TECHNOLOGY TRANSFER: ASSESSING THE IMPACT OF ITC/RECTAS DESKTOP CARTOGRAPHY COURSE ON MAPPING PROFESSIONALS IN NIGERIA (1998 – 2001)

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ABSTRACT:

The introduction of digital cartographic processing is a recent phenomenon in Nigeria as in most developing countries in Africa. Much of cartography in its teaching and practice is still in the realm of manual (traditional) mapping. Conversion from analogue to digital mapping as exemplified by the activities of the Federal Surveys (Nigerian national mapping agency) is a phenomenon of the late 1990s. This has necessitated the need for training and retraining of cartographers in the tenets of digital mapping in Nigeria. This paper is an overview of the effectiveness of training mapping personnel 'on-the-job' vis-à-vis its impact on training needs and benefits to trainees and their organizations. In this regard, participants at the 'Desktop Cartography Course' (DCC) organized by the Regional Centre for Training in Aerospace Surveys (RECTAS, Nigeria) and the International Institute for Geo-Information Science and Earth Observation (ITC, The Netherlands) from January 12 to 23, 1998, were surveyed. A follow-up was undertaken to assess the programme's impact on trainees' performance in the execution of their mapping assignments in various public and private mapping organizations in Nigeria over a three-year period. This paper provides feedback on the DCC based on trainees' responses. Such feedback will invariably prove invaluable in planning for and executing future short-term courses by international institutions and organizations keen at fostering international cooperation and promoting technology transfer through training and retraining of mapping professionals in developing nations such as Nigeria.

1. INTRODUCTION

Technology transfer, in a general sense can be said to be a set of processes involving the flow of technological know-how, experience and equipment. With respect to Geo-information technology (GIT), its transfer and management involve such issues as, the analysis of information system requirements, spatial data acquisition, processing, system design, storage and integration of data, supply, sharing and exchange of spatially referenced data. Geo-information is needed to support a diverse range of applications, such as, cadastre and land registration, urban management, rural development, environmental and natural resources management (Bujakiewicz, 2000). The broad and inclusive term "transfer" encompasses diffusion of technologies and technology co-operation across and within countries. It covers technology transfer processes between developed countries, developing countries and countries with economies in transition; amongst developed countries, amongst developing countries and amongst countries with economies in transition. It comprises the process of learning to understand, utilise and replicate the technology, including the capacity to choose and adapt to local conditions and integrate it with indigenous technologies (IPCC, 1998).

In Africa, awareness on advantages of GIT had risen considerably. This is due to various activities such as information transfer through electronic networking, participation in international, regional and national workshops and seminars, many internationally sponsored projects, long and short term training of African professionals in Europe, USA and African regional training centres. Nevertheless this transfer of GIT into Africa has not been progressing as expected. Apart from the high cost of infrastructure, there are problems concerning establishment of standards and specifications of the source material and their acquisition, as well as the availability

of mapping manpower (see Bujakiewicz, 2000). In order to ensure an effective GIT transfer to African countries, all the stakeholders, viz, the governments of the various countries, the private sector (especially those in mining/natural resources exploration) and research/educational institutions must demonstrate full commitment to the cause.

The treatment of GIT in this paper is with particular emphasis on the aspect of knowledge dissemination. This paper is aimed at giving an impression of the impact the DCC had in enhancing trainees' capabilities in digital cartography. Its main concern is in assessing the impact of the course on trainees' performance in the execution of their mapping assignments in their organizations over a three-year period. Trainees for the DCC were carefully drawn from various public and private mapping organizations in and outside Nigeria, although only Nigerians eventually participated. The DCC is a typical example of a short-term course which is targeted at retraining mapping professionals on-the-job. The DCC has been replicated by the ITC in collaboration with other institutions at different time periods in other places.

A look through the literature and actual projects reveal that varied approaches are taken to transfer technology. Some were highly successful while others led to dismal failures.

2. APPROACHES FOR SUCCESSFUL TECHNOLOGY TRANSFER

Human resources development should be at the very heart of any endeavour geared towards technology transfer. This is because it is the people that need to be taught the know-how, use equipment and properly channel money donated to

development. Some major approaches advocated include the following.

