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### The printing industry in sub-Sahara Africa: An exploratory study

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THE PRINTING INDUSTRY IN  
SUB-SAHARA AFRICA

AN EXPLORATORY STUDY

by

H. Richard Harmsen

A thesis  
submitted in partial fulfillment of the  
requirements for the degree of  
Master of Science  
in the  
School of Printing in the College of Graphic Arts and Photography  
of the  
Rochester Institute of Technology

May 1982

Thesis Advisor: Professor Robert G. Hacker

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## DEDICATION

To my beloved wife, Joyce, whose patience, sacrifice, and loving support made the completion of this work possible.

## ACKNOWLEDGEMENTS

I wish to extend my sincere thanks to all those survey respondents and interviewees who made this study possible. I am particularly grateful to my primary Thesis Advisor, Dr. Robert Hacker for his constant encouragement; to Dr. Vince Samar for his time and expertise regarding computer utilization and statistics; and to Dr. Paul Miller, for his gentle and positive manner of guiding the development of my thesis. I am also grateful to Mr. Robert Rosenfeld for his input during the conceptual stages of the study, and for contributing valuable reference materials. Last but certainly not least, I am thankful to Mary Brashier for contributing her professional editorial skills during the final stages of the Thesis.

## ABSTRACT

The printing industry in Sub-Sahara Africa faces numerous problems inhibiting further growth and development. Because of a scarcity of published information regarding these problems, and regarding the nature of the industry in general, this study hoped to establish a beginning and baseline for researchers, printing managers, suppliers, development planners, and anyone else interested in the development of the African printing industry.

Specifically, the objectives of this study were to identify: 1) the general characteristics of the printing industry in Sub-Sahara Africa; and 2) the primary constraints inhibiting its further growth and development. Information was gathered by several means, including a search of the literature, interviews, and a survey of manufacturers. General economic data was also gathered and statistically analysed by country cluster and factor analyses. Further, the industry is examined in terms of international technology transfer research findings.

The study showed that the printing industry in Sub-Sahara Africa is characterized by the following generalizations: A wide range of diversity in technological sophistication from one country to another; rapid technological change; a scarcity of local sources of printing equipment and supplies; a generally low level of printing quality; predominantly single color printing; a relatively high cost for raw materials; high tariffs on industry inputs; a scarcity and low level of technical skills; poor management; a generally rudimentary level of technology; considerable infrastructure problems; small and

underdeveloped markets; poor environmental control; poor printer/publisher relations; and a scarcity of training and educational institutions for the graphic arts. Recommendations to participants and recommendations for further research are presented.

**Abstract approved:**

thesis advisor

Prof.

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3-26-83

date

School of Printing  
Rochester Institute of Technology  
Rochester, New York

CERTIFICATE OF APPROVAL

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MASTER'S THESIS

---

This is to certify that the Master's Thesis of

Richard Harmsen

name of student

With a major in Printing Technology  
has been approved by the Thesis Committee as  
satisfactory for the thesis requirement for the  
Master of Science degree at the convocation of

June 1983

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**CHAPTER I**  
**INTRODUCTION**

## CHAPTER 1

### INTRODUCTION

This pilot study has taken a very broad view of the subject of printing in Africa. It is a logical first step since almost no research has been done in this area. The study contributes to the general body of knowledge regarding the status, directions, and problems facing the printing industry in Sub-Sahara Africa.

Several disciplines have been drawn from, and the study can thus be considered multidisciplinary in its approach. Although it is at times theoretical, every stage has been related to either objective data or, more often, to empirically derived information based on personal experience or to the observations of marketing and production people from the field.

The study is exploratory in two respects. In the first sense it explores the status of printing in Sub-Sahara Africa. The term exploratory is also appropriate because approaches have been used which have not previously been tried, most notably the application of "international technology transfer" research findings to the printing industry in Africa.

The principal objectives of this study are to describe the printing industry in Sub-Sahara Africa in broad terms and to identify the major constraints inhibiting industry development. This report does not provide a detailed analysis of each country. Rather, it is a pilot study which clarifies the basic relationships required for later in-depth and more specific research.

The region of Sub-Sahara Africa which has been chosen consists of 39 countries (figure 1). The Northern countries and the extreme southern sector of Africa have been excluded. The Northern countries have been omitted because of fundamental cultural and social differences as well as differences in the problems and risks these countries face. South Africa and South African controlled Namibia have been excluded because they have substantially more developed economies than those in the study area. The general region has been called by many names, among them Black Africa. The term "Sub-Sahara" has been adopted, and although slightly misleading because of the extension of the northern countries into the Sahara, it is basically descriptive.

The impetus for this study came primarily from personal experience in The Gambia. The difficulty of securing information on equipment and supplies, the absence of local suppliers, the scarcity of skilled labor (only a few of the problems) resulted in low productivity, high cost, excessive waste and very long equipment down-times. From observations and reports from the field it was apparent that these same frustrations are faced by the printing manager throughout most of Africa as well. The result can be crippling to the projects and operations essential to both public and private sector development.

It appears, therefore, that a better understanding of the conditions and problems faced by printers in Sub-Sahara Africa is a logical and significant first step to finding solutions.



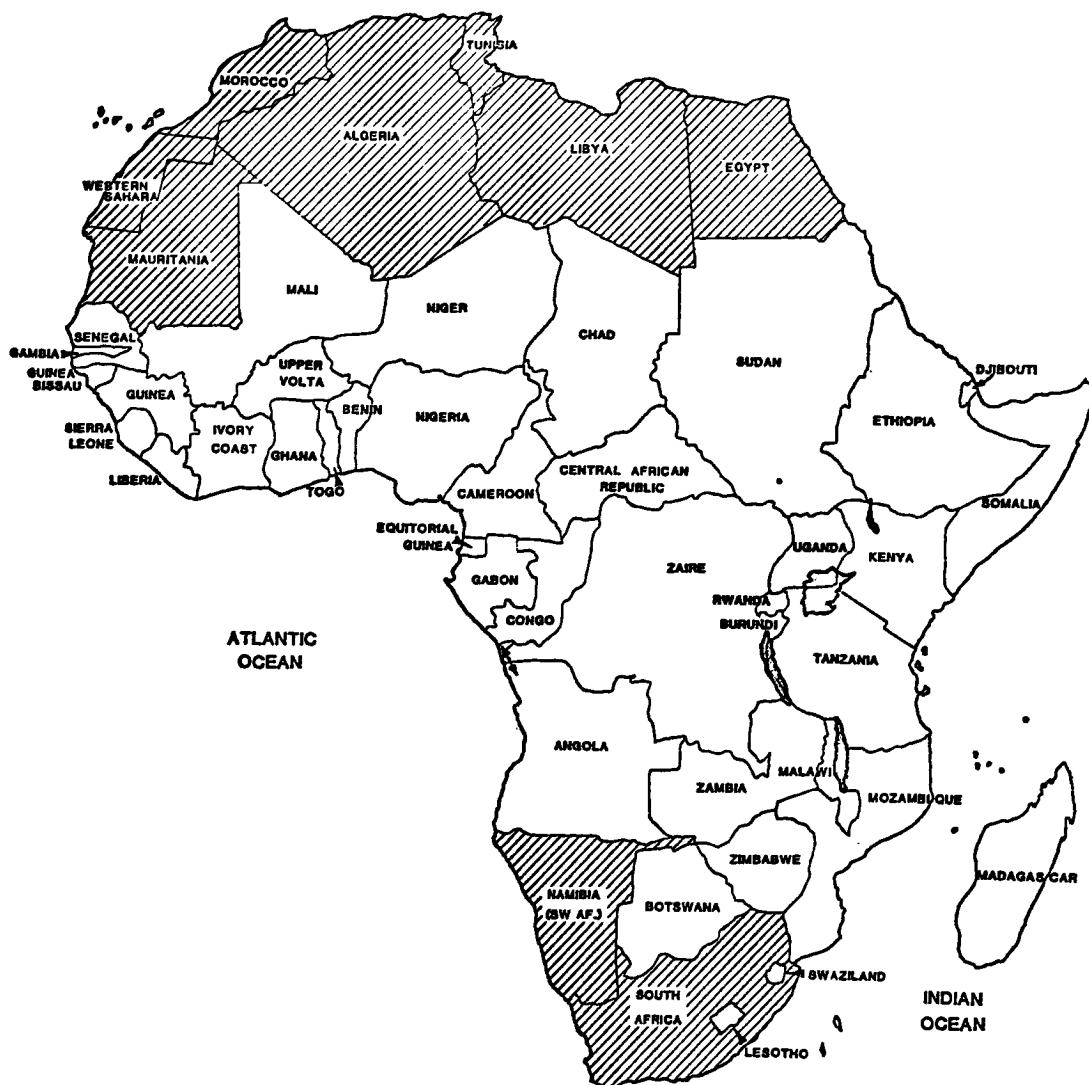


Figure 1: African Study Parameters

## **CHAPTER II**

### **METHODOLOGY**

## CHAPTER 2

### METHODOLOGY

Because, to this writer's knowledge there has been no research conducted specifically on the printing industry of Sub-Sahara Africa, this pilot study has taken a broad approach, setting the stage for further studies. The approach shown in the flow diagram in Figure 2 outlines the steps and the relationships between them and illustrates the requisite information necessary to complete each step in the study.

The total lack of research specific to printing in Sub-Sahara Africa rendered the classical literature search unrealistic. All of the literature specific to printing in Africa is of an empirical nature, consisting of isolated observations. Because, for the most part, this information is consistent in type with the information gathered by other means (and in the interest of readability), it was considered preferable to present all the information within Chapter 3 in a discussion format.

The information has been gathered by several means: through a search of the literature; through conversations with persons with appropriate working experience associated with Africa; through a survey of manufacturers of graphic arts technologies; and through a statistical analysis of socio-economic data of certain countries.

The more objective statistical analysis relates to the "printing industry" only indirectly, and is treated in a separate section of the study (part D of chapter 3). It represents a markedly different approach to answering the basic question of "what is the printing industry like in Sub-Sahara Africa", and is based on numerical data

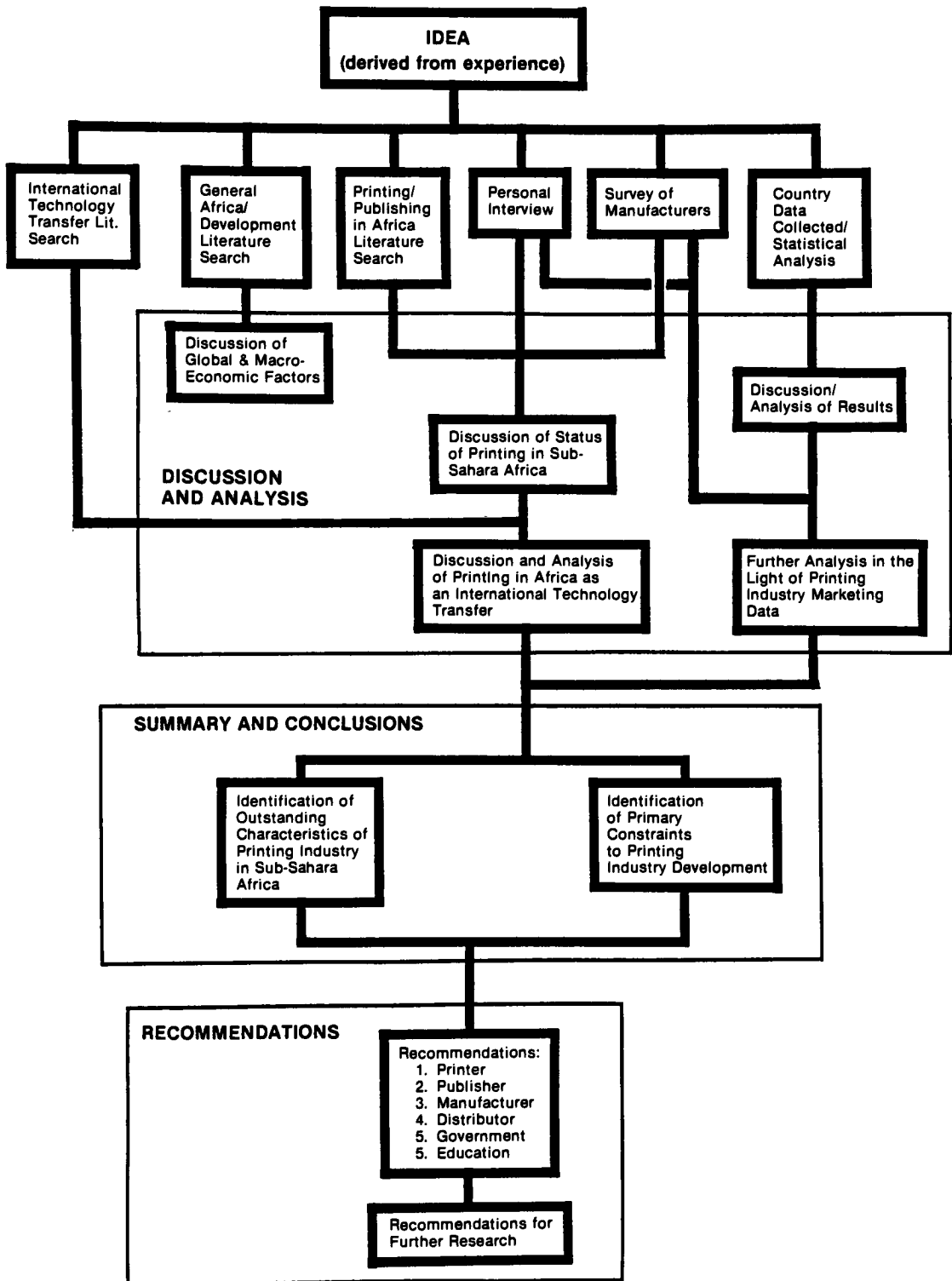


Figure 2: Study Logic Flow Diagram

and is analyzed by quantitative methods in contrast to the empirical and theoretical approaches of the initial sections of that chapter.

### Study Logic

As Figure 2 illustrates, the literature search on African and national development provides the background required for a discussion of global and macro-economic factors which directly or indirectly influence the printing industry in Sub-Sahara Africa.

The literature search on printing and publishing in Africa, the survey of manufacturers, and the personal interviews constitute the basis of an empirically based discussion on the general status of printing in the region. A subjective synthesis of this discussion with the more structured research literature on international technology transfer constitutes the subsequent section of the paper. Country level data processed by a statistical computer program is followed by a discussion of results, which leads to further analysis in view of additional data not suited to the program. All these discussions then lead to the final conclusions and recommendations.

### Information Gathering Techniques

#### Literature Search

Literature searches were conducted in three general areas as follows:

1. General literature on Africa and national development.
2. Printing and publishing in Africa.
3. International Technology Transfer (I.T.T.).

## **Personal Interviews**

Five interviews contributed to the discussion on the status of printing in Africa and to the analysis of printing as an international technological transfer. Two interviews were conducted with Nigerians formerly working in the printing industry in their country but who were furthering their education at the Rochester Institute of Technology. An additional three telephone interviews were held with the African sales managers from DuPont, MacBeth and 3M companies, two of whom have traveled extensively throughout Africa. The personal experiences of this writer in The Gambia also contribute to the discussion. In addition, dozens of undocumented discussions with Africans and temporary residents and visitors to the continent confirmed the impressions, observations, and data collected for this study. Appendix A lists the names and recent background of the interviewees.

Results of the interviews are presented at appropriate points in the subsequent discussions.

## **Survey of Manufactures**

The survey was one of several means of acquiring information. Its purposes were to identify supplier trends and to define the state-of-the-art of printing technology in the region. Therefore, a general request (in a letter format) was designed and distributed, asking for information on the type and volume of graphic arts products marketed to the appropriate countries (see Appendix B for a copy of the survey letter).

A detailed list of questions was determined inappropriate because of the extreme diversity of the products being marketed by the firms and because of the broad-based objectives of this pilot study, which made it difficult to derive specific questions meaningful to both the companies and the objectives.

The manufacturers. Of the 85 companies surveyed, 30 responded. Of these 30, 17 (Appendix C) actually provided marketing information on their products in Africa. All of the 17 are either already actively pursuing sales in Sub-Sahara Africa or plan to at some point in the future.

It is important to note that the companies surveyed were assured that data or other information specific to their firm would not be specifically referenced.

The overall impression received from the survey was that of increased interest and intensification of marketing efforts by printing technology suppliers within Africa. The information from the survey, like the information from the literature searches and personal interviews, is presented at appropriate points in Chapter 3.

**CHAPTER III**  
**DISCUSSION AND ANALYSIS**



## CHAPTER 3

### PART A

#### Global Context

##### Economic Factors

This section provides background on the African situation and identifies those factors that influence national development and thus the printing industries of Sub-Sahara Africa.

Africa is the least industrialized continent of the globe. Huybrechts and Logli<sup>1</sup> point out that African countries began to industrialize later than other third world countries of Asia and South America and have progressed more slowly. Agriculture is still predominately at subsistence level, and natural resources are exported almost exclusively in their raw state. The manufacturing industry is barely developed.

In 1976 Africa was responsible for only 0.7 percent of world manufacturing of value added, compared to 4.8 percent and 3.1 percent for Latin America and Asia respectively.<sup>2</sup> Gross domestic product per capita growth rates for Africa were well below all other regions of the globe.<sup>3</sup>

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<sup>1</sup> Huybrechts, A. and Logli, "Industry in Africa", Africa South of The Sahara 1980-81 Tenth Edition (London, Europa Publications Limited, 1980), p. 49.

<sup>2</sup> Ibid., p. 50.

<sup>3</sup> Hopkins, M., "A Global Forecast of Absolute Poverty and Employment", International Labor Review, Vol. 119, No. 5 Sep-Oct 1980.

Davidson<sup>4</sup> shows the necessity of judging the present economic status of Africa within the context of history. From the beginning of the slave trade in the 1440's, through the establishment of colonies which began in the 1880's, the European presence in Africa can be viewed as a process of exploitation which "did little or nothing to close the technological 'power gap' between blacks and whites."<sup>5</sup> Davidson significantly points out that even with the development of new and thriving commercial and industrial activities, with very few exceptions, this was an "unassimilated technology."<sup>6</sup> All this bears closely on the whole concept of development. When one considers the radically different social structures of traditional Africa and the nature of European involvement and its influence on these cultures, it would indeed be surprising if Africa were not the least developed region of the world.

