99).

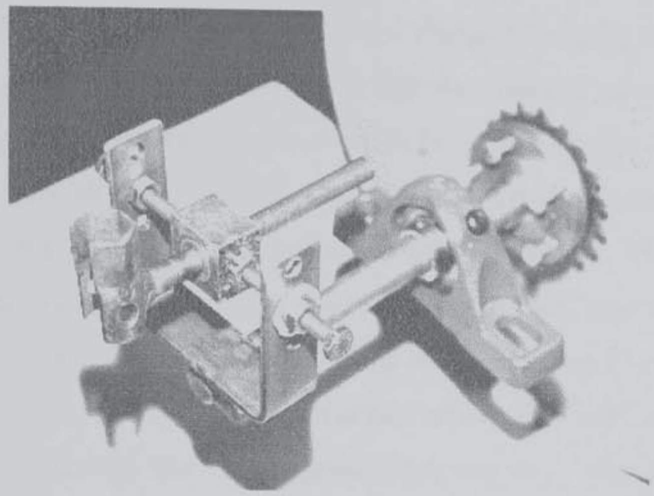

Figure 99. Mechanical system was modified to allow it to be constructed using simple production technology.

To conduct the necessary modifications proved to be a major problem, because I was relying on the Federal University's workshop. Unfortunately, lecturers and staff went on a strike which lasted over one hundred days, more than the total time of the field study. Thus, it was necessary to find a private workshop, a task which proved very difficult because most of the potential workshops were busy or charged very expensive prices to construct the machine. I managed to get help from one of the firms I was going to interview, where I knew the owner personally. However, the construction of the machine was very slow because we depended on the lathe operator being free to machine the parts after his normal working hours. This process took well over 45 days.

A second meeting was agreed and a panel and a slide presentation containing information on the history of clothes washing, and on the previous prototype which used the impeller system of agitation, was prepared. The meeting took place at the Santo Antonio Municipal Wash House and around fifteen women were present. There was also a female student from the Industrial Design Course at Federal University of Paraíba who was assisting me with the research. The fact that the student was a female proved to be very important as, gradually, the washer women identified with her and built-up a good relationship. Building this relationship was crucial to the research, as women were much more open about their problems. The women were very interested in the information and especially the historical aspects of clothes washing. It seemed important for them to see that their profession is a very old profession, and some of the comments clearly showed their pride in being a washerwomen. Valuing their profession was an important aspect in breaking the initial communication barrier, as it showed we had respect for them and this created an informal atmosphere between us. They laughed at some of the comments I made about how women washed clothes in Scotland until the last century, by trampling over the clothes bare footed in freezing weather. My comments about the voyeurs looking at the women legs, while they worked, also amused them and highlighted the important aspect of sexual taboos which, up to that moment, had not been considered. At a later date, when the machine was installed, some aspects related to sexual taboos were raised and the fact that I was a man created some initial obstacles. This was mainly because, as the machine was pedal powered, when the operators pedalled, their tights were exposed. Some of them were worried about this and said they were not going to pedal while I was present. We discussed the problem in a very informal atmosphere and they came out with a simple solution: to change the way they dressed when working. They decided to wear shorts instead of skirts.

Because they have no technical training and very little information on technical matters, I had some difficulty in explaining what a prototype was and it's purpose was. This difficulty was overcome when I compared the prototype with preparing a new food dish, a cake. I explained to them that when they made a new cake a number of problems could occur, such as the cake cooking too much or having too little or too much sugar etc. Thus, it was necessary to make a number of cakes before getting it right. This proved to be a perfect example and they immediately grasped the meaning.

Another point which they had difficulty in understanding was my real objective in relation to the research. It was difficult for them to understand the concept of conducting research and the fact I had no intention of making financial gains with the machine. This subject emerged occasionally during the tests. Their idea of my relationship with the project was that, once I had finished with the tests I was going to set up a factory and start to produce washing machines. I explained that my aim was to test the prototype in conjunction with them, who are the specialists concerned with washing activity and then publish the results in the form of a hand book which, if I had the proper funds, would be distributed to small manufacturers in the metal manufacturing sector. They were very sceptical of what I was saying and said that I could make money with this project. I replied that I had my salary from the Federal University and thus, could afford to do such research without making a commercial profit from it. I made clear that my profit would be an 'academic profit', which would be translated into more money for doing other research, and the pleasure, of publication and, if the prototype worked properly, of seeing the machine replicated and used in other wash houses. I think this point is important because these people are so used to competition and to the idea that no one does anything for others if there is no economic interest behind it. Later example of lack of co-operation within the community would highlight this point. (cf.6.9.)

When the machine was finally installed the first reaction of the washer women was that of curiosity, with some showing scepticism in relation to the quality of wash. It was a considerable problem to convince some of the women that this could be of any benefit to them. Their main worry was that it would be very heavy to pedal. Others said that machine washing was never as good as hand washing and, for that reason, they would not even try the machine. This first reaction followed the assembly of parts of the machine *in loco* and after some women sat and pedalled for about two minutes. This initial reaction proved valuable in understanding the relationships within the wash place. It became clear that there were some women that who exerted leadership over others and that there were a number of women who played the role of the 'devil's advocate', constantly creating obstacles to the acceptance of the machine by the others. Other women appeared to very apathetic and just carried on with their business. Nevertheless, the machine made an impact in this micro-universe and stirred up discussion between the women. It is important to point out that the women are used to paternalistic behaviour from the authorities. For example, the wash place is maintained by the Municipality which pays for the water, the electricity used in ironing the clothes, and the wages of the night guard. The washer women also share one of the rooms with a group of retired elderly people who have a weekly club meeting there. It is interesting to note that this support given by the municipality is used, when convenient, for political purposes. I was aware of the possibility that the Municipality could use my work to promote themselves and that I would have little control over this. This proved to be true at a later date when the Prefecture took photographs of the machine — which was broken at the time — using the women as models to show the 'social work' conducted by the public authorities. This was then used in an exhibition without informing me or giving any credit to the author.

In 1993 I came back to the UK and left the research assistant to monitor the tests. A number of difficulties occurred during the first six months of the tests. The main problem was that the women who had agreed to participate in the tests, had done it only a few times and in the wrong way, using less water than they were supposed to and thus finding it very heavy to pedal. This created a bad atmosphere in which to continue the tests. The main complain was about the weight of the load when the machine was in operation. They said it was only possible to pedal for a couple of minutes and then they had to stop. This was particularly worrying for the older women. Some of the women who had more serious health problems were also concerned about the effect of pedalling on their illness. There were some serious cases of varicose veins which clearly needed some medical advice. There were also complaints about back problems, heart disease and low blood pressure. They also suggested that a plastic hose should be purchased to replace the hand filling of the machine which was done using a bucket. In response to on their concerns, the research assistant explained to the women that the machine operated similarly to equipment used by physiotherapists, but she thought it was better to seek medical advice. The washerwomen also complained that the clothes washed were not clean enough and that, occasionally, they had to move the clothes round so that they would not entangle. In an attempt to stimulate the tests, the research assistant explained to them that these problems could be linked to the amount of water, and to the quantity of soap used and could be sorted out by the tests. Despite this attempt they continued to be concerned about using the machine for health reasons.

For a number of weeks the machine remained locked in a room unused and the women shared no interest in it. It was then decided to contact a physiotherapist to discuss the possibility of bringing him/her to the wash house to explain to the washerwomen that the machine could be beneficial to their health and improve their working conditions. A physiotherapist from the State University of Paraíba was contacted and agreed to help us. In his opinion there was no counter indication for using the machine, on the contrary he stressed that it could have positive effects for people with back problems and particularly for the sufferers of varicose veins, as pedalling stimulates blood flow. A meeting with the washerwomen was arranged to clarify possible questions.

There were 20 washerwomen at the meeting, almost half of all associates. The physiotherapist explained what the best postures would be for working, and how to alleviate every day problems related to washing in a standing position, e.g. having a device like a step in front of the leg and alternatively placing one leg on the step and another on the floor, to activate blood flow and stop the legs swallowing. The women were very attentive and repeated the explanations to one another, trying to memorise as much information as possible. The physiotherapist explained the advantages that the machine could bring them, such as working in a seated position which would improve blood circulation and reduce back pain. They were enthusiastic about the explanations but remarked on the weight of the machine when pedalling. The physiotherapist suggested that some modifications should be made: providing an arm support in the chair to improve the synchronism when pedalling and that the metal pedal should be replaced with a plastic one. The second recommendation was really unnecessary. His suggestion was based on the fact that the women were pedalling without wearing any shoes, using the metal pedal which has a rough surface. This problem was later solved by the construction of a plastic 'sandal' which provided comfort, safety and ventilation for the foot (Figure 100).

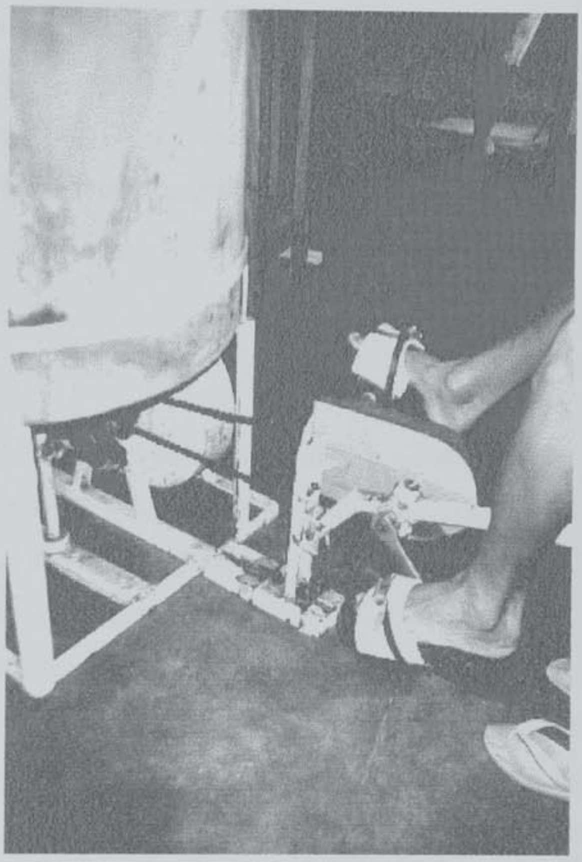

Figure 100. Safety 'Sandal'.

Based on the suggestions of the physiotherapist, and on the observations of the washer women, two steps were taken. One was to measure the torque when the machine was in operation, this was done by the research assistant who took some clothes and made some tests herself. She concluded that the effort required to operate the machine made the women tired after a few minutes of pedalling. She found out that adding more water helped to move the clothes around the tub but the weight was increased. It was decided to make the modification suggested by the physiotherapist and to change the ratio between the chain wheel and the sprocket. A smaller chain wheel was fixed by the side of the existing one to ascertain which one would work better.

The machine had to be removed to the University because it was difficult to make the necessary modifications in the wash house. When this was put to the women one of the 'devil's advocates' said that there was no need to bring it back, suggesting that the machine was not going to work anyway. Others laughed and made jokes but, said they were going to test the machine because the 'professor' had made this machine to improve their working conditions and that they should not let him down. It was put to the social worker that, when the machine returned to the wash place, we were going to try to restart the tests. She suggested that a timetable should be organised and that every week two women would be chosen and two tests made. In the beginning the research assistant and the social worker would be present and monitor the tests but, gradually the idea was that the women would take the initiative and control the tests themselves. This was put to the women and they agreed. The machine was moved and the modifications started until another strike halted the work for a couple of months. This had a negative effect on morale in the wash house and brought some problems later on.

## 6.7. Second Trip to Brazil

Due to the problems related to testing the machine, it was necessary to make a second trip to Brazil. When I arrived in Brazil, the machine had not been used for a long time. One of the reasons was the fact that the pipe used to drain the machine was too small and draining the machine took approximately 5 minutes to completely remove the water. This upset the women who returned to washing by hand and lost interest in the continuation of the tests. The situation was critical and I assumed that the only way to change it was to solve this problem as quickly as possible and thus boost their morale. I personally carried out the necessary changes in the washing machine and managed, by installing a large flange, to reduce the draining time to less than one minute. The fact that I arrived in the washing place every day at 5.30 a.m. was important in gaining the confidence of the washerwomen about my objectives, and to prove my good intentions. This proved particularly important because arriving at the wash house this early meant meeting the women before they started working and allowed me the opportunity to have informal conversations with them and to collect information who could help me remove future obstacles during the tests. This also gave me an insight into the daily life of this wash house and helped to remove some of my preconceptions about that context. This is one aspect constantly forgotten by designers who, in general, work in isolation from their customers.

Having solved the drainage problem, and after some informal discussions with the group, there was consensus that we should move the washing machine to another room which was unused at the time, because the present room was shared with the Elderly Club, the neighbourhood group which had weekly meetings at the wash house. It was very rare for any initiative to come from the women, which made it difficult to change even the simplest things. It was clear that economic pressures are so great for these workers that their life is bound up with basic survival and thus it becomes difficult to generate new ideas, even if they are ideas which can improve their working and living conditions. This apathy also appears to be linked to the paternalistic approach of the state which rarely stimulates any change in behaviour. So it was clear that, if the equipment was to be accepted, it was necessary to involve the women in every step of the process.

Changing the place of the machine proved to be a positive step as it was now easier to fill it with water because it was closer to the water tanks. It was also easier to remove the soapy water directly into the external area of the wash house and to spread the clothes on the ground, one of the subsequent washing operations. One drawback was the lack of security in relation to the equipment. At night time, despite a night guard, people could damage or steal parts of the machine. When it was suggested that they should talk to the night guard about this, the women pointed out that they were not keen to ask him anything because he had a reputation for being aggressive (this man's two children had drowned recently) and was mentally unstable. This was confirmed by the SETRABES social worker, who suggested that she should handle this matter personally if necessary. We agreed that it was better to leave it as it was. This meant that the machine had to be moved every day in and out of the room, which involved considerable work. The machine is very heavy because of the metal parts and because of the weight of the concrete tub. It was evident that they were not very keen to carry on doing this for long. It was agreed to leave it inside the unused room. This had some negative effects related to high temperatures in the summer. When the machine was kept outside it was much cooler, and windy and using it was more pleasant particularly during the summer time when temperatures can reach over 40°c. We tried to improve the conditions in the room by changing the small light bulb for a stronger one and by reorganising the room. Having better lighting was important for checking the quality of the wash. One advantage was that this room had a toilet and shower next to it, which helped when draining the tub. However this toilet had no water and thus the tub had to be filled by hand carrying the water from the tanks. This was heavy work as one load of clothes took around four buckets of water.

Despite improvements, the women appeared to be sceptical and did not want to invest time in the tests. It was only after talking to one of the women who exerts some leadership, that I managed to convince her to participate in the tests. This proved to be a turning point in the whole project. This woman washed a number of clothes and was satisfied with the results.

She subsequently washed various loads of clothes in the machine with good results. While she was washing, the other women were pretending not to be interested and kept on washing in the concrete tanks. However, when good results started to emerge a couple of women came to the machine and started asking the operator if she was tired and how well the clothes were washed. We had timed the tests and realised that she managed to cut normal washing time by half. All the clothes in the test were washed in the first washing operation — scrubbing. We were limited to this operation because of the lack of water. The rinsing operation needs a quantity of clean water to be done properly. Another woman then decided also to test and washed a considerable number of clothes in a relatively small time and also liked the wash quality.

This was enough to spark a number of tests by different women. Nevertheless, a number of women remained sceptical and even tried to 'sabotage' the tests by suggesting that the women with some kind of health problem would never be able to pedal. Some women also pretended to approve the quality of the machine wash when myself and the research assistant were in the wash place, but later when we had left the site, they would immediately try to convince the group that the machine was not viable. Although creating problems, these women played a positive and important role in the tests because the effect of their criticism was to uncover a number of problems which had to be solved, such as the distance between the chair and the pedals, which was later reduced. It was clear that the only way these women were to be neutralised was by proving to them that the machine could bring some sort of benefit. I initially thought that the health benefit would be seen as a priority but, when the tests started, it was clear that an economic benefit, due to by the reduction of washing time, allowing them to leave the job earlier or even getting another load to wash, would be the most important factor in convincing the women to use the equipment. The health aspect appeared now to be secondary.