2.1 Participatory Approach

The success of efforts at technology transfer would be enhanced if the mapping needs of the recipient country or countries were first identified and the indigenous people are permitted to have a say in the choice of technology. There is an absence of effective local participation and involvement in strategic planning, formulation, programme identification, design and implementation. This runs counter to a "hit and run" approach where on the platform of a project, a developed country hastily brings high technology or equipment into developing countries, acquires all necessary data and leaves after a short duration without real participation on the part of the developing countries. Developing countries used to be requested to provide data, building and local arrangements such as transportation but not to join the data processing and analysis (see Murai, 2000). Active participation of indigenous professionals in such projects allows them to acquire hands-on experience and training in digital mapping, which is vital for the successful transfer of this technology in a sustainable manner.

2.2 Theoretical and Software Approach

The strengthening of the digital mapping capability of developing countries can not be sufficiently done without thoroughly grounding trainees in geo-information theories and concepts. It is inadequate to train only on the use of existing software, alongside indigenous manpower need to be trained to adapt technology to suit the local conditions. There are no geomatics technologies that are universal. Social, institutional and cultural peculiarities constitute the foundation of consistent geomatics development in each country. Therefore, the dissemination of geomatics solutions in transitional countries has to go along with a detailed analysis of the local situation (Roche and Caron, 2001). This realisation is most pertinent since in actual sense, development is never achieved nor can it be sustained from outside the developing country. The strategic place occupied by indigenous professionals in the transfer of GIT can be better deduced from Taylor (1991):

> "GIS will not, of course, in itself solve the problems of development but as a tool it will be useful only if it is introduced and used in a way which is congruent with the particular social, economic and political situation facing each nation. It is in this respect that indigenous scientists have an important role to play as they have an appreciation both of GIS technology and of the development problems faced by their home countries"

2.3 Integrated Approach

Until a decade ago, the traditional disciplines of photogrammetry, cartography, remote sensing and surveying were all autonomous and each had its distinct identity. Today with the introduction of computer processes, the developed world had recognised that keeping apart these disciplines would be a significant barrier to speedy progress and effectiveness of mapping. Thus we saw the emergence of such terminologies as "integrated map and geo-information production" and later "geo-information production and management". The reverse is the case in the African mapping setting since there is an unhealthy competition and strife for dominance between the traditional mapping disciplines. This so far has been the bane of

mapping in Africa because mapping specialists fail to realise the need to work as a team.

3. METHODOLOGY

Two sets of questionnaires were administered to the DCC participants. The first questionnaire which is aimed at course evaluation from the point of view of trainees, was administered at the close of the two-week course. In all fifteen (15) participants responded to this evaluation. The second questionnaire which is aimed at follow-up on the participants, was administered by post in year 2001 (three years after the course). In all eight (8) of the participants responded, that is about 53%. The probable reason could be as a result of change of contact address, as was noticed from some responses. The objectives of the two questionnaires are shown in Table 1.

Objectives	Questionnaire 1	Questionnaire 2
Background and job description	�	
Identify eligibility criteria	▒	
Course assessment	▒	▨
Training needs	▒	▨
Knowledge utilization		▨
Perception of course impact		▨

Table 1. Objectives of questionnaires

4. RESULTS AND DISCUSSION

While technology transfer processes can be complex and intertwined certain stages can be identified. These may include, assessment of conditions of transfer, agreement and implementation. Evaluation and adjustment to local conditions, and replication are other important stages (IPCC, 1998). We present here the results in line with the objectives highlighted in Table 1. These are eligibility criteria, course assessment, some inhibitions to knowledge utilization, training needs and finally the perceived impact of the DCC.

4.1 Trainee Eligibility Criteria

To be eligible to attend a course like the DCC, a minimum level of educational attainment should be specified so as to reliably ascertain the level of trainees' mapping competence. The highest educational attainment of trainees for the DCC are Ordinary level (O'L)/Diploma (13%), B.Sc. (7%), P.G.D. (33%), M.Sc. (33%) and PhD (13%). While the level of digital mapping proficiency definitely varied amongst the trainees, their need to be computer literate can not be compromised. Computer literacy, as an eligibility criteria, must be strictly enforced because usually the course is of a short duration, thus making the teaching of computer rudiments most unlikely. In a setting where this condition can not be met, then the teaching of computer rudiments must be an integral part of the course.

