

JOINT EDUCATIONAL GEOMATIC PROGRAMMES IN BRAZIL AND GERMANY SINCE 1981 STRATEGIES FOR SUSTAINABLE DEVELOPMENT

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ABSTRACT:

The various educational programmes and projects implemented between Brazil and Germany are analysed with respect to strategies to attain sustainable results. Therefore, while minor stress is laid on the description of the particular programmes in contrast to focus on elements from which long-term success emerges.

1. INTRODUCTION: THE ROLE OF SPATIAL MANAGEMENT AND GLOBAL DEVELOPMENT

There are many components, which contribute to a successful development of countries, regions and societies. They all show a common feature, which is their relationship with space (Bähr, H.-P., 1992). Space is the most prominent figure, the most important resource for human environment. Although many disciplines are involved in environmental management, geodetic sciences are, much more than others, responsible for the quantitative and qualitative description and archiving of human's sphere of living.

In the long run, management of the environment is a vital issue for sustainable development. The Rio Conference in 1992 made this very clear. In the same year the German Society for Technical Co-operation (GTZ) summarized the main fields of their policy for Brazilian development as follows:

- *Large ecosystems (erosion, desertification, tropical forests and biotic diversification)*
- *Agriculture (sustainable use, biological and chemical stress, water resources)*
- *Urban growth (living conditions, industrialisation, demographic explosion, quality of life)*

In all of the mentioned challenges, geodetic sciences play an important role in recording and monitoring the parts and the whole.

2. EXPLAINING TERMS

“Education”

The listed tasks in paragraph 1 are all long-term oriented. They only may be adequately tackled when well-trained personnel is available. The training of personnel again, is a task which is only successfully concluded when starting from long-term visions.

Education goes far beyond simple training. It includes not only full perception of main problems and actions of priority to be taken in the respective environment. The term “education” in the title of this paper will point out that all training elements discussed have to be seen in the context of full understanding of education in its widest sense. There is, of course, no strict separation between training on the one hand and education on the other, but it seems to me convenient to discriminate carefully between both concepts.

The agreement signed between the governments of Brazil and Germany in the year 1980 formulating the basis for future co-operation in geodesy reads:

“The governments of the Federal Republic of Germany and the Federal Republic of Brazil agree to support for a period of up to 3 years the University of Paraná in Curitiba in the field of graduate education and research by developing PhD courses.... By this action an educational centre of excellence is to be established, taking over a leading function in Brazil and contributing in the long run solving the cartographic problems of the country.”

“Cartographic problems” are hidden in all the features shown in paragraph 1, i.e. providing the necessary and sufficient data about vital resources management for sustainable development of the country.

“Geomatics”

“Geomatics” in the title stands for a global term which comprises geodetic sciences and related fields, including, of course, geo-information - systems (GIS). In consequence, the denomination of the programme, which emerged from the agreement mentioned in paragraph 2.1 was entitled “geodetic sciences”. “Geodesy” in this context incorporates surveying, photogrammetry, cartography, GIS, remote sensing and related sciences. This is all summarized by the term “Geomatics” as it has been called by Canadian professionals.

As for the terms and concepts, translation from one cultural environment to the other is not a trivial affair. This is particularly true for low-level operations (cartography, surveying, Vermessungswesen, topographia etc.), not so much for high-level activities like “geodesy” and “geomatics” which define a broader professional field.

“Sustainable”

The Rio Conference 1992 put the term sustainable into a new context relating it to long-term stable development. This requires careful use of renewable and non-renewable natural resources. “Sustainable” therefore is set in contrast with a type of globalisation which aims short-term growth and capital return.

This scenario from environmental protection may to a certain extent be transferred to the area of education and scientific co-operation. Like nature and environment, this field requires long-term visions and careful actions in order to avoid stress allowing stable growth. The metaphors “stress”, and “stable growth” clearly reveal the very close relation between environment and human individuals.

Education and scientific co-operation also have to reach a stable performance, because like in nature, a permanent change is involved. This article puts “sustainable” as the guiding line for the analysis of the co-operation between Brasil and Germany in the field of educational geomatic programmes (Bähr, H.-P., 1992,1996; Renuncio et al., 1998)

3. STRATEGIES AND TOOLS

3.1 The role of political support

Education and scientific co-operation are highly political issues. This is very often not taken into consideration by academics who need in contrast to political regulations a free, liberal environment to allow creativity. At least when it comes to formal international co-operations, a political frame is unavoidable. Binational agreements and diplomatic notes between governments in general define priorities in the particular fields of co-operation. For instance during the visit of the German minister of education and research, Mrs. Edelgard Bulmahn in November 2000, several letters of intent were signed, addressing the main fields of mutual interest, e.g. research in future-oriented fields, like space technology and genomics.