It is perhaps significant that in a 1981 report of economic prospects of the developing countries<sup>7</sup> where East Asia, South America, and Southern Europe are analyzed as regions, Africa is not mentioned. This neglect of Africa is generally typical of such business oriented research. The reason is not hard to guess. Sub-Sahara Africa represents the least developed region of the world in terms of

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<sup>4</sup> Davidson, B. "Africa in Historical Perspective", Africa South of The Sahara 1980-81 Tenth Edition (London, Europa Publications Limited, 1980), p. 14.

<sup>5</sup> Ibid.

<sup>6</sup> Ibid.

<sup>7</sup> "Economic Prospects in 16 Developing Countries", Business Intelligence Program Report Number 646 (Menlo Park, Stanford Research Institute International, 1981).

industrialization, capital investment, and gross product and as such has been less attractive to business interests than more prosperous regions. However, it is equally significant that Africa is the world's leading exporter of many raw materials, notably peanuts, cocoa, edible oils, diamonds, cobalt and gold. In fact, the underground wealth of the continent is still largely unknown.<sup>8</sup> In addition, Africa possesses enormous hydroelectric capacity, two-fifths of world potential.<sup>9</sup> Africa has great potential for growth and development in the long run.

#### Factors Affecting Economic Growth

Slowing of world economic growth and the rising price of energy are two factors constraining economic growth which have been outlined in a recent Science Research Institute Business Report.<sup>10</sup> These factors indirectly influence the present and future development of the printing industries in the respective countries of Africa. The world gross domestic product growth rate in the 1960's was 5.2 percent.<sup>11</sup> The 1970's saw a reduced growth rate equaling 3.9 percent, and growth rates for the 1980's are expected to slow even more.<sup>12</sup> Virtually all the slowdown in growth coincided with the 1974 oil crisis; availability of energy supplies is considered the greatest constraint to future growth in the developing countries. As a consequence, it has become

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<sup>8</sup> Bonnardel, R., The Atlas of Africa (New York, The Free Press, 1973), p. 22.

<sup>9</sup> Ibid., p. 25.

<sup>10</sup> "Economic Prospects in 16 Developing Countries", pp. 7-10.

<sup>11</sup> Ibid., p. 7.

<sup>12</sup> Ibid.

imperative for all countries, and especially the low income countries, to reduce their dependence on imported energy by reducing domestic consumption and by expanding local energy sources.

Balance of payments deficits is another major problem facing many African nations.<sup>13</sup> In developing economies, payment deficits are not unusual or necessarily undesirable, and can be expected as imports of goods and services exceed exports. Such deficits are commonly offset by foreign capital inflows. However, when these inflows are insufficient to balance the deficits, it affects growth. If deficits become too large, foreign reserves dwindle and the country must borrow heavily from foreign financial institutions. This adds to the burden as foreign debts mature. When this stage is reached, lenders become increasingly reluctant to extend further credit to cover further deficits.<sup>14</sup> This is the situation in a number of countries in Sub-Sahara Africa.

Political instability is perhaps the greatest threat to economic stability in Africa.<sup>15</sup> None of the countries being considered can be said to be immune from political tensions in the next ten years. The primary mechanism for the transfer of printing technology is the direct sale of equipment through distributors. In this case, the risks do not

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<sup>13</sup> U.S. International Trade Administration, Overseas Business Reports: Market Profiles for Africa (Washington D.C., U.S. Government Printing Office, March 1980). Numerous other sources indicate excessive balance-of-payment deficits for many of the countries in this study.

<sup>14</sup> "Economic Prospects in 16 Developing Countries", p. 10.

<sup>15</sup> First, R., "Political and Social Problems of Development", Africa South of the Sahara 1978-79, Eighth Edition (London, Europa Publications Limited, 1978), pp. 19-24.

involve such high stakes as in direct investment. Whatever political situation results, the demand for printing technology will remain. The printer will seek whatever equipment and processes he needs whenever the economy continues functioning. Thus, the development of the African market by foreign manufacturers is likely to offer long term dividends, despite present instability.

The stabilization of foreign exchange has in the last decade been positive for African nations. The instability of their currencies since independence had been a major handicap when dealing in the international market. The establishment of the Committee on Reform of the International Monetary System in 1972 marked a significant turning point in the traditional gold reserve system and a trend toward reducing the monopolistic control exercised over it by the industrial powers.<sup>16</sup> In 1978 the Committee on Reform put its official seal on reducing the monetary role of gold and set up a trust fund to help low income countries with their financial problems.<sup>17</sup> In 1980 the Committee developed a plan that would gradually reduce and eventually replace the dollar as the world's reserve currency.<sup>18</sup> These developments go far to enhancing the status of low income country currencies, which is essential for effective participation in the world marketplace.

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<sup>16</sup> Cline, W.R., International Monetary Reform and the Developing Countries. (Washington D.C., The Brookings Institution, 1976), p. 3.

<sup>17</sup> Habermeier, W.O., "The SDR as an International Unit of Account", Finance and Development, Vol. 16, p. 11. March 1979.

<sup>18</sup> Anon., "The LDC's Big New Role in the Dollars Future", Business Week, Vol. 3, May 5, 1980, p. 121.

Industrialization is the most fundamental and significant potential force stimulating economic growth in the vast majority of low income countries. By examining how countries have progressed toward industrialization, Sub-Saharan leaders may be able to predict and adjust to the industrialization process in their own countries.

Import substitution industrialization is the common road taken by the more industrialized, low income countries of South America and Asia.<sup>19</sup> Sagasti outlines two stages in this type of industrialization.<sup>20</sup> The first stage consists of substituting imported consumer and some light durable goods with local versions. Transition to the second stage, which is not always smooth or continuous, involves the gradual manufacture of intermediate basic and capital goods. The main ingredients of this process have in the past been,

deficits in the balances of trade and payments, the availability of finance for local investment, and the existence of a social class with the means for increasing and diversifying its consumption.<sup>21</sup>

These components seem to exist in most African countries. These initial stages generally require government protection in the form of tariffs, unless natural trade barriers exist.<sup>22</sup> At this stage there is little competition and quality is not an important factor.<sup>23</sup> Tariffs make sense not only because local markets in low income countries do not

<sup>19</sup> Sagasti, F., Science and Technology for Development (Ottawa, International Development Research Center, 1978), p. 39.

<sup>20</sup> Ibid.

<sup>21</sup> Ibid.

<sup>22</sup> Ibid.

<sup>23</sup> Ibid.

necessarily require highly refined products, but even more so because local industry requires protection and time to learn basic production functions. Many countries then gradually begin the painful process of reducing import restrictions, thereby increasing competition which serves to streamline and upgrade local industry by forcing local entrepreneurs to become more cost conscious, technologically inventive, and risk taking.<sup>24</sup>

Import substitution would be a sensible development in a local printing industry of Sub-Sahara Africa, especially as most printed materials still come from overseas.<sup>25</sup> But many African governments - Nigeria being a good example - seem to be preventing rather than promoting the growth of the printing industry by allowing printed materials to enter the country free while at the same time imposing crippling duties on paper, ink and printing machinery.

A high level of capital investment has been another major contributor to strong economic growth in low income countries.<sup>26</sup> The availability of capital to fund investment is not seen as a problem in the immediate future for most low income countries.<sup>27</sup> However, because domestic capital generation becomes more efficient as the per capita income levels increase, many countries will be forced to continue to rely upon foreign investment and multilateral aid to supply the needed

<sup>24</sup> Ibid., p. 41.

<sup>25</sup> This statement is based on observations from individuals living or traveling in Africa, notably the 3M Sales Manager for Africa, H.C. Proper. (see appendix A).

<sup>26</sup> "Economic Prospects in 16 Developing Countries", p. 6.

<sup>27</sup> Ibid.

capital reserves.<sup>28</sup> A number of African countries with higher per capita earnings will continue to increasingly satisfy their capital needs from within. The process works roughly like this:

As more individuals accumulate enough wealth to become savers, the complex system of financial markets and institutions becomes broader and more efficient. Local companies have access to a wider range of lenders and financing options.<sup>29</sup>

It is also encouraging that the overall climate for foreign investment is much more favorable than it was ten years ago, and is expected to continue to improve, especially where developing countries become more receptive to such investment.<sup>30</sup>

Rapid expansion of exports has long been a critical element in the economic success of the East Asian countries. In fact, this area has become a major world exporter of printed matter in a relatively short time.<sup>31</sup> Sub-Sahara Africa's main export has traditionally been agricultural and mineral resources. It is not expected that the region will export consumer goods (i.e. printed matter) in a significant way for some years to come.

The trend toward the use of national development plans for guiding economic policies is likely to have a positive effect on economic growth, if for no other reason than providing domestic and foreign businesses

<sup>28</sup> Ibid

<sup>29</sup> Ibid.

<sup>30</sup> Ibid.

<sup>31</sup> Anon., "Markets in the East: (7) Fastest Growth of All", Litho Printer, February 13, 1980, pp. 32, 33.  
Battacharya, S.K., "South East Asia: A New Cauldron for Printing Developments", World Wide Printer, Jan-Feb. 1980, pp. 22, 25.



with some indication of the direction that economic policies are likely to take.<sup>32</sup>

A basic awareness of the above conditions and processes provide an essential context within which a realistic look at printing in Africa can occur.

## PART B

### The Status of Printing in Sub-Sahara Africa

It is not an easy task to give a clear picture of the printing industry in Africa. Changes happen rapidly, and the countries exhibit an extreme range of differences. For orientation, a few examples are given.

The Gambia may be representative of the "very low income" end of the scale. As of August 1978, there were only four printing establishments in the country.<sup>33</sup> The largest of the four was the Government Printery which had a number of letterpress platen and cylinder presses, metal type (but no type casting capability), flat cutter, and hand operated saddle and side stitching equipment. It employed about 20 people. Only type work utilizing low grade paper and simple binding styles were employed. In the early 1970's a new building was added to house a lithographic offset facility. Although it was functioning, it was operating far below capacity. Of the four 17" offset presses, the most this writer found operative were two, and these two were operating at well below 50 percent capacity.

<sup>32</sup> "Economic Prospects in 16 Developing Countries", p. 7.

<sup>33</sup> This figure and the following information on The Gambia is based on this writer's personal experience as a two year resident in that country from September 1976 to August 1978.

The second largest facility was a commercial enterprise which started up when it acquired several letterpress machines and type from the Government Printer at the time of the introduction of the offset lithographic unit. The firm was never seen producing work, and it is doubtful that it was printing at as much as five percent capacity. The problem appeared to be a sheer lack of market rather than technical problems or poor management of production.

The third facility was part of a multimedia production unit attached to the Ministry of Agriculture and Natural Resources and was created to serve any governmental organization involved with rural extension. Like the Government Printer, it provided service at no cost (at that time) to the client. Consequently, there was seldom a shortage of requests for printed matter. The unit initially utilized a single offset press, darkroom and process facilities, and basic saddle and side stitching equipment.

A fourth printer, who left the country in 1977, operated a very small table top office duplicator on a commercial basis, and although he appeared to do better than the larger commercial printer, his enterprise was never profitable enough to support him and his family without supplementing his income in other ways. His main business was in quick copy printing and low quality, one color labels for the small local soft drink industry.

Finally (as of 1978), one or two firms utilized electrostatic copiers. Electrostatic copiers could also be found in a number of government departments, banks, and other businesses.

Nigeria in contrast to The Gambia, had over 175 printing organizations in 1974<sup>34</sup> employing some 60,000 workers. Of these, 60 employed over 100 workers and nine employed over 1,000 workers.<sup>35</sup> The Nigerian printing sector is quite diverse, composed of approximately 20 chiefly foreign owned publishers, approximately 120 commercial firms, and some 70 firms publishing and printing magazines and periodicals.<sup>36</sup> The Nigerian printing industry is expanding and changing so rapidly that it is impossible to predict future developments. Trends are toward photopolymer relief plates, phototypesetting, and web and sheet-fed offset lithography.<sup>37</sup>

At other extremes the Ivory Coast has a modern commercial sector with the presence of a number of European printing firms and a large expatriate work force.<sup>38</sup> A textile screen printing industry catering to the indigenous textile market also exists. Ethiopia has only eight printing establishments.<sup>39</sup> Kenya has a large and relatively modern printing sector.<sup>40</sup> Further to the south, Zimbabwe has a relatively well developed printing industry with perhaps the best trained indigenous

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<sup>34</sup> U.S. International Trade Administration, "Printing and Publishing in Nigeria", NIGERIA: A Survey of U.S. Business Opportunities (Washington D.C., U.S. Government Printing Office, 1978), p. 15.

<sup>35</sup> Ibid.

<sup>36</sup> Ibid., pp. 15, 16.

<sup>37</sup> Ibid., p. 13.

<sup>38</sup> Interview with G. Nanin, DuPont (see Appendix A).

<sup>39</sup> Ibid.

<sup>40</sup> Interview with H.C. Proper, 3M (see Appendix A).

work force in all of black Africa.<sup>41</sup>

### Printing in African History

The primary impetus for the spread of printing in the non-Western world was initially overwhelmingly religious, and was carried out by missionaries.<sup>42</sup>

However, in some areas the progenitors of printing were not concerned with the spiritual life of the natives, as in the case of South Africa which first initiated printing to meet the demands of copying an ever "increasing number of official documents" for the government.<sup>43</sup> The actual history of printing in Africa is sketchy. Available records indicate that the first printing press was introduced to Africa in 1784 in Cape Town.<sup>44</sup> The next press to be established - according to available records - was by a mission in Madagascar in 1826, followed by a government press in the Gold Coast in the 1830's.<sup>45</sup> This was followed by a proliferation of government and mission presses, which were followed, around the turn of the century, by the appearance of the first newspaper and private presses a considerable number of which were in operation all over the continent by the Second World War. Since independence, the development of printing has been rapid in

<sup>41</sup> Nanin, Interview.

<sup>42</sup> Clair, C., ed., The Spread of Printing, A History of Printing Outside Europe in Monographs (Amsterdam: Vangejdt and Co., 1969).

<sup>43</sup> Smith, A.H., The Spread of Printing: South Africa (Amsterdam: Vangejdt and Co., 1977), p. 12.

<sup>44</sup> Klitgaard, S.A., Educational Books in West, Central and East Africa (London, Harrap and co. Ltd., 1967), p. 41.

<sup>45</sup> Ibid.

many countries - although not in all, by any means.

### Printing Industry Development

There appear to be five general categories of printers in Sub-Sahara Africa. They are government presses, university presses, mission presses, newspaper presses and private presses.<sup>46</sup> In reality, the functions of these different types of presses are not necessarily distinct. For example, the official function of government presses is "to cater to the printing of official forms, gazettes, announcements and books."<sup>47</sup> In countries which do not have a private sector to speak of, for all practical purposes the government printer functions as a commercial printer. Even where a commercial sector does exist, some government printing houses were designed to run on a commercial basis as in Nigeria, Ghana, and Guinea.<sup>48</sup> Similarly, newspaper presses can be government controlled or private, and can function uniquely for newspaper production, or additionally as commercial printers producing school books and periodicals. For that matter, even missionary presses have operated on a commercial basis.<sup>49</sup>

Commercial printing receives its work from two related sectors, namely the publishing sector and the industrial-commercial sector. The publishing sector can include everything from newspapers to schoolbooks to technical and scholarly journals to religious tracts - if printed for profit. Industrial printing, as defined in this study,

<sup>46</sup> Ibid.

<sup>47</sup> Ibid., p. 42.

<sup>48</sup> Ibid.

<sup>49</sup> Ibid.

includes package and label printing and printed material related to the sale, operation, and maintenance of industrial and commercial products.

### Publishing in Africa

There has been very little publishing in Africa, despite the presence of foreign publishing firms since the early 1900's. In fact the presence of publishers is not indicative of the act of publishing in Africa. The exception to this was a number of mission presses whose "activities extended beyond this narrow area of interest (religious literature) to embrace general publishing, albeit always with an evangelical aim or interest."<sup>50</sup>

Foreign publishers, such as Longmans and Oxford University Press, have gone through four basic stages of development in English speaking Africa.<sup>51</sup> Stage one is when a foreign publisher sends a representative simply to see if he can sell any books - this occurred nearly 60 years ago for Oxford University Press in Nigeria.<sup>52</sup> Stage two involves the establishment of an overseas editorial department based in the home country which sends representatives to commission books aimed at the educational market - which took place in 1926 in Nigeria for Oxford University Press.<sup>53</sup> Stage three involves a locally-based staff - with offices and warehouses - who are to sell books and

<sup>50</sup> Irele, A., "The African Publisher", Publishing in Nigeria (Lagos, Etheope Publishing Corp., 1972), p. 6.

<sup>51</sup> Mitchel, W., "The Non-Indiginous Publisher in Nigeria", Publishing in Nigeria (Lagos, Etheope Publishing Corp., 1972), pp. 34, 35.

<sup>52</sup> Animashaun, A.I., "Some Reflections on the Problems of Establishing a Modern Book Printing Industry in Nigeria", Publishing in Africa in the Seventies (Ibidan, University of Ife, 1973).

<sup>53</sup> Ibid.

communicate with the home offices on matters of books for the local market. Oxford University Press reached this stage in 1949 in Nigeria.<sup>54</sup> Stage four is when local publishing actually begins which Oxford University Press achieved in 1963 in Nigeria.<sup>55</sup>

Unfortunately, local publishing is not synonymous with local printing. In fact, even with the emergence of indigenous publishers since independence, the great majority of book printing is still done outside of Africa in Britain and France, and more recently in Hong Kong, Malta, and Singapore as well.<sup>56</sup>

Nottingham of the East African Publishing House, gives three primary reasons for supporting publishing within Africa, and outlines the formidable obstacles such publishers face.<sup>57</sup> The first reason to support it is nationalistic.

Books are still probably the most effective single instrument for the purveying of ideas in the developing countries, and we cannot accept that these ideas must all originate or first be subject to sieving, in London, New York, Paris or Brussels.<sup>58</sup>

The second reason is based on economic grounds. By import substitution (or by publishing and printing books in Africa which have hitherto been printed abroad) significant scarce foreign exchange can

<sup>54</sup> Ibid.