Another turning point was when the President of the Association, who suffers from acute varicose veins decided to test the machine independently of the advice we gave her which was, to wait for the physiotherapist's diagnosis to make certain that she could use the machine. When I arrived one morning she told me she had finished her whole wash load and was already going home. One of the woman asked her if it was really true she had finished and started praising the machine. The President then went home and later brought with her two large white carpets in a wheel barrow and, with help from me and another woman, washed them in relatively little time. From that day onwards the word spread that the machine was working properly and over 7 women started washing every day. We asked the president to wait for the doctor's visit and one day we were surprised to see this woman pedalling using her hands (Figure 101).

Figure 101. Woman suffering from varicose veins was keen to use the machine.

One of the main problems in this wash place was the lack of water. For some reason this neighbourhood is only supplied with water for two days a week and there were times when there was no water at all for weeks. This constantly disrupted the continuity of the tests. During the week, the concrete tanks were filled at night time and the women who arrived at the wash house first were entitled to get one tank and use the water. This caused a number of arguments and accusations between associates and sometimes caused chaos in the tests. SETRABES was contacted to discuss the possibility of constructing a water tank but, as it was expected, this was rejected due to lack of money. Thus, for long periods, tests which were arranged had to be postponed due to lack of water.

The lack of water was a dangerous factor and threatened to destroy the existing climate for the tests. As there was no finance available from the women to buy or construct a water tank, I suggested that, to try to minimise the problem, that a 1000 litre water tank should be acquired. I explained to the women that I had no budget for that and that I would try to obtain the money necessary for the purchase by asking people I knew. I explained to the women that I was doing this because I had an interest in using the water to test the machine and that the tank would stay there after I left, so the tests would not stop. It was important to make this very clear to remove any idea of charity or paternalistic behaviour on my part. After the tank had arrived, a discussion about the use of water emerged. Some women wanted to use the water for the every day wash and some others, who were using the machine, wanted to monopolise the water to wash in the machine. To reduce the risk of further arguments and because one tank was not sufficient to conduct the tests, I later bought another 1000 litre tank with my personal funds.

I considered also the possibility of filtering the water used in the wash and contacted a sanitary engineer to verify this possibility. The engineer explained that the process was very sophisticated because the water has to be very clean because in Campina Grande there were a considerable number of people with Hansen disease (leprosy). It would also be an expensive system because it was necessary to have staff specifically trained for the job. At the time there was also a cholera epidemic in some parts of Brazil. Due to these difficulties the idea was abandoned.

To reassure the women with health problems, another meeting with the physiotherapist was arranged. During the meeting, a series of questions were raised. First, the physiotherapist made clear to the women that pedalling was something very healthy to everyone and that the machine would bring benefits to people with back problems, varicose veins, kidney problems etc. He made clear that, referring to case of the President of the Association, that pedalling using her hands was prejudicial to her back.

Some of the women commented that they were very satisfied with the machine and that it had reduced considerably the amount of time needed to wash. It was suggested that a maintenance team should be trained to allow future self sufficiency in relation to problems with the machine. Some women said that they were aware of how to adjust the chain and the chair and would be keen to be involved with this work. Six women volunteered to be on the team. They seemed satisfied with the use of the equipment and mentioned that in 1993 the machine did not work appropriately because it was not tested properly, remaining a long time without any use. Once again some women mentioned that they were happy because now that the machine was working, the 'professor' could make money producing it. Once more I clarified my objectives with the research.

Another point raised by me, in attempt to encourage participation in design, was that, if in the future we were to have more machines in the Santo Antonio Municipal Wash House and in the other wash places, then we should be able to finish the design of the present prototype: that is through the involvement of every one in the wash house.

The present prototype was constructed using waste materials and some ready made parts. It was made to test whether the mechanical system worked satisfactorily. The problems related with to the human interface with the product were deliberately only superficially addressed. My idea was that these factors would be addressed in a participatory manner as the design of the equipment was developed, with the users suggesting modifications and improvements related to the utilisation of the equipment. Some women suggested that the pedals should be closer to the seat and that a cushion should be added to the seat.

At a later date I asked one of the woman if she had detected any problems in using the machine. She was reluctant to answer and said that I was the 'professor' and I should be defining these things. To that I replied that they were the only ones who could really design the machine, because they spent most of their lives washing clothes, I was just an outsider. I made clear my limitations, not only as an outsider but also as a man who, had very little experience in clothes washing (in this region washing clothes is a female occupation). This conversation appeared to have stimulated her ideas. She pointed out the fact that after they washed the clothes, they had to put the wet items in a basin or bucket on the floor and then lift it up, a heavy job as the bucket or basin could weight around 13 kg. I promptly showed her and some other women the proper position for lifting a load, which would minimise the risk of hurting their backbone. She then suggested that we should put a raised surface by the side of the tub where the basin would rest and, after it was filled, it would just be a matter of carrying it away, without having to lift it off the floor. When asked how we could do that, she said it was going to be very complicated because there was no material available, that they had no money etc. I suggested that we should look around the wash house to see what we could find. We managed to find a piece of plywood and brought two chairs from the Elderly Club and temporarily solved the problem (Figure 102, 103). This was a crucial moment in our relationship because the women felt that I really wanted to see things improving. Solving small problems immediately when they occur stimulated the women. When the President saw the improvised solution she said that her son worked in a wood workshop and could bring a bench to replace the chair. The use of the chair later proved to be a source of internal conflict because another woman in charge of the maintenance of the Elderly Club was one of the 'devil's advocate'. She also had some previous grievances with the President. Their discussion led on to other topics and an angry argument between the women related to personal problems erupted. It is interesting to note that the fact that they were discussing such matters in front of strangers showed we had managed to gain acceptance by the group.

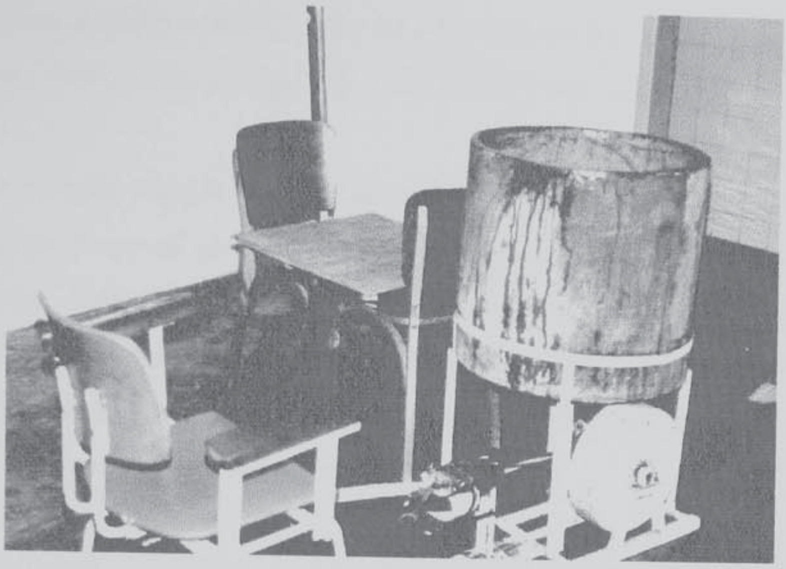

Figure 102. Solving small problems immediately when they occur stimulated the women.

Figure 103. Solution proposed by women.

The tests continued. Every day myself or the research assistant counted the amount and the type of clothes contained in the dry load before each wash started and measured the amount of soap and water used and the temperature of the water. More women now were trying the machine. There was a woman, who only occasionally came to wash, who had complained about her legs being stiff when washing standing up. She said that after pedalling she felt so good that she was even considered coming to wash more often. She also made some comments about some of the women who continued to try to discredit the machine. Some women started to spread the benefit of the washing machine into the community. Even the local priest came to see it and pedalled it. This was another positive aspect because the priest is a respected person. His opinion is regarded as important by the community.

At a later date one woman brought her 18 year old son to pedal for her. That was a very positive move because it served as an example to other women who were old or who had some health problems. Other women imitated this behaviour by bringing their daughters and even a ten year old grandson came to help his grandmother (Figure 104). Washerwomen from other wash houses came to try the machine and liked very much. They had seen a report that the local television had made about the machine.

Figure 104. Women started bringing their daughters and even a ten year old grandson came to help his grandmother.

As part of our agreement, the women using the machine would have to start to register the tests they made. We then purchased the proper 'measuring equipment', a digital watch, a graduated cup and a thermometer. We also designed a sheet to fill in with the data. When discussing the kind of information to be registered, we felt some concern about the expression on the womens' faces, and realised that most of them were illiterate or semi-literate. This was confirmed by some of them. It was evident that we had to use symbols. We then prepared a sheet with drawings and wrote the weight of the most common clothes by the side of the symbols. We conducted some tests to see how clear the symbols were and had to change some of them. Most were clear but some were interpreted in a totally different way than it was intended. Due to the time constraints we decided to use the symbols as they were and trained the women to identify them.

Latter we asked them to fill in the corresponding rectangles using a mark or 'sticks', one for each type of clothes. They started doing this without any difficulty, sometimes writing slightly outside the rectangles. An interesting fact occurred in relation to filling the rectangles. A couple of days after the women started filling in the sheets, one of them came up to me and asked if, instead of using 'sticks', they could fill the squares with proper numbers. The women were verbally but not numerically illiterate. This was a clear example of how the external agents brings his/hers misconceptions into the research. In this case this was not critical and the women just switched to numbers.

Another interesting fact was an attempt to reduce the costs of soap. The women had been complaining that powdered soap was expensive but that they had to use it because it gave a pleasant smell after the clothes were washed. I suggested that perhaps diluting the bar soap by melting it would enable it to be used in the machine. They immediately grasped the idea and using a small cooker melted a bar of soap (Figure 105). Then the soap was put in the machine to see if it foamed enough. The result was good and the quality of the wash was satisfactory, the advantage was that the bar soap was much cheaper. The problem of the 'nice' smell was solved by them adding a small amount of powdered soap to the mixture.

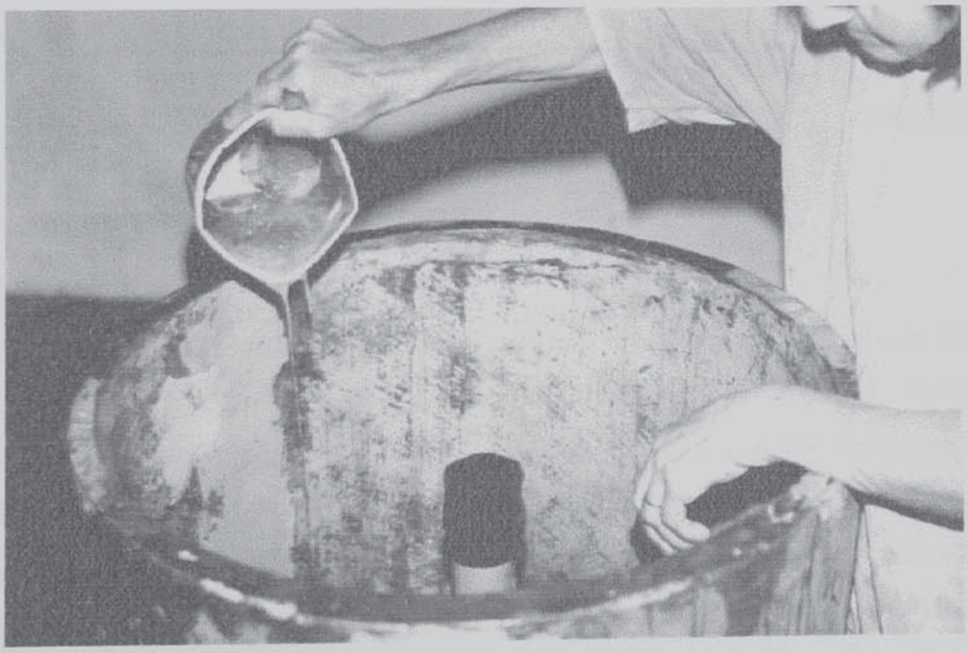

Figure 105. Melted bar soap used as an alternative to expensive powdered soap.

Another fact which is worth mentioning is how some women perceived the improvements in the design of the equipment. I suggested to one of the leaders the idea of installing a cooling device, a fan, in front of the tub to cool their bodies when the machine was being used. To that she replied laughing that this was too much of a luxury. They seemed to accept that products which are made for the poor had to be badly made and uncomfortable. If the product did the job reasonably well, other factors such as safety and the comfort of the operator did not matter too much.

The lack of water continued to be a critical problem. Only one of the 1000 litre tanks was filled with water. This means that they had to reduce considerably the amount of clothes they were washing. They also had given up rinsing in the machine. One of the reasons for using the machine was because it was very economical in water. Some women wanted to take the water home to wash but the President refused this explaining that the water was there to be used in the machine. This was a worrying situation because it created a bad atmosphere. But the problem was at least minimised and, when I left to return to the UK, attitudes towards the washing machine seemed positive. In recent months however, I was informed that internal disagreements have erupted again and the women have been accusing each other of monopolising the machine. At the moment, there is little that I can do about this situation, as my research assistance lacks experience and will have to leave the project soon. My intention is that when I return to Brazil, I will immediately assemble another washing machine prototype and continue the tests for one more year. Then, according to the results, I will try to obtain funds to construct five other machines to put in other washing places.

## 6.8. Evidence from the Presentation and the Workshop Conducted at Monte Santo Neighbourhood Association

### 6.8.1 Presentation

Contact was made with the president of the Associação dos Moradores do Monte Santo. It was explained to her that my intentions were to have a first contact with the community to introduce the activity of industrial design. I made clear that it was my understanding that industrial design could have a role to play in providing some basic products needed by the low income population. Thus I would like to meet the community and discuss their needs and what could be the possible intervention of designers through the Association. A date for a future meeting was agreed, and at that date, a set of slides was presented together with a number of live products.

I introduced design as an activity which was performed by lay people and also by professional designers. I gave a number of examples of products used in daily life in Campina Grande which were designed by unknown designers and showed slides of work produced by myself and by my students at the university. The products designed by students were concerned with education and health, and my work also covered such areas as agriculture.

The presentation sparked a lively discussion and it appeared to be stimulating to the community. It was of particular interest to the viewers to the see the products used in their daily life. Their questions concentrated on the difficulties of making some of the products and how could they have access to them. Some of the products appealed directly to some participants as was the case with the children, who were particularly interested in a card board rocking horse designed for both disabled and able-bodied children (Figure 106-109). I had brought with me a scale model which was passed around the group. The children suggested we should construct one rocking horse, to which I replied the product would take too long to make and I was short of time as I had to return to the UK.

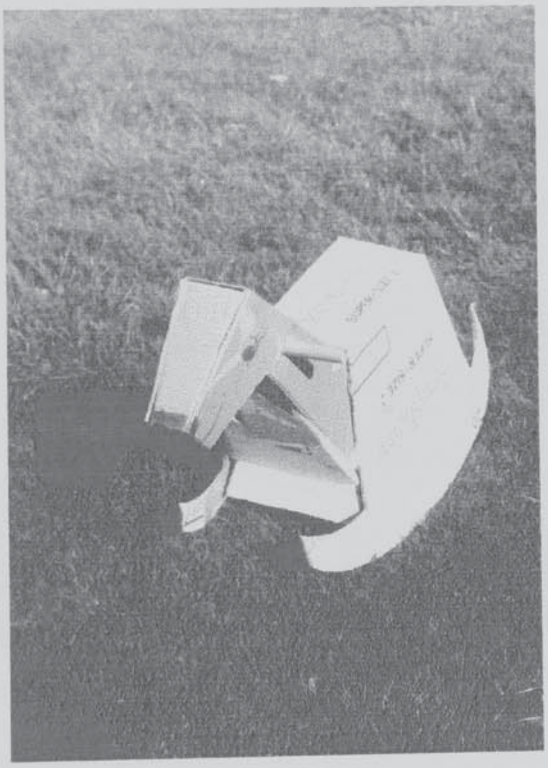

Figure 106. Initial idea for the rocking horse.