There are agreements between the federal states, too. For example the state of Baden-Württemberg and the state of Paraná realised in the early nineties a cadaster project, which aimed at supporting the Brazilian efforts to establish an ownership cadaster in Paraná.

Coming to the university level, formal agreements are not compulsory for co-operation between individual institutes. This changes in the moment when formal educational matters are touched. As an example we may take the UNIBRAL-programme, recently started as a joint programme between the Brazilian CAPES and the German DAAD (Deutscher Akademischer Austauschdienst). The final aim of this programme is the mutual recognition of university courses in different fields. The idea is to exchange students and to recognize the exams obtained in Brazil and Germany, respectively. This already works widely in the European context (e. g. SOK-RATES programmes by the EU). The UNIBRAL-programme in

contrast to the mentioned European ones tries to define partner universities from both continents and to formalize access, contents of courses and certificates as it is under way in geodetic sciences jointly in Karlsruhe and in Curitiba. The main target groups are undergraduates (nota bene: in Brazil “cursos de graduacao”). It would be redundant to say, that for this purpose formal agreements are necessary.

On the other hand common *research* projects between individual institutes do not require a formal agreement. Some universities even do not like this type of formalisation as the prevailing conviction is that projects have to grow bottom-up; i.e. a formal umbrella never substitutes lacking activities.

The strategies of joint educational programmes must provide a long-term view. Long-term means at least a period beyond ten years. This is indeed much longer than the frequency of elections, i.e. the units for which politicians feel responsible. In our real life there are features which may not be accelerated; sustainable development of educational programmes and co-operation are such features. This will be very clearly shown in the examples given in paragraph 4. Financial support is another vital factor for developing educational projects and programmes. A central question is whether private investments in the future may fully or partially substitute investments from the public sector. In Europe, education is still considered to be mostly the responsibility of the national governments. It is an investment without direct returns but the indirect return for the national economy is enormous. Both, long-term orientation and indirect pay off are in a way in contradiction to what politicians are looking for.

Nevertheless, in nearly all cases investment from the public sector that means from the governments involved, is obligatory. This will be shown for the examples given in paragraph 4 as for the GTZ-programme in the decade of the '80s and '90s as well as for the later, more specialised PROBRAL and UNIBRAL-programmes sponsored by the Academic Exchange Services of Brazil and Germany. Although co-operation and input from the private sector had been included from the beginning, the major part of the necessary financial support has always been on the side of the public sector.

A point widely discussed is whether to “think big” versus “small is beautiful”. Our experience is that there exists no general answer. In paragraph 4 examples for both alternatives will be given as for the GTZ-programme the “think big-approach” and both PROBRAL and UNIBRAL for the “small is beautiful”- approach. It is an excellent, long-term oriented strategy to start with a big programme in order to establish laboratories, co-operation and personal liaisons to continue with specific smaller projects. This top down approach may be, however, completely put upside down when starting with smaller programmes in order to bring individuals together and then continue with a bigger high-level programme. The experiences reported in this paper are from the first type, the top down approach.

Referring to political issues one has to be aware, that priorities of international co-operations are set by international agreements. The large University project sponsored by the German/Brazilian co-operation for international development emerged from the bilateral understanding, that support of the academics and scientific co-operation between Brazil and Germany were of mutual priority. This was possible in 1980 but it would not be realizable now as the political priorities have changed. With regard to Brazil, it changed to environmental

protection, to fight against poverty, and to small entrepreneurship among others.

3.2 Elements for successful development

3.2.1 Personalities, the starting points: Even in top down approaches, no project starts at a zero level. As far as the German/Brazilian co-operation is concerned, it overlooks a long tradition. For geodesy and photogrammetry initial elements were photoflight companies. Close to the Deutsche Lufthansa the photoflight company Hansa Luftbild was founded in the '20s and a co-operation with the respective Brazilian companies started already in the '30s. The names of Viktor Pölsler and Placidino Fagundes will always be mentioned as pioneers of photogrammetric co-operation between Brazil and Germany. In the '60s and '70s this co-operation continued on a new base, i.e. in relation with so-called third world activities. The first German photogrammetric expert, responsible for the acquisition and operation of Zeiss photogrammetric equipment in Recife was Herbert Erwes who later served as a WILD representative in Brazil.