<sup>55</sup> Ibid.

<sup>56</sup> Ibid.

<sup>57</sup> Nottingham, J., "Establishing an African Publishing Industry: A Study in Decolonization", Publishing in Africa in the Seventies (Ibidan, University of Ife, 1973), p. 139.

<sup>58</sup> Ibid.

be saved.<sup>59</sup> Third, there are inestimable cultural advantages of local publishing which are becoming increasingly recognized. An African publisher related the advantages of indiginization:

Apart from providing work for the few printing presses and encouraging their expansion, it has provided outlets for graphic artists and fine artists, opportunities for the training of editors and production and warehouse staff, and stimulated local authors to write in English and in the principal home languages.<sup>60</sup>

The obstacles to locally owned and operated publishing are significant. Foreign interests have been able not only to retain but even to extend their economic hold in most African countries since independence.<sup>61</sup> In Nottingham's view,

Western economic imperialism is a far more subtle and slippery animal than his political brother. He will do anything, compromise any principles, as long as he can still see something somewhere in it for him.<sup>62</sup>

Thus, foreign publishers are generally not supportive of local publishing efforts and tend to be critical of local attempts.

In the wider imperialist context it is perhaps significant that there is little pressure for this (localization of publishing) among French speaking countries and that much of the initiative in the English speaking areas has come from individual British firms seeking an advantageous commercial position vis-a-vis their rivals.<sup>63</sup>

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<sup>59</sup> Sagasti, p. 41.

<sup>60</sup> Nottingham, p. 303.

<sup>61</sup> Ibid.

<sup>62</sup> Ibid.

<sup>63</sup> Ibid., p. 139.



Perhaps obstacles of equal weight are the British and French educational legacy and the conservatism of those indoctrinated into these systems.<sup>64</sup> Another obstacle is the large amount of capital required for publishing.<sup>65</sup> In addition to these, Irele points out that "most Nigerian authors prefer to go to the established houses with international connections."<sup>66</sup> In this respect, the emerging publisher is competing with foreign publishers who are generally more heavily capitalized, linked to larger and international markets, and have established quality reputations.<sup>67</sup>

According to Dihang, Editor of Editions CLF in Cameroon, the situation in French speaking Africa is even less desirable for printers and publishers than in English speaking countries.<sup>68</sup> The French system operating during colonial times is in many respects still intact. It took (in 1973) from four to six weeks for a book printed in France to reach any West African port, and four to five times that for books to travel between West African ports.<sup>69</sup>

This deplorable state of affairs can be explained by the fact that in the former French colonies or protectorates one may import books from France without any formalities and pay for them by a simple postal transfer, while in the

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<sup>64</sup> Ibid., p. 141.

<sup>65</sup> Irele, A.

<sup>66</sup> Ibid.

<sup>67</sup> Mitchell, W., "The Non-Indiginous Publisher in Nigeria", Publishing in Nigeria (Lagos, Etheope Publishing Corp., 1972), pp. 36, 37.

<sup>68</sup> Dihang, J., "Publishing and Book Distribution in Frankophone Africa", Publishing in Africa in the Seventies (Ibidan, University of Ife, 1973), p. 128.

<sup>69</sup> Ibid.

transactions between African countries import licenses and foreign exchange approvals require such an amount of paperwork as to make it highly discouraging for most people.<sup>70</sup>

Dihang adds that "it is virtually impossible for publishers to make use of local printing facilities."<sup>71</sup> He does not explain what he means by this statement, but considerable change has taken place in the last eight years in some countries. Some Francophone countries are said to have a relatively modern commercial sector, notably Ivory Coast and Cameroon. It should be kept in mind that these countries have a sizable expatriate population. For example, there were approximately 30,000 Europeans living in the Ivory Coast during Colonial times compared to 350,000 today.<sup>72</sup> It should also be noted that despite progress in a few countries, the great majority of color printing is still done overseas. Where quality standards are good, the reason given for printing overseas is the slow turnover and high cost of local printers.<sup>73</sup>

Two other important factors inhibiting the growth of publishing and printing are the duty free status of imported educational books and the heavy import tariffs on printing machinery and printing papers.<sup>74</sup> The weak purchasing power and underdeveloped reading habit of the

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<sup>70</sup> Ibid.

<sup>71</sup> Ibid.

<sup>72</sup> Telephone interview with G. Nanin, Sales Manager: Printing and Industrial for Africa, DuPont, USA (see Appendix A).

<sup>73</sup> Ibid.

<sup>74</sup> Diahang, p. 129.

vast majority of Africans<sup>75</sup> also must be considered. The closing words of Dihang seem all too significant:

Judging by the experience of CLF in its first decade ... we can say that the future of the book industry depends above all on the development of a communications system within Africa and on the easing of the custom restrictions on printing equipment.<sup>76</sup>

#### **Publisher/Printer Relations**

According to Animashaun,<sup>77</sup> managing director (in 1972) of a large book printing house in Nigeria, the relations between publisher and printer are characterized by a master-servant relationship. This, of course, is the printer's point of view. He is really referring to the publisher's reluctance to print locally, following the established pattern. Animashaun points out that:

Particularly at the early stages it was almost impossible to persuade publishers to print with us, and in order to attract them, we had to give very low figures, sufficient to cover only the cost of running our machines.<sup>78</sup>

In the mind of this printer, "the total lack of communication between printers and publishers is a great source of handicap in the development of an appropriate printing industry," and "no satisfactory progress can be made towards developing the (printing) industry unless there is fundamental change in the present thoughts and practices (of publishers)."<sup>79</sup> He goes on to develop the thesis that many of the

<sup>75</sup> Ibid.

<sup>76</sup> Ibid., p. 133.

<sup>77</sup> Animashaun, p. 71.

<sup>78</sup> Ibid.

<sup>79</sup> Ibid., p. 73.

deficiencies in local printing capability could be resolved by proper communication and cooperation with publishers and by a more reliable market established by a commitment to the local printing industry on the part of publishers.

From the publisher's point of view, local printing facilities are inadequate due to "low standard of skills," long delays in production due to a "scarcity of technical skill for the maintenance of their machines," and total reliance on costly imports due to "the absence of ancilliary industries to supply the raw material."<sup>80</sup> Expressing the publisher's point of view, Solaru states the problem in no uncertain terms:

Even where the publisher is able to provide good artwork, and his production staff has given accurate and specific instructions about type size, spacing and imposition, the quality of a book can be marred in the process of typesetting and printing, as well as by poor binding.<sup>81</sup>

### State Participation in Publishing

Because of the problems identified in the foregoing discussion, the publishing of educational books - the most lucrative area of publishing - has been, until recently, the exclusive domain of the foreign publisher. Part of the trend toward localization of publishing has been, since independence, the formation of a number of state-owned publishing houses, such as The Ghana and Tanzania Publishing Corporations.<sup>82</sup> It is thought that state publishing offers one solution

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<sup>80</sup> Solaru, T.T., "Educational Publishing and Textbook Production", Publishing in Africa in the Seventies (Ibidan, University of Ife, 1973), p. 304.

<sup>81</sup> Ibid.

<sup>82</sup> Irele, p. 11.

to the need for the extensive capital so difficult for the private local publisher to acquire.<sup>83</sup>

From an economic - though not from a democratic - point of view, central control of printing and publishing makes sense. In technical terms, there is little difference between controlling a large publishing empire from a state-run publishing house or by private enterprise. The editorial facilities are the same. Production equipment is put to comparably efficient use.<sup>84</sup>

State participation can also take the form of capital subsidies and state patronage to a selected and constantly reviewed list of private publishers.<sup>85</sup> But whatever form it takes, the conference on Publishing in Africa at the University of Ife in December of 1973 was skeptical of entirely state owned publishing because of fears of red-tape, corruption, stagnation, mismanagement and political interference.<sup>86</sup> Joint ventures with foreign publishers have also faced considerable mistrust.

Evidence...so far is that the outside interests get much of their profits from producing the material in question outside Africa and selling it to these State publishing houses, which thus become mere merchandising depots.<sup>87</sup>

The general trend, then, in African publishing is not only toward local production, but toward local control of the publishing process itself.

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<sup>83</sup> Ibid.

<sup>84</sup> Jaspert, W.P., State of the Art: An Update on the Graphic Communications Industries (London, Printing Industries of America, 1980), p. 8.

<sup>85</sup> Oluwasanmi, McLean, Zell, ed., Publishing in Africa in the Seventies (Ibidan, University of Ife, 1973), p. 2.

<sup>86</sup> Ibid., p. 3.

<sup>87</sup> Nottingham, p. 142.

## Paper Supply Constraints

Adequate, timely, and affordable paper supplies are perhaps one of the single greatest problems facing African printers. Not only are they concerned about escalating and fluctuating prices, but they must sometimes worry about obtaining paper at any price.<sup>88</sup> The primary paper suppliers to Africa are based in Europe, and according to the Director of the Academy Press in Nigeria after meeting with several of these suppliers, the suppliers "confessed that they (European paper merchants) were not interested in the African market, and that they could sell all their products, or at least ninety percent of them in Europe and Russia."<sup>89</sup> At a time when paper shortages are common in the industrialized countries, it is certain that African countries are at the bottom of the paper suppliers list in terms of priorities. Added to this problem is the substantial duty on imported printing paper many countries require.<sup>90</sup> There does not appear to be a rational reason for these high duties, as equipment and paper imports do not compete with local industries. The only possible conclusion would be to provide revenue for government - albeit to the detriment of private business and industry.

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<sup>88</sup> This view was expressed by several African printers, notably Silva Opusunju, a Nigerian, and was based on previous experiences with paper shortages in that country.

<sup>89</sup> Animashaun, p. 74.

<sup>90</sup> Oluwasanmi, E., "The Book Publishing Process: The Nigerian Experience", Publishing In Nigeria (Lagos, Ethiope, Publishing Corp., 1972), pp. 15, 16).

Paper, requiring an extremely high energy input, is likely to continue to increase in price. With paper and transportation prices steadily increasing, and paper shortages commonplace, Third World countries are beginning to establish domestic production facilities for their newsprint and book paper needs. In fact, this seems to be the only long term answer for Sub-Sahara Africa.

Unfortunately, paper manufacturing is extremely capital intensive, requiring enormous initial expenditures at a time when most African countries - Nigeria being the exception - are experiencing a scarcity of foreign exchange. Furthermore, the energy requirements and recurring costs are considerable. Due to these and other factors, the number of ventures to establish manufacturing facilities in low income countries have in the last two years actually declined.<sup>91</sup> Tanzania, Nigeria, and Ghana are scheduled to open printing paper plants in 1982, 1982 and 1985 respectively.<sup>92</sup> Mauritius, Tanzania and Nigeria will open new newsprint plants in 1981, 1982 and 1982 respectively.<sup>93</sup> Pulp mills are underway in Cameroon, Gabon, Ghana, Ivory Coast, Kenya, Madagascar, Malawi, Nigeria, Swaziland and Tanzania.<sup>94</sup>

Establishing pulp and paper industries in low income countries was discussed at the recent Comprint International Conference in Denmark where it became evident that "the over-emphasis by financiers and

<sup>91</sup> Anon., "World Pulp, Paper and Board: New Capacity Projects", Paper, Sep. 22, 1980, p. 34.

<sup>92</sup> Ibid.

<sup>93</sup> Ibid., p. 35.

<sup>94</sup> Ibid.

advisors from the developed countries on such doctrines as economies of scale has impeded progress."<sup>95</sup> State-of-the-art paper manufacturing technology involves a high degree of computerized automation and control. This technology has been developed to meet the needs of the Western industrial economies. It almost seems too obvious that a less automated and less sophisticated technology would be more suited to the smaller markets and significantly lower technological capacity of most African nations.

### Trends

Trends of foreign suppliers. If there is one particular characteristic which, more than any other, stands out about printing in Sub-Sahara Africa, it is that of rapid change. This is particularly true of the oil-producing nation of Nigeria.<sup>96</sup> Reminiscent of the gold rush in the American West, suppliers of printing technology are rushing to enter this rapidly expanding market. To a lesser degree, this rapid transformation is generally characteristic of most African nations.<sup>97</sup> One Nigerian printer<sup>98</sup> who had been out of his country for two years said it was impossible for him to even guess what was taking place at that

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<sup>95</sup> Jaspert, p. 11.

<sup>96</sup> This was confirmed by all the interviewees who either worked in or have visited Nigeria. As it is an oil rich nation, a great deal of money is changing hands and, in the opinion of Western observers, is being literally thrown away. Although a great deal of printing equipment is being acquired in Nigeria, Western observers consider it to have more than its share of problems in terms of industrial and commercial development.

<sup>97</sup> This observation is based on survey respondents and interviews.

<sup>98</sup> Interview with David B. Namiji (see Appendix A).



moment, so rapid was the change.<sup>99</sup>

The survey of manufacturers shows a keen and growing interest in the African market. A number of suppliers who have not been active in the market, acknowledge having plans involving the region within the short term future.<sup>100</sup>

**Prepress trends.** By all indications, phototypesetting, despite considerable problems, is rapidly gaining acceptance. One manufacturer attributed this to the widespread growth of offset lithography, the most compatible process to phototypesetting. Photomechanical processes are also spreading, with a reported annual consumption of six to seven million square feet of lith film for the region.<sup>101</sup> Interest in less sophisticated color separation systems is also increasing.<sup>102</sup> The introduction of bright light film systems have also been reported.<sup>103</sup>

**Press trends.** Approximately 60 percent of printing in West Africa is done by offset lithography; while in East and South East Africa, offset accounts for only 50 percent, with letterpress holding around 40 percent of the market.<sup>104</sup> Flexography is growing widely in Kenya with

<sup>99</sup> For example Mr. Namiji went to a vocational printing school which utilized entirely letterpress printing. After leaving the country for two years he returned to find the entire facility converted to offset lithography.

<sup>100</sup> The names of specific manufacturers relating to individual marketing practices is being purposely withheld as promised in the initial survey letter (see Appendix B).

<sup>101</sup> Nanin, interview.

<sup>102</sup> Ibid.

<sup>103</sup> Proper, interview.

<sup>104</sup> Nanin, interview.

a reported market share of as much as 10 percent for all of East Africa.<sup>105</sup> The gravure process is known to be in use in two countries, namely, Ivory Coast and Nigeria.<sup>106</sup> Based on the information received from the survey, which is considered far from complete, there are fourteen countries reported as having web offset installations.<sup>107</sup>

Binding and Finishing. Suppliers in this area expected the demand for their labor saving bindery systems to increase in the coming years as education expands and general development progresses and as the cost of labor increases. It was reported that most in-line book production systems have been for government sponsored projects relating to education and were sponsored by either bilateral or multilateral organizations.<sup>108</sup> The majority of sales appears to be in smaller, more labor intensive sewing, stitching and adhesive binding machines.

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<sup>105</sup> Ibid.

<sup>106</sup> Ibid.

<sup>107</sup> This observation is based on actual sales figures from three press manufacturers.

<sup>108</sup> Burns, D.C.R., Sales Manager (Africa), Harris Bindery Systems Division-Europe.

## PART C

## I.T.T. and the Printing Industry in Sub-Sahara Africa

Technology, according to Wortzel,<sup>109</sup> consists of the package of skills, knowledge, and procedures for making, using and doing useful things. The following similarly broad statements are representative of the proliferation of definitions which can be found.

The sum of the ways in which a social group provide themselves with the material objects of their civilizations.<sup>110</sup>

The practice, description and terminology of any or all of the applied sciences which have practical value and/or industrial use.<sup>111</sup>

Printing by definition then is one form of technology. Since the 1950's there has been a growing body of literature on the international transfer of technologies to low income countries, but printing technology has not been specifically studied in any of these cases. It would make sense then, to examine the printing industries of Sub-Sahara Africa within this context as yet another way of evaluating the current status and problems of the industry. This is certainly appropriate for an exploratory study of this nature. Therefore, this section subjectively relates current findings in "technology transfer" to what we know of the status of printing in Sub-Sahara Africa.

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<sup>109</sup> Wortzel, L.H., "Technology Transfer in the Pharmaceutical Industry", UNITAR Report No. 14 (New York, UNITAR, 1971).

<sup>110</sup> Stein, J., ed., The Random House Dictionary (New York, Random House, 1966).

<sup>111</sup> Collocott, T.C., ed., Dictionary of Science and Technology (New York, Barnes and Nobel, 1971).

## I.T.T./A.T. and the Capacity to Absorb Imported Technology

With the proliferation of research and literature on the choice and transfer of technology, there are numerous overlaps of terminology as well as polarization of views. It is perhaps worthwhile to briefly review the more primary overlaps and issues.

International technology transfer" defined. "International technology transfer" can be defined as "the acquisition and utilization of technological knowledge by a country other than that in which this knowledge originated."<sup>112</sup> The bulk of the literature generated in the 1950's and 1960's concerned the international flow of technology to low income countries, assuming this to be the primary answer to technological underdevelopment.<sup>113</sup> More recently, "international technology transfer" tends to encompass all aspects, problems and issues implied by this broad term.

What is "appropriate technology"? "Appropriate technology" is an ambiguous term because it has a wide variety of meanings to different groups of people. The term emerged in the 1960's, perhaps as a response to the relatively unopposed presence of multinational corporations in many less-developed countries and their rather indiscriminate transfers of sophisticated technologies after World War II.

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<sup>112</sup> Derakhshani, S., "Structuring International Transfer of Technology: Lessons From Iran", Unpublished Ph.D. dissertation, Cambridge, Harvard University, 1980, p. 1.

<sup>113</sup> Williams, G.W., "The Capacity to Absorb Imported Technology: An Exploratory Study", Unpublished Ph.D. dissertation, University of Texas at Austin, 1977, p. 2.

The term "appropriate technology" has been used - or misused - to mean many different things to many different people. To the purist, it is synonymous with unsophisticated labor intensive technologies. Advocates of this extreme tend to be opposed to advanced, large scale, sophisticated or high technologies on moral and political grounds. This group claims that sophisticated technologies lend themselves to domination of large groups of people by a small technocratic elite, and result in deleterious effects on the cultural values of traditional society.<sup>114</sup>

Watanabe's definition of "appropriate technology" is perhaps more generally representative.