4.2 Course Assessment

This section is concerned with the course content/material, presentation and duration. The course content was assessed by the trainees as being 'excellent' (62%), 'very good' (12%) and

'good' (12%). Some suggested improvements to the course content include the following:

- Incorporation of GIS and DIP (20%);
- Inclusion of colour separation exercises (7%);
- Mapping from raw data to final production (14%);
- More practical oriented, less theory (14%).

Seventy-five (75%) percent of the trainees assessed the course material as 'excellent' while 7% assessed it as being 'very good'. A trainee suggested the generation of their own maps for exercises. As regards course presentation which centres more on delivery, 78% assessed it as 'excellent' and 13% adjudged it as 'very good'. The course duration of two weeks was regarded as 'too short' by 75% and as being 'okay' by 13%. For those who regard the course duration as too short, they were asked to suggest a suitable time frame. Their responses are as follows: 3 to 4 weeks (25%), 4 weeks (38%) and lastly, 6 weeks (13%). The main reason given was that this would give ample time for exercises.

4.3 Inhibitions to Knowledge Utilization

A major inhibition (noted by all respondents) which prevented trainees from maximally benefiting from the course was that the computers provided were too few, moreover some systems were not in English language. This resulted in having too many people working on a system. Other inhibitions encountered by trainees are as regards utilizing the knowledge gained after the course in their various organisations. Table 2 shows these inhibitions and the solutions proffered by the trainees themselves. Some of the solutions suggested are applicable to the course organisers while others are the responsibilities of the mapping organizations.

Inhibitions	%	Solutions	%
Non-availability of software (Freehand) to practise	20	Distribute free software demos	13
		Encourage women to participate	13
		Organise digital mapping enlightenment course for policy makers	25
Inadequate funding for digital mapping	20	More budgetary allocation to survey and map	25
No direct involvement in cartography	13	Periodic inter-departmental movement	13
Emphasis is on quick profit-yielding ventures	13		
Non-availability of computers	13		

Table 2. Inhibitions to knowledge utilization

Although course organizers will be more concerned with some solutions than others, it ought to be recognised that most developing countries, especially in sub-Saharan Africa have too few mapping professionals, relevant equipment and software to work with are inadequate/obsolete, and their organizations often lack adequate funds to embark on useful projects. These inhibitions are similar to the experience of indigenous professionals trained in developed countries, who are not always in the position to apply the knowledge thus acquired back home because of the aforementioned problems. It happens most often that, after their course, people are forced to regress from the use of sophisticated equipment for data collection to a measurement tape, paper and pencil (see Siteur, 2001). The situation makes it worth considering organising periodic enlightenment workshop/seminar of very short duration (2-3 days) for policy makers and government officials. This would help them to see and understand the need to map in order to get them to release funds.

4.4 Training Needs Assessment

Training needs seem to differ between the academia and mapping organisations. Those trainees from the academia tend to have in their future career goals, the pursuance of courses such as M.Sc. in Geo-information with specialization in Cartography. On the other hand, trainees in the mapping organizations are more particular about learning to use various mapping software. It is noteworthy that the training needs of academics remain in cartography while for those in the mapping organisations, their area of need is tending towards photogrammetry and remote sensing. This could be understandable because spatial data collection is more of a day-to-day task for them whereas in the academia, each one is somewhat constrained (by teaching and research) within his unit or area of specialization.

This difference in training needs between the academia and mapping organisations, will have strong implications for short-term course organization in various ways, namely:

- In defining the target audience for a course;
- In identifying the objectives the course is out to achieve;
- In striking a balance between theoretical and software content of a given course.

The ability of course organizers to harmonise course content with the training needs of mapping professionals will go a long way to determine the impact of such courses as means of technology transfer. Trainees further supported the following options to cater for their training needs in cartography. That:

- DCC should be repeated to serve as a refresher course for participants (30%);
- Advanced DCC (e.g Web cartography) should be organized to cater for the new training needs of DCC participants (60%).

For the benefits the trainees anticipated from their choice of cartographic training option and the repeat frequencies suggested, see Table 3.