Another large joint project, the development of cartographic centres of excellence at the universities in Curitiba and Recife from 1981 to 1995, which will be described in more detail in paragraph 4, did not start at point zero either. In 1981, at the Federal University of Curitiba a master course in geodetic sciences was already under way. It had been initiated by Prof. Camil Gemael in 1971. He brought ideas and strategies from the Ohio State University (USA) where he had graduated. As for Recife, an undergraduate course in cartography was already running, coordinated by Prof. Jorge de Seixas and others. Prof. de Seixas had specialised in photogrammetry at the ITC in Enschede (The Netherlands). Thus for both locations in Curitiba and in Recife the starting point for a project of educational co-operation was not at zero.

3.2.2 Cross Fertilisation and joint Teaching and Research: Another element of successful development is to integrate research and teaching from the very beginning. Geomatics is no theoretical science but strongly related to engineering. Consequently, labs and practical field work together with seminaristic projects are essential. The labs are not restricted to closed rooms since the natural environment itself becomes a lab during field campaigns.

This is an additional motivation for the counterparts from foreign countries. It is very attractive for Germans to work in a Brazilian environment and vice versa, because common research under specific local conditions guarantees high motivation.

3.2.3 Compatibility of all Required Elements: A third important feature is compatibility. This holds true for the organisational structure as well as for tools and final results. As for Brazil and Germany, there are similar organisational components on both sides like the Federal Constitution, the science foundations (DFG/CNPq), the academic exchange services (DAAD/CAPES) and the bodies for technical co-operation (GTZ/ABC). The university systems in Brazil and Germany are, however, not fully compatible as the Brazilian department system is in contrast to the prevailing structure of faculties and institutes in Germany.

Another aspect of compatibility relates to common equipment in joint projects. Same or similar hardware and software makes

co-operation easier and more effective. Students, PhD-candidates or senior researchers may familiarise with them at their home university and may start straight away with the respective research topics at the partner university.

A lacking compatibility in educational co-operation between Germany and Brazil is given by the monolithic diploma career at German universities in contrast to the two-step bachelor/master-system in Brazil. This makes co-operation in the educational field difficult at least for undergraduate programmes. In the graduate domain (nota bene: called *post-graduacao* in Brazil) the co-operation with German senior students or doctorate candidates works very well (Bähr, H.-P., 2001).

Another very important element for successful co-operation is the language. Worldwide, in most cases of academic co-operation, the English language prevails. In this respect it substitutes in a way the medieval Latin. Nevertheless, this is not fully the case for co-operation with Latin America. There are many reasons which contribute to the fact, that the English language is not fully accepted in the Brazilian academic environment. Among others there is the point, that Brazilians do communicate easily with people from the surrounding countries. The lack of opportunities to practise English has a very negative impact on proficiency in English for Brazilians. Therefore, it is a good advice for any type of experts who wants to work in that country to learn the national language and try to communicate in Portuguese. English may be the last resort – however, it seems to be preferable to communicate in bad Portuguese than to expect that the counterpart would rather like to speak English. Surprisingly, young Brazilians generally are eager to study German once they know that they are accepted for an exchange programme. Finally it should be mentioned that technical German is not much more difficult than English.

3.2.4 Personalities, main Elements in Educational Projects: The main element to be analysed when seeking for a successful co-operation are the individuals. The range goes from professors to students, and as a function of time from a couple of days (e. g. during congresses) to years. The aim of a visit to a foreign university is to learn (e. g. students) or to teach (e. g. experts); in any case a cross fertilisation can be expected. For visiting experts the effectiveness depends on the level of communication on the one hand and on the type of the contribution. Pure lecturing has the weakest effect, especially when it is just done in English. The strongest output comes from lecturing plus laboratory work plus research, especially when the language used is Portuguese. Senior students may play an important role in co-operation. They are highly motivated and open to learn a foreign language; besides, they are often experts in the operation of new, important software. Apart from the point, that students very often give logistic support like providing accommodation, they are, together with their families and their co-students, positive factors of multiplication.

Exchange and co-operation has to focus on a concrete target. This may range from examinations passed in the guest country over diploma or master thesis to a full Phd. In the course of these steps, common publications in national and international journals are additional results. Submission of common papers for international congresses are further options, an excellent base for presenting the results of common research.