It is a set of production techniques which do more to improve the standard of living of the masses through employment generation and economic growth than any available alternative.<sup>115</sup>

Trak and Mackenzie<sup>116</sup> developed five general prescriptions as guidelines to be used in appropriate technology choice:

1. Low capital intensity to utilize the abundant supplies of labor.
2. Simplicity in construction, operation, repair, and maintenance, and organization appropriate to scarcity of skills.
3. Small size, both for lower capital intensity and to promote access to entrepreneurs with limited capital and experience, this contributing to a more equal income distribution.

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<sup>114</sup> This general viewpoint has been popularized by such writers as Goulet in The Uncertain Promise, and Schumacher in Small is Beautiful.

<sup>115</sup> Watanabe, S., "Institutional Factors, Government Policies and Appropriate Technologies", International Labour Review, Vol. 119, No. 2, March, April 1980.

<sup>116</sup> Track, A., and Mackenzie, M., "Appropriate Technology Assessment", Technological Forecasting and Social Change, Vol. 17, 1980, pp. 330, 331.

4. Income distribution problem dealt with to make products and services appropriate for use by "the masses" rather than a small elite.
5. Appropriate technology planned to entail least risk for its user.

In general, a technology is likely to be appropriate or economically efficient if the factors of production - labor, capital, energy and raw materials - are brought together roughly in proportion to their cost and availability. The guiding economic principle should be to minimize the input of the scarcest factor in relation to the other factors, while at the same time maximizing the output of the same.<sup>117</sup>

Important contributions of the "appropriate technology" movement have been to increase awareness of the non-neutrality of technology in a social, cultural, legal and administrative sense.<sup>118</sup> Technology embodies cultural and social implications which must eventually be recognized. Perhaps more importantly, it has increased the awareness of the resulting technological and economic dependence, which "manifests itself in all spheres of social activity".<sup>119</sup>

Problems with the appropriate technology concept. However much common sense the "appropriate technology" principles may seem to make, there are some contradictions in the "appropriate technology" argument. There are arguments against the assumptions regarding

<sup>117</sup> Norman, C., "Appropriate Technologies for Developing Countries", Worldwatch, March 1980, p. 18.

<sup>118</sup> Track and Meckenzie, p. 129.  
Non-neutrality has to do with the cultural, educational, and other biases which are implicit rather than explicit influences. Once this is recognized the problems associated with technology choice become much more apparent.

<sup>119</sup> Ibid.

capital intensity and high skill requirements maintained by advocates of appropriate (or labor intensive) technologies. For example, Braverman<sup>120</sup> has gathered evidence to support the idea that increasing capital intensity is associated with the elimination of skills. This certainly holds true for the quick copy, office duplicating and inplant printing markets. However, technical service is an essential requirement for these new systems and one of the biggest problems in Sub-Sahara Africa. Arrighi<sup>121</sup> argues that capital intensive technologies usually require semi-skilled and high level manpower, whereas labor intensive technologies generally require unskilled and skilled labor. Under the conditions he observed in Africa, it was easier to find semi-skilled and high-level personnel than to find skilled labor. He thus rationalizes the capital intensity of the multinationals operating in Africa.<sup>122</sup>

In addition, several empirical studies, among them the recent International Labor Organization Mission to Kenya, support the concept that the nature of the market determines the product requirements and thus the choice of technology.<sup>123</sup> Local markets as in import substitution under government protection, tend to call for labor intensive techniques, whereas larger international markets exposed to

<sup>120</sup> Braverman, H., "Labor and Monopoly Capital", Monthly Review Press, New York, 1974.

<sup>121</sup> Arrighi, G., "Multinational Companies and Labor Elites in Tropical Africa in "Imperialism and Underdevelopment", Rhodes, R., ed., Monthly Press Review, New York, 1970.

<sup>122</sup> Ibid.

<sup>123</sup> Track and Meckenzie, p. 332.

more intense competition tend to require more capital intensive technologies.

The importance of the aggregate extent of the market is not given sufficient emphasis in the existing literature on appropriate technology. Once its relevance is fully recognized, it becomes obvious that whether a technology is appropriate or not depends not only on its technical characteristics, but also on the marketing capacity of its user.<sup>124</sup>

Redefining "appropriate technology". It is clear that "appropriate technology" as defined possesses a social perspective. Perhaps to be more functional for the African printer, "appropriate" should be defined from the entrepreneur's point of view, in this case less concerned with the masses and more concerned with whether a technology is functional in an economic sense. In other words, can it get the job done and make money at the same time? Or better still, can it get the job done more efficiently and thus make more money than any available alternative based on local factor endowments (i.e. labor, energy, etc.) and market characteristics? A labor intensive technology may be most appropriate within the context of the national economy as defined, but may be unable to compete in the international marketplace.

The most "appropriate" printing technology in Sub-Sahara Africa might be hand typesetting and small format hand fed letterpress printing. However, if this printer is in the educational textbook market, he may be competing with modern printing firms in Europe, Hong Kong, Singapore, and Taiwan. For this printer perhaps a more sophisticated capital intensive technology (ie. web offset) would be more appropriate - otherwise he may simply not compete at all.

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<sup>124</sup> Watanabe.



Is this more capital intensive, high output technology then inappropriate in the national context? Not necessarily, but there are numerous other problems which often arise with the introduction of more sophisticated technology which could threaten an operation's viability.

What is the "capacity to absorb imported technology"? A recent approach taken by William,<sup>125</sup> and which overlaps significantly with the "appropriate technology" approach - but seeks to avoid the polarization and prejudices associated with it - is the measure of what is called the "capacity to absorb imported technology" (CAT). According to Williams, the basic subject of the capacity or ability of a nation to absorb imported technology has been neglected in the literature<sup>126</sup> "Absorption of technology" is used to mean integration of new technology into actual productive operations, which implies full transfer of technology to the recipient nation.<sup>127</sup>

By whatever name, "technology transfer", "appropriate technology", or the "capacity to absorb imported technology", the purpose of all such studies are the same, to determine what is necessary to achieve a successful selection and transfer of technology as defined by the participants.

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<sup>125</sup> Williams.

<sup>126</sup> Ibid., p. 5.

<sup>127</sup> Ibid., p. 7.

## Local Constraints and the Choice of Imported Technology

Although there is relatively easy access to new technologies in the international marketplace, the technological gap between the industrialized and the developing nations tends to produce constraints on technology absorption by the importing nation. The importing nations lack the domestic resources, markets and infrastructure needed to promote significant absorption of imported technology.<sup>128</sup>

As one lives or travels in Africa it may appear that Western technology is obtrusive and inefficiently utilized - or in any case not well integrated in most cases. Research indicates that the primary cause of this lack of integration and efficiency is due to local limitations. An analogy will serve to make this point. In the same way that an infant or young child lacks the skills and knowledge required to operate and maintain an automobile, low income nations often lack the capacity, resources, markets and infrastructure necessary to utilize imported technology.

Baranson<sup>129</sup> lists the primary constraints to technology transfer to less developed countries as: 1) the narrow range of industrial capability; 2) a necessarily small scale of production for domestic markets; and 3) a dearth of technical and management skills necessary to adapt and absorb modern technologies in a broad range of industrial activities.

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<sup>128</sup> Ibid., p. 22.

<sup>129</sup> Baranson, J., "Technical Adjustment in a Developing Economy: A Study of the Transfer of Technology by an International Corporation", Unpublished Ph.D. dissertation, Indiana University, 1966.

<sup>130</sup> Najappa, L.L., "Choice and Adaptation of Technology in Developing Countries", O.E.C.D. Development Center Publication

Najappa<sup>130</sup> similarly lists the following general problems in establishing industrial technologies in developing countries:

1. The raw material problems (scarcity and high price)
2. The human problems (scarcity of skills and training)
3. Technical problems (including infrastructure problems)
4. Market problems (small local market, inability to compete abroad and prestige of developed country products)

The literature time and again repeats the same constraints. Adler<sup>131</sup> broadly summarizes these constraints as: 1) lack of knowledge (or information); 2) lack of skills; 3) lack of management experience; 4) institutional factors; and 5) cultural and social constraints.

The choice of technology. These local constraints tend to complicate the technology selection process, often beyond management's ability to make seemingly rational, much less optimal, choices. It is important for this reason to discover those factors which must be dealt with if a technology is to be functional in the broad sense.

McEachron<sup>132</sup> lists the factors which affect and, in turn, are affected by the choice of imported technology in developing countries. In addition to those factors listed above, he adds climate, geography, bureaucratic capabilities and price policies. Available information about technological and institutional alternatives are also limiting factors.

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(Paris, O.E.C.D., 1974).

<sup>131</sup> Adler, J.H., "Absorptive Capacity: The Concept and Its Determinants" (Washington D.C., The Brookings Institution, 1965).

<sup>132</sup> McEachron, M.B., et. el., "Technology Choices in Developing Countries" Paper prepared for the National Science Foundation, (Menlo Park, Stanford Research Institute International, 1980), Section II, p. 1.

Becoming more specific, Holton<sup>133</sup> suggests ten criteria which impact upon the choice of technology, most of which refer to the local and operational levels.

1. Quality of product
2. Quality of process
3. Price, relative to the price on international markets
4. Cost performance
5. Level of training of work force
6. Level of training of management team
7. Level of training of customer firms
8. Development of local suppliers
9. Development of linkages with local training and education institutions, and
10. Development of unique capabilities through in-house or purchased research

The everyday operational questions which relate to these criteria have to do with the actual acquisition of specific equipment and processes - their appropriateness, service component, communications with suppliers and customers, improvement efforts for products and processes, accounting and control systems, financial targets (profits, return on investment inventory turnover, etc.), marketing targets and production targets.

The literature overwhelmingly confirms that technological choice is a significant problem in less developed countries.

Many of the small and medium size industrial enterprises...are too limited in their resources, scope of operations and managerial outlook to be able adequately to

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<sup>133</sup> Holton, R.H., in Derakhshani, p. 16.

appraise, select and utilize foreign technology.<sup>134</sup>

Another point which arises again and again in the literature regards the technological baseline of the receiving firm. One of the biggest problems in the printing industries of Sub-Sahara Africa is excessively long "down-time" of equipment due to lack of spares, or more frequently, lack of adequate technical support capability.<sup>135</sup> The most recent models of printing equipment incorporate more and more electronics. Front end systems and phototypesetters pose challenging problems. The distributor's factory trained representatives have difficulties dealing with more than routine matters, and do not generally possess high level skills in electronics.<sup>136</sup>

Hawthorn<sup>137</sup> makes a cogent point when he points out that the real mechanism for the transfer of technology is the "enterprise-to-enterprise relationship". He goes on to say, "for the transfer process to be effective, the key elements of the technology must either be present already or be readily absorbed..." The sorry truth is that most countries in this study do not seem to have the

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<sup>134</sup> "Transfer of Technology - What does it cost", in Williams.

<sup>135</sup> This problem was confirmed by both Africans interviewed and by this writer's experience. The problem seems not always to be lack of capability as much as dependability and trustworthiness on the part of distributors.

<sup>136</sup> This conclusion comes not only from observations but was deduced from the fact that short term factory or on site training is the type most employed by manufacturers and distributors of graphic arts equipment. High level skills obviously do not result from this approach. Furthermore, a manufacturer of phototypesetting equipment who markets extensively within the region named scarcity of electronic service technicians as one of its biggest marketing problems.

<sup>137</sup> Hawthorn, E.P., in Williams, p. 24.

broad-based knowhow or the key elements at the firm or industry level. The exception may be those countries with relatively large expatriate populations as in some French speaking countries, notably Ivory Coast.

All this being said, it is evident that there is a need for 1) an awareness of the existing constraints and the factors which most influence the success of a technological transfer, and 2) the development of a set of corresponding criteria which consider the unique requirements of each operation, taking into account the relevant environmental factors and local constraints. Planning and forethought are obviously required. Along this line, the Defense Science Board Task Force Report<sup>138</sup> has concluded that three conditions should exist at the firm and industry level for probable efficiency of a technological transfer to take place. These are:

1. A well-defined goal and adequate resources committed to accomplishing it.
2. Key individuals competent in the technology, who will be directly involved in applying the newly received technology.
3. And an adequate infrastructure capable of providing necessary parts, supplies, instrumentation and manufacturing equipment.

#### **Reasons for inappropriate choice of technology**

McEachron<sup>139</sup> offers two primary reasons for inappropriate choice of technologies: 1) the wrong methods are selected from all known methods, and the situation could be put right by changing the selection; or 2) appropriate knowledge is not available. As already pointed out, privately optimal (appropriate) choices are often

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<sup>138</sup> Defense Science Board Task Force Report, in Williams, p. 55.

<sup>139</sup> McEachron, Section 1, p. 2.

excessively capital intensive and thus inappropriate from a social welfare point of view, or if judged by most definitions of appropriate technology. Thus it is becoming increasingly clear that technology choice in developing countries is a complex process for which there are no pat formulas. Each economy, each industry and each operation needs to be assessed on a case-by-case basis. As Derakhshani put it:

Given the complexity of the issues and various objectives, criteria and perspectives, a universal definition of a successful transfer of technology is not possible.<sup>140</sup>

Dunkerley<sup>141</sup> has identified other reasons for poor choice. Lending restrictions, inadequate price signals and the bias of Western training are three reasons for inappropriate or poor choice of technologies in low income countries. The restrictions imposed by lending institutions, such as restricting loans for only capital costs requiring foreign exchange, create efforts at the local level to maximize contributions which in turn tend to bias the choice of technology toward capital intensity.<sup>142</sup> This writer's experience in West Africa confirms this. As technical advisor for a film production unit, this writer was asked to recommend film making equipment for the unit. After considering such things as ease of operation and maintenance and recurring costs, as well as capital costs, 8 mm technology was recommended. A much more expensive, harder to operate and maintain 16 mm technology requiring many time higher recurring costs was

<sup>140</sup> Derakhshani, p. 19.

<sup>141</sup> Dunkerley, H.B., "Appropriate Technologies for Developing Countries", Finance and Development, Dec 1976, pp. 36-37.

<sup>142</sup> ibid., p. 37.

chosen. The reason given was simply that the money was there and "we might as well have the best."

Misleading price signals which do not reflect relative scarcities is another reason given for inappropriate technology choice.<sup>143</sup> Overvalued currencies, low interest rates (as are available to LDC's through multilateral agencies), and artificially high wages, particularly in politically protected occupations, tend to bias technology choices toward capital intensity.<sup>144</sup> This is significant to the printing industry because many (educationally) related projects involve the establishment of book production facilities, with the danger of over capitalizing due to the above reasons.

One Nigerian printer<sup>145</sup> said that in his family owned business they were seeking more automated printing systems to eliminate manpower because of government legislation which was continually raising the minimum wage. Yet the business could expect slow, expensive and undependable service on the equipment.

The crux of the problem always seems to come back to the technological gap existing between supplier and recipient nation, and more importantly between the supplier and trading company, and between the trading company and the printer. As Hawthorn<sup>146</sup> put it: "for the transfer process to be effective, the key elements of the technology must either be present already or be readily absorbed..."

<sup>143</sup> Ibid., p. 38.

<sup>144</sup> Ibid., p. 38.

<sup>145</sup> Opusunju, S.A., (see Appendix A).

<sup>146</sup> Hawthorn in Williams, p. 24.



And as Williams<sup>147</sup> put it: "Modern technology requires an astonishingly complex infrastructure of medium and small firms." With the more recent printing technologies short term factory training would seem inadequate to give effective servicing to the printer. In this regard a manufacturer of phototypesetting machines expressed the lack of electronic service capability as a major problem in marketing this type of technology to African countries.<sup>148</sup>

This lack of technical support capability is of course an important rationale for choosing less sophisticated technologies in line with the "appropriate technology" argument. It is argued, with considerable logic, that any benefits a printer is seeking to derive from more advanced capital intensive technologies are likely to be negated by lost production due to down-time and the cost of increased dependence upon the supplier. As Williams points out, all these different arguments must be balanced together when determining what is the appropriate choice:

Thus, the definition of appropriate technology may simply be a feasible compromise of what is appropriate to the requirements of the LDC, the motives of the MNC, and the methods of transmission. The common arguments for/against capital-intensive technology or labor-intensive technology tend to lose some force in the light of practicality.<sup>149</sup>

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<sup>147</sup> Williams, p. 35.

<sup>148</sup> No reference to specific manufacturers regarding marketing problems or data has been made in this study.

<sup>149</sup> Williams, p. 38.

## Actors in International Technology Transfer

It is important at this stage to identify the actors or participants in the international transfer of technology. The process of technology transfer, according to Williams, implies a donor, a recipient, a technology, and frequently, a facilitator or intermediary.<sup>150</sup> For the purposes of this study, the donor can be considered a manufacturer - most often a multinational corporation. The recipient or importer is another industrial concern (printer) or government enterprise (Department of Education or Government Printer). The intermediary is likely a private corporation (such as a local or multinational trading company). A facilitator may be involved and is usually a multinational agency such as UNESCO, or a national agency working bilaterally such as USAID or the British Overseas Development Ministry (ODM).

Suppliers of printing technology. There appear to be two types of donors marketing printing technology in Sub-Sahara Africa. The most common seems to be the multinational corporation involved in the manufacture and distribution of printing equipment or related supplies.<sup>151</sup> Sales are made in one of three ways:<sup>152</sup> 1) by direct sales to a private or government printer, department of education, or an in-plant operation within a large corporation; 2) by intermediary through an indigenous or local trading company, or through a bilateral

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<sup>150</sup> Ibid., p. 17.

<sup>151</sup> This was really a foregone conclusion as private enterprise is the only source of printing machinery and supplies, and everything in the study supported this.

<sup>152</sup> These are the only realistic alternatives, all of which were evident in the survey of manufacturers.

or multilateral organization; or 3) by direct local representation. Direct representation appears to be the least used method.<sup>153</sup> The reason for this is assumed to be the considerably greater investment and thus risk. The second type of supplier is the company which deals in either used or reconditioned equipment.<sup>154</sup>

The survey suggested that direct sales between donor and recipient firms is most often accomplished through correspondence, and is most often facilitated by advertising in trade journals and participation in international exhibitions.<sup>155</sup> Several suppliers who had made sales in this way said they had not begun active marketing in the region. A manufacturer of prepress technology gave high cost and the difficulty of locating distributors as the reasons for not entering the African market.<sup>156</sup>

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<sup>153</sup> This is to say that most suppliers of printing technology use distributors or market directly to printers from overseas. Only the largest manufacturers of printing supplies (i.e. 3M and DuPont) have branch offices in the countries being considered.