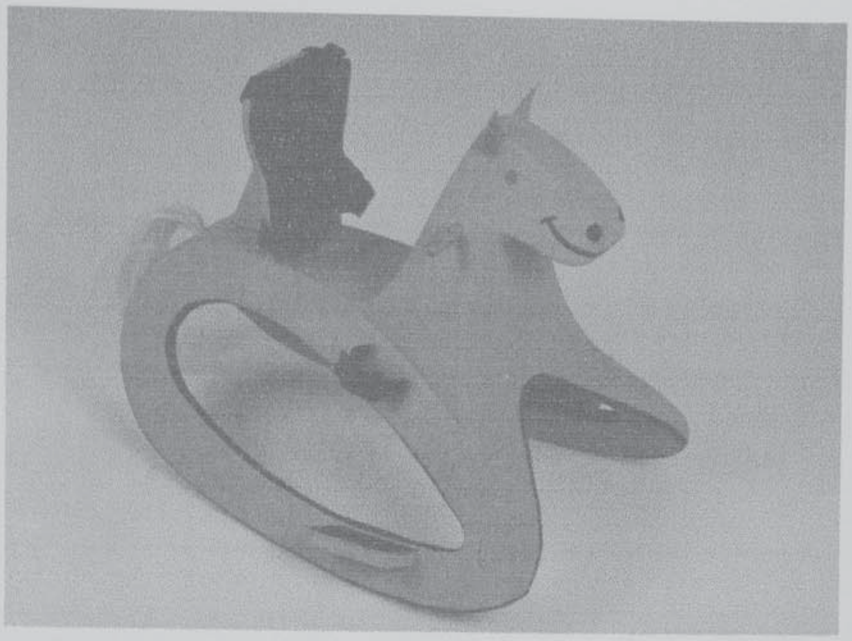

Figure 107. Scale model of the product development.

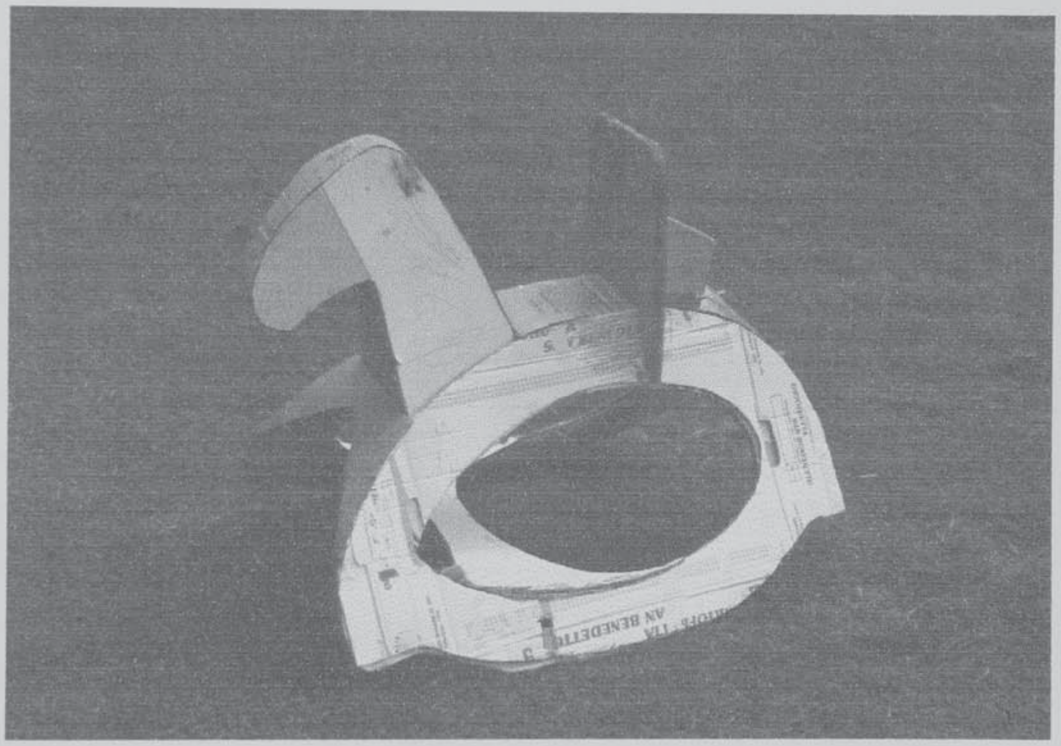

Figure 108. Full scale prototype made from packaging boxes and fixed with flour glue.

Figure 109. Prototype was then covered with newspaper or cloth to improve finish.

Another group of participants was very interested in the teacher education resources (Figures 110-112) for two reasons: some of them were primary teachers and there was an evening literacy class in the Association where those teachers taught adults how to read. They explained that, because they had very few resources, it was very difficult to obtain materials to teach, causing difficulties for the evening classes. They picked out one of my students' projects which was made using waste match boxes assembled into a module which could be assembled in different positions allowing the construction of syllables, words and sentences (Figure 100). The product particularly appealed to them because it was easy to construct and to obtain the raw materials. After the slide presentation, a group of late comers arrived, they were mainly teachers and people who worked until late and because of transport difficulties had been unable to get there on time. They asked if it was possible to show the slides again, which I did.

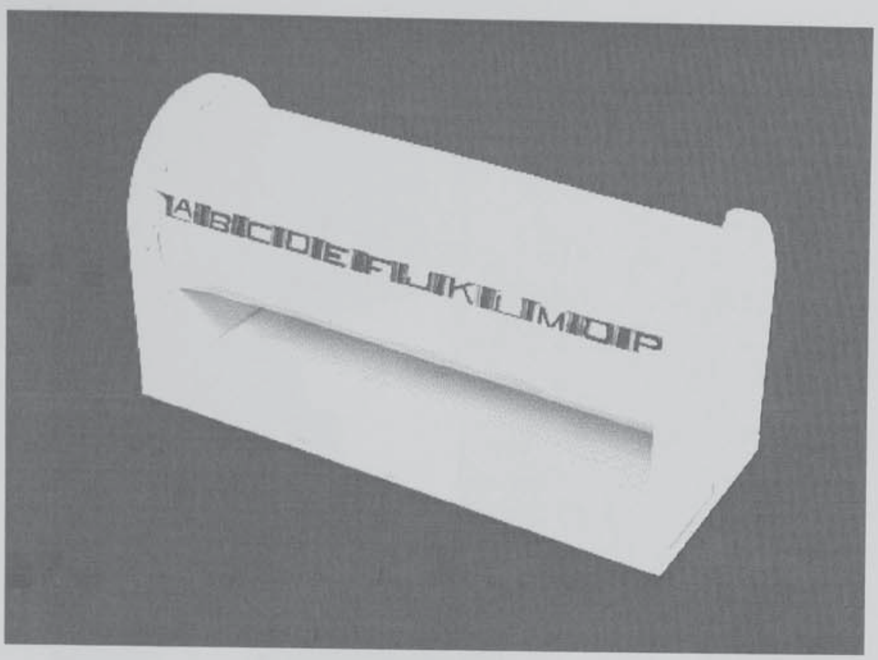

Figure 110. Teacher resource used in literacy classes.

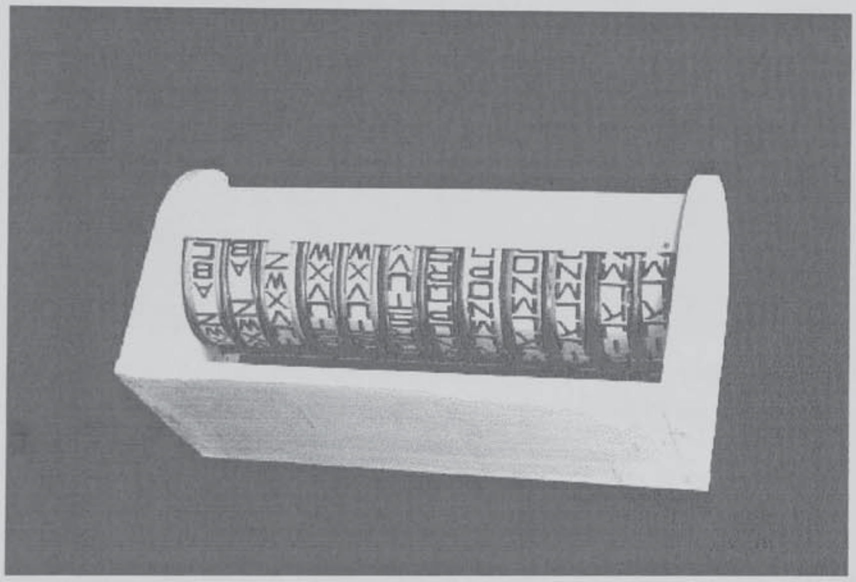

Figure 111. Waste, round guava sweet cans are fixed to a shaft. They moved around by the children, forming words.

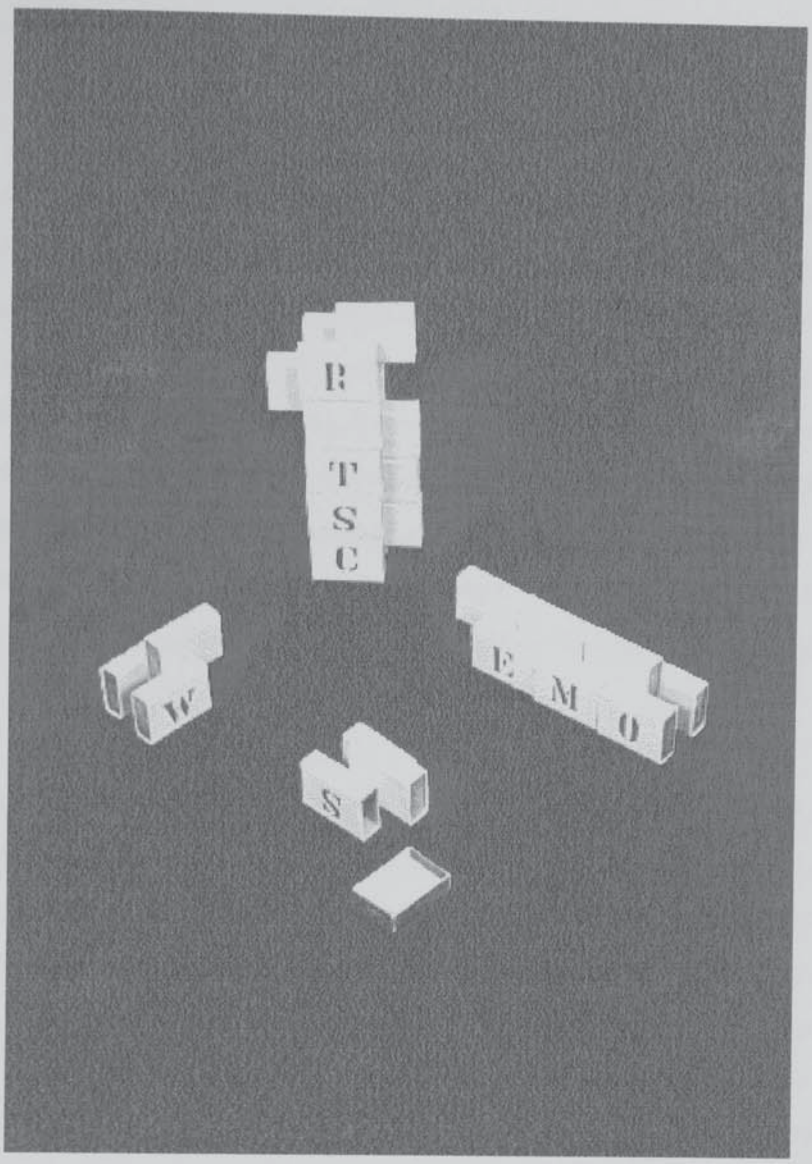


Figure 112. Teacher resource module made from waste matchboxes. They are put together in a row or piled up to form words. (Author: Mark Damon)

After the slide show, and discussion, the group decided that the product which could benefit them in the immediate future was the match box module. It was then decided that other people who had not come to the presentation would be contacted to ask their opinions about the proposal. The President of the Association would then telephone me to set up a date for the workshop.

### 6.8.2. The Workshop

The workshop took place in June 1993 at 19.00 hours at the Association building. There were 19 people present, including two female children aged around 9 years old. Occasionally some boys would come in and look at the activity which was going on but they did not want to participate. It is important to note that this was a day in the middle of the week and that there was a thunder storm. This fact showed how keen the community was to get involved with the workshop.

Again I introduced my self and the students who accompanied me to the people who were not present at the first slide presentation. In the first part of the workshop the student, author of the project, explained the origin and function of his design. This product had been designed in conjunction with the Education Department at the Federal University of Paraíba. The brief was very simple: to produce low cost equipment and resources which could be used in state and municipal schools. The conditions of those schools are precarious as resources are rarely available to buy teaching aids. The students produced a number of alternatives which took into consideration existing constraints and resources. Most of the products used waste materials and very simple technology which would allow the teachers and students to make them.

The student then explained the material needed to construct the module and the stages in its production, and constructed one module slowly showing all the steps. He also showed the copy of his report with all the research involved to show how a design project was made. The first stage in the construction was to measure the waste computer paper to wrap the match boxes, then cut the pieces of paper and glue them around the boxes. The next step was to finish the edges with a pair of scissors and then to write the letters on the sides of the boxes. After the complete process had been demonstrated, material was distributed to the participants who started to construct the modules individually. The fact that no ruler or any other measuring device was used, had a positive effect in removing the anxiety of the participants and emphasised the simplicity of the product's construction and design.

Each participant made one module and when they were finishing it, I decided to intervene and stimulate a discussion on how the workshop was going up to the moment. I then questioned the effectiveness of the way we were working. A discussion developed and a number of people commented that it was a bit slow, and that, if it continued like that it would not get very far. I then asked them to suggest how production could be improved. As they spoke, I wrote on a blackboard. One of the men present suggested that he could specialise in the cutting operation, cutting the paper which was wrapped around the boxes. Other participants suggested specialising in gluing, and others in assembling, the module. Based on these peoples' suggestions I provoked a discussion on how could we turn this workshop into a factory. There was a very positive response and other suggestions aiming at speeding up production were made. Some participants said we should change the layout of the room and give specific jobs to each person or groups of persons. I continued to record these comments on the blackboard and from that information, visible to every one, a new layout emerged.

Quickly the group began to change the positions of the tables and work started on preparing material for production. This working process proved very fruitful and lively and people appeared to be enjoying it thoroughly. Gradually new divisions in the process started to emerge. One woman made a cross with a piece of chalk in the side of the match box, to mark the position for gluing the other match boxes. Another participant specialised in finishing the edge of the boxes with a pair of scissors. Production reached a crescendo until we ran out of matchboxes. Gradually the work was finished.

I then started a discussion to seek their opinions about the whole process. Some participants said that they were very surprised to see the amount of work they managed to do in two hours and with no previous experience. Others commented that in the beginning they were very sceptical that any thing real would come out of this workshop. But it was particularly the teachers who expressed feelings of joy with the result. They said they were happy because now they had the material needed for the night classes in the Association and that they would also use it in the primary schools where they worked. Some even decided to use it at home to teach their own children. The President of the Association also expressed surprise to see how people got together around a common objective and worked so hard and that this was an example of what could be done if they united to fight for what they needed. As it was over 10.30 p.m. we decided that it was time to finish the workshop and thank every one for their help. We made it clear that we would contact them again in the future when we could discuss other products and ideas they wanted to design and construct.

## 6.9. Commentary

Both the washing machine case study and the workshop at the Association provided crucial information which can be used both in the design of policy and of interventions at micro-level aimed at the poor population.