A very difficult question is how the educational programmes might be assessed. It is generally believed that what counts are quantities: the number of students, the number of international

publications or the acquired scientific projects. All the listed factors give a specific view and do open just a minor sector for answering the question of quality without giving a complete, satisfactory answer.

4. EXAMPLES

4.1 The Curitiba Case

The big geodesy project at the Federal University of Paraná in Curitiba started in 1981 and was officially closed in 1995. It was from the beginning formally linked to a subproject realised at the Federal University of Pernambuco in Recife. The main aim of the activities were defined as follows:

- *the Universities of Pernambuco and Paraná train, according to the demands of Brazil, high-qualified experts in surveying and do fulfil their tasks for application oriented research and consulting.*

The activities fell into four phases and focused the following fields:

- *a) Curitiba: satellite geodesy (GPS), gravimetry, surveying, photogrammetry, cartography*
- *b) Recife: satellite geodesy (GPS), cadaster, GIS, surveying, photogrammetry, remote sensing*

The activities were supported by eleven full professors (directors of institutes) namely four from Hannover, three from Bonn, two from Karlsruhe and one from Darmstadt and Vienna respectively. Beside the many visits of Brazilian counterparts to the mentioned universities, installation of instruments of similar type at both Brazilian universities simplified the realisation of the final goal. For Curitiba, the following hardware components were acquired:

- *Zeiss Planicomp C100 analytical plotter*
- *Rollei SLX 6x6 réseau camera*
- *GPS receivers*
- *Work stations, personal computers etc.*
- *Installation of a earth tide laboratory*

while the acquisitions for Recife were:

- *Zeiss Planicomp C120 analytical plotter*
- *Rollei 24x36 réseau camera*
- *GPS receivers*
- *5 total stations*
- *Installation of a laboratory of metrology*

The hardware components were accompanied by the respective software which was introduced by German experts. From the mentioned configuration emerged research which is widely documented in international publications (see references). It is worth mentioning that the investigations from the '80s and '90s are all still in use.

As mentioned earlier, an indication for success was, among others, the realisation of a doctorate course in geodesy at the Federal University of Curitiba. Formally it was very early installed i. e. the first students started in 1985. The course was fully shaped after the anglo-american type where the doctorate courses are integrated in a graduate programme (in Brazil called *postgraduacao*) which means, among other components, attending lectures and passing examinations is compulsory including a "final examination" before writing the PhD-thesis. There are

advantages and disadvantages compared to the classical German system where "just" a thesis has to be submitted to the faculty of the university, a process, which takes approximately 5 years.

Once the PhD course had started in Curitiba, the first candidates were students from their home university, and lectures were widely given from professors of other universities who held a Phd. After a weak phase, towards the end of the '90s the PhD course in Curitiba was strongly attended, and today there are approx. 20 students matriculated a number of them coming from other South American countries. Since Curitiba is at present the only place in South America offering a Phd course in geodesy, it holds a well renowned reputation. The publications in the series of the graduate courses from geodetic sciences in Curitiba reflect high level research and full integration in internationally recognized research.

Under the scientific projects between Curitiba and Germany in the '90s, the geodetic domain and the specific links to Hannover have to be highlighted. In the realm of scientific-technical cooperation (WTZ) the south american GPS based reference system SIRGAS was developed in cooperation with Germany, supported jointly by CNPq and BMBF. The Hannover Geodetic Institute ("Erdmessung") established regional and local reference systems in Paranaguá and Recife. All projects have been thoroughly documented in publications (Campos, M.A. et al., 1988; Seeber, G., 1999; Willigalis, S. and C. Krueger, 2000; Romao, V.M.C., 2001; Willigalis, S. et al., 2001).

The development of geodetic sciences in Curitiba in close relationship with German academic tradition opened the way to take a new step towards further collaboration. This step was initiated in the year 2001 and aims at the mutual recognition of teaching modules of the universities in Karlsruhe and Curitiba. The process is integrated in the bilateral agreement between the CAPES/Brasil and the DAAD/Germany, the so-called UNIBRAL-programme. The final goal is a full recognition of courses (in different disciplines) between Brazil and Germany. In contrast to former conventions students are now addressed as the central group. While in former programmes support of labs, research projects and scientists were the objects of main concern, now the major "clients" of the university systems, the students, are in the focus. It is still too early to give a report of the UNIBRAL-programme. However, it is obvious, that all the activities performed during the previous two decades, form an excellent, strong basis for such a programme. It goes without saying that the clients, the students, are enthusiastic about the opportunities which are offered to them.