<sup>154</sup> Two of the survey respondents, one based in the U.S. and the other in Britain, were in this category, which deals in the used and reconditioned overseas markets.

<sup>155</sup> Two companies which indicated direct sales-direct sales meaning the firm receives orders via mail or telex along with a bank draft and ships the product direct-indicated trade journals and international exhibitions as the point of contact for the sale. There are obvious risks associated with direct shipments and seldom supplier commitment after the initial sale because of obvious cost factors.

<sup>156</sup> This difficulty of locating basic information, such as the names and addresses of distributors, quickly became apparent during this study and can be considered one of the many constraints to further development of the industry.

<sup>157</sup> Derakhshani, p. 12.

Supplier motives. Derakhshani<sup>157</sup> lists "gaining footholds in new markets, countering competitive pressures, and use of cheaper raw material and labor abroad" as some more common objectives of suppliers of technology. Heller<sup>158</sup> and Robinson<sup>159</sup> have much more detailed lists of motivations for direct foreign investments. Because of the nature of most printing technology transfer in Africa, the search for new markets is considered the primary motive. The motive is profit and the strategy is the widest possible dissemination of products and processes before the advantages are lost. Or, as an article in Business Week put it, "nothing is more perishable than technology. The widest possible dissemination its owner can make is the route to maximize profits."<sup>160</sup>

Recipients of printing technology. The end users of printing technology are the private and public sector printers. It was pointed out that one technology supplier gave high cost and the difficulty of locating distributors as the reasons for not actively marketing in the donor country.<sup>161</sup> This means that equipment is often purchased from overseas without local representation and support. This has obvious disadvantages to both parties. Communications are delayed, and servicing and spare parts are a major headache. In The Gambia, it was found that a number of companies were not even interested in doing

<sup>158</sup> Heller, H. and Heller, E., Japanese Investment in the United States (New York, Praeger Publications, 1974).

<sup>159</sup> Robinson, H., The Motivation and Flow of Private Foreign Investment (Menlo Park, Stanford Research Institute, 1961).

<sup>160</sup> Anon., "Knowhow Jumps the Language Barrier", Business Week, Dec. 19, 1970.

<sup>161</sup> Survey respondent.

business where they had no local representation.

Although acquisitions of printing technology directly from suppliers has distinct disadvantages, and are inhibited by time, distance, and communication barriers, in some cases it is preferable to dealing with a trading company exercising monopolistic power. For the local printer to become completely dependent upon a single local distributor encourages abuses such as overpricing and poor after-sales service.<sup>162</sup>

Even in larger and more active economies, distributors can occupy an oligopolistic position. For many years, a single trading company dominated Nigeria and functioned almost as the sole clearing house for the main manufacturers of printing equipment and supplies.<sup>163</sup> After sales service was poor and undependable, and many printers - particularly the smaller ones of which there are many - entirely gave up using the company for service and began seeking local alternatives. In one printer's words, "you had better rely on the auto mechanic."<sup>164</sup> He went on to say that "if you have a friend in the trading company you can get good unofficial, after hours service. If not, you don't get any, or if you do, it's no good and costs too much."<sup>165</sup> A conflict of interests was blamed for the unpleasant situation where government officials responsible for giving licenses to distributors also occupied

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<sup>162</sup> The author experienced this type of situation in The Gambia where there was only one distributor. Although service was generally quite good, the monopolistic circumstances encouraged abuse by creating an extremely dependent printer-distributor relationship.

<sup>163</sup> Opusunju and Namiji (see Appendix A).

<sup>164</sup> Ibid.

<sup>165</sup> Ibid.

high level positions in this dominant trading company.<sup>166</sup>

Recipient motives Much is written concerning the motives of the less developed recipient country (Mason, 1973; Pramartadi, 1974; Schon, 1967). Basically, the objectives of national governments are: increasing national technological capacity, improving balance of payments, reducing technological dependence abroad, and reducing unemployment.<sup>167</sup>

The objectives of the private recipient are often quite different from that of government. Some of the possible motives of private firms for acquiring new technology, according to Derakhshani, are "profits; gaining financial, technical and managerial expertise; entry into new markets or product lines; and gaining international links."<sup>168</sup> For the private African printer, and for most private firms anywhere, the bottom line is nearly always to increase profits. This is usually achieved through increased productivity or entry into new markets usually requiring the acquisition of new technology. For public sector printers the motive may have more to do with increasing output and quality, also achieved through the acquisition of new technology.

Intermediaries and facilitators of printing technology transfer. These include national and international trading companies, international organizations (i.e. U.N.) and national agencies (i.e. AID, ODM, etc.).

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<sup>166</sup> Ibid.

<sup>167</sup> Williams, p. 26.

<sup>168</sup> Derakhshani, p. 12.

Based on all available data, domestic and multinational trading companies are the dominant channels of printing technology to Sub-Sahara Africa.<sup>169</sup> The status, number and circumstances surrounding the trading company seem to be vital determinants in the success of printing technology transfers.

One responding company's policy is to market through local organizations who would represent them exclusively in the field of graphic arts. This approach might go far to alleviating any monopolistic or oligopolistic situations which may have developed. This does seem to be the preferred method of distribution from the point of view of both the manufacturer and the printer. Examining the motives of trading companies, it appears to be less likely that the interests of the individual manufacturer will be protected when numerous companies are represented by the same trade house. For the printer, the more distributors to choose from within the local market - in other words the more competition - the greater are his/her chances of receiving adequate service and fair prices.

The motives of distributors, like manufacturers and printers, are profit oriented. They also seek new markets and higher profits. In this case, they would benefit by representing as many manufacturers as possible. Thus, there is a conflict of interests here. The problem which came out in every case from the printer's point of view, and which is supported by this writer's experience, is in the area of after sales service and repair of equipment.

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<sup>169</sup> Although we are unable to offer statistics here due to the incomplete (exploratory) nature of this research, the response overwhelmingly supports this conviction.

## Transfer Mechanisms

Transfer mechanisms refer to the actual ways and means that technology is transferred from one place, economy or institution to another. Technology here is used in its broad sense encompassing not only hardware, but ideas and other non material aspects as well. Identification of transfer mechanisms is considered fundamental to an understanding of the process of technology transfer and therefore necessary to examine.

The 1969 Economic Bulletin for Latin America<sup>170</sup> presented this rather comprehensive list of ways of transferring technology:

1. the flow of books, journals and other scientific and technical publications
2. movements of people between countries
3. direct importation of machinery and equipment by industrialized countries
4. the flow of direct foreign investment accompanied by movements of equipment and specialist personnel
5. the utilization of licensing, patent and know-how agreements, and
6. the operation of technical cooperation programs (bilateral and multilateral)

All but the fifth method seem to relate to printing technology transfer in Sub-Sahara Africa. The flow of textbooks and trade journals (1) is certainly one mechanism for transferring printing technology to Sub-Sahara Africa, albeit of questionable consequence.<sup>171</sup>

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<sup>170</sup> In Williams, p. 31.

<sup>171</sup> Because of the scarcity of graphic arts instructional institutions in Sub-Sahara Africa the widespread use of printing textbooks and the like is questionable. However, printed materials in the form of operator and maintenance manuals and advertising literature surely



Movements of people between countries (2) is significant and involves Africans traveling to foreign schools and to factories for training, and manufacturers' representatives travels to Africa.<sup>172</sup> The third (3) method of direct importation of printing equipment is unquestionably the primary mechanism of technology transfer. The flow of direct foreign investment (4) is less important but is occurring, particularly in some French speaking countries with the establishment of European printing firms, which is accompanied by the movement of personnel. Number five (5) does not seem to be important for printing technology transfer at the present stage of development due to the absence of capacity for the manufacture of capital goods. The operation of technical cooperation programs (6) seem to be significant, as a number of equipment sales were reported by companies in the survey that were financed through bilateral and multilateral sources for developmental and educationally related projects.

Abeboye<sup>173</sup> adds two mechanisms to the list, namely: technologists' mobility - movement of technical personnel from one organization to another; and technological entrepreneurship - technologists moving out of established firms to set up their own business. There is evidence that both are significant mechanisms for

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has a significant role in the transfer of printing technology. Widespread illiteracy and a generally underdeveloped reading habit may detract from the effectiveness of this mechanism however.

<sup>172</sup> Again, statistics are lacking, but the fact remains that at least for some countries a sizable number of nationals go abroad for factory training or higher education relating to the graphic arts.

<sup>173</sup> Abeboye in Derakhshani, p. 32.

printing technology development.<sup>174</sup>

Lack of education and training has been recognized for many years as a major developmental constraint in all sectors. The movement of people between countries for educational purposes is a significant transfer mechanism.

Factory training is seen as the most common form of training for distributors' representatives. Research on the interaction between local firms and foreign suppliers suggests that factory training is a good approach for local companies.

The requirement of personal interaction is found to be best met by short-term interaction in the form of travel and brief visits by recipient and supplier personnel to each others operations.<sup>175</sup>

The desirability of short-term interaction is supported by Damachi and Diejamaoh.<sup>176</sup> The brain drain, or personnel losses are concentrated among those Africans who go abroad for extended periods for education. Thus, postsecondary education offering Associate and Bachelor's programs do not offer promising results for African nations because of the probability of those persons migrating back to where they were educated or not returning to their home country at all.

The obvious and ideal solution would be to educate and train printers and printing managers locally. In reality there seem to be very few graphic arts training facilities in all of Africa at the

<sup>174</sup> In The Gambia movement of people was common despite the very limited size of the industry in that country. Opusunju and Namiji observed similar behavior in Nigeria.

<sup>175</sup> Derakhshani, p. 379.

<sup>176</sup> Damachi, U.G. and Diejomaoh, V.P., ed., Human Resources and African Development (New York, Praeger Publishers, 1978).

postsecondary level, and fewer still at the secondary school level.<sup>177</sup> This is perhaps partly a result of the influence of the British and French educational legacy, which de-emphasized vocational and technical training.

### Success in International Transfers of Technology

Given the complexity of the issues and various objectives, criteria and perspectives, a universal definition of a successful transfer of technology is not possible.<sup>178</sup>

The elemental features of international printing technology transfer in Sub-Sahara Africa having now been identified and examined. Now the question of what determines success needs to be addressed. Depending on whether you are a businessman, salesman, production manager, or politician, success and failure will have different meanings and criteria. The literature uncovers several different perspectives.

"Level of absorption" as criteria. "Absorption of imported technology" is a useful concept in understanding the success of a particular transfer. Williams<sup>179</sup> describes five levels of absorption in ascending order as:

1. the ability to use and maintain imported technology only with considerable imported support;
2. the ability to only use the new technology;
3. the ability to use, maintain and support the new technology;

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<sup>177</sup> Again, no statistics are available. The only countries known to have graphic arts training facilities are Kenya and Nigeria. It is suspected that a number of other countries have such facilities, but in any case, whatever exists falls far short of meeting the ever growing need for a skilled work force.

<sup>178</sup> Derakshani, p. 19.

<sup>179</sup> Williams, p. 7.

4. the ability to reproduce the new technology within the recipient economy; and
5. the full absorption and diffusion of the technology to other applications within the recipient economy.

The "absorptive capacity" of printing technology in Sub-Saharan Africa must be considered on a country by country basis. For example, a particular African nation may be able to operate, maintain and even support a small letterpress operation utilizing hot metal technology, whereas that same nation may find itself at the very first level (1) if it employed multiple unit web offset printing and computerized phototypesetting technologies.

If this concept were defined in terms of printing technology, it may provide an effective means of evaluating the suitability of specific printing equipment and processes. The definite need for a more systematic and workable approach to printing technology selection and transfer was experienced by this writer and confirmed by numerous reports of transfer failures from others working in Africa.<sup>180</sup>

Traditional criteria. Derakhshani<sup>181</sup> sees two basic levels in a hierarchy of performance that represent criteria for success. The first, or "operational level", is concerned with traditional measures of firm performance (i.e. return on investment, level and growth of sales and profits, market share, production efficiency, quality of product and cost performance).<sup>182</sup> Basically these measures indicate the firm's ability or inability to remain economically viable under current

<sup>180</sup> Opusunju, Namiji, Nanin, Harmsen, and others.

<sup>181</sup> Derakhshani, p. 19.

<sup>182</sup> Ibid., p. 20.

environmental and economic conditions and present levels of government support and tariff protection. The second level outlined by Derakhshani relates to involvement in the international marketplace, the extent of indiginization of the activity and the ability of the firm to innovate in terms of products and processes.<sup>183</sup>

**Suggested criteria for African printing firms.** In regards to printing in Sub-Sahara Africa a modification of Derakhshani's two level hierarchy is suggested. Two similar but different categories requiring distinct evaluation, namely "domestic market" and "international market" oriented companies is, suggested. The primary concern is with the "domestic market" oriented firm as very few, if any, internationally oriented printing firms exist within Africa.

Within "domestic" oriented firms there are again two basic types. There are: 1) the less sophisticated printers catering to the less exacting market (traditionally dominated by government, mission and small private printers); and 2) "import substitution printers", or those firms breaking into the market previously dominated by overseas printers, producing process color work, textbooks and other higher quality printing.

Within each of these two categories the criteria of a successful transfer using this modified model would be measured in ascending order by:

1. traditional economic indicators (i.e., ROI, sales, profits, etc.);
2. degree of dependence upon supplier(s) in terms of operations, maintenance and repair; and

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<sup>183</sup> Ibid., p. 21.

3. indignization of the operation indicated by a) extent of reliance on domestic personnel (ie. managerial, technical and skilled labor) and b) reliance upon domestic intermediate goods and inputs (ie. paper, ink).

### Factor Substitution and the Choice of Printing Technology

Now that transfer requirements and constraints, as well as criteria for selection and success have been roughly delineated, it is necessary to have an idea of the range of technology potentially available to the printer. For this reason, and because of the impact of technology upon the utilization of factor endowments, the extremes of technological sophistication are highlighted.

It has previously been mentioned that there is a wide range of factor substitution possibilities within the scope of available printing technologies. To illustrate this we need only mention the extremes. At the upper end are the four lines of fully computer controlled nine unit Metro web offset presses being developed by Rockwell Goss for the Baltimore Sun Newspaper. In prepress the SciTex system which digitally separates, corrects and modifies color and image is most notable. Again in the newspaper and publications industry there are the computer controlled and completely automated addressing and mailing systems. At the low end of the range there is the hand powered platen relief press, handsetting of lead type, and hand binding methods. The range literally covers everything between these extremes.

Bright<sup>184</sup> identified 17 levels of mechanization, ranging from hand operation to machines that anticipate the required performance and adjust themselves accordingly prior to the event. A cursory review of

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<sup>184</sup> Bright, J.R., in Amsalem.

the wide range of old and new graphic arts technologies available suggests that all 17 levels of mechanization, from the lowest to the highest, are hypothetically available as alternatives to the printing industry.

The range of proportions of high level, skilled and unskilled manpower required for these various technologies is vast, and presumably any combination of required proportions can theoretically be satisfied by choosing the appropriate technology. However, one must remember the many variables which enter into the picture, such as quality of product, available alternatives, the number and quality of suppliers of technology and raw or intermediate goods, market characteristics and availability of skilled labor, to mention only a few.

The findings on the nature and problems of printing in Sub-Saharan Africa are summarized in the conclusions in Chapter Four.

## PART D

### Country Level Analysis

This section takes a markedly different approach to the study of Sub-Saharan Africa. By collecting actual data on the countries of Sub-Saharan Africa this study hoped to make inferences regarding their respective printing industries.

A brief synthesis of these statistical conclusions with printing equipment sales data is presented in PART E, and provides the basis for a cross reference or check on the country grouping results.

## Block Clustering

A block clustering program, Biomedical Package 3M, was chosen for its capacity to cluster on both cases (nations) and variables. Cluster analysis is a form of factor analysis which clusters particular types of cases - in this case nations - based on similarities of predetermined variables. Its purpose in this case was to come up with groupings of nations relative to their general economic development, and by inference, the general developmental potential of their printing industries. The underlying hypotheses is that there is a positive correlation between general economic development and potential printing industry development in any given country.

The variables chosen for this analysis can be classified according to two types. Direct indicators refer to those variables which appear to have some direct relationship with the printing industry, i.e. printing paper consumption. Indirect variables are more general economic indicators which have no apparent direct relationship to printing, such as import statistics.

Although over 50 variables were originally identified, this number was eventually reduced to 18, primarily because of a lack of actual or current data on the majority of countries. Unfortunately, many of the variables eliminated were direct variables. Another reason for eliminating some of the variables was their questionable relationship to either economic or printing industry development. The 18 variables used in the final cluster analysis were:

1. newsprint consumption 1980 (NC)
2. printing paper consumption 1980 (PC)



3. weekly/bi-weekly/bi-monthly newspapers 1980 (WN)
4. daily newspapers 1980 (DN)
5. electricity production (EP)
6. literacy rate (LIT)
7. gross domestic product (GDP)
8. publishers (other than newspapers and journals) (PUB)
9. monthly and quarterly journals (MJ)
10. imports (INP)
11. gross domestic product per capita (GDPPC)
12. school enrollment (SCH)
13. multilateral aid (MA)
14. bilateral aid (BA)
15. exports (EXP)
16. gross domestic product growth rate (GDPGR)
17. population (POP)
18. industrial growth rate (IGR)

Where no dates are given, the data can be assumed to range from 1975 to 1979.

The state-of-the-art of data collection and analysis in much of Africa is in its infancy. Often, data are simply not available, or when available are based on estimates and therefore of questionable accuracy. All this being said, we have proceeded with the available data. The sources are listed in Appendix D.

The countries. Thirty-nine countries are represented in the geographic area under consideration. In the final analysis only 29 countries were used to compute the cluster analysis. All but one of

these were eliminated due to lack of data. Nigeria was eliminated because for some variables the figures were so large that their inclusion would substantially reduce the sensitivity of the program.