In relation to the washing machine, in general users are rarely consulted when products of this nature are designed, and important information was derived from this participatory approach. For example, there is considerable prejudice against women in relation to technical issues, thus it was regarded as important that the women should be completely involved in all matters concerning the machine. This was considered an important aspect of the diffusion of the equipment as, due to the lack of support, these workers will have to reach a certain level of self-sufficiency in maintenance, improvements etc., after the product has been introduced into the washing houses.

It was essential for the acceptance and diffusion of the technology that an informal relationship was established. External agents have to approach the community with respect and recognise that people have important things to say just as much as the agents themselves. This includes abandoning any preconceptions about the situation in which the product is going to be introduced and diffused.

This behaviour from the external agent facilitated co-operation and reduced the suspicion of the people. Initially, daily contact was crucial not only to gain the necessary confidence of the subject, but because it is through daily contact that important information about the context emerges getting to know the personalities and behaviour of group leaders appeared to be necessary to improve relations and integrate to the group. For example, in the wash place there were outspoken women who played the role of 'devil's advocate'. They fulfil an important part by questioning aspects of the technology to be introduced. This role was not always explicit. Some of the women pretended to be positive about the product in front of the external agent and then when he left, they would say negative things about the machine to the other women but they pointed out faulty aspects of the design from either the mechanical or industrial design perspective. To the agent, it is of fundamental importance to 'neutralise' these 'advocates' by proving that the product works. This means gaining the confidence of the other part of the group (also leaders) who are willing to test the equipment. From the beginning it was necessary to clarify that the project was concerned with research. I had to make clear that I was not running for a political post (politicians appear in the wash house every four years to try to win votes and after the election never appear again) nor had any intention of manufacturing the machine for my own profit. I made clear that my relationship with them was based on an exchange of interests. I would provide the equipment, which I hoped would work and would bring benefits to them both in terms of minimising occupational health problems, and positive economic benefits by reducing washing time, thus 'stretching' their money. This was put to them in the first meetings and I reminded them latter on. Even so, several times women would come to me and say that I was going to make a lot of money from the machine. It appeared that there was a considerable difficulty in understanding my proposal. From time to time I had to remind them that my 'profit' would be the results of the tests and the subsequent diffusion of the equipment.

In discussions with the group, the decision was made to transfer the machine from the inside room to a place outside. This appeared to be something which many of the women wanted but they did have not the courage to ask for it. This behaviour was repeated with different matters. This is related to the points mentioned above, that the external agent has to become integrated with the group, and create a relationship of trust.

Another important aspect is to solve as quick as possible the problems which emerge on a daily basis: for example, problems related to the lack of water. I managed to collect money and brought the 1000 litre water container, which at least minimised the problem. Such an attitude and the actual delivery of the container had a positive effect because it showed that the external agent meant what he said. Gradually the external agents became more integrated with the group. This is another important aspect as these people are very poor and have no reason to give the external agent 'credit' in advance. It is different when you are introducing products to higher income groups who have already fulfilled their basic needs. The washerwomens' mistrust arouse from the economic difficulties of their life. For them, and to most of the Brazilian population, the comforts of modern life have not materialised.

An informal relationship helped to integrate the women with the tests. A simple fact exemplifies the difficulties of working in a co-operative way. I had brought a box of chocolates from England and gave it to the President of the association of washerwomen. The idea was to give the box to the group in one of the meetings. A couple of weeks later, when asked about the box, the President reacted in a worried manner and said she was very ashamed but that there were no chocolates left. A group of five women had convinced her not to wait until the meeting and that they should share the chocolates between themselves immediately. If this example is applied to the use of the machine it raises a number of questions. Once the equipment is operating in a profitable way, will the women share it? There is only one machine available. Who will use it first? Who will maintain it? Will a re-organisation be necessary to enable the use of the new product?

Some of these questions are already being answered. The machine is, at present, being used by about nine women who are satisfied with the results of the washing. There are concrete examples of solidarity between the women due the introduction of the equipment. Women as old as 72 years, are using part of their time to help others who consequently can leave the wash house earlier. The users are also bringing members of their family, including men, to help with pedalling. This is a positive aspect because before, men would not be willing to stand at a tank and do washing. Now, because the equipment is a machine, the involvement of men is more acceptable.

Although this case study is a small illustration, it makes clear that industrial designers who have a commitment to socially useful design have to approach the problems of design differently from working with formal enterprises or higher income users. It requires a much closer involvement with potential users of the products, and an initial respect for existing indigenous knowledge. It is desirable that other professionals be involved in the project, but as sometimes this will not be possible, the designer has to have a wider understanding of the context and of human relationships. The industrial designer might also have to be involved with aspects of mechanical engineering.

In relation to the workshop, there were some very positive feedback. One thing is clear, the community was very keen to sort out their immediate problems. The fact that most of them had never heard about design did not prevent them from grasping that this activity could have an immediate impact on their lives. People proved to be responsible in the selection of products and in their solidarity with other people who had more urgent requirements. They also showed a sense of unity and worked together in a manner rarely seen among professionals. This team work and a pleasant working atmosphere was the main characteristic of the workshop. Another important aspect was the fact that they managed to organise a simple production line by themselves with minimum intervention. They also showed that they understood the dynamics of production. Although there was no opportunity of involving participants in the design process it is clear that the potential to generate products is there.

The workshop raised questions such as: what kind of methodology should be used when involving lay people in the design of products? what can initial experiences teach us about maximising the impact of such methodologies? Would it be best to educate special trainers or hold many workshops in different communities? How can we stimulate the interest of the population in design? How can design by the poor for the poor be included in policy? Both the workshop and the case study provided evidence that if properly stimulated, poor users can make an important contribution to the design of their products. More importantly, they can be involved in the manufacture of a number of less sophisticated products which will have an immediate impact on their lives.

# Chapter VII

# Conclusions and Recommendations

## 7.1. Introduction

This chapter presents the main conclusions of this investigation, and proposes possible interventions to create or improve existing design capacity in microenterprises. It ends with recommendations for further research and interventions in self-help schemes run by the poor.

## 7.2. Conclusions

The main conclusion from this investigation is that design has an important role to play in the context of social needs in less industrialised economies. This role however, has little to do with the present way in which industrial design is being used in formal production units and departs from the elitist view of design which excludes non-professional designers. In fact, the recognition of non-professional design is seen as a key issue for the diffusion of design to the low income population.

The first assumption, that there is design capacity related to both capital and consumer goods in microenterprises, was confirmed by the literature review and the case studies in Northeast Brazil. However, most of this design consists of incremental innovations. This is related to the fact that, as in MIEs industries, making evolutionary improvements to existing technology is a less risky strategy for firms than trying to introduce new products into the market (Walsh et al. 1992:30).

The second assumption, that support institutions involved with microenterprise development do not take local design seriously was also found to be true. This is evident from the almost total lack of specific programmes targeting support for design. The few existing programmes, in general, provide financial support for R&D and professional design for small firms, but neglect design by small enterprises (PATME 1993). It emerged from the literature review that relatively few attempts have been made in this direction. In the literature on innovation and design, the predominant view is that this profession is mainly linked to competition between more sophisticated production units and more recently, is a strategic tool in international competition. The social role of industrial design appears only to be discussed on the fringes of the MIEs' innovation literature, and is treated almost as something exotic, which only occasionally gets into the mainstream literature. In the literature on industrial design in LIEs the situation is even more critical. The two major authors who have addressed the relationship of industrial design to the needs of the poor are ironically from the more industrialised economies. The emerging literature on industrial design in LIEs is mainly focused on the problems of NICs and almost no research about design in microenterprises has been conducted (Er 1994, Panchal 1995). This raises an important point about the role of design in LIEs. Gui Bonsiepe has a number of times pointed out that design has been mainly an academic preoccupation and that it has not penetrated industry in most LIEs. In relation to the needs of the poor this raises the question: which industrial units are we referring to? It is obvious that it is not the industries producing sophisticated expensive goods which are inaccessible to the majority of the population in LIEs. As the evidence from Chapter III and Chapter V shows, manufacturing for the poor is mainly the concern of small and microenterprises. The characteristics of finance-starved microenterprises call for a very different design from that which occurs in more wealthy firms.

The literature review shows that most of the research concerned with manufacturing microenterprises can be found in the literature on development, particularly in the appropriate technology literature. It is clear from the review that although engineering design is frequently addressed in this literature, industrial design is rarely a subject of study. This might be related to the fact that the AT movement puts too much emphasis on the techno-functional aspects of technology and neglects human-factors in product design. Such emphasis ignores the complexity of the human relationship with products and the market.

The first step in developing a more socially useful role for industrial design in LIEs is to start research specifically aimed at examining how design activity occurs at micro-level, and what obstacles impede its development. Although some findings of the present investigation can be related to other contexts, peculiarities from country to country do occur. It became evident from the literature review and the survey in Campina Grande that there are important lessons to be drawn from informal design methods. The most important finding is that the firms are using alternative forms of design which might give clues to ways to enhance communication with and within this industrial milieu. Some may criticise the quality of these goods, but if criticism is to lead to positive action, it is important to understand the constraints suffered by microenterprises.
The third assumption, that design can play a role in the creation and improvement of the overall quality of goods produced and consumed by socially vulnerable groups, and that enhancing design capability would accrue benefits for both low income producers and consumers alike, has also been confirmed. In fact, design might be the main tool for improving the overall quality of

products for the poor population in the immediate future. Design in microenterprises could be a tool to allow the entrepreneur a better control over all operations involved in the managing and manufacturing of products.

Existing design capacity, if properly stimulated, can improve conditions immediately. For example, for micro-production units design has a potential role to play in the organisation of production. Simple interventions such as: changes in the lay-out of the workshop; improvement of lighting conditions; improvement in the workstation through the application of ergonomics, improvement in management; and better control over different stages of production through the use of control charts, which are specially designed for and with the participation of illiterate or semi-literate workers; might bring immediate benefits to firms. Graphic design can also create an identifiable image of the microenterprise for the market by using a 'corporate image', logotype and other graphic devices.

Industrial design can have an important impact both on the design of capital and consumer goods, not only in the functional, engineering sense, but particularly in the user interface with the product. In relation to capital goods it can address the physical and psychological characteristics of workers, for example by considering anthropometric data of the working population — something rarely mentioned in articles about products designed by appropriate technologists. It can facilitate the operation of the equipment by positioning the controls in the proper location, specify efficient use of materials, thus making the product reliable, and improving its performance, make it easy to manufacture and easier to repair and maintain using available raw materials and equipment. It can have a particular impact on designing capital goods which are appropriate to the scale of the microenterprises. Reliable design in capital goods is crucial as little after sales service will be available.

Moreover in the design of capital equipment, engineering design skills should be stimulated but, industrial design skills are crucial to the improvement of the overall quality of the product. Because much of the production equipment in micro-production units is adapted and constructed in house, improvements through design can easily be incorporated. Thus, it is essential to make the non-professional designer aware of the potential benefits which can accrue from industrial design. On the consumer goods side, design can also play an important role in improving a number of features, including safety improvement, making the product more user-friendly. Immediate benefits can be seen to accrue from design. Through design it is possible to reduce costs in manufacturing by reducing the amount of raw materials used and by simplifying or eliminating manufacturing operations. Using design can help to improve overall product quality and thus enhance the possibility of acceptance by consumers and success in the market.

From the results of the survey of existing products in Campina Grande, it appears that there is scope to develop this innovative potential especially in relation to consumer goods, as they require less investment in both design and production than capital goods, and are easier to market. Design is particularly important in this context because of its role in determining the characteristics and the quality of the product to be manufactured. Design, can tailor the products to existing production capability by making the best use of production equipment, and to specific social-cultural characteristics of the user. It can also differentiate between existing products competing in the same market; expand product choice; and aggregate value to products without the need for immediate investment in capital equipment, thus 'stretching' the life of existing capital goods. This benefits both consumers and producers and gives a competitive advantage to the firm with design capability. This capability is particularly important as the market expands and small entrepreneurs sell their products to higher income consumers.

Attention must also be paid to local aesthetic codes and respect for local culture. The aesthetic factor is also important because, despite the popular belief that the design of products aimed at the poor should not consider aesthetics, the case studies in Campina Grande and Kenya (Kabecha 1994) provided evidence that this is also an important aspect to be considered. Aesthetic factors are also important in capital equipment. Here we must clarify that these factors in product design do not mean the superficial 'make up' or cosmetic treatment of products after the techno-functional aspects have been resolved. In the case of machinery design details can have an influence on the efficiency of operation and health and safety matters. The importance of industrial design in engineering has been to a certain extent recognised in the recent engineering design literature. For example, the *Journal of Engineering Design* states that its focus

> [...] deliberately embraces both industrial and engineering design research activities across the major disciplines of engineering. Coverage includes: industrial design and total design; product design and form design [...] (Journal of Engineering Design 1993).

Other authors in the engineering literature also recognise the importance of the relationship between engineering and industrial design

> Industrial design, which embraces aesthetic, ergonomic and graphic [...] ...provides tools that can assist in the specification of what is needed by the market and in design for the man/machine interface. These techniques are used by the designer to analyse the interfaces through which the two-way traffic of information, control instructions, manual operations,

> environmental influences and impressions pass between machines and those who use them, or are affected by them, and to guide their detail design requirements [...] they are an essential part of the wide spectrum of techniques drawn on by the engineer, including specialist expertise when appropriate. The problems to which they can be applied can therefore be considered in terms of the engineer's criteria of performance, quality and cost effectiveness [...] aesthetic, ergonomic and graphic techniques all contribute to some extent, depending on the type of product and the nature of the interface problems. (Flurscheim 1983:1-18)

Consumers can also benefit if design is introduced in self-help schemes. Self-help schemes run by the poor exist in most LIEs. Some of them are run by organisations such as churches and NGOs, others are spontaneous schemes which emerge from solidarity between neighbours. For example, in Brazil, it is common practice to have a 'mutirão'. This is free help offered by peasant neighbours who get together on a specific day to work for the benefit of one person, who on this day, gives a party at his/her expense. The work performed might be harvesting, planting or even the construction of a house. This practice has also spilled over to poor communities in urban areas. As the workshop in the Monte Santo Neighbourhood Association showed, introducing design 'mutirões' does not involve any complicated organisational procedures or a huge amount of resources, and can have immediate effects on the lives of people. Although the product constructed in the workshop used very simple technology, it could have a much wider educational impact on this community. Because people are marginalised, their schools, which are run by the Paraíba State Education Secretary, lack even the most basic resources. It might be argued that there are other priorities to be addressed, but education is uniquely important in the sense that once that stage of a child's life has passed, there is no turning the clock back. If essential aspects of education are missed at an early age then education at later stages of a person's life will be affected.

In other basic needs areas, like housing, self-help schemes occur daily in most Latin American cities as they are the only alternative for the homeless (Turner 1988). The kind of social security available in MIEs, is rare in most LIEs. Most governments are unable, or unwilling, to provide the funds to fulfil basic needs. What is clear from the literature review and the case studies is that there are important lessons to be learned from what is already being done in communities. As design activity is carried out most of the time by the entrepreneurs or the low income communities themselves, any interventions aimed at products produced and consumed by the poor should build upon existing structures. This view is shared by Poston who proposes

> [...] an approach to intervention which capitalises upon existing skills, practices and social relationships rather than requiring the development of new practitioners, skills and social relationships [...] by working with existing structures and skills rather than undermining them

the sustainability of the enterprises which are developed is greatly enhanced (Poston 1990:168).

It is thus necessary to use a broad definition of design which encompasses the work of innovators without formal training, and acknowledges their capacity to generate and redesign products, is thus necessary. As pointed out in Chapter III, in Europe, non-professional design had been practised long before a distinction between design and making occurred and design professionals appeared in the 20th century. In many parts of the developing world non-professional activity is the only option open to small enterprises.