Anticipated benefits		Repeat frequency	
Regular knowledge update	46%	Quarterly	13%
Improved skill in Desktop cartography/ Freehand software	27%	Annually	50%
Training in digital mapping would compel the government to go digital	9%	Two years	13%
Clarification of knotty issues arising from mapping activities	18%	Three years	26%

Table 3. Anticipated benefits from cartographic training options

4.5 The Place of Short and Long-Term Courses

The option of long-term courses is gradually losing its charm as it is not being readily embraced by most mapping organisations in Nigeria. A probable reason could be the difficulty employers face in getting substitutes, especially in a situation where there is a dearth of mapping personnel. Although enhancing the mapping capability of an employee is beneficial to the organization, it is being viewed with negativity because this increases the risk of losing such competent hands. The non-retention of personnel after their training is a huge obstacle to the implementation of GIT. Presently, where the need for a long-term course is obvious, most organizations get their employees bonded for the duration of their absence before approval to proceed on study is granted.

With the incessant and rapid technological changes observable in the mapping sciences, short-term courses (on-the-job training) like the DCC are more often sought after to help professionals to get their knowledge of the field updated. Moreover, often such courses allow the personnel to still be productive on the job, while training. However, the danger lies in the tendency for employers to use short courses as the training method where a theoretically sound training is needed. Short-term courses are particularly beneficial where the practical training far outweighs theoretical study. From the foregoing, African countries need both short and long-term courses for efficient critical mass human resource development for GIT implementation.

Three years after attending the DCC, 50% of the trainees had attended other short-term courses (ranging from those related to geo-information, computer to management). Only 25% had undertaken long-term courses, while the rest had had no further training ever since. This reveals that short-term courses are favoured and are playing a more prominent role in manpower development for mapping, especially in updating mapping skills.

4.6 Perceived Impact of DCC

At the close of the DCC, trainees were asked about their achievements in the course. Responses ranged from "it served as an exposure to digital cartography" (40%), "it is a refresher course for updating my mapping knowledge" (26%), to "it was an introduction to Freehand 5.0" (20%). The responses to their

perceived impact of the DCC on trainees' mapping activities were, "the strengthening of my theoretical base" (20%), "efficiency and speed in mapping" (67%). As regards the perceived impact of the DCC on their various organisations, 37.5% were of the opinion that there was not much impact while 63.5% saw the DCC as having much impact on their organisations. One particularly mentioned that he helped in organizing a similar course in-house (i.e within his organisation). This is greatly encouraging as there is the possibility of achieving critical mass training if the right people in an organization are trained, who will in turn train others less expensively.

5. CONCLUSION

Measuring the impact of the DCC (as a means of knowledge transfer) on trainees' mapping capability and by implication on their respective organizations has not really being a straightforward task. Prof. Dr. Martien Molenaar (Rector of ITC) reiterated when answering a question on the impact of ITC's fifty years of knowledge transfer on students countries of origin and on their respective organisations:

> "This is a very difficult question. How should such impact be measured? We keep in contact with our alumni and their organisations. Many organisations, including universities, have a substantial number of staff with an ITC education background. This has certainly had an impact on the performance of these organisations and upon the perception of the role played by the individual organization in society." (Lemmens and Lemmen, 2001)".

Several approaches for successful technology transfer were examined while advocating that the training of indigenous manpower should be geared towards thorough grounding in geo-information principles (theory and concepts). This is very crucial because indigenous professionals are strategically positioned to adapt modern mapping technologies to local conditions, which will be in line with the development problems confronting their home countries. For development to be achieved and sustained, it has to be from within a country not from outside it.

The DCC was assessed in terms of its content, presentation and duration. As is the case in many initiatives geared towards GIT transfer in African countries, the inability of both the contributing and participating agencies to follow-up, reinforce and extend the training of those in an initial course, would result to knowledge dissipation. This happens because on returning to their organisations, most participants invariably are unable to implement the skills acquired due to several inhibitions. Among such inhibitions is the non-availability of computers and necessary software to work with, as well as the emphasis of policy makers on quick profit-yielding ventures. Thus there is inadequate funding for digital mapping.

While professionals in Africa are being trained to acquire new GIT skills through short and long-term programmes, it has not been easy retaining them due to poor remuneration. When they leave the profession and/or their country a vacuum is created which takes at least a decade to fill. It is therefore imperative for African countries to attract, motivate and retain trained professionals. Until this is done, successful GIT transfer in Africa will be elusive.

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