The program. is based on a rather complicated logical and arithmetic routine (see Appendix E for explanation). It was chosen in this case as the best available alternative which would yield a clustering of nations.

**Cluster Analysis on Countries.** The cluster analysis for countries is illustrated by a tree giving joining sequence (Appendix F). Overall the results did not produce a clustering that was easily interpreted. This outcome is attributed to several factors which have already been mentioned, primarily data and program limitations. Appendix G contains the codified data used in the analysis.

**Interpreting the results.** There was no obvious causal relationship evident in the clustering. In this sense the analysis failed to produce the desired results. However, the clustering could be explained in terms of general economic development if certain clusters were combined. Figure 3 shows a grouping based on this principle and the program tree.

This is obviously a very crude grouping, and vast differences exist between countries in each group. However, this information potentially provides useful insights into the printing industries of Sub-Sahara Africa. If printing industry development correlates positively with general economic development, the countries in the "Most" group are likely to have a more developed printing industry. However, a safer assumption would be to conclude that these three

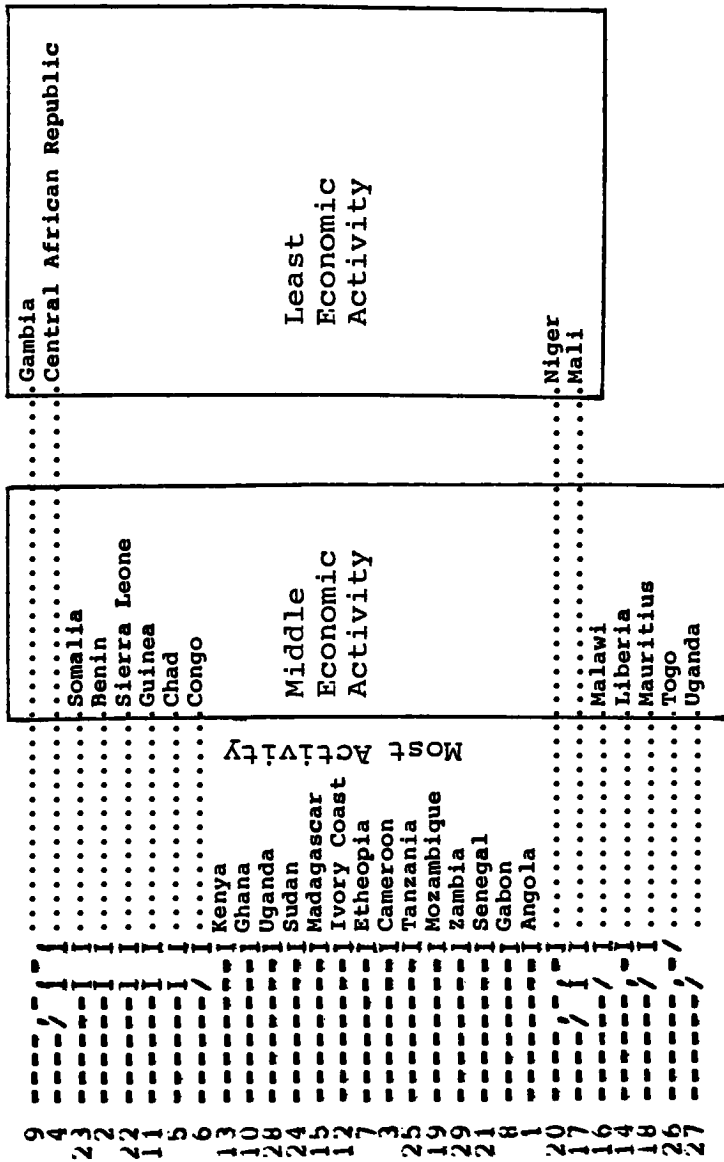


Figure 3: Country Grouping

categories represent three levels of potential printing industry development. This is not a conclusive pronouncement but rather in the nature of an exploratory hypothesis which will require varification from future research.

### Factor Analysis

The cluster analysis thus failing to produce the hoped for result, it was deemed appropriate to examine the variables used in the analysis. A factor analysis (BMDP4M) was carried out on the 12 "indirect" variables in terms of the 29 countries. Four factors were derived from the 12 variables, each factor appearing highly distinct with each variable loading highly on only one of the four.

A factor in this case is a hypothetical construct, used provisionally in the hopes of gaining some further insight into the problem at hand. The factors are derived statistically and in this sense are objective, based on actual numbers rather than subjective judgements and approximations.

The four factors, tentatively identified as listed. The loading of variables is as follows:

Factor	Loading Variables	Percent variability accounted for
1. Commercial and Industrial Index	a. exports	87
	b. imports	83
	c. gross domestic product	82
	d. electrical prduction	70
2. Population Index	a. multilateral aid	83
	b. population	80
	c. bilateral aid	76
	d. gross domestic product per capita	55
3. Educational Index	a. literacy rate	90
	b. school enrollment	83
4. Economic Growth Index	a. gross domestic product growth rate	84
	b. industrial growth rate	79

The percentages listed above refer to the amount of variability in that particular variable accounted for by the corresponding factor. Statistically speaking, this outcome is far more satisfactory than for the previous cluster analysis. These correlations could prove useful to economists and other social scientists conducting similar research.

### Multiple Regression

Having isolated four factors which account for the 12 indirect variables, it was decided to take two of the six remaining "direct" variables and, using multiple regression, determine the correlation between these variables and the four derived factors. This was done by assessing the percent variability of each variable associated with each of the principal components (factors).

One useful possibility of this analysis was that of predicting "printing related" variables via the factors or "non printing" variables. This could be significant because one apparent limitation of studies in this area is the scarcity of direct printing related statistics over the entire range of nations. Economic indicators, on the other hand, are much more readily available for all nations.

The printing related variables chosen were 1). daily newspapers and 2). printing paper consumption. These are referred to as dependent variables, while the factors or principal components are considered independent variables. Only 51 per cent of the variability of "printing paper consumption" and 32 per cent of the variability of "daily newspapers" could be explained by the four principle components (factors). These relatively low R square values indicate questionable if not poor predictability. It should be noted that some social scientists

would be ecstatic about accounting for 57 percent of the variability, as in "printing paper consumption". However, in this case it is not considered significant or of practical value.

One possible explanation, outside of very poor predictability, could be that the relationship between the factors and variables is not linear as assumed in the analysis. Another more likely explanation is that the data on paper consumption and newspapers is inaccurate and thus misleading. In any case predicting "direct" variables via "non-direct" variables does not seem feasible under present conditions.

## PART E

### Further Country/Regional analysis

Two categories of information have not fit in elsewhere, but are significant. One of these areas regards the significance of cultural and economic ties with former colonial powers. The other category relates to printing equipment marketing data, which, however incomplete, does offer further information for analysis.

#### Cultural and Economic Ties

Generally Sub-Sahara Africa can be divided into former British or former French colonies. The most significant attributes of this connection relate to language, currency or economic systems and relationships, and the cultural and educational legacy of the former colonial power.

Language is perhaps the most striking feature. Obviously language determines to a large extent who one deals with, and can facilitate or restrict communication and commerce. The former occupation of colonial powers still leaves an impression on the economies

and thus the printing industries of Sub-Sahara Africa. Figure 4 presents the basic languages of business and government. In some countries African languages have superseded European languages as the official language, but these are recent developments and the dominant European language still dictates commercial ties which have a bearing on the character of the printing industry.

The economic systems established in colonial times provide the basis for the current national economies of African nations. These systems further support the restrictive tendency caused by language. A publisher from Cameroon highlights the restrictive influence of the economic system as follows:

In the former French colonies or protectorates one may import books from France without any formalities and pay for them by a simple postal transfer, while in the transactions between African countries import licenses and foreign exchange approvals require such an amount of paperwork as to make it highly discouraging for most people.<sup>185</sup>

The cultural and educational legacy of former colonial powers also has a likely influence on the character and development of the printing industry. The British educational legacy in East Africa is reported to leave a general prejudice against locally published and locally printed materials.<sup>186</sup> In French countries a general bias against non-French products (i.e. printing technology) has been observed.<sup>187</sup> Numerous other significant cultural influences no doubt exist but are beyond the

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<sup>185</sup> Dihang, J., "Publishing and Book Distribution in Frankophone Africa", Publishing in Africa in the Seventies. (Ibidan, University of Ife, 1973), p. 128.

<sup>186</sup> Nottingham, J., p. 139.

<sup>187</sup> Dihang, J., p. 128., Proper (interview).

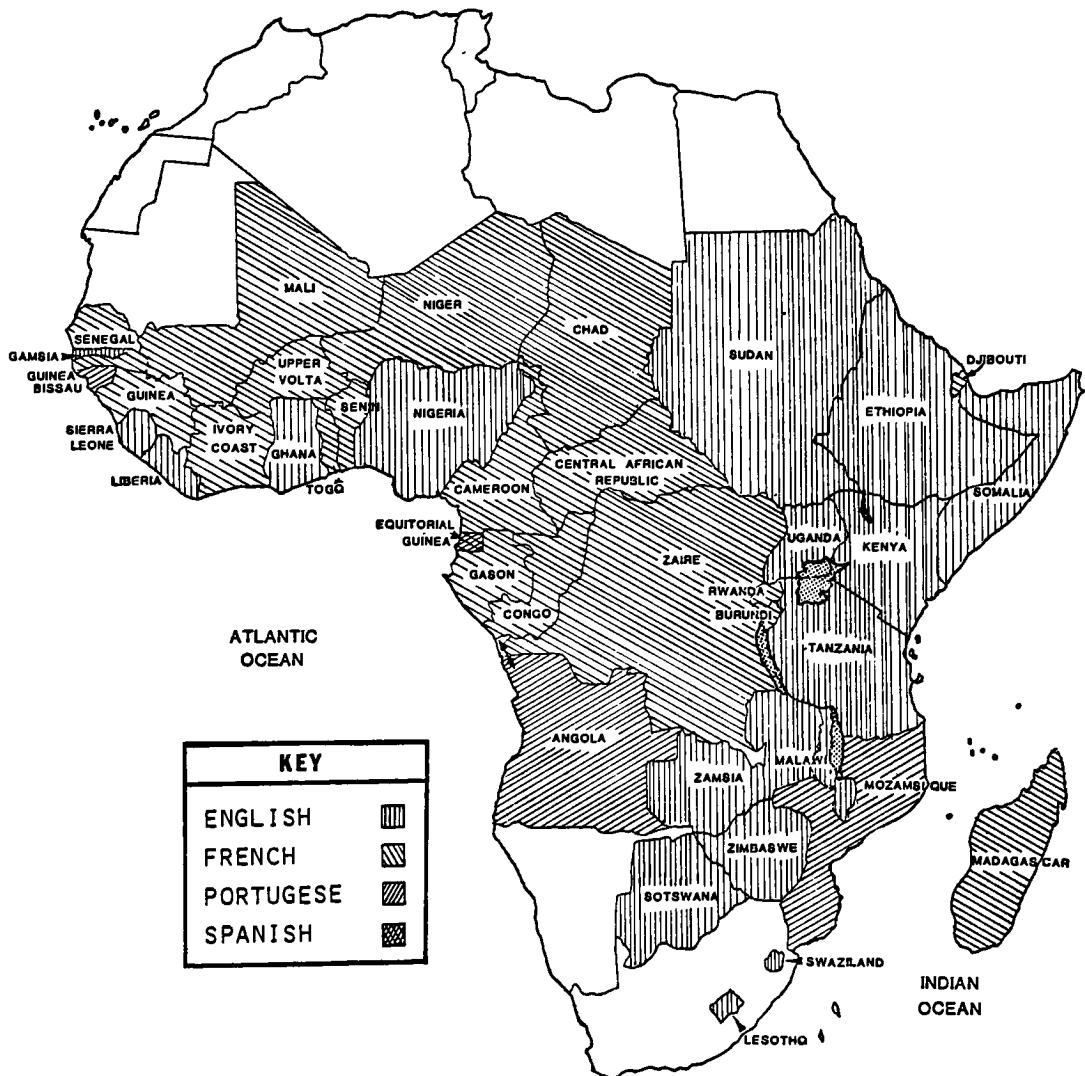


Figure 4: Languages of International Commerce



scope of this study.

The significance of these tendencies is that the principal suppliers of technology to the countries of Sub-Sahara Africa are almost universally the former colonial powers. This is verified by the 1980 Overseas Business Reports Market Profiles for Africa.<sup>188</sup>

The primary exception to this rule is in the case of countries in close proximity to South Africa which have become its principal trading partners. Figure 5 shows the principal trading partners in Sub-Sahara Africa based on the 1980 market profiles for Africa.

Within the printing industry however, this principle seems to hold true only for consumables such as ink, plates and paper.<sup>189</sup> In the supply of printing and bindery equipment, other countries having no former colonial relationship with Africa seem to predominate. This is indicated by worldwide data on the sale of graphic arts equipment provided by a major press manufacturer, but presumably originating with the United States Chamber of Commerce.

In the printing press market the summary showed Germany, F.R., United Kingdom, Italy, Switzerland, France, Sweden, the Netherlands and the United States as the most active countries in the region under consideration. In the typesetting market United Kingdom, Germany, F.R., Switzerland, Netherlands, Belgium-Lux., Italy, France and the United States are listed as the most active. In the area of bookbinding

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<sup>188</sup> U.S. International Trade Administration, Overseas Business Reports: Market Profiles for Africa (Washington D.C., U.S. Government Printing Office, March 1980).

<sup>189</sup> Nitsche, M. "The Printing Industry in Kenya", Polygraph, Vol 33, No. 19, Oct. 1980, p. 1698.

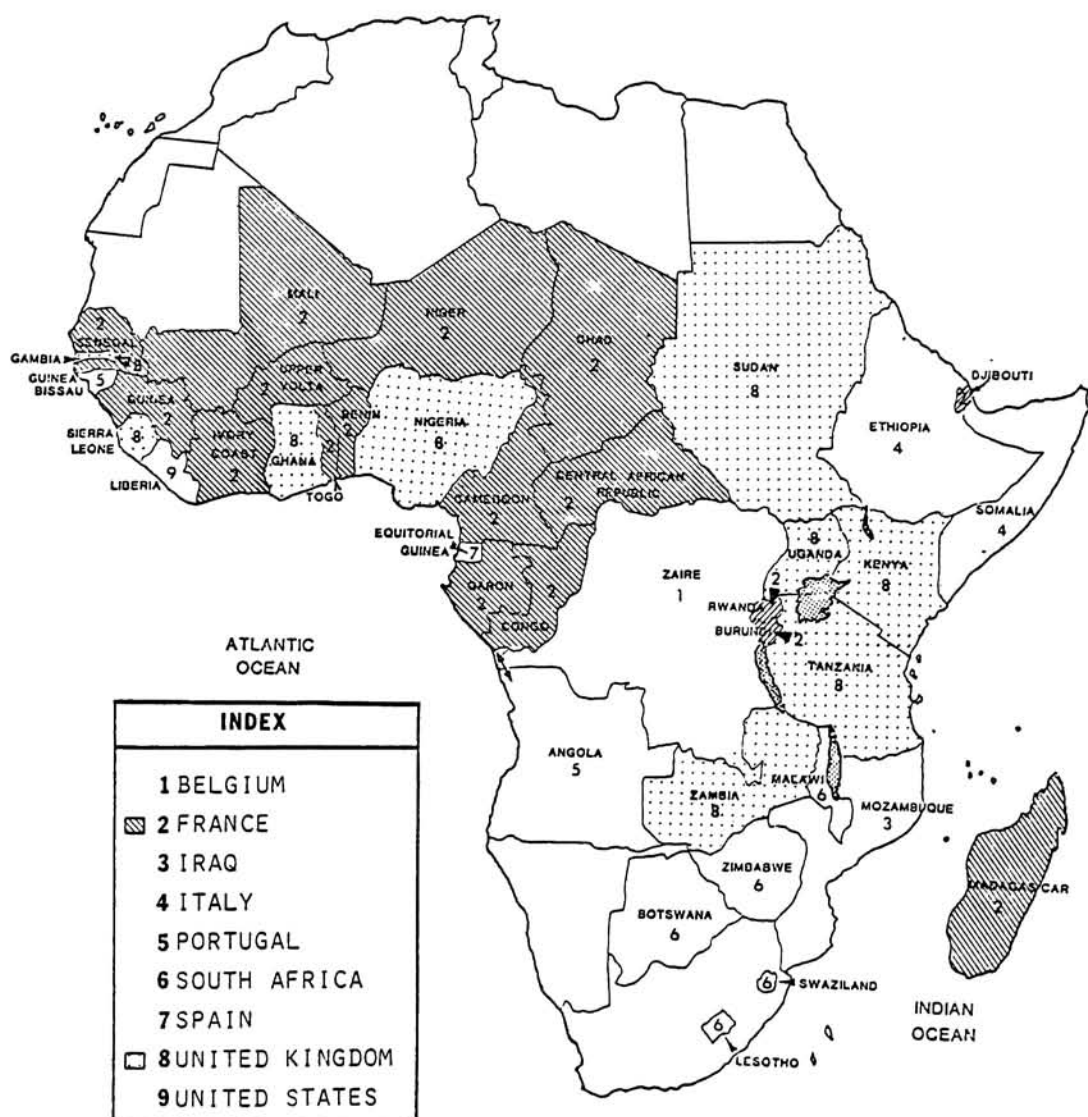


Figure 5: Principal Trading Partner

machinery the most active countries are Germany, F.R., Switzerland, United Kingdom and the United States.

Kenya provides a typical example of what is actually going on in this region of the world. Inks, blankets, plates, etc. are imported primarily from the United Kingdom - which excersized former colonial rule. German suppliers are particularly active in the printing press sector, whereas Dainippon Screen, from Japan, is the leader in the pre-press and reprographics markets.<sup>190</sup>

It is expected that Japan will become increasingly active in all areas of the printing industry in Africa.<sup>191</sup>

#### Additional Data

Additional relevant data was gathered in the areas of printing equipment sales and paper manufacture.

Printing equipment sales data for Africa are not readily available and presumably incomplete. It was found especially difficult to secure statistics from European countries, notably the French speaking countries. Statistics from Japan were equally lacking.