Nevertheless, formally educated designers have the potential to play an important role in the development of innovative capability in these small units. Co-operation between designers and small businesses could be used to address human factors related to the operation of products such as safety aspects. For example, Figure 113 illustrates the danger of products made from reused materials being given to children. The truck's mirror has no finishing, which gives it the sharpness of a blade. A simple folding of the edges of the sheet would provide protection without any major investment in terms of tools.

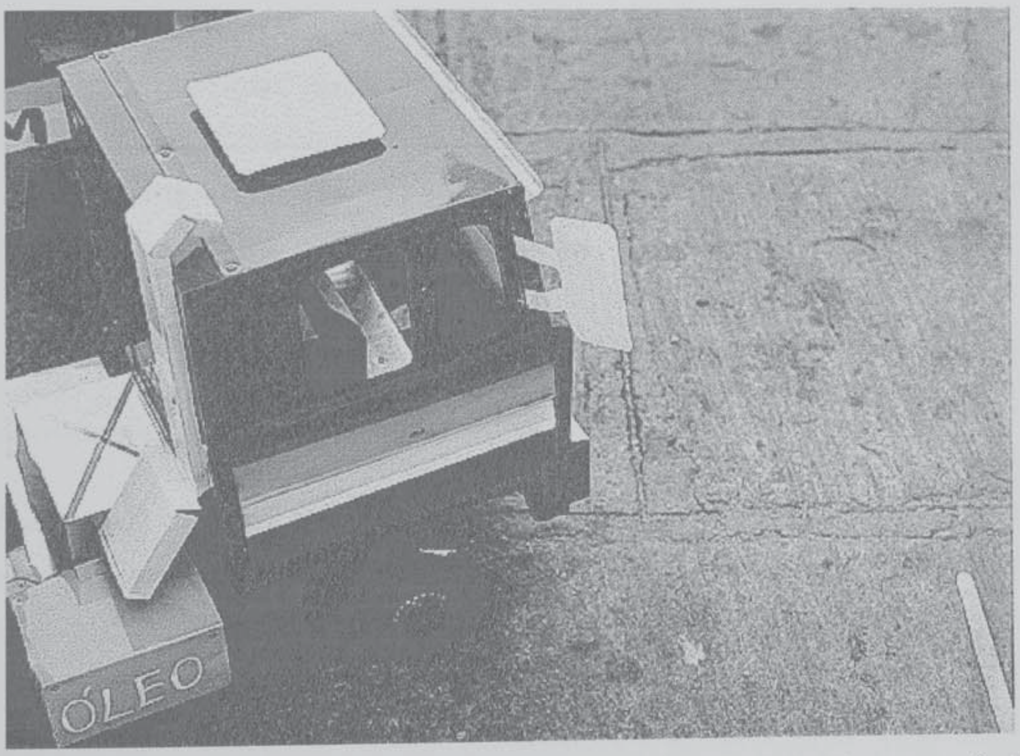


Figure 113. The truck's mirror has no finishing, which gives it the sharpness of a blade.

However, it would be naïve to think that design is the solution for all the problems of a manufacturing firm. An integral approach involving all aspects of management is necessary regardless of the size of the firm. It appears that smaller and poorer firms can benefit most from such an approach. Management skills are crucial in a situation of such constraints and can help the microentrepreneurs in making decisions which can mean survival or disappearance from the market. Microentrepreneurs are 'juggling' with information from a number of sources, consciously or unconsciously. Thus they might require external help.

The role of the designer may be that of an 'enabler', or a 'catalyst', co-operating with the small entrepreneurs to develop their own capability, and their own ideas, introducing new techniques, exchanging experiences and learning with the local innovators. Vyas, referring to a similar context in Indian small enterprises suggests

[...] In general, a designer's specific contribution here would be in three areas: the consideration of human factors (ergonomics) perceiving and solving problems from the point of view of totality (a systems approach) and sensitivity to visual factors (aesthetics). [...] His challenge lies in being involved, not only in the design process but also with the total chain of manufacture. He requires to combine with design sensitivity a strong technical bias which is sufficiently generalist in nature for him to employ his capacity for innovation to match the entrepreneur's approach. [...] An equally important service by the industrial designer would be in designing and constructing basic production equipment (Vyas 1991:187-210).

This thesis argues that, to be able to interact with informally trained designers in the context of NE Brazil and other LIEs, formally trained designers have, as a point of departure, to recognise the existing knowledge and experiences of entrepreneurs and that design is not the exclusive domain of educated professionals. Working at this level requires an approach which values peoples' (entrepreneurs and consumers) experiences and an understanding of design in a wider sense, as a basic human problem solving activity. As pointed out by Pacey

...To think in these terms is to begin to redefine the role of the professional designer, in terms of empowering people as designers, to design for themselves and actively to participate with professionals in the design process (Pacey 1992:217-225).

Professional designers can play an important role in bringing crucial information to the microentrepreneur to which she has no access. Although in a different context and on a different scale, this resembles the role of the information 'gatekeeper' in innovative companies, which has been emphasised in the management literature. Roberts (1977:124-7), suggests that these communicative individuals are crucial for the 'flow of technical information in a research and development organisation to enhance new product development or improvement'. Research and development organisations also need what he calls the 'market-gate keepers'

[...]engineers or scientists, or possibly marketing people with technical backgrounds who focus on market-related information and communicate effectively to their technical colleagues. Such a person reads trade journals, talks to vendors, goes to trade shows, and is sensitive to competitive information. Without him, many research and development projects and laboratories become misdirected with respect to market trends and needs.[...]'Roberts (1977:124-7)

### 7.3. Summary of Main Issues Related to Product Design in Micro-Production Units

It emerged from the investigation that there are a number of issues related to product design in micro-production units and that they are interrelated. Microeneterprises supply the low income population with products which are appropriate to their customs, needs and finance. Although there are clearly microenterprises where the owners are good entrepreneurs, the vast majority of manufacturing activity is related to personal survival. Labour involves mainly family members and the output is low. The investigation also shows that there is little institutional (public or independent) support for innovative activity in micro-production units. Enterprises have little access to market information even where the microentrepreneur is literate and there are difficulties in accessing wider markets as they are geographically isolated. There is also stiff competition between microenterprises and, in some product sectors, micro-production units compete with larger manufacturers.

The research found that there is a certain level of design activity in micro-production units but that this capacity varies significantly, depending on factors such as training background and access to credit. Although there were examples of ingeniously designed capital goods, these were mainly copies and adaptations from mass produced products. However such adaptation appears to be important in the build up of technical knowledge. Technical skills are mainly acquired by informal methods and the level of such skills is low. There was higher incidence of ability to design and adapt consumer goods, mainly because they are easier to market and require less time to produce. Most consumer products are household items, and were designed mainly by the entrepreneurs themselves or by people involved in production. The involvement of professional designers is minimal.

There was a high level of improvisation, particularly in relation to the use of raw materials in both capital and consumer goods. This occurs mainly because entrepreneurs have difficulties in accessing raw materials as they are too expensive or unavailable. However such improvisation comes at a price. Products lack quality in relation to finishing, aesthetics, and safety. Other aspects such as ergonomics are neglected. In general, there is little product diversification. However, the scale of the firm and level of technology employed — which is very basic — allow them to be flexible and many firms produced a variety of products which were not related to their main activity. This was an attempt to fulfil occasional market demands and worked as a life-line for many production units.

Small workshops are design intensive as they work to order. This practice requires involvement in all steps of design as some of the products demanded do not exist or there is little information about them which can serve as a reference in their manufacture and construction. Incremental innovation is the norm. Design activity is mainly related to routine engineering (use of well known technology) or fashion design (modifications in the external aspects of products).

The methodology used by non-professional designers is mainly based on common sense and based on trial-and error. There are few instruments available to predict possible pitfalls in the process and the products are based on cumulative practical experience. There is little use of either two or three dimensional means of process representation — written, graphic or modular. The work in general proceeds directly from the abstract concepts in the designers mind to the construction of a full scale prototype.

The research found that people who were involved in the design of products had a confused perception of design activity. This was particularly highlighted in the confusion between the attributions of a mechanical engineer and the industrial designer. However, design activity was associated with creative activity and invention. The entrepreneurs found such activity challenging and regretted the fact that they had little time to dedicate to it. Design activity was mainly conducted during leisure time as something separated from the other aspects of the business. Capital goods, in particular were designed in close contact with the customers who, to a certain extent, shared the costs of development. In general such costs were not defined and were included in the overall price of the order. Such behaviour is related to the fact that microenterprises have little access to research and development and testing facilities. This limits their access to more technical information and also affects the quality of the products they produce, making them more vulnerable to competition from larger and more technologically advanced firms. Having no access to R&D limits them in term of patent protection and limits their market penetration

### 7.4. Intervention guidelines

The selection and range of interventions targeted at creating or enhancing product design capacity in microenterprises, have to be in tune with the existing policy environment in which the interventions will take place. Such an approach should consider the available technology, market environment, existing educational/training levels, sustainability of interventions and the reproducibility of measures. A multi-disciplinary approach and a holistic view of the problem is thus required, as the design of products is an activity which has to be integrated within the enterprise to be successful.

Government and private institutions can play an important role in the development of design capacity in micro-production units. The first step in providing such support should be the recognition that there is design capacity at this level and that professional design is not the only way to introduce design activity into small firms. A campaign aimed at making micro-producers aware of the potential benefits of design for their business is also required. Support institutions can create mechanisms which will allow small units access to market information through the creation of a product database which would specialise in information pertinent to microenterprises. Institutional support should also structure mechanisms which allow microenterprises access to wider markets. This could be in the form of purchase by government institution, sales networks etc.

At macro level, government policy instruments should address external constraints such as a hostile environment, lack of infrastructure, lack of land ownership, and technology policies which rarely support entrepreneurs and can hinder development and growth in manufacturing microenterprises. Changes in the regulatory environment (less taxes, etc.) could create a more stable situation and stimulate enterprises to invest in technology and in the design and production of new products. National technology policies should include micro-production units when being formulated and should give preferential treatment to more innovative enterprises.

In relation to the financial constraints suffered by microenterprises, governments have the power to provide fiscal incentives and investment promoting measures, and change the general trend of giving priority to larger firms. Credit should be available in order to allow entrepreneurs to develop new, or to improve on existing, products. Government and private lending institutions should be more prepared to evaluate the product design needs and market needs of microenterprises. More access to credit for innovative firms should be made available. A more just tariff structure for import of capital goods which takes into consideration the constraints suffered by microenterprises should also be considered.

Of particular importance is the stimulation of communication between non-professional designers and professional designers and the strengthening of multi-disciplinary work focusing on product design. Government support is crucial in linking different actors who have the potential to co-operate with micro-production units. These might be industry federations, chambers of commerce, non-governmental organisations and grass-roots organisations. Easier access to information on patents and protection for design can also be facilitated by institutional support.

Although important, support aimed at improving the environment within which manufacturing firms operate is not sufficient to create or develop design capacity. One crucial aspect is the know-why and know-how of manufacturing. As the research showed, technical skills are low and support in this area is required. Training can involve considerable resources and thus should be selective. The focus should be on the expansion of existing enterprises. Programmes should take into consideration existing structure and constraints such as the fact that most businesses are linked to family survival. Careful consideration should also be taken in defining where training would occur. Many entrepreneurs did not attend formal schools and might feel uncomfortable in a traditional school set up.

The training proposed should consider design at the core of the micro-production unit and relate design activity to other aspects of the manufacturing business. Support programmes should introduce product design training modules into their management skills training courses. The design of these modules should be developed in close consultation with local innovators. Modules should be exploratory and provide information which could be used in the design of a wider training programme aimed at training trainers. The content of the training should stimulate the use of some methodology used by designers but draw mainly on the research on informal design methods. These modules should be based on action learning and not use conventional class work. They should be based mainly on practical work and take into consideration the existing apprenticeship system. Training should not be provided free, but alternative forms of payment should be considered. Policy should target the development of local technical skills and consider particularly the introduction of technical subjects such as Craft Design and Technology, into primary schools. Co-ordination at government level and interdisciplinary teams should be involved in structuring a specific curricula which takes into consideration micro-production units. Microenterprise development should be considered in the educational policy of the country. Improvement should occur in formal and non-formal training but informal training which is already in place should be considered in the microenterprises sector. Introduction of design in industrial vocational courses is desirable.

Universities are in a privileged position to support micro-production units. Beneficial effects can accrue from co-operation. Existing physical facilities and human resources available can easily focus on micro-enterprise activity. Units specialising in design within microenterprises should be created. Such units could centralise and disseminate information pertinent to firms.

## 7.5. Recommendations for Further Research

What I have identified in this research suggests that deeper investigation will be necessary to provide a more global picture of the situation. This is crucial for the design of future policies for microenterprises. Further research might involve registering alternative solutions for hardware: for example, alternative components for machinery (cf. Figures 70-75). There are many solutions being used in microenterprises which may not be state of the art technology, but which work quite well in the context in which they are being used. Another necessary line of research is related to design methodology. For example, the body of evidence shows that two dimensional means of representation, such as technical drawing or perspective drawings, are rarely used in microenterprises which rely mainly on three-dimensional means of representation such as scale models and prototypes. Thus a detailed examination of in more detail how such forms of in-house and external communication, can provide important information which could be used in the design of training programmes.

Another key point for future research is the design of capital goods suitable for the size and resources of micro-production units and which can increase production and improve the quality of products. For example the products which are made from waste plastic (polyvinyl chloride - PVC) drink bottles under-utilise this material, in the sense that other products which would use the same amount of material, but would aggregate more value, could be designed and manufactured. To be more specific, if one cuts the extremes of the large, 2 litre PVC bottles, a hollow cylinder of approximately 100 mm diameter will be left. If one side of the cylinder is cut longitudinally, a sheet of approximately 300 mm x 170 mm will be available. For small producers, this is a valuable material which can be used in a number of ways. If the entrepreneur were to buy this material from large PVC manufacturers, a number of obstacles would appear. The first and most obvious is the price of the material. PVC used in the food industry is very expensive. Added to that, manufacturers sell the products in large bobbins weighting a minimum of 50 kg. This is out of the reach, and in many cases, exceeds the needs of small producers. Another aggravation is the fact that mass produced PVC requires capital equipment e.g. a vacuum forming machine, which is out of the reach of most poor entrepreneurs. Although there are small versions of this equipment they are still very expensive. Thus, what entrepreneurs need is a low cost, small and flexible vacuum forming machine which can be made with very simple, locally available technology. This includes the vacuum pump, an essential piece of the mass produced equipment. Such equipment should be flexible to allow for the use of masks which would enable smaller bottles and other pieces of waste PVC to be used. However, the technology alone will not be sufficient if there is not a saleable product. Thus there is need for product design in consumer goods. This is a good example of both engineering design and industrial design being required to work together. Having design capacity would then widen the spectrum of the products manufactured and enhance the chances of survival in the market.

The way in which entrepreneurs innovate in this context raises further questions such as, how can the present relationship between formally educated designers and informally trained designers be improved? How can formal mechanisms of support for innovation be made more effective? What kind of informal mechanisms of support for innovation can be established? Are students trained at local design schools really aware of the needs of small entrepreneurs - their potential employers? For example, it is clear that the existing larger and medium enterprises will not be able to absorb all trained design graduates in NE Brazil. Some small firms could employ design graduates part-time or as free-lance designers. If this relationship is to materialise, educational bodies should work closely with small businessmen and be aware of the constraints under which they operate. They should demonstrate to small entrepreneurs that there are positive aspects to hiring designers. This relationship could bring positive results and enhance the chances of young graduates getting a job.

Support on a wider scale requires that other agents should be involved. Among potential support agencies which could be interested in such programmes are the International Labour Organisation, United Nations Industrial Development Organisation, the World Bank and many other charities involved with microenterprise support in LIEs. At a more local level, for example in Brazil, government agencies and private organisations would also be targeted to support such a programme. Among those are SEBRAE and CEAPE. These non-government support agencies are of particular interest because they operate all over Brazil.