4.2 The Florianópolis Case

The University of Santa Catarina (UFSC) in Florianópolis was not involved in the geodesy project during the '80s. Nevertheless, a student of the master course in Curitiba who took a Phd from there became professor in geoprocessing at the university in Florianópolis in the State of Santa Catarina, three hundred kilometres south of Curitiba. As a former student in geodesy at Curitiba university he established a very strong co-operation with the Karlsruhe University in Germany. This included exchange of professors and Phd-students as well as common research projects. Starting from individual, isolated efforts, the co-operation finally was formalised in a number of international research programmes. One of them is the RETAC programme sponsored by the Brazilian government where the UFSC received a modern laboratory for digital photogrammetry including a Zeiss SCAI scanner and a PHODIS digital photogrammetric workstation.

Another programme was the PROBRAL-agreement between the German DAAD and the Brazilian CAPES. This type of programme aims the exchange of scientists of both countries on the basis of projects which are already under way and sponsored from other sources. Consequently, the financial support from both Brazil and Germany in PROBRAL is moderate compared to those programmes, where salaries have to be paid.

There were two mayor scientific investigations under way at both Florianópolis and Karlsruhe University in the area of developing Campus Informations Systems on the basis of maps, 3D city models and Geo-Information-Systems. Consequently, Brazilian Phd-students and professors were trained on the job in Karlsruhe and vice versa. Taking advantage of the experience from the Curitiba project, the same hard- and software was installed at both places. In this case it were the PEN-TAX 4 cm x 5 cm cameras for photogrammetric acquisition of the building facades and industrial components (Bähr, H.-P., et al., 2001; Bähr, H.-P. and Landes, S., 1999) as well as the photomodeler software. As mentioned earlier, this allowed training in hard- and software in the respective home country of the exchange individual in advance.

In parallel to the campus information projects a very similar technology was used to develop a digital mapping system of Brazilian historical towns of the famous colonial style. From this research many international publications emerged (among them see references Renuncio, L.E. et al., 1998; Bähr, H.-P. 1999, Renuncio, L.E. and Bähr, H.-P., 2000) and a Phd- thesis written by a Brazilian student was submitted to the university of Karlsruhe in a sandwich programme from DAAD/CAPES.

The well-established COBRAC international conferences held in Florianópolis every 2 years since 1994 serves as an excellent platform to display the succesful cooperation under way between Florianópolis and Karlsruhe (Bähr, H.-P., 1994; 1998; Weindorf, M., et al., 2000).

5. RESULTS: NETWORKING, LEADING TO SUSTAINABLE CONDITIONS

What are the lessons learnt from more than 20 years of co-operation in the field of education in geodesy between Brazil and Germany? What are the elements which turn the activities sustainable?

The experience is summarised in the following conclusions:

- 1) *Educational programmes are investments for future benefits. Quick success should not be expected. There are ups and downs and all formalised programmes have to be embedded within the education policy of the particular nations.*
- 2) *In geodesy, besides a good theoretical knowledge, training and practical projects are a vital obligation. To this end, the stable operation of hard- and software in the laboratories is necessary. For a co-operation, the partners should have access to the same hard- and software tools.*
- 3) *A further element of stable co-operation is the opening towards industry and to the public sector, too. Students working in the industry or in the public service sector may easily bridge the gap which sometimes isolates universities from other institutions.*
- 4) *Continuous exchange of persons from all levels results in exchange of knowledge, experience and ideas. It is a vital factor of sustainability.*

- 5) *An excellent indicator for sustainable development and successful results is networking starting a snowball effect. As for the educational co-operation in geodesy between Brazil and Germany the contents are not restricted just to universities. Apart from Curitiba, Recife and Florianópolis on the one hand and Karlsruhe, Bonn and Hannover on the other hand, the network includes, among others, the Universidad del Litoral in Santa Fe/Argentina. Here, presently under very difficult economic conditions, a cartographic centre of excellence is established in close relationship with Karlsruhe and Florianópolis.*

The scale of sustainable development is, however, not restricted to the limited field of professional activities. The cultural environment, personal contacts and friendships are in the long run, a most stable factor.

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