The principle source of printing equipment marketing data was derived from confidential reports from three major press manufacturers and from a copy of world-wide sales figures for graphic arts machinery presumably put out by the U.S. Chamber of Commerce, again supplied by a major press manufacturer. Despite the several sources of data, they were obviously incomplete and sometimes conflicting. While recognizing the incompleteness of the data - particularly for French

<sup>190</sup> Ibid.

<sup>191</sup> Nanin, Interview.

speaking and South African countries - it can be used to cross reference the country ranking as it relates to English speaking countries. Specifically the data can be examined to see if it conforms to or contradicts the previous grouping arrangement. However this can only be effective for referencing the countries which reported to have relatively high volumes of sales. Most countries are reported as having zero equipment purchases, which is contradicted by undocumented reports from the field that equipment is in fact being purchased in all countries.

The data seems to support the previous grouping arrangement. Every country showing purchases of web offset printing or in-line binding equipment is among the "Most Economic Activity" group, with the exception of two countries, Liberia and Uganda, which appear in the "Middle" group. Only three countries from the "Most" group did not appear in the statistics, namely Tanzania, Gabon and Zimbabwe.

Gabon, being a French speaking country with strong economic ties with France, might well be a case of unavailability of data. However, it could be that in terms of its printing industry it would fit in the middle grouping. That Gabon has the highest per capita gross domestic product in black Africa, and is an oil and mineral producing nation is no doubt the principal reason for its position in the "Most group."<sup>192</sup>

Trade statistics for Zimbabwe are generally not readily available. Although no printing machinery trade statistics showed up, it should not be excluded from the "Most" grouping. Reports from the field substantiate it as having one of the more developed printing

<sup>192</sup> Ibid.

industries.<sup>193</sup>

Paper manufacturing capability is another factor which has obvious influence on the present and future development of the printing industry. Paper availability and cost is considered one of the primary constraints to printing industry development in Sub-Sahara Africa.

The statistics regarding newsprint and printing paper production are certainly noteworthy. Reports show that Kenya, Madagascar, Ethiopia, Angola and Nigeria currently produce some type of printing paper.<sup>194</sup> Projects currently underway involve Tanzania, Nigeria and Ghana.<sup>195</sup> Paper pulp manufacturing projects are planned for Cameroon, Gabon, Ghana, Ivory Coast, Kenya, Madagascar, Nigeria and Tanzania.<sup>196</sup> Again all these projects are in countries falling within the "Most" grouping in the cluster analysis.

In conclusion, the above data does support the country grouping. Although the above country level analysis is admittedly crude and of limited utility, it does provide a baseline for future studies, and has as its basis, objective data and data analysis.

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<sup>193</sup> Ibid.

<sup>194</sup> Anon., "World Pulp, Paper and Board: New Capacity Projects", Paper, Sep. 22, 1980, p. 34.

<sup>195</sup> Ibid.

<sup>196</sup> Ibid.

**CHAPTER IV**  
**SUMMARY AND CONCLUSIONS**

## CHAPTER 4

### Summary and Conclusions

There is no single source, or sources, from which to learn about the state-of-the-art of printing in Sub-Sahara Africa. Even if there were such a source, it would quickly be outdated due to the rapidity of change in this aspect of African society.

The objective of this research has been to develop a baseline or description of the nature and problems of the printing industries of Sub-Sahara Africa to serve as a foundation for further, more in-depth studies. This study is thus considered a prerequisite to any meaningful synthesis of the diverse and piecemeal data which is available. Specifically, the objectives were to identify:

1. The primary characteristics of the printing industry in Sub-Sahara Africa, and
2. The primary constraints inhibiting the development of that industry.

These findings are generalizations with undoubted exceptions. Because of the wide range of differences in the countries of Sub-Sahara Africa, these generalizations are intended only as approximations.

For the source of reference and more detailed discussion of the topics outlined below, refer to the discussions throughout Chapter 3.

## PART A

### Characteristics of Printing in Sub-Sahara Africa

Diversity among countries is the most obvious characteristic of printing in the region. Almost all levels of sophistication, excepting the most sophisticated and capital intensive technologies, can be found in Africa, depending on which country is being considered. The great preponderance are small scale and labor intensive printing technologies. However, isolated facilities in some of the more developed economies such as Kenya, Ivory Coast and Zimbabwe have well developed printing industries with relatively modern printing technologies.

Rapid technological change is the second most obvious characteristic. Offset lithography, and in some cases, flexography, are rapidly replacing letterpress technology. Offset lithography now accounts for over 50 percent of all printing production in the region under consideration. In the higher income countries, direct entry phototypesetting is replacing hot metal and strike on composing systems. Photomechanical processes are also increasing dramatically, with an annual lith film consumption of six to seven million square feet for the region. There is also increasing interest in less sophisticated color separation techniques.

Traditionally government and mission presses predominated. Since World War II, and especially since independence, university, newspaper and private presses have grown tremendously, with a general trend toward local printing and indigenous control of the publishing process, as well as a trend toward state control of publishing in some countries.



The bulk of book printing, process color printing, and higher quality commercial printing has traditionally been produced in Europe. More recently, foreign publishers have been using South East Asian printers. There appears to be a slow trend toward raising the generally low quality standards of printing in Sub-Sahara Africa, thereby attracting publishers to print within Africa. However, there is evidence of resistance to change as publishers are often reluctant or completely unwilling to even consider this option.

The publishing industry is dominated by established European firms. Consequently, although there is a trend toward indigenization of the publishing process, it is extremely difficult for local entrepreneurs to enter the industry because of:

1. the need for large amounts of capital;
2. scarcity of publishing skills;
3. the reluctance of local writers to patronize the less experienced firms with no international connections;
4. a scarcity of locally available training facilities;
5. the competitive advantage of foreign firms (with established reputations, access to capital and international connections); and
6. the conservatism of African print buyers indoctrinated into the French and British educational systems.

Several reasons have been offered by publishers to explain why the bulk of printed materials, and almost all quality and color work is produced overseas. Some of these reasons are:

1. generally low quality of local printing due to low quality of workmanship and poor maintenance of equipment;
2. slow turnover of printed material attributed to:
  - a) excessively long down-time of equipment;

- b) lack of spares;
  - c) difficulties in securing raw materials;
  - d) high cost of local printing, for the same reasons;
3. lack of local technical capability (usually no process color capability); and
  4. the influence of vested interests who stand to gain one way or another from printing overseas.

This tendency of publishers to print overseas is indicative of the unhealthy and uncooperative local printer/publisher relationship which generally exists.

On the technology supply side, African countries are generally characterized by one or a few distributors of printing equipment and supplies, resulting in monopolistic or oligopolistic situations in some countries, with negative consequences for the printer - such as high prices and costly and unreliable after sales service. However, there are indications that Western suppliers are becoming increasingly interested in entering the African printing market, which will no doubt have a beneficial influence on the printing industry.

High quality and process color printing produced in Africa is generally accomplished by foreign personnel. Furthermore, observations suggest that generally there are only limited efforts to train local personnel in anything but the most rudimentary tasks. Most printing done in the region is single color.

African printers, as the recipients of printing technologies, have been characterized by a general lack of planning and management capability. This has been pronounced in the choice and transfer of new printing technologies.

Education and training for printing technicians, craftsmen and managers is nearly nonexistent in most African countries. Printing industry personnel are primarily trained in England, France, Germany, the United States and some other countries. Post secondary schools offering printing curriculums are known by this writer to exist only in Nigeria, Ghana and Kenya. Research suggests that long term overseas training is a major factor relating to the brain drain in Africa, and thus, these people often do not contribute to the printing industry in Africa.

Factory training of suppliers' local representatives is also a significant form of technology transfer, and appears to be increasing. This short term form of training avoids the risk of long term higher education but produces only low level technicians.

Other transfer mechanisms of printing technology besides direct importation of equipment and overseas education, include the flow of various printed materials and direct foreign investment, involving the movement of technology and specialist personnel as in the case of some French speaking countries.

As a region it is useful to view the countries of Sub-Sahara Africa in terms of their cultural and economic ties to Western Countries. English speaking country economies generally have been dominated by United Kingdom firms while French speaking country markets have been dominated by French companies.

## PART B

### Constraints to Future Printing Industry Development

Listed here are those factors which have been cited as constraints to the development of the printing industries of Sub-Sahara Africa.

**Raw materials problem.** The high price and scarcity of imported materials, notably paper is a major problem for African printers. The fact that there are not supportive industries (ink, paper, and film manufacturing) and that everything must be transported from overseas insures high prices where a scarcity of capital is the rule rather than the exception. The ever-present threat of a paper shortage is especially real because of the low priority status African countries occupy among European paper merchants.

Paper, plate and film deterioration are also major problems in Sub-Sahara Africa because of extremes in climate and the extended shipping time, as well as other unfavorable shipping conditions.

**High tariffs.** Some countries impose heavy duties on printing equipment and supplies, in some cases reaching as high as 80 percent, thus increasing the already high cost of materials. These duties are considered a major constraint to future printing industry development. Related to this, many printed materials can enter some countries duty free. This situation encourages the use of overseas printers and discourages the development of the local printing industry.

**Scarcity and low level of technical skills.** Generally, there is a scarcity of skilled labor of any kind in Sub-Sahara Africa, and this is true of the printing industry. Of those who are considered skilled, the level of technical sophistication is relatively low by Western standards.

There does not appear to be a quick solution to this problem due to an equal scarcity of technical training facilities for the printing trades.

Poor management, or lack of efficient management at all levels of the private and public sectors is considered by many as the biggest obstacle to be overcome. The need for efficient management of resources is especially critical because of the relatively high cost of inputs and the scarcity of capital. In other words, under current constraints, there is less room for error and waste if a facility or industry is to become economically viable and survive, much less grow and develop.

Rudimentary technological baseline. The existence of predominately rudimentary technologies at the firm and industry level is another primary constraint. This constraint accounts to a great extent for the very limited capacity of the printing industry to absorb and sustain more advanced printing technologies. This condition severely restricts the technological options which would be locally sustainable, and thus realistic or appropriate.

This low level of technological development is considered the primary cause of the extreme dependence of low income countries on foreign know how, materials and technologies.

Infrastructure problems, such as unreliable utilities (electrical power), poorly maintained roads and congested and inefficient seaports are other constraining factors.

Marketing problems. The small size and undeveloped nature of local markets, an inability to compete abroad and a general lack of confidence in local printing facilities by potential print buyers are all seen as constraints.

Extreme environmental conditions, such as high heat and very high and low humidity are problems in many countries, especially when coupled with unreliable utilities which makes environmental control unrealistic.

Poor printer/publisher relations, which tend to perpetuate the pattern of purchasing printing overseas, as well as a lack of long term commitment to the local printing industry on the part of publishers, are seen as obstacles to growth.

The domination of foreign publishers, which is an inhibiting factor in the growth of a locally controlled publishing industry, is seen as a constraint because smaller local publishers would be more likely to patronize local printers.

Scarcity of graphic arts trading companies in many countries is a negative factor because it encourages monopolistic and oligopolistic practices resulting in overpricing and poor after sales service. Poor and unreliable maintenance and service on printing equipment by distributors has dealt a crippling blow to the industry in some countries.

Poor inter-Africa communications and government regulations, carried over from colonial times, which encourage commercial dealings with a particular country and make it very difficult to deal with others, are yet other constraints.

Cultural and social constraints, such as generally low literacy rates in most African countries, a general lack of the reading habit among those who are literate, as well as the low level of industrialization - which is a source of commercial and industrial printing - and other

cultural and social factors such as corruption and tribalism, are all considered constraining factors.

**CHAPTER V**  
**RECOMMENDATIONS TO PARTICIPANTS**



## CHAPTER 5

### PART A

#### Recommendations to Participants

##### Printer

With all that we have found, it appears that the printer in Sub-Sahara Africa is pretty much at the mercy of a number of forces beyond his/her control. However, within the printers' sphere of influence, there is room for vast improvement in such areas as marketing, production management, long term planning and in the acquisition and integration of new technologies.

Poor planning in technology transfers as in the purchase of printing equipment was found to be common. In this regard a more systematic approach to technology selection and acquisition is recommended. The recurring costs of specific choices need to be more carefully considered by printers, especially as it relates to dependence upon suppliers. Among the more important criteria that need to be considered are (not necessarily in this order):

1. the relative costs of the factors of production;
2. the required quality and specifications of the intended end product (printing);
3. the cost of production, relative to the price on international markets;
4. availability of maintenance and technical support, as well as their cost and reliability;
5. materials handling considerations required by specific choices of technology (ie. web offset requires considerably more hardware and mechanization, as well as capital expenditure than sheet-fed lithography);

6. energy requirements of specific technologies;
7. manpower requirements;
8. level of training of the local workforce;
9. level of training of the management team;
10. presence or absence of local training capability;
11. consistency and dependability of local utilities;
12. climatic considerations in light of number 11 above;
13. presence or absence of local suppliers, and whether they are dependable in terms of after sales service;
14. the availability of capital;
15. the estimated total recurring cost of specific technology choices;
16. training offered by suppliers; and
17. the ease of operation and maintenance of the technology and its reliability.

This list is neither exhaustive nor new, but does outline important criteria which are often overlooked and which result in costly consequences.

Plate, film and paper deterioration are significant problems in Africa. The printer should insist whenever possible that these products are newly manufactured, and that the shipment of already aging products be sharply criticised. These products should be shipped in waterproof and airtight packaging if at all possible.

#### **Publisher**

Both foreign and indigenous publishers can have a dramatic effect on the development of the local printing industry by making a commitment to using it, and it is recommended that they do so. It is

expected that a commitment on the part of publishers would benefit both parties by providing work for the printer and by eventually reducing costs for the publisher. Such a commitment would enable printers to make capital investments that would reduce the cost of production, and thus the cost of the product.

### **Manufacturer**

There is evidence that the number of manufacturers represented within a particular country, and the arrangements they have made for distributing and servicing their products, have significant ramifications on not only the range of available technologies, but also on the quality and dependability of technical service.

Generally speaking, the greater the number of companies locally represented, the greater will be the competition, which results in better service. However, much more important than the number of companies represented is the number of local distributors representing those companies. This being the case, it is recommended that manufacturers facilitate the increase of local sources of printing technology by seeking exclusive representation where there is only a single or very small number of distributors. This would benefit both the local printing industry and the manufacturer by reducing the negative consequences of monopolistic or oligopolistic situations. A competitive situation is equally desirable for manufacturers as it is for local printers because it increases the likelihood of good service on its products.

It is recommended that technology suppliers become more aware of local constraints and market those technologies which have a good chance of being locally maintained at a reasonable cost. Where new

products are being marketed which introduce more sophisticated or advanced technologies, care should be taken to insure that adequate and timely technical service and support will be available, and at a reasonable cost.

Manufacturers should also seek to increase the opportunities for factory and on-site training for both distributors' representatives and end users of their technology.

Lastly, manufacturers of perishable supplies such as films, plates and paper, should seek to develop ways and means of protecting these products from the extreme African climate. They should also see to it that the latest possible production lots are sent to Africa to assure the African printer a better chance of receiving a quality product.

#### **Distributor**

There appears to be a conflict of interests among local distributors, suppliers and end users of technology in that distributors stand to gain both by marketing products from as many different manufacturers as possible and by dominating the local market. However true this may be in the short term, in the long term the present practices of overpricing and poor after sales service reported in Sub-Sahara Africa are bad business and are likely to have eventual negative consequences for those distributors. In the long run, a distributor which insures reliable service at a reasonable cost stands to grow and thrive, and, if not followed by others, will have a good chance of dominating the market.

Here again, the distributor has a definite part to play in insuring that the printer receives a useable quality product. Attention must be

given to proper storage, and in keeping a balance between having an adequate supply of perishable products on hand, while keeping turnaround time to a minimum.

### **Government**

High tariffs on printing equipment and paper have been cited as among the constraints inhibiting the growth and development of the printing industry. In view of the importance of the printing industry in national development, and the potential savings in foreign exchange made possible by developing "import substitution printing", not to mention the social benefits such as increased employment, it is recommended that governments entirely eliminate duties on all printing industry inputs which are not domestically produced. It is further recommended that trade barriers between other African countries, as well as all third world countries, be lifted.

Related to this, governments should support the establishment of pulp and paper manufacturing industries. There are a great many problems to overcome, and research is needed to adapt these technologies to the conditions and circumstances of the countries of Sub-Sahara Africa, but a dependable supply of affordable paper is essential for the future development of the printing industry.

A final recommendation for government is to include printing as a subject of study in trade and/or technical schools. There appear to be pathetically few opportunities available to learn printing skills anywhere in Sub-Sahara Africa.

## Education

Every effort should be made to develop local training institutions for the printing industry. This should be geared to producing operators, technologists and managers. Short term overseas interaction, such as factory training and intensive courses extending two or three months, are recommended until local alternatives can be developed.

## Criteria for success

In terms of the development of a viable indigenous printing industry in Sub-Sahara Africa the following general criteria are suggested for evaluating the overall condition of printing operations:

1. traditional economic indicators (i.e. ROI, profits, etc.);
2. degree of dependence upon supplier(s) in terms of operations, maintenance and repair; and
3. degree of indigenization of the operation indicated by:
  - a) extent of reliance on domestic personnel (i.e. managerial, technical and skilled labor);
  - b) reliance upon domestic intermediate goods and inputs (i.e. paper, ink).

These criteria are intended only as guidelines and may require modification depending on the particular circumstances surrounding each individual case (such as the nature of the product and market).

## PART B

### Recommendations for Further Research

The above findings and conclusions provide a baseline for further studies and suggest promising directions for those studies to pursue. Because there is literally nothing in the published research specific to printing as it relates to Africa or the international transfer of technology, there are any number of avenues future studies might take. The following are suggestions based on the above conclusions.

#### Scarcity of Data

Perhaps the most overwhelming obstacle faced in this study was lack of data specific to printing in Africa. Any research effort that would involve the collection of data from the African printing industry would be worthwhile.

The suggested approach at this stage is to increase the pool of knowledge in as many areas as possible. That is, a general or wide angle approach to raise the baseline is still in order.

#### Raw materials

The problem of high cost and occasional scarcity of the raw material inputs to the printing process is another problem in need of further analysis. These inputs include raw or intermediate supplies such as ink, plates, film and paper. Africa is seen as a relatively low priority market by the producers of these materials. This is further complicated by government duties and tariffs, slow transportation and inadequate storage conditions.