However, I consider the introduction of exploratory training modules in these main programmes of fundamental importance as the basis for further intervention in the area of product design. It will be necessary to train a small group of teachers to start the exploratory modules. I believe that a realistic time frame to obtain proper feedback would be at least one year covering three main states. After this year, sub-modules should be designed and tested for another year. According to the availability of resources, the idea would be to start to train more trainers. Another stage would then be the implementation of a larger training programme in the most industrialised states of the NE. This work would be co-ordinated by the Social Design Sector (SDS) at the Federal University of Paraíba. The Sector has been involved in the design of socially useful products for the low income community in Campina Grande (Whiteley 1993). For this new endeavour, the Sector would have to be restructured to function as a centre for dissemination and training in design for microenterprises. The initial idea is to structure a database of existing products manufactured by microenterprises in the North-eastern region. This would also include the existing manufacturing processes. Wider research on other industrial sectors would be necessary to compile a global picture of design in microenterprises in the whole of the Northeast.

The SDS would also be involved in stimulating design by the poor communities in self-help schemes. In addressing product design and social needs in LIEs, the participation of socially vulnerable groups which are not involved in entrepreneurial activity should be considered. I therefore suggest that interventions, aimed at helping to improve living conditions of the poor population, should target two distinct groups: people involved in manufacture as their main means of survival and the community in general. Such an approach, I assume, would allow a better allocation of resources and be more effective. For example in the case of manufacturing microenterprises, the entrepreneurs will be aware of a number of activities and problems related to production, technical skills and so on, which the community is less likely to be involved with. Nevertheless, the potential exists for organisation of the community to create and produce their own products for self use. Potentially such an approach will stimulate community members to become small entrepreneurs.

Finally, the main beneficiaries of further investigation in this area will be the small entrepreneurs, as they could use the results of research to improve their company's ability to innovate and compete more effectively in the market place. This is extremely important in local markets, which are becoming saturated with similar products, as production in the informal sector exceeds the capacity of the market. Product design can reduce prices and improve the quality of products, benefiting both poor manufacturers and poor users. Enhancing the internal capability of design in such a context would put the innovative firm in an advantageous position in the market, thus augmenting its chance of survival and potential for growth. The gains to the manufacturer of having this enhanced ability are evident, ranging from the better use of raw materials, reduction in the costs of production, to a reduction in development time, and a consequent increase in profit margins. There are also advantages for the user such as a wider variety of products of better quality available in the market, designed to satisfy local needs, and accessible to the low income consumer.

# Bibliography

**Adegboye**, R.O. and Akinwumi, J.A. 'Cassava processing innovations in Nigeria', in Gamser, M., Appleton, H. and Carter, N. (eds.). *Tinker, Tiller Technical change - Technology from the People*. IPT. London. 1990. pp. 64-79.

**Allen**, T. and Thomas, A. (eds.). *Poverty and Development in the 1990s.* Oxford University Press/Open University. Milton Keynes. 1992.

**Appleton**, H. 'Technical innovation by women-implications for small enterprises.' *Small Enterprise Development* Vol. 5 No. 1. March 94. pp. 4-12.

**Arraes**, M. 'Pernambuco, Nordeste Brazil'. *Folha de São Paulo*, 24 October 1994, Caderno 1 page 3.

**Associação** Brasileira de Desenho Industrial. *Newsletter* No. 1. September 1977. p. 1

**APT**. *Annual Review 1994*. APT Design & Development. Moreton-in-Marsh. 1994

**ATDA**. *Hand Washing Machine*. Appropriate Technology Development Association Lucknow. India. 1977.

**ATI**. *Annual Report - Technology for Small-Scale Industry.* Washington D.C. Appropriate Technology International. 1985.

**Auböck**, C. *Contributions for an Outline of Industrial Design as a Federal Policy in Brazil'*. UNIDO. 1974. DP/BRA/73/022/11-01/74.

**Auböck**, C. *Contribution to a Regional Programme of Industrial Design by SUDENE for the Northeast of Brazil.* UNIDO. 1974. PR74/pprs/app/UP. IS/BRA/73/016/11-01/14.

**Back**, N. *Metodologia de Projeto de Produtos Industriais.* Guanabara Dois. Rio de Janeiro. 1983.

**Bannock** , Graham, Baxter, R. E., Davis, Evan. *The Penguin Dictionary of Economics.* (fifth ed.) Middlesex. 1992.

**Barroso**, E. *Concurso Equipamentos Agrícolas Apropriados ao Pequeno Produtor Rural.* CNPQ. Brasília. 1983. pp. 55-6.

**Barzanti**, B. 'Nonaligned Nations'. *Microsoft Encarta 95.* Microsoft Corporation. 1994.

Design & Interiores. 'Em Florianópolis, apoio às indústrias e ao ensino. *Design Interiores*. Nov/Dec. 1987, No.05 p. 119.

**Bassey**, M. 'Pedagogic research: on the relative merits of search for generalization and study of single events'. *Oxford Review of Education*, 7(1), 73-93, quoted in Bell, J. *Doing Your Research Project: A Guide for First-time Researchers in Education and Social Science*. Open University Press. Milton Keynes. 1992.

**Bell**, J. *Doing Your Research Project: A Guide for First-time Researchers in Education and Social Science.* Open University Press. Milton Keynes. 1992.

**Bhagavan**, M.R. *Inter-relations Between Technological choices and Industrial Strategies in Third World Countries.* Research Paper No. 49. The Scandinavian Institute of African Studies. Uppsala. 1979.

**Bhalla**, A. S. and James, D. (Eds.). *New Technologies and Development Experiences in Technology Blending.* Lynne Rienner Publishers. Boulder. 1988.

**Bhalla**, A. S. 'Innovations and Small Producers in Developing Countries'. *Economic and Political Weekly*. February 1989. pp. M2-M7.

**Bhalla**, A. S. 'Innovations and Small Producers in Developing Countries', in Bhalla, A. S. (ed.). *Small and Medium Enterprises: Technology Policies and Options.* ITP. London. 1992. pp. 82-100.

**Bicknell**, J. and McQuiston, L. *Design for Need: The Social Contribution of Design.* ICSID/Pergamon. 1977.

**Bishop**, Terry. *Management of Innovation.* Design Council/Engineering Industry Training Board. London. 1975.

**Bittencourt**, B. 'Ases do Improviso'. *Veja*, 21 February 1990, pp. 16-18.

**Blanchard**, F. 'Foreword', in Fluitman, F (ed.) *Training for Work in the Informal Sector.* International Labour Office. Geneva. 1989.

**Blaug**, M. 'The quality of population in developing countries with particular reference to education and training', in Hauser, P. M. (ed.). World Population and Development. Syracuse University. New York. 1979. Quoted in Herschbach, D.R. 'Training and the Informal Sector: Some and Issues and Approaches' in Fluitman, F. (ed.) *Training for Work in the Informal Sector.* International Labour Office. Geneva. 1989. pp. 3-15.

**BNB**. *Programa de Fomento à Geração de Emprego e Renda no Nordeste do Brasil.* Banco do Nordeste do Brasil. Fortaleza. 1993.

**Bonsiepe**, G. *Development Through Design.* UNIDO/ITD Working paper.. Vienna. 1973.

**Bonsiepe** G. 'Design e Sottosviluppo'. *Casabella*, No. 385 Jan 1974. pp. 42-4.

**Bonsiepe** G. 'Between Marasm and Hope'. *Industrial Design and Development.* Proceedings of the XI Congress and Assembly of ICSID. Mexico, OCT. 14-19, 1979a. pp. 45-40.

**Bonsiepe**, G. 'Fragmentos do Desenho Industrial na América Latina'. Text published in 'Summario' No. 34, Buenos Aires, 1979b, in Bonsiepe, G. *A Tecnologia da Tecnologia.* Edgard Blücher. São Paulo. 1983. pp. 68-75.

**Bonsiepe** G. 'Metodologia clássica e metodológia alternativa'. Lecture delivered at the International Design Meeting - CENFE, Madri 1979c, in Bonsiepe, G. *A Tecnologia da Tecnologia.* Edgard Blücher. São Paulo. 1983. pp. 51-58

**Bonsiepe**, G. 'Assimetria Tecnológica - um dilema da periferia.' Lecture delivered at the Núcleo de Desenho Industrial, NDI/CIESP, São Paulo, September 1980a, in Bonsiepe, G. *A Tecnologia da Tecnologia.* Edgard Blücher. São Paulo. 1983. pp.13-26.

**Bonsiepe**, G. 'Habitat e objeto - afinidade e diferença'. Lecture at the II Bienal de Arquitetura de Quito, Equador; November 1980b, in Bonsiepe, G. *A Tecnologia da Tecnologia.* Edgard Blücher. São Paulo. 1983. pp 91-98.

**Bonsiepe**, G. 'Fissuras no industrialismo'. Text based on a lecture at the Escola Superior de Desenho Industrial. Rio de Janeiro. May 1981, in Bonsiepe, G. *A Tecnologia da Tecnologia.* Edgard Blücher. São Paulo. 1983. pp.78-83

**Bonsiepe**, G. 'Descrição de alguns projetos com um anexo sobre tecnologia vernacular', in Bonsiepe, G. *A Tecnologia da Tecnologia.* Edgard Blücher. São Paulo. 1983. pp 123-186.

**Bonsiepe**, G. *A Tecnologia da Tecnologia.* Edgard Blücher. São Paulo. 1983.

**Bonsiepe**, G. "Developing Countries: Awareness of Design and the Peripheral Condition." *History of Industrial Design.* Electa. 1990. Volume 3, 1919-1990 The Dominion of Design. pp. 252-269.

**Bonsiepe**, G. 'Designing the Future-Perspectives on Industrial and Graphic Design in Latin America'. *Design Issues*: Vol. VII, Number 2 Spring 1991, pp 17-24.

**Bonsiepe**, G. *Teoria e Prática do Desenho Industrial: Elementos para um Manual Crítico*. Centro Português de Design. Lisboa. 1992.

**Borges**, A. and Carrascosa, J. 'Gui Bonsiepe: uma análise para reflexão.' *Design & Interiores*, Ano I No. 07 March April. 1988. pp. 55-59.

**Branford**, S. 'Boom times for industry of drought'. *The Guardian*. London. February 20, 1993.

**Braun**, E. *Wayward Technology*. Frances Pinter. London. 1984.

**Braun**, E. and Collingridge, D. *Technology and Survival*. Butterworths. London. 1977.

**Brum**, Argemiro J. *O Desenvolvimento Econômico Brasileiro*. Editora Vozes. Petrópolis. 1991.

**Burns**, T. and Stalker, G.M. 'The Social Context of Innovation', in Roy, R. and Weild, D. (Ed.). *Product Design and Technological Innovation*. Open University Press. Milton Keynes. 1990 (rep.). pp. 10-17.

**Cadbury**, A. 'The English Midlands: Cradle of Technology'. Keynote Address at the European Conference on Management of Technology. *Technological Innovation and Global Challenges Conference*. 5-7 July 1995. Aston university Birmingham UK.

**Cardoso**, F. and Affini, M. 'Computadores Arretados'. *Super*, February 1992. pp. 37-40.

**Carr**, M. 'Institutional Aspects of *Microenterprise Promotion' in Levtisky, J. Microenterprises in Developing Countries: Papers and Proceeding of an International Conference*. IT Publications. London. 1989. pp. 165-176.

**Carr**, M. *'Promotion of Small Scale Enterprise in Developing Countries: Creative Donor Intervention*", UNIFEM, Harare, 1989 in Smillie, I. *Mastering the Machine Poverty, Aid and Technology*. IT Publications. London. 1991.

**Christensen**, C. 'Two Professionals: Complementary Skills and Cast Iron Stoves, Afghanistan', in Mitchell, R.J. (ed.) *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980. pp. 27-34.

**Chukwujekwu**, S. 'Development of Design and Manufacturing Capabilities in a Small Nigerian Company', in Bhalla, A.S. (ed.) *Small and Medium Enterprises: Technology policies and options*. IT Publications. London. 1992. pp. 175-181.

**Chuta**, E. and Liedholm, C. *Employment and Growth in Small Scale Industry: Empirical Evidence and Policy Assessment from Sierra Leone*. Macmillan. London. 1985. pp. 82-83, quoted in Kabecha, W. *The Quality of Informal Sector Production: Poor Quality or Quality for the Poor*. PhD Thesis. Department of Engineering, University of Warwick. 1994.

**Colombo**, U. and Keichi O., *Technology Blending: An Appropriate Response to Development*. Cassel Tycooly. London. 1989.

**Colombo**, U. and Mazzonis, D. 'Integration of old and new technologies in the Italian (Prato) Textile Industry' in Bhalla et al. *Blending of New and Traditional Technologies: Case Studies*. Tycooly. Dublin. 1984.

**Constanzo**, Lucia. 'Young, free and single'. *Engineering* Vol. 234 No. 1 January 1994 pp 10-13.

**Consumers Association**. 'Presawash Washing Machine'. *Which* Vol. 24. 1981. Consumers' Association td. London. 1981.

**Cooley**, M. 'Socially useful design', in R. Langdon and N. Cross (eds.), *Design Policy*, Vol.1: Design and Society, Design Council, 1984, pp.51-4.

**Cooley**, M. 'Socially Useful Design', in Roy, R. and Weild, D. (eds.) *Product Design and Technological Innovation.* Open University Press. Milton Keynes. 1990 (rep.). pp. 305-312.

**Cressonnieres**, J. Belgian Government Mission. Colombia. 1975/6

**Cross**, N. 'The Changing Design Process', in Roy, R. and Weild, D. (eds.) *Product Design and Technological Innovation.* Open University Press. Milton Keynes. 1990 reprint. pp. 36-47.

**de Soto**, H. 'Structural Adjustment and the Informal Sector', in Levitski, J. *Microentrerprises in Developing Countries.* IT publications. London. 1989a. pp. 3-12.

**de Soto**, H. *The Other Path: The Invisible Revolution in the Third World.* I.B. Tauris. London. 1989b.

**Desrochors** J. *India's Search for Development and Social Justice: 1- The Development Debate.* Centre for Social Action. Bangalore. 1976.

**Design Council**. *Design to Win: A Chief Executive's Handbook.* Design Council/DTI. London. 1988.

**Design&Interiores**. 'Em Florianópolis, apoio às indústrias e ao ensino.' *Design Interiores.* Nov/Dec. 1987 No.05. p. 119.

**Design&Interiores**. 'Do NDI ao DETEC, uma história de desenvolvimento'. *Design Interiores.* No. 1, June 1987. p. 174.

**Design & Interiores**. 'Governo Incentiva o Design'. *Design & Interiores*, No. 48 Sep. 1995. pp 85-86.

**Dickenson**, John P. *Brazil.* Dawson. Westview. 1978.

**Dosi**, G. *Technical Change and Industrial Transformation: The Theory and an Application to the Semiconductor Industry.* MacMillan. London. 1984.

**DTI**. *Competitiveness: Helping Business to Win.* HMSO. London. 1994. p. 71

**DTI**. *Successful Product Development; Management case studies.* DTI/Design Council. London. 1994. p. 1.

**DTU** - Development Technology Unit (leaflet). Department of Engineering, University of Warwick. 1988.

**Dunn**, P.D. *Appropriate Technology: Technology with a Human Face.* Macmillan Press. London. 1978.

**Eames**, C. and Eames R. 'The Eames Report'. *Design Issues*: Vol. VII, No. 2 Spring 1991. pp. 63-75.

**Editora Abril**. *Almanaque Abril 87.* Editora Abril. São Paulo. 1986.

**Editora Abril**. *Almanaque Abril 92.* Editora Abril. São Paulo. 1992.

**Elliot**, D. and Elliot, R. *The Control of Technology.* Wykeham Publications. London. 1976.

**Elliot**, D. *Design Criteria and Innovation: Some Conclusions.* Open University Press. Milton Keynes . 1986a.

**Elliot**, D . *Design and Innovation.* T362 Block 4 Units 11-12. Open University. Milton Keynes. 1986b.

**Er**, H. A. and Langrish, L. *Industrial Design in Developing Countries: A Review of the Design Literature*. Institute of Advanced Studies, Manchester Metropolitan University. Manchester. 1992.

**Er**, H. A. *Industrial Design in Newly Industrialised Countries: An Exploratory Study of the Factors Influencing the Development of Local Design Capabilities*. Institute of Advanced Studies, Manchester Metropolitan University. Manchester. 1993.

**Er**, H. A. *The Emergence and Development Patterns of Industrial Design in Newly Industrialised Countries with particular reference to Turkey*. PhD Thesis. Institute of Advanced Studies, Manchester Metropolitan University. Manchester. 1994.

**FAC**. *Relatório de Avaliação do Projeto Meio de Vida*. FAC. João Pessoa. 1993.

**FAC**. *Feira Projeto Meio de Vida - FEMEV*. FAC. João Pessoa. 1994.

**Farrel**, G. 'Quito (Ecuador)', in Maldonado, C. and Sethuraman, S. V. *Technological Capability in the Informal Sector: Metal Manufacturing in Developing Countries*. ILO. Geneva. 1992. pp. 131-150.

**FIEP**. Federação de Indústrias do Estado da Paraíba. *Cadastro Industrial do Estado da Paraíba*. Campina Grande. 1992.

**FIESP**/DETEC/NSDI 1991, p.58-67.

**Fluitman**, F. 'Editors' introduction', in Fluitman, F. (ed.). *Training for Work in the Informal Sector*. International Labour Office. Geneva. 1989.

**Flurscheim**, C.H. 'Objectives and techniques of industrial design in engineering', in Flurscheim, C.H. (ed.) *Industrial Design in engineering: a marriage of techniques*. Design Council/Springer Verlag. London. 1983. pp. 1-18.

**Freeman**, Christopher. *The Economics of Industrial Innovation*. Penguin. Harmondsworth. 1974.

**Freeman**, Christopher. *The Economics of Industrial Innovation*. Frances Pinter. London. 1982.

**Freeman**, C. (ed.). *Design, Innovation and Long Cycles in Economic Development*. Department of Design Research /Royal College of Art. London. 1984.

**Freeman**, C. 'Successful Industrial Innovation', in Roy, R. and Weild, D. (ed.) *Product Design and Technological Innovation*. Open University Press. Milton Keynes. 1990 reprint.

**Freeman**, C. 'Design and British Economic Performance', lecture given at the Design Centre, London 23 March, Brighton: Science Policy Research Unit, Sussex University. 1983 (mimeo), quoted in Walsh, V. et al. *Winning by Design: Technology, Product Design and International Competitiveness*. Blackwell. Oxford. 1992. p. 23

**Gamser**, M. and Almond, F. 'The Role of Technology in Microenterprise Development' in Levitski, J. *Microentrerprises in Developing Countries*. IT Publications. London. 1989. pp. 189-201.

**Gamser**, M., Appleton, H. and Carter, N. (eds.) *Tinker, Tiller Technical change - Technology from the People*. IPT. London. 1990.

**Gamser**, M. *Power from the People*. ITP. London. 1988.

**Gardiner**, P. and Rothwell, R. *Innovation; A Study of the Problems and Benefits of Product Innovation*. Design Council. London. 1985.

**Gorb**, P. , Dumas A. 'Silent Design'. *Design Studies*, Vol. 8 No.3 July 1987. pp150-156.

**Gorb**, P. (ed.). *Design Management: Papers from the London Business School.* Architecture and Design Technology Press. London. 1990.

**Gosh**, B.N. 'Bicycle power for rural development', in UNESCO. *Technologies for Rural Development.* UNESCO Press. Brussels. 1981. pp 129-136.

**Governo do Estado da Paraíba** - Fundação de Ação Comunitária - FAC. *Projeto Meio de Vida: Uma Realidade, uma Necessidade.* João Pessoa - PB. 1993. p 1.

**Guerrero**, J.R. 'Training for informal sector enterprises in Latin America', in Fluitman, F. (ed.). *Training for Work in the Informal Sector.* ILO. Geneva. 1989. pp. 159-166.

**Guillois**, I. E. 'Para Vencer o Subdesenvolvimento'. *Design & Interiores.* Ano 2 No. 09 July/Aug. 1988. pp. 102-3.

**Guimarães**, L. *Alternative Washing Machine.* Master of Arts Dissertation. City of Birmingham Polytechnic. Birmingham. 1988.

**Harper**, M. 'Appropriate Technology and the Entrepreneur'. *Appropriate Technology*, Vol. 10 No.3. pp. 11-2.

**Harper**, M. *Small Business in the Third World.* John Wiley & Sons. Chichester. 1984.

**Harper**, M. 1995. Private correspondence with the author.

**Harris**, N. *The End of the Third world: Newly Industrialising Countries and the Decline of an Ideology.* Penguin Books. Harmondsworth. 1990 (reprint).

**Harrison**, P. 'Small is Appropriate'. In Carr, M. *The AT Reader - Theory and Practice in Appropriate Technology.* Intermediate Technology Publications. London. 1985. pp. 399-403.

**Haan**, H.C. 'Issues in informal sector with special reference to the technology factor', in Fluitman, F. (ed.). *Training for Work in the Informal Sector.* ILO. Geneva. 1989. pp. 39-46.

**Heathen**, B. *Development theory and the three worlds.* Longman. Harlow. 1992.

**Heckland**, J.M. 'Building Indigenous Technological Capability Through Foreign Assistance to Small/ Medium Enterprises', in Bhalla, A.S. (ed.) *Small and Medium Enterprises: Technology Policies and Options.* ITP. London. 1992. pp. 101-108.

**Herschbach**, D.R. 'Training and the Informal Sector: Some and Issues and Approaches' in Fluitman, F. (ed.) *Training for Work in the Informal Sector.* International Labour Office. Geneva. 1989. pp. 3-15.

**Heskett**, J. *Industrial Design.* Thames and Hudson. London. 1991.

**Hettne**, B. *Development Theory and the Three Worlds.* Longman Scientific & Technical. New York. 1992 (reprint).

**Hewitt**, T. 'Developing Countries - 1945 to 1990', in Allen, T. and Thomas, A. (eds.). *Poverty and Development in the 1990s.* Oxford University Press/Open University. Milton Keynes. 1992. pp. 221-237.

**Hot Point**. *Domestic Washing Machines and Dryers.* Leaflet. p. 1.

**IDI**. Institutional Prospectus. Rio de Janeiro. 1978. no numbered pages

**International** Labour Office. 'Training Workers in the backward sectors of the economy'. *International Labour Review*, Vol. 116, No. 2,1977. pp. 217-229, quoted in Herschbach, D.R. 'Training and the Informal Sector: Some and Issues and Approaches' in Fluitman, F. (ed) *Training for Work in the Informal Sector.* International Labour Office. Geneva. 1989. pp. 3-15.

**International** Labour Office. *Small Enterprise Development Programme*. ILO. Geneva. 1982. p.4.

**International** Labour Office. *Rural Small Industries and Non-farm Employment: A Progress Report on research and Operational Activities*. ILO. 1990.

**INSTRAW** (a). Editorial. 'African Women: Coping with Economic Crises'. *INSTRAW* No. 16. 1991.

**INSTRAW** (b). 'INSTRAW Project on the Informal Sector in Africa Attempts Statistical Break Through'. *INSTRAW* No. 16. 1991.

**ITDG**/IBT. Leaflet *Women Mean Business*. (ND)

**Jamil**, A.Z.B. and Said, R.Bt. Md. 'Management and Technological Capabilities of Malaysian Small and Medium Enterprises: Constraints and Potential', in Bhalla, A.S. (ed.) *Small and Medium Enterprises: Technology policies and options*. ITP. London. 1992. pp. 167-172.

**Jeffrey**, K.R., Hunt, D. 'Design in small manufacturing companies in Scotland'. *Design Studies*. Volume 6 Number 1, 1985. pp. 18-23.

**Jéquier**, N. 'Appropriate Technology: Some Criteria.', in Bhalla, A.S. (ed.). *Towards Global Action for Appropriate Technology*. Pergamon Press. Oxford. 1979. pp. 1-22.

**Jones**, J. C. *Design Methods*. Wiley-Interscience. London. 1970.

**John Noble**. *First in Fashion Catalogue* - Spring/Summer 1987. John Noble, Manchester. 1987. P.833.

**Jornal do Brasil.** Caderno 6, 26 de October 1994.

**Journal of Engineering Design**. Vol. 4 Number 1, 1993. Inside front cover.

**Julier**, G. *The Thames and Hudson Encyclopaedia of 20th Century Design and Designers*. Thames and Hudson. London. 1993.

**Kabecha**, W. *The Quality of Informal Sector Production: Poor Quality or Quality for the Poor*. PhD Thesis. Department of Engineering, University of Warwick. 1994.

**Kaplinsky**, R. *The economies of small: appropriate technology in a changing world*. Intermediate Technology Publications. London. 1990, quoted in Allen, T. and Thomas, A. (eds.). *Poverty and Development in the 1990s*. Oxford University Press/Open University. Milton Keynes. 1992.

**Kindervater**, S. 'Would you buy pickled onions from this women?' *Appropriate Technology* Vol. 15 No. 4 March 1989 pp 8-10.

**King**, K. 'Skill Acquisition in the Informal Sector of an African Economy: The Kenyan Case.' *The Journal of Development Studies*, Vol. 11(2), 1975.

**King**, K. 'Education for Employment and Self-Employment Interventions in Developing Countries: Past experience and Present Prognosis' in *Defusing the Time Bomb?* International Foundation for Education with Production, Gaberone, 1990. p. 105, quoted in Smillie, I. *Mastering the Machine: Poverty, Aid and Technology*. ITP. London. 1991. p. 204.

**King**, K. and Abuodha, C. *'The building of an industrial society: Change and development in Kenya's informal sector 1972 to 1991'*. Centre for African studies, University of Edinghburgh and Institute for Developing Studies, University of Nairobi, 1991, in Masera, D. 'Product development for the informal sector in Kenya'. *Appropriate Technology* Vol. 21 No. 2 September 1994. pp. 34-35.

**Kubitschek**, J. *Meu Caminho para Brasília: cinquenta anos em cinco*. Rio de Janeiro. Bloch. 1978, in Niemeyer, L. 'Os Paradoxos em Curso nos Designíos do Desenhista Industrial'. *Estudos em Design*. No. 1, Ano 1 Aug. 1993. pp. 64-67.

**Langrish**, J. *The Importance of Design in Technology Transfer*. Institute of Advanced Studies. Manchester. 1987.

**Latouche**, S. *In the Wake of the Affluent Society: an Exploration of Post Development*. ZED Books. London. 1993.

**Leon**, Ethel. 'ALADI, Celebrando a Mairoridade'. *Design & Interiores*, No. 27 Nov./Dec. 1991. pp. 45-48.

**Levitsky**, J. (ed.). 'Introduction', in Levitsky, J. *Microenterprises in Developing Countries*. Papers and proceedings of an International Conference held in Washington, D.C., USA, 6-9 June 1988. ITP. London. 1989. p.ix.

**Levitsky**, J. 'Summary Report of the Conference', Levitsky, J. *Microenterprises in Developing Countries*. Papers and proceedings of an International Conference held in Washington, D.C., USA, 6-9 June 1988. ITP. London. 1989. p. xiii.

**Levitsky**, J. *Microenterprises in Developing Countries*. Papers and proceedings of an International Conference held in Washington, D.C., USA, 6-9 June 1988. ITP. London.. 1989.

**Liedholm**, C. and Mead, D.; 'Small Industries in Developing Countries; Empirical Evidence and Policy Implications', International Development Paper No. 9, Michigan State University, East Lansing, 1987, reference in Smillie, I. *Mastering the Machine Poverty, Aid and Technology*. ITP. London. 1991. p. 201.

**Lima**, M. L. M. 'Campina Grande Capital do Trabalho'. *Veja 28 Graus*, October 1991. No page numbers.

**Llosa**, M.V. 'Foreword', in de Soto, H. *The Other Path: The Invisible Revolution in the Third World*. I.B. Tauris. London. 1989b.

**Madge**, P. 'Design, Ecology, Technology: A Historiographical Review'. *Journal of Design History* Vol. 6 No. 3, 1993. pp. 149-166.

**Male**. C. 'Women's issues related to microenterprises and the informal sector' in OECD. *New Directions in Donor Assistance to Microenterprises*. OECD. Paris. 1993. pp. 35-42.

**Maldonado**, C. and Sethuraman, S. V. *Technological Capability in the Informal Sector: Metal Manufacturing in Developing Countries*. ILO. Geneva. 1992.

**Maldonado**, C. and Sethuraman, S. V. 'Introduction'. *Technological Capability in the Informal Sector: Metal Manufacturing in Developing Countries*. ILO. Geneva. 1992. pp. 3-24.

**Mansfield**, H. 'Tools for Living'. *Industrial Design*. Jan/February 1988. pp. 66-69.

**Margain**, A. L. 'Historia de las Profesiones del Diseño Industrial y Gráfico de Mexico, Estados Unidos y Canadá'. IX Reunión de Historiadores Mexicanos y Norteamericanos. Intercambio Técnológico y Creativo en America del Norte Siglo XX. Mexico City 27-29 October 1994. pp. 1-16.

**Masera**, D. 'Product Development for the Informal Sector in Kenya'. *Appropriate Technology* Vol. 21 No.2 September 1994. pp. 34-5.

**McRobie**, G. And Carr, M. *Mass Production or Production by the Masses?* ITDG. London. 1982.

**MCT/CNPq/IBCIT**. *Programa de Apoio às Technologias Apropriadas*. Ministério da Ciência e Tecnologia. Brasília. 1993.

**Mitchell**, R.J. 'Local AT Experts, Indonesia', in Mitchell, R.J. (ed.). *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980. pp. 103-111)

**Mitchell**, R. J. *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980.

**Mitchell**, S. (ed.). 'Introduction'. *The Logic of Poverty: The Case of the Brazilian North East*. Routledge & Kegan Paul. London. 1981. pp. 1-9.

**Moody**, S. *The Role of Industrial Design in Technological Innovation*. PhD Thesis. Aston University in Birmingham. 1984.

**Moura**, L. 'Design'. *Arte Vogue* 1 May 1977 No. 24 -B. pp. 121-146.

**Mwamadzingo**, M. 'Residue stoves in Kenya', in Gamser, M., Appleton, H. and Carter, N. (eds.) *Tinker, Tiller Technical change - Technology from the People*. IPT. London. 1990.

**Naveiro**, D.M. '20 Anos de Atuação da Unidades de Programas de Desenho Industrial do Instituto Nacional de Tecnologia'. *Estudos em Design* Vol. 2, No.2 Nov 1994, *Anais P&D Design 94*. pp. 35-46.

**Naylor**, C. (ed.) *Contemporary Designers*. St. James Press. Chicago/London. 1990.

**Ncube**, M. 'The grate cooking system in Zimbabwe'. Gamser, M., Appleton, H. and Carter, N. (eds.) *Tinker, Tiller Technical change - Technology from the People*. IPT. London. 1990

**NEDO**, ? in Walsh, V. et al. *Winning by Design: Technology, Product Design and International Competitiveness*. Blackwell. Oxford. 1992.

**Nichols**, P. *Social Survey Methods: A Field guide for Development Workers*. Oxfam. Oxford. 1991.

**NMFA** - Netherlands Ministry of Foreign Affairs. *Small Scale Enterprise*. Netherlands Ministry of Foreign Affairs. The Hague. 1993.

**Nevin**, P.F. *The Survival Economy: Micro-Enterprises in Latin America*. ACCION International/AITE. Cambridge, Mass. 1982.

**Nkonoki**, S.R. 'The coffee pulper in northern Tanzania', in Gamser, M., Appleton, H. and Carter, N. (eds.) *Tinker, Tiller Technical change - Technology from the People*. IPT. London. 1990.