The biggest raw material problem has been in the accessibility, quality and cost of paper. A first step should no doubt be to delineate

and analyse this problem from the point of view of the paper merchant, the government and the printer. The issues involved in establishing domestic paper manufacturing facilities also need to be examined.

### **Labor supply**

The scarcity of skilled labor is another area that requires specific examination. Initially the relevant question should relate to what training and education mechanisms and institutions presently exist in the region. This could be accomplished by a survey.

The second step would involve determination of the actual discrepancy between the supply and demand for technicians and craftsmen. The third step would involve the determination of ways and means of eliminating the discrepancy and thereby meeting each country's need. In this regard the possible role of Western institutions of higher education should be explored.

### **Management Capability**

A low level of management capability is a constraint common to all sectors. Whenever there is rapid growth and technological change, as in most low income countries, the supply of qualified managers runs behind the demand. This is especially true in Africa because of the lack of education and training institutions. Again, research investigating the present need, existing discrepancies and alternatives for remedial action is in order.

### **Government Regulations**

Tariffs on imported goods is considered a constraint to industry development in some countries. Study into the actual reasons for imposing these duties, and the consequences on the printing industry would be a valuable contribution.



### Printer/Publisher Relations

Another potential area of beneficial study is the affect of the relationship which exists between the local printer and the publishing industry. Again this could be effectively accomplished by examining parts of Africa where this relationship is favorable, areas where it is not, and by comparing the two to determine the relavant effect of good and poor relations on the health of the local printing industry. Of course all other relavent factors would have to be taken into account.

### Distribution Arrangements and its Affects

Another factor requiring further study is the effect of the absence or presence of local distributors - and their relative number on the success of technology transfers and the general character and well being of the printing industry.

### Capital Intensive vs. Labor Intensive Technologies

The question of which printing technologies are best suited to the needs of the printing industries of Sub-Sahara Africa requires continuing investigation.

By conducting case studies of "successful" and "unsuccessful" operations utilizing printing technologies of various sophistication, a basis for evaluating the relative merits and weaknesses of the different levels of technology could be developed. The important questions have to do with which technologies, labor or capital intensive, are best suited to the general African market and whether "high" technologies can be successfully integrated into industry, and if so, what are the requisites for success. Research specific to printing and the countries under consideration is required.

### **Systems Model for Technology Selection/Implementation**

Bounded rationality or the limited rational capabilities of those responsible for selecting and implementing new technologies, as well as the lack of complete information regarding options and consequences, makes the management of productive systems less than a science. What is needed are tools to enhance a manager's ability to make rational choices in situations of considerable uncertainty. The fields of information science, business decision making and systems analysis have come about in response to such needs. As a tool for printing managers and printing technology marketing personnel as well, a systems model for choosing and implementing graphic arts technology would be a great contribution to the industry.

A systems approach would of necessity take into consideration all significant variables and factors, such as the wide range of technological alternatives, local availability, factor substitution possibilities, local factor endowments and constraints, and the numerous other variables identified in this study.

### **Manufacturers Survey**

Because of the broad based nature of this research, it was difficult to derive specific survey questions meaningful to both the study and the manufacturers. However, after the conclusions had been drawn, a number of potentially meaningful questions became evident. Any subsequent survey should involve questions specific to the constraints identified in this study. It should also include additional companies, and more fully investigate the suppliers views of the existing potential African market.

## Statistical Analysis

An exploratory hypothesis was used as a premise for the objective section of this study. It stated that a positive correlation exists between the general economic condition of a country and potential printing industry growth. Although used as the theoretical basis of that analysis, it remains an unvarified hypothesis.

As more data becomes available the validity of this hypothesis can be statistically tested. If supported, this knowledge could serve several sectors, particularly suppliers of printing technology.



## Appendix A

### FIGURE 6: NAMES AND BACKGROUNDS OF INTERVIEWEES

**Namiji, David B.;**

Mr. Namiji worked both as a production operator and production supervisor for two different printing companies in Nigeria from 1971, receiving graphic arts training during part of that time. R.I.T. interview, Spring 1981.

**Nanin, Guy;**

Mr. Nanin is presently Printing and Industrial Products Sales Manager in Africa for DuPont International Sales Corporation, and has traveled extensively throughout many countries of Africa in this capacity. Telephone interview, Spring 1981.

**Opusunju, Silva A.;**

Mr. Opusunju grew up working in his family's owned and operated Nigerian printing company, and has functioned in a management capacity in recent years. R.I.T. interview, Spring 1981.

**Proper, H.C.;**

Mr. Proper is presently the 3M Company Sales Manager for Africa, and in this capacity has traveled extensively throughout many countries of Africa. Telephone interview, Spring 1981.

**Van Arsdell, Robert;**

Mr. Van Arsdell is presently the MacBeth Sales Manager responsible for Sub-Sahara Africa, and handles all sales transactions to those countries. Telephone interview, Summer 1981.

## Appendix B

### FIGURE 7: SURVEY LETTER TO MANUFACTURERS

I would appreciate your cooperation in a research project I am presently undertaking concerning the printing industries of the less developed countries of Africa and their present and future market potential for graphic production technologies. After spending two years in West Africa, I have chosen to study printing technology transfer and markets within the context of a Master's Thesis at the School of Printing at the Rochester Institute of Technology.

Africa represents the least developed of the continental markets and offers tremendous potential for growth as the literacy rate, commerce, and overall development increase. The study will not only identify the current status and character of these nations in terms of their printing industries, but will utilize an disciplinary approach, applying the most recent findings in "appropriate technology transfer" to the graphic arts, within the context of African economics and culture. This is expected to be of value to both producers and users of printing technology.

Perhaps the most effective means of determining the "state of the art" in specified countries is by identifying the marketing trends of equipment manufacturers and suppliers to these nations. Thus I am writing to you and to a number of other large and internationally known firms requesting information as to the type and volume of graphic arts products marketed to these countries.

The information I am requesting is not being published and only an aggregate figure representing all manufacturers will be presented in this study. If there is no objection, the name of your company will only be listed as a general contributor and gratefully acknowledged as such.

Specifically, we are interested in the past and present marketing behavior of your firm within the countries of Africa (South of the Sahara and excluding South Africa). The basic types and volumes of product, as well as gross sales over the last five to ten years would be particularly valuable. If a detailed breakdown of sales is available, and data relating to how Africa relates to world sales, it would be appreciated as well.

## Appendix C

### FIGURE 8: RESPONDING COMPANIES

1. **Barnnett, W.D**  
Export Manager; Printplant International, England.
2. **Burn, D.C.R.**  
Sales Manager (Africa); Harris Corporation, Bindery Systems Division, Europe, England.
3. **Campos, L.**  
International Sales Manager; Baumfolder Corporation, U.S.A.
4. **Echhardt, H.T.**  
Merchandising Manager, Harris Corporations, Publication Press Division, U.S.A.
5. **Gelwicks, J.**  
International Division Manager, NVARC Company, Inc., U.S.A.
6. **Holl, R.E.**  
Manager, Market Analysis; Harris International Corporation, U.S.A.
7. **Hoppman, A.**  
Vice President, Marketing; H. Wohlenber KG.GmbH and Company, West Germany
8. **Lacourt, P.**  
Marketing Department; Web Press Division - Europe, Harris Corporation, France.
9. **Lillich, K.**  
Export Manager; Stahl GmbH and Co. West Germany.
10. **Maloney, D.J.**  
International Sales Manager; Harris Corporation, Bindery Systems Division, U.S.A.
11. **Martini AG, M**  
Martini AG, M; Muller Martin AG, Switzerland.
12. **Nanin, G.J.** Sales Manager; P and I, Africa, DuPont, U.S.A.
13. **Nesbitt, C.J.**  
Vice President, Marketing; McCain Manufacturing Corp.
14. **van der Ploeg, J.**

Vice President; International Business Development, Compugraphic Corporation, U.S.A.

15. Van Arsdell, R.  
International Sales Manager; MacBeth Division, U.S.A.
16. Varga, E.  
Assistant Regional Manager; A.B. Dick in Belgium.
17. Proper, H.C.  
Sales Manager for Africa, 3M Co. U.S.A.
18. Alpert, S.D.  
Graphic Export Corporation, U.S.A.
19. Collum, N.M.  
National Accounts Manager; ASOPLATE, U.S.A.
20. Ferrer, E.  
Vice President; International Sales, Mergenthaler Linotype Company, U.S.A.
21. Fritze, K.  
Klimsch and Company, West Germany.
22. GAF Corporation, U.S.A.
23. Heidelberg, West Germany.
24. Higgins, J.F.  
Vice President & General Manager; Itek Graphic Products, Itek Corporation, U.S.A.
25. Lemanski, E.  
Vice President; Miehle Products, Graphic Systems Division, Rockwell International, U.S.A.
26. Mackay, I.D.  
Baker Perkins, England.
27. McAvoy, R.E.  
Vice President; Sales & Marketing, S.D. Warren Co., U.S.A.
28. Niederhauser, F.W.  
Regional Manager; Macbeth, Division of Kollmorgen AG, West Germany.
29. Saville, D.  
Executive Vice President; Forms Manufacturers Equipment, Inc.; U.S.A.
30. Von der Luhe  
AGFA-GAVERT AG; West Germany.



## Appendix D

### FIGURE 9: DATA SOURCES FOR CLUSTER ANALYSIS

Africa: South of the Sahara 1980-81, Tenth Edition (London, Europa Publications, Ltd., 1980).

Africana Contemporary Record 1978-1979: Annual Survey and Documentation, Vol. 1 (New York, Africana Publishing Company 1980).

Europa Year Book 1980: A World Survey, The, Vol. 2 (London, Europa Publications Ltd., 1980).

Kurian, G.T., The Book of World Ranking (New York, Facts on File, 1979).

UNESCO Statistical Yearbook 1980. (Paris, UNESCO, 1980).

United Nations Statistical Yearbook 1978. (New York, United Nations, 1979).

United Nations Yearbook of Industrial Statistics 1978: Commodity Production Data 1969-1978. (New York United Nations, 1980).

## Appendix E

FIGURE 10: PROGRAM EXPLANATION

**OPURPOSE**----- THE PROGRAM REPRESENTS THE DATA COMPLETELY WITH RELATIVELY FEW PRINTED SYMBOLS. AFTER PERMUTATION OF ROWS AND COLUMNS, A BLOCK DIAGRAM IS PRINTED OUT, AND CERTAIN BLOCKS, SUBMATRICES OF CONTIGUOUS VALUES, ARE OUTLINED. ALL VALUES WITHIN A BLOCK MAY BE RECOVERED FROM THE VALUE IN THE UPPER LEFT HAND CORNER, SO ONLY THESE VALUES ARE PRINTED. THE ROW MARGINS OF EACH BLOCK FORM A ROW CLUSTER, THE COLUMN MARGINS FORM A COLUMN CLUSTER, AND THE BLOCK ITSELF IS A CLUSTER OF EQUIVALENT DATA VALUES.

**OMETHOD**----- FIRST CODE ALL VARIABLES INTO THE RANGE 1,...,9,A,...,Z. THE NUMBER OF TIMES EACH VARIABLE TAKES EACH VALUE IS COMPUTED. THE MATRIX IS COMPUTED SO THAT FREQUENTLY APPEARING VALUES ARE PUSHED TO THE UPPER LEFT CORNER, TO REDUCE DEPENDENCE OF THE FINAL CLUSTERS ON INPUT ORDER. A LEADER STRUCTURE ON ROWS AND COLUMNS IS NEXT COMPUTED. ON THE FIRST PASS THROUGH THE DATA, THE FIRST ROW IS A LEADER, AND ALL SUBSEQUENT ROWS WHICH ARE NOT WITHIN THRESHOLD DISTANCE OF A PREVIOUSLY DEFINED LEADER. IF NOW I IS NOT A LEADER, BUT IS CLOSEST TO ROW J AMONG PREVIOUSLY DEFINED LEADERS, SAY THAT J LEADS I AT LEVEL 1. ON ALL LATER PASSES, ONLY THE ROW LEADERS ARE USED. ON THE SECOND PASS, COLUMN LEADERS ARE DEFINED SIMILARLY, AND ONLY THESE COLUMNS ARE USED IN LATER PASSES. THE PASSES CONTINUE, ALTERNATING ON ROWS AND COLUMNS, UNTIL FINALLY, ONLY THE FIRST ROW AND COLUMN REMAIN.

ROWS AND COLUMNS ARE NOW PERMUTED, SO THAT IF I IS A LEADER AT PASS K, NO J GREATER THAN I HAS A LEADER LESS THAN I AT PASS K. A LEADER STRUCTURE IS NEXT DEFINED ON THE DATA VALUES THEMSELVES. IF I LEADS ROW I AT LEVEL K AND JJ LEADS COLUMN J AT LEVEL L, THEN (I,J) LEADS (I,J) IF K IS LESS THAN L, AND (I,JJ) LEADS (I,J) IF K IS GREATER THAN L. IF THE VALUE AT (I,J) MAY BE PREDICTED FROM THE VALUE FOR ITS LEADER, THE VALUE AT (I,J) IS NOT PRINTED ON THE BLOCK DIAGRAM.

**OTHRESHOLDS**----- THRESHOLDS SPECIFY THE MINIMUM DISTANCE BETWEEN LEADERS AT EACH PASS. MOST COMPUTATION TIME IS SPENT IN PASSES WITH SMALL THRESHOLDS. WITH MORE PASSES FEWER BLOCKS ARE NECESSARY TO REPRESENT THE DATA, MORE THAN TWICE THE NUMBER OF VARIABLES IS RARELY NECESSARY.

**OCODINGS**----- EACH VARIABLE IS CODED UNTO THE RANGE 1,...,9,A,...,Z, ACCORDING TO ONE OF THE FOLLOWING OPTIONS.  
 NO IS THE NUMBER OF INTERVALS FOR A VARIABLE. THEN  
 (1) IF NO IS GREATER THAN ZERO, THE RANGE IS DIVIDED INTO NO INTERVALS OF EQUAL LENGTH. VALUES IN THE VARIOUS INTERVALS ARE CODED 1,...,NO.  
 (2) IF NO EQUALS ZERO, BUT THE VARIABLE TAKES INTEGER VALUES BETWEEN 1 AND 35, THE VALUES ARE CODED DIRECTLY ONTO 1  
 (3) IF NO EQUALS ZERO, BUT THE VARIABLE TAKES VALUES OUTSIDE THE RANGE (1,...,35), THE FIRST 35 DIFFERENT VALUES ARE ORDERED AND CODED 1,...,2, RESPECTIVELY.

**OCOUNTS**----- THE NUMBER OF TIMES EACH VARIABLE TAKES EACH OF ITS CODED VALUES.

**OLEADERS**----- ROW AND COLUMN LEADERS, AFTER PERMUTATION OF ROWS AND COLUMNS, ARE PRINTED OUT IN THE FORM: TO FIND THE LEADER OF A GIVEN ROW, GO FURTHEST EAST, NORTH, WEST THE POSITION OF THE NORTH SEGMENT OF THIS PATH IS THE PASS NUMBER. EACH T-INTERSECTION DEFINES THE CLUSTER OF ALL ROWS WHICH REACH THE INTERSECTION BY EAST OR NORTH MOVEMENTS.

**OBLOCKS**----- USING THE PERMUTATION OF ROWS AND COLUMNS DEVELOPED TO DISPLAY THE LEADER STRUCTURE, BLOCKS ARE OUTLINED AND VALUES ARE PRINTED IN THE UPPER LEFT CORNER OF EACH BLOCK. FROM THE PREDICTION TABLE SPECIFYING RELATIONS BETWEEN VALUES IN DIFFERENT COLUMNS, THE FIRST ROW OF THE BLOCK MAY BE PREDICTED. ALL OTHER ROWS IN THE BLOCK ARE IDENTICAL TO THIS ONE.

ANY ENTRY IN THE DATA MATRIX MAY BE RECOVERED FROM THE BLOCK VALUE OF THE SMALLEST BLOCK CONTAINING IT. MISSING VALUES ARE REPRESENTED BY ASLASHES. A GOOD CLUSTERING IS PRINTED/IOIAL VALUES = 0.1. A MEDIOCRE RECOVERY IS PRINTED/TOTAL VALUES = 0.5.

**OPREDICTION**----- THE PREDICTION TABLE IS COMPUTED DURING THE CONSTRUCTION OF COLUMN LEADERS. IF COLUMN J LEADS COLUMN I, A PREDICTION RULE IS GIVEN SPECIFYING A VALUE IN COLUMN I FOR EACH VALUE IN COLUMN J. THE VALUE OF I MUST FREQUENTLY ASSOCIATED WITH THE GIVEN VALUE OF J. THE PREDICTION RULES ARE USED FOR RECOVERING DATA VALUES IN THE BLOCK DIAGRAM. THUS IF COLUMN 6 TAKES VALUE 3 IN THE UPPER LEFT CORNER OF A BLOCK, FIND THE VALUES OF OTHER COLUMNS ON THAT ROW IN THE PREDICTION TABLE WHERE VARIABLE 6 TAKES VALUE 3. FILL IN THE FIRST ROW OF THE BLOCK FROM THESE VALUES.

# Appendix F

FIGURE 11: TREE GIVING JOINING SEQUENCES

9	----	.....	Gambia
4	-----	.....	Central African Republic
23	-----	.....	Somalia
2	-----	.....	Benin
22	-----	.....	Sierra Leone
1	-----	.....	Guinea
5	-----	.....	Chad
6	-----	.....	Congo
13	-----	.....	Kenya
10	-----	.....	Ghana
28	-----	.....	Uganda
24	-----	.....	Sudan
15	-----	.....	Madagascar
12	-----	.....	Ivory Coast
7	-----	.....	Etheopia
3	-----	.....	Cameroon
25	-----	.....	Tanzania
19	-----	.....	Mozambique
29	-----	.....	Zambia
2	-----	.....	Senegal
8	-----	.....	Gabon
1	-----	.....	Angola
20	-----	.....	Niger
17	-----	.....	Mali
16	-----	.....	Malawi
14	-----	.....	Liberia
18	-----	.....	Mauritius
26	-----	.....	Togo
27	-----	.....	Uganda



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