**Nurul Amin**, 'Bankok (Thailand)', in Maldonado, C. and Sethuraman, S. V. *Technological Capability in the Informal Sector: Metal Manufacturing in Developing Countries*. ILO. Geneva. 1992. pp. 105-129.

**Niemeyer**, L. 'Os Paradoxos em Curso nos Designíos do Desenhista Industrial'. *Estudos em Design*. No. 1, Ano 1 Aug. 1993. pp. 64-67.

**Night**, P. T. *Brazilian Socio Economic Development Issues for the Eighties*. World Bank Report Series, Nr. 203. London. 1981, quoted in Third World Editors. *Third World Guide 89/90*. Montevideo. 1988.

**Oakley**, M. *Managing Product Design*. Weindenfeld and Nicolson. London. 1984.

**Oakley**, M. (ed.) *Design Management - A Handbook of Issues and Methods*. Blackwell Reference. Oxford. 1990.

**OECD**. *Innovation in Small and Medium Firms - Background Reports*. Organisation for Economic Co-operation and Development. Paris. 1982.

**OECD**. *Technology and the Economy: The Key Relationships*. OECD. Paris. 1992.

**OECD**. *Science and Technology Indicators*. Organisation for Economic Co-operation and Development. Paris.

**OECD**. *New Directions in donor Assistance to Microenterprises*. OECD. Paris. 1993. P. 18

**Okelo**, M.E. 'Support for Women in Microenterprises in Africa in Levitski, J. *Microentrerprises in Developing Countries*. IT Publications. London. 1989. pp. 240-250.

**OUP**. *Oxford Electronic Dictionary*. Oxford University Press. Oxford. 1993.

**OXFAM** Trading Information Office. *Work-Shop-Link*. OXFAM. Oxford. 1992.

**Pacey**, P. 'Anyone Designing Anything?' Non-Professional Designers and the History of Design'. *Journal of Design History* Vol. 5 No. 3 1992. pp. 217-225.

**Panchal**, J.A. Vice Chairman (Training). National Institute of Design. Ahmedabad, India. 1995. Private correspondence with the author.

**Papanek**, V. *Design for Human Scale*. Van Nostrand Reinhold. New York. 1983.

**Papanek**, V. *Design for the Real World: Human Ecology and Social Change*. Thames and Hudson. London. 1985 (reprint).

**Papola**, T.S. *Urban informal sector in a developing economy*. Vilcas Publishing House. New Delhi. 1981 quoted in Herschbach, D.R. 'Training and the Informal Sector: Some and Issues and Approaches', in Fluitman, F. (ed.) *Training for Work in the Informal Sector*. International Labour Office. Geneva. 1989. pp. 3-14

**The Patents Office**. Patent Specification No. 100,110. Birmingham. January 11, 1917.

**PATME**. Programa de Apoio Tecnológico às Micro Pequenas Empresas. SEBRAE/FINEP. 1993.

**Presawash**. The Original Pressure Washing Machine Co. Ltd. Kent. Leaflet.

**Poston**, D. *The Development of Rural Manufacturing Industry in Central Africa, with Special Reference to Metal Working*. PhD. Thesis. University of Warwick, Department of Engineering. December 1990.

**Powell**, J.W. 'University Involvement in Appropriate Technology'. *Appropriate Technology* Vol. 6 No. 4, February 1980. pp. 12-14.

**Pye**, D. 'The Nature of Design', in Roy, R. and Weild, D. (ed.) *Product Design and Technological Innovation*. Open University Press. Milton Keynes. 1990 (reprint). pp. 48-51.

**Pyne**, A. 'The Katpadi furniture project; making more from less'. *Appropriate Technology*, Vol. 15 No. 1. June 1988. pp. 24-25.

**Reid**, J. *The State of Industrial Design in Developing Countries: A Report on the Pilot Mission to India, Pakistan, Egypt and Turkey*. UNIDO/ICSID. Geneva. 1978.

**Roberts**, E.B. 'Generating effective Corporate Innovation', in Roy, R. and Weild, D. (eds.) *Product Design and Technological Innovation*. Open University Press. Milton Keynes. 1990 (rep.). pp. 124- 127.

**Rodrigues**, C. 'Social Exclusion in Brazil'. *Brazil Network Bulletin*. August-October 1994. pp. 21-23.

**Rothwell**, R. and Zegveld, W. *Industrial Innovation and Public Policy: Preparing for the 1980s and the 1990s*. Francis Pinter. London. 1981.
**Roy**, R. (ed). *Design Studies: Special Issue on Product Design and Innovation in Industry*. Volume 6, No. 1 January 1985.
**Roy**, R. and Weild, D. (ed.) *Product Design and Technological Innovation*. Open University Press. Milton Keynes. 1990 reprint.
**Roy**, R. and Potter, S. *Design and the Economy*. Design Council. London. 1990.
**Ruétalo**, J. *Informe de Monitoreo Proyecto UR-155*. Unidad Técnica de Apoio en Marketing y Desarollo e Innovación del Producto. Montevideo. 1993.
**Samuelson**, P.A. *Economics*. MacGraw-hill. New York. 1982.
**Santos**, M. C. 'Interview'. Buenos Aires 1980. In Bonsiepe, G. *A Tecnologia da Tecnologia*. Edgard Blücher. São Paulo. 1983. pp. 27-50.
**SERVIS**. Twin Tub Washing Machine
**Sethuraman**, S.V. 'Bangalore (India)', Maldonado, C. and Sethuraman, S. V. *Technological Capability in the Informal Sector: Metal Manufacturing in Developing Countries*. ILO. Geneva. 1992. pp. 49-79.
**Sethuraman**, S. V. and Maldonado, C. 'Technological Adaptations in the Informal Sector: Conclusions and Policies Implications', in Maldonado, C. and Sethuraman, S. V. *Technological Capability in the Informal Sector: Metal Manufacturing in Developing Countries*. ILO. Geneva. 1992. 223-235
**Shankland**, A. 'Jacqueline's garden'. *New Internationalist* No. 267, May 1995. pp. 29-30.
**Schulmann**, D. *O Desenho Industrial*. Papirus. São Paulo. 1994.
**Schumpeter**, J. *The Theory of Economic Development*. Oxford University Press. Oxford. 1961.
**Schumacher**, E.F. *Small is Beautifull: A Study of Economics as if People Mattered*. Abacus. London. 1986 (11th edit.).
**SEBRAE.** *Pesquisa Nacional Sobre Competitividade Industrial*. SEBRAE. Brasília. 1990.
**SEBRAE**. Serviço Brasileirio de Apoio às Micro e Pequenas Empresas (promotional leaflet). Brasília. 1992.
**SLNDC** - Sri Lanka National Design Centre. Prospectus. Ministry of Tourism and Rural Industrial Development. 1993.
**Smillie**, I. *Mastering the Machine Poverty, Aid and Technology*. IT Publications. London. 1991.
**SPRU**. *Success and failure in industrial innovation*. Centre for the Study of Industrial Innovation. London. 1972.
**Stearns**, K. and Otero, M. *The Critical Connection: Governments, Private Institutions, and the Informal Sector in Latin America*. ACCION International. Washington D.C. 1990.
**Stewart**, F. 'Introduction', in Carr, M. (ed.). *The AT Reader: Theory and Practice in Appropriate Technology*. ITP. London. 1985.
**Stewart**, F. *Technology and Underdevelopment*. MacMillan. London. 1978 (2d ed.).

**TGWU** -Transport and General Workers Union. 'Arms Conversion', in Roy, R. and Weild, D. (ed.) *Product Design and Technological Innovation.* Open University Press. Milton Keynes. 1990 (rep.) pp 299-305. (Transport and General Workers Union, A Better Future-Strategy for Arms Conversion, TGWU, 1983).

**Tiberghien**, R. *Biens D'equipment dans les Pays en Developpement.* IREP. Grenoble. 1981, in Third World Editors. *Third World Guide 89/90.* Third World Editors. Rio de Janeiro/Montevideo. 1988.

**The Economist**. 'Half-empty or half full? Survey of Brazil. Insert, *The Economist* April 29th 1995. pp. 4-34.

**Third World Editors.** *Third World Guide 89/90.* Third World Editors. Rio de Janeiro/Montevideo. 1988.

**Tianzu**, W. 'Technological Transformation of Small enterprises in Zhejiang Province, China', in Bhalla, A.S. (ed.) *Small and Medium Enterprises: Technology Policies and Options.* ITP. London. 1992. pp. 139-151.

**Tilak**, J. B. G., 'Education and its Relation to Economic Growth, Poverty and Income Distribution: Past evidence and further Analysis'. World Bank, Washington, 1989, in Smillie, I. *Mastering the Machine Poverty, Aid and Technology.* ITP. London. 1991.

**Titley**. *Machines, Money, Man: An Economic and Social History of Great Britain 1700-1970's.* Hart-Davis Educational. St. Albans. 1978.

**Toye**, J. *Dilemas of Development: reflections on the counter-revolution in development theory and policy.* Basil Blackwell. Oxford. 1987, quoted in Hewitt, T. 'Developing Countries - 1945 to 1990', in Allen, T. and Thomas, A. (eds.). *Poverty and Development in the 1990s.* Oxford University Press/Open University. Milton Keynes. 1992. pp. 221-237)

**Trindade**, S. 'Foreword', in Bhalla A.S. (ed.) *Small and Medium Enterprises: Technology Policies and Options.* ITP. London. 1992.

**Turner**, B. (ed.) *Building Community: A Third World Case Book.* Building communities Books. London. 1988.

**Turner**, J. *World Inequality: the problem of world poverty.* Longman. London. 1980.

**UFPB**. *Programa de Estudos e Ações para o Semi-Árido - PEASA/UFPB.* Universidade Federal da Paraíba. Campina Grande. 1994 no pages

**Waldenström**, E. IIA 1986 Stockholm, in een, G. and Joste, S. (ed.) *One Hundred Innovations for Development.* ITP in association with International Inventors Awards 1988. London. 1988.

**Walsh**, V. et al. *Winning by Design: Technology, Product Design and International Competitiveness.* Blackwell. Oxford. 1992.

**Walsh**, V. et al, 'Perspectives in Design and Innovation'. *Creativity and Innovation Management.* Vol. 2. No. 2 June 1993. pp. 78-86.

**Weizsacker** E. U. et al. *New Frontiers in Technology Application.* Tycooly. Dublin. 1983.

**Wharton**, D. 'Designing with Users: Developing the Lorena Stove, Guatemalata', in Mitchell, R.J. (ed.) *Experiences in Appropriate Technology.* The Canadian Hunger Foundation. Ottawa. 1980. pp. 21-26.

**Wainwright**, H. and Elliott, D. *The Lucas Plan: A new trade unionism in the making?* Allison & Busby. London. 1983.

**Wiedenhaupt**, R. *Making the Nava Jeevan Washer for Pleasure and Profit.* Goble Printing Company. Greenfield, Indiana. 1965.

**Williamson**, J. 'Development Workshop: A Local Catalyst, Iran', in Mitchell, R.J. (ed.) *Experiences in Appropriate Technology*. The Canadian Hunger Foundation. Ottawa. 1980. pp. 35-40.

**World Bank**. *World Development Indicators 1988*. World Bank. Washington D.C. 1988, in Smillie, I. *Mastering the Machine Poverty, Aid and Technology*. IT Publications. London. 1991.

**Worsley**, P. 'How many worlds?' *Third World Quarterly*, 1(2). pp. 100-8. 1979, in Allen, T. and Thomas, A. (eds.). *Poverty and Development in the 1990s.* Oxford University Press/Open University. Milton Keynes. 1992.

**van deer Bliek**, J. and van Veldhuizen, L. *Developing Tools Together: Report of a study on the role of participation in the development of tools, equipment and techniques in Appropriate Technology Programmes*. ETC/GATE. Leudsen. 1993. p.35.

**van Dijk**, M.P. 'The Technology in the Case of Small Enterprises Development', in Riedijk, W. (ed.) *Appropriate Technology for Developing Countries.* Delft University Press. Delft. 1987 (3d edition).

**VITA** - Volunteers in Technical Assistance. *Hand Operated Clothes Washer.* Vita Technical Bulletin 51013. VITA. Arlington, V.A. p.1.

**Vyas**, K. H. 'The Designer and the Socio-Technology of Small Production'. *Journal of Design History* Vol. 4 No. 3 1991, pp. 187-210.

**Zoomers**, E.B. 'From service delivery to business development: experiences of a rice milling project for women in Mali.' Paper for the ASC/ILO workshop on *'De-Agrarianization and Rural employment'*. May 10th-12th 1994. pp 1-20.

# Appendix I
# Questionnaire used to interview microentrepreneurs

**a) Management**

1. Interview No. Date
2. Name of respondent: Job:
   Age: Sex:
3. Name of unit:
4. Address:
   Telephone: Fax:
5. Name of owner:
6. Size of factory (m2):
7: What are the main products manufactured in your firm?
8. How many people work here? How many in production and how many in office work?
9. Is this number enough for your needs?
10. Why did you start this kind of business?
11. Why did you decide to work in this site?
12. Are the workers here people you knew before?
13. How long is the oldest employee been with you?
14. How did you learn your skills?
15. Did you attend any course at SENAI (technical school supported by the National Industries Federation)?
16. Have you been employed in bigger and modern enterprises before?
17. In your opinion what kind of work is the industrial designer involved with? What could he do in your firm? (the words for **industrial designer** in Portuguese are **desenhista industrial** which is normally associated with a draftsman)
18. Have you heard the word 'design' before?
19. In your view, what is a mechanical engineer? What can he do in an industry like yours?
20. Have you employed apprentices from the university? If negative, why not? If positive, what is your opinion about their work?
21. Do you have any contact with the university? What kind?
22. From what age do you employ people?
23. Does the company receive any kind of support? Did you try to obtain any kind of support?
24. Do you belong to any professional association?
25. Do you have children? What do they do?
26. What does you wife do?
27. Do you have another kind of income?
28. What is you biggest difficulty?

**b) Marketing/Sales**

29. How do you present your products?(Leaflets, direct mail etc.)
30. How do you 'sniff' the market?
31. Is there anyone manufacturing the same thing as you in the city?
32. Did this product existed before you manufactured it? (specify the product, references etc.)
33. If not, what was used to substitute it?
34. Price of product in the market?
35. Do your work by ordering or do you keep stock?
36. Do you have any idea of how many products you sell each week?
37. Did you ever had to take a product out of production line? Why?
38. Where do you sell your products?
39. Do you have a salesman working for you?

40. Is the way you sell today useful for your company?
41. Who are your customers?
42. Do your customers give any suggestions about your products? What kind of suggestions?
43. Do you ask for any suggestions from your customers about the products you intend to manufacture?
44. Have these suggestions being useful for you?
45. Have you ever participated in any exhibitions of industrial products? Was it useful for the firm?

**c) Internal Capability of Innovation/Product Design**

46. Do you invent your products? Why is there a need to invent new products?
47. Do you have any kind of support when inventing your products ?
48. Describe how do you invent your product.
49. How did the idea for this product appeared?
50. Are your production machinery constructed here?
51. How is the process of inventing machinery? Is it different from inventing the products you manufacture?
52. Is there any one from SENAI, the university or any other technical school inventing products for you?
53. Do you know of any women which invents products or machinery in Campina Grande or another city? How about women working in workshop? Why do you think there are very few woman working in this field ?
54. Do you have any consultation with you clients when inventing new products.
55. What do you think is important in the product to satisfy the client?
56. Do you think beauty is important in the product? Why?
57. Does beauty helps selling the product?
58. What kind of machinery and equipment are used in your firm?
59. When you finish manufacturing a product, do you check about any mistakes? Describe how?
60. Do you know any form of cheaper, less tiresome way of improving production?
61. Did have to stop production this year? Why?
62. Is it easy to find the machines you use, in the market?
63. Who maintains and repair your machinery/equipment?
64. Who invents and construct your tooling?
65. Which is the main energy source of your